

CHEMISTRY

IN SRI LANKA



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The Tri-Annual Publication of the Institute of Chemistry Ceylon

Founded in 1971, Incorporated by Act of Parliament No. 15 of 1972

Successor to the Chemical Society of Ceylon, founded on 25th January 1941

Vol. 30 No. 2

May 2013

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Theme for the year -

"Role of Chemistry for Sustainable Agriculture"

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Outline of our Institute

The Institute of Chemistry Ceylon is a professional body and a learned society founded in 1971 and incorporated by act of Parliament No. 15 of 1972. It is the successor to the Chemical Society of Ceylon which was founded in 1941. Over 50 years of existence in Sri Lanka makes it the oldest scientific body in the country.

The Institute has been established for the general advancement of the science and practice of Chemistry and for the enhancement of the status of the profession of Chemistry in Sri Lanka. The Institute represents all branches of the profession and its membership is accepted by the government of Sri Lanka (by establishment circular 234 of 9-3-77) for purposes of recruitment and promotion of chemists.

Corporate Membership

Full membership is referred to as corporate membership and consists of two grades: **Fellow (F.I.Chem.C.)** and **Member (M.I.Chem.C.)**

Application for non-corporate membership is entertained for four grades: **Associate (former Graduate) (A.I.Chem.C.)**, **Licentiate (L.I.Chem.C.)**, **Technician (Tech.I.Chem.C.)** and **Affiliate Member**.

Revision of Membership Regulation

All Special Degree Chemists can now apply directly to obtain **Associate (Graduate) Membership**. Three year B. Sc. Graduates (with an acceptable standard of Chemistry) can

- directly become **Licentiate**
- obtain corporate membership in a lesser number of years.

Tech.I.Chem.C.

Those who have passed the DLTC examination or LTCC examination or have obtained equivalent qualification and are engaged in the practice of Chemistry (or chemical sciences) acceptable to the Council are entitled to the designation Tech.I.Chem.C.

Members/Fellows are entitled to the designation of **Chartered Chemist (C.Chem.)** on establishment of a high level of competence and professionalism in the practice of chemistry and showing their commitment to maintain their expertise.

All corporate members (Members / Fellows) are entitled to vote and become Council/ Committee members whether Chartered Chemists or not.

Membership Applications

Any application for admission to the appropriate class of membership or for transfer should be made on the prescribed form available from the Institute Office.

Current Subscription Rates

Fees should be paid on 1st of July every year and will be in respect of the year commencing from 1st July to 30th June

Fellow	Rs. 1200
Member	Rs. 1200
Associate	Rs. 900
Licentiate	Rs. 750
Technician	Rs. 500
Affiliate	Rs. 500
Membership for Life	Rs. 10000

Entrance Fee

All the grades	Rs. 500
Processing Fees*	Rs. 200
Processing Fee for Chartered Chemist designation	Rs. 1000
Institutional Members	Rs. 2500

*per application for admission/transfer to any grade

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Council 2012/2013

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Prof.(Ms) Hema Pathirana	Mr Ivan Dassanayake
Dr R Senthilnithy	Prof. Sudantha Liyanage
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Prof. (Ms) Ramee D Wijesekera
Dr. (Mrs) C Udawatte

CHEMISTRY IN SRI LANKA

Chemistry in Sri Lanka is a tri-annual publication of the Institute of Chemistry Ceylon and is published in January, May and September of each year. It is circulated among the members of the Institute of Chemistry and students of the Graduateship/DLTC course and libraries. The publication has a wide circulation and more than 1500 copies are published. Award winning lectures, abstracts of communications to be presented at the annual sessions, review papers, activities of the institute, membership news are some of the items included in the magazine.

The editor invites from the membership the following items for publication in the next issue of the Chemistry in Sri Lanka which is due to be released in September 2013.

- Personal news of the members
 - Brief articles of topical interests
 - Forthcoming conferences, seminars and workshops
 - Latest text books and monographs of interest to chemists
- All publications will be subjected to approval of the 'Editorial and Publicity Committee' and the Council of the Institute of Chemistry Ceylon.*

Further, prospective career opportunities for chemists, could be advertised in Chemistry in Sri Lanka at a nominal payment. The editor welcomes from the members suggestions for improvement of the publication.

From the Editor



We are getting closer to the month of June again. June is an exceptionally busy month for the Institute of Chemistry Ceylon. The most important event of the calendar of activities of the Council year, "Annual Sessions" is scheduled for June. During the annual sessions a new Council is appointed to take over from the outgoing Council. This is an occasion for the well wishers and the members of the institute to get together and to plan for the future activities of the Institute. It is also an occasion for members to present their research findings and discuss their research work with their peers. It is also a platform for young chemists to gain knowledge and experience in presenting research papers at a scientific meeting. Annual Sessions provide an opportunity for social get together as well. The Inauguration of the Annual Sessions is relatively well attended although participation of the members at the activities conducted throughout the year by the institute is sadly poor. Better participation of the members is essential as the backbone of the Institute is its members. Usually the Inauguration is followed by a daylong Theme Seminar which is followed by the presentation of research papers. All in all the Annual Sessions continue for three days culminating in an annual dinner. The participation of the full membership is requested at the Annual Sessions to improve and expand the activities of the Institute of Chemistry Ceylon for the future.

A noteworthy observation this year is the large number of research papers received from many areas in chemical sciences for the technical sessions. The more than forty (40) papers received were reviewed by experts in the areas of natural products chemistry, biochemistry, analytical chemistry, food chemistry, Inorganic chemistry, organometallic chemistry, semiconductors, industrial research and chemical education. Hopefully this year with the participation of many members, lively discussions on the presented research papers will take place providing opportunities for the scientists to get new ideas to continue their research work. Some of the papers are of high quality showing the capability of our researchers to carry out research using the limited facilities at their disposal. The papers presented are from the Universities, College of Chemical Sciences, Research Institutes and other organizations. We hope

this trend will continue and that scientists will use the Annual Sessions as a forum to present their research findings to the scientific community in Sri Lanka. This year, research work were also submitted for the C L de Silva Gold Medal and the Sultanbawa award.

The Institute of Chemistry Ceylon also has conducted several international conferences very successfully. The next international conference is scheduled for April 2014 coinciding with the 40th anniversary of the commencement of the Diploma in Laboratory Technology in Chemistry programme. The theme of the conference is "Professional Chemical Education & Research for Industrial Development & Sustainable Growth in a Knowledge Based Economy". This will also be an occasion for members to get together and contribute so that a successful event is conducted. International conferences require resources and we are hopeful that members and well wishers will contribute enthusiastically to this event.

The Institute publishes three issues of Chemistry in Sri Lanka annually in September, January and May, during a Council year from July to June. The May issue invariably has material related to the Annual Sessions; Programmes of the Inauguration & the Theme Seminar and abstracts of the research papers to be presented at the Technical Sessions. In addition, the other activities conducted by the Institute and the College of Chemical Sciences are incorporated. The September issue carries the details of the Annual Sessions and the full papers presented by the award winners. The January issue contains mainly articles written by the members.

The magazine includes activities of the Institute and the College of Chemical Sciences, research articles and articles of general interest, current events of interest to chemists and the student corner. Contributions from the members of the institute are very essential to produce Chemistry in Sri Lanka as an acceptable and up-to-date magazine of high standard. It is often the Editor who has to persuade and plead with the members to provide material suitable to be published in the magazine. As the Editor I request all the members to take a keen interest to see that the Institute produces a magazine of high standard. To achieve this, contributions from the members is a must! I therefore appeal to the members to support the Institute in every way possible to achieve the ideals set by the Institute for its members, the student community and the country at large.

Institute of Chemistry Ceylon

Forty Second Annual Sessions and Seventy Second Anniversary Celebrations 2013

Inauguration of the 42nd Annual Sessions, Institute of Chemistry Ceylon

Wednesday, June 19th 2013

Central Bank Auditorium, Rajagiriya

8.00-8.45 am	Arrival of Members and Guests (refreshment will be served)
8.45 am	Ceremonial Procession of the Council Members and Past Presidents
8.50 am	Inauguration by lighting of the Traditional oil lamp and playing the National Anthem
8.55 am	Welcome Address by Dr S. Mohanadas President, Institute of Chemistry Ceylon
9.00 am	Presidential Address: <i>"Role of Chemistry in Sustainable Agriculture"</i>
9.30 am	Address by the Chief Guest Dr. P Rethinam Director Asia Pacific Coconut Community <i>"The role of Chemistry on Plantation Crops"</i>
10.00 am	Address by the Guest of Honor Dr. H A J Gunathillake Director, Coconut Research Institute <i>"Application of Chemistry on Recent Advancement of Agriculture in Sri Lanka "</i>
10.30 am	Presentation of Awards, Prizes and Certificates Honorary Fellowship - Mr. T Kandasamy Distinguished Service Awards - Prof. M D P De Costa & Dr. G H N D Ediriweera ICHEMC Gold Medal - Ms. P M Jayasinha Dr. C L de Silva Gold Medal - Prof. S Ekanayake Graduateship Examinations in Chemistry-Scholarships, Prizes and Awards All Island Interschool Chemistry Quiz Prizes
11.10 am	Dr. C L de Silva Gold Medal lecture by Professor S Ekanayake Department of Biochemistry, University of Sri Jayewardenepura <i>"Sri Lankan Foods: Glycaemic indices and physico-chemical factors affecting the glycaemic indices "</i>
11.50 am	Vote of Thanks by President Elect
11.55 am	Close of Ceremony
12.15pm	Annual General Meeting of Corporate Members of the Institute of Chemistry Ceylon

Chief Guest at the 42nd Annual Sessions - Dr. P. Rethinam



Dr Rethinam received an undergraduate Degree in Agriculture from Agricultural College and Research Institute Coimbatore, Tamil Nadu in 1963. He received the Masters in Agronomy from Madurai University and Doctorate in Agronomy from Tamil Nadu Agricultural University, Coimbatore. His professional career began in research in 1963. He was an Assistant Professor of Agronomy and Assistant Agronomist for four years. He was selected for All India Agricultural Research Services in 1976 and worked as a Scientist grade 1 and 2. He was selected as a Project Coordinator (Palms) in 1982 for the All India Coordinated Research Project on Palms. In this position he widened the scope of the project by including oil palm and palmyrah. He was also responsible for coordinating the release of the coconut hybrids and varieties for the first time in India in the year 1985 and subsequently paved way for releasing more hybrids and varieties from Kerala, Tamil Nadu, Andhra Pradesh and Maharashtra.

In 1987, he became the first Assistant Director General, Plantation Crops at the Indian Council of Agriculture Research Head Quarters, New Delhi. During that period, he was responsible for research coordination and management for 3 Institutes, 3 National Research Centers and 5 Coordinated Projects. He was the Founder Director of the National Research

Center for Palm oil. He was also functioning as Ecosystem Director for the Coastal Ecosystem under National Agricultural Technology Programme (NATP). He coordinated, formulated and implemented various research programmes in agriculture, horticulture, animal science, fisheries, etc. In 2000, he was nominated as Chairman, Coconut Development Board, Ministry of Agriculture, Kochi, Government of India. In that role, he introduced many innovative development programmes on community approach for the benefit of coconut growers and processors.

In 2002, he was the first Indian to be elected as the Executive Director of Asia and Pacific Coconut Community, an Inter-Governmental organization. He was also the Vice President for BUROTROP (2002-2004) and member of COGENT Steering Committee since 2002. He was the winner of Konda Reddy Gold medal and Rolling Shield, Dr Nathanael Gold Medal for Best Research work at TNAU, Coimbatore and Life Time Achievement Award in Plantation Crops by farmers of Andhra Pradesh. Recognizing his contribution to the Global Coconut Research and Development, he was conferred with Kalpa Vriksha Award at the International Coconut Summit 2007 by Swedeshi Nalikera Mission and Peekay Tree Crops Foundation and M H Marigowda National Award for the Best Horticulture Research, 2008 by the University of Agricultural Sciences. He is the founder President of Society for Promotion of Palm oil Research and Development. He is a Fellow of Indian Society for Plantation Crops and Horticulture Society of India and life member of many scientific societies in India. He has published 186 articles, co-edited 25 books and many technical bulletins and reports.

Guest of Honour at the 42nd Annual sessions- Dr H A J Gunathilake



Dr. Gunathilake is the present Director of the Coconut Research Institute of Sri Lanka. He obtained a B Sc (Agric) Degree from University of Peradeniya and Ph D Degree from University of Wales. He specialized in Coconut Agronomy and Land Productivity Improvement. He has done a lot of experiments on

the development of renewable energy particularly on use of gliricidia as a fuel wood and fertilizer tree. Hence he won the National Science and Technology Award in 2008 on "Development of Eco-materials/Eco-friendly process for Food Industry". He has undertaken several contracts of ADB as a consultant on short-term forestay and FAO too. Since 2004 – 2010 he served as the Chairman of the Coconut Cultivation Board and Tea, Rubber, Coconut Land Fragmentation (Control) Board. He is a Member of the Board of Management of the Postgraduate Institute of Agriculture, Peradeniya and Board Member of the National Institute of Plantation Management.

Institute of Chemistry Ceylon Awards

Distinguished Service Award, 2013 - Professor M Dayal P De Costa, *C. Chem., FIChemC*



Professor M Dayal P De Costa is a Professor in Chemistry at the University of Colombo. He served as the Head of the Department of Chemistry from 2003 to 2009. His area of research is in Photochemistry and he has published a large number of research papers in the field in recognized international and local journals. He has supervised and produced several M.Sc., M.Phil. and Ph.D. students. He received Presidential Award for Research in 2000 and 2002 to 2005. He also received the Award for Research Excellence from the University of Colombo in 2001. He received the M U S Sultan Bawa Award in 2003 and the Devanathan Memorial Award in 2004. He has published several books and monographs in the field of Chemistry.

Professor Dayal De Costa is an active member of the Institute of Chemistry Ceylon and the Sri Lanka Association for the Advancement of Science (SLAAS). He was the President of the Institute of Chemistry in 2010/2011 and the President of the Section E2 of the SLAAS in 2004.

Professor Costa has been a member of the Institute of Chemistry since 1991 and has contributed substantially to the activities of the Institute. He held many important positions of the Institute : Joint Secretary during 1998-2001, Treasurer from 2002 to 2004 & 2012, Member of the House, Finance & Membership committee from 1994 to date, Member of the Monograph committee from 2008 to date, Member of the Interschool Chemistry Quiz committee from 1994 to date and its Chairman in 1996-1997, Chairman of the Australian Chemistry Quiz competition from 2003 to date, Member of the committee for Popularization of Chemistry from 1995 to 1999, Member of the Council from 1994 to date.

He also made a substantial contribution to the activities of the College of Chemical Sciences. He is a visiting lecturer from 1991 to date and has been an examination coordinator from 1993 to date. He was the Assistant Secretary of the Education Committee from 1994 to 1996 and its Secretary from 1996 to 1999. He is a member of the Board of Examiners from 1991 to date and a member of the Educational Committee from 1993 to date. He served as a visiting Professor for a year from 2009 to 2010.

In recognition of his long and dedicated services to the Institute of Chemistry Ceylon and to the College of Chemical Sciences, the Council of the Institute of Chemistry unanimously decided to award Prof. M Dayal P De Costa the "Distinguished Service Award".

Distinguished Service Award, 2013 - Dr Nandanie Ediriweera, *C. Chem., FIChemC*



Dr Nandanie Ediriweera, Professional Member of Institute of Food Technology, USA (until retirement) has a distinguish record of services to the Industrial Technology Institute for 38 years.

She was the Head of Agro Food Technology Division for a period of about 10 years and provided services for the development of Agro Food Industry on product, process development, transfer of technology, process certification, post harvest management, analytical services, quality assurance, productivity improvement, diversification of food industry etc. She has obtained seven patents on development of coconut products and other food products.

In recognition of her services she was awarded CISIR service award 1995. With the objective of enhancing ITI capability to provide technological support services to the food industry to upgrade quality, safety, wholesomeness and out put of processed food that are vital for healthy living. Dr Ediriweera was instrumental in obtaining a Japanese Government Grant of Rs 460 Million for the construction and facilitating a pilot plant for food processing and other related laboratories. Staff training was organized through a JICA/ ITI Fellowship programme.

Dr Ediriweera has been a member of the Institute of Chemistry Ceylon since early 1970's and is a Fellow of the Institute of Chemistry. She has been a member of the Council from year 2000 to 2004, Vice President during 2005/2006, President Elect during 2006/2007, President during 2007/2008. From 2008 onwards to date she has been a member of the Council.

She has served several important committees of the Institute. During year 2000, the Institute started Training Seminar Workshops and Dr Ediriweera served as the Chair Person of these workshops for several years from year 2000 to 2007. These workshops attracted many young scientists from Academia and Industry. She served as the Treasurer during 2001/2002. Over the years she has served many Institute Committees such as House Finance Membership Committee, Admissions and Ethical Practices Committee, Annual Sessions Committees, IYC Committee, College of Past President's, Board of Trustees, Awards Committee and Building Project Committee etc.

The Institute of Chemistry Ceylon Gold Medal Award (Year 2000) was awarded to her for an outstanding contribution in the use of chemical sciences for the development of innovations in industry for the national development in Sri Lanka. As the President of the Institute during 2007/2008, she organized the "International Symposium 2008" on Innovations in Food Science and Technology and Health-care for social well-being. Several distinguished resource persons and many scientists participated. During the year 2008/2009, a certificate course on Functional Foods including both theoretical aspects and laboratory practical was organized for scientists in food industry.

In recognition and appreciation of Dr Nandanie Ediriweera's long and dedicated services to the progress of the Institute of Chemistry Ceylon, the Council unanimously decided to award the distinguished service award to her.



Honorary Fellowship - Mr. T. Kandasamy, *C.Chem., FIChemC, FRSC*

Mr. T. Kandasamy served the Government Analyst Department since 1951 and retired from service as the Government Analyst in 1986. He worked in the food and drugs division and the forensic division. He represented the department in several interdepartmental committees; Food Advisory Committee, Drug Advisory Committee, Pesticide Formulatory Committee and the committees of the Sri Lanka Standard Institution.

Mr. Kandasamy served the Food Advisory Committee for a continuous period of nearly 50 years from 1963 to 2011, representing the Analyst Department and then in his personal capacity after retirement. In 1969 as a member, he contributed to the revision of the Food and Drugs Act 1949 resulting in two separate Acts, the Food Act 1980 and the Cosmetics, Devices and Drugs Act 1980. He was a consultant to the WHO to prepare draft food regulations and food standards regulations, code of practice for advertising food and sampling of food analysis. He was appointed as an UN National Consultant in Chemical Analysis in the FAO/UNDP programme "Strengthening of Food control infra structure in Sri Lanka, Phase II". He was responsible for the setting up of a well equipped food laboratory at Anuradhapura for the Health Department for food control activities. His contributions to the Food Advisory Committee and to the SLSI are highly recognized. He was presented with a memento for the "Pioneering efforts in expanding food analytical services and strengthening food act & its regulations from its inception for almost half a century" and awarded a Gold Medal for the outstanding contribution to Standardization.

Mr. Kandasamy worked as an UN national consultant at the National Building Research Organization from 1988 to 1992 in the pollution control laboratory and in the landslide hazard project on environment.

Mr. Kandasamy was an active member of the Scientific Associations. He joined the Chemical Society of Ceylon (Institute of Chemistry Ceylon) in 1951, the Sri Lanka Association for the Advancement of Science (SLAAS) in 1951 and the Royal Institute of Chemistry (Royal Society of Chemistry) in 1952. He served as a member of the General Research Committee of the SLAAS and then as the Chairman. He held the position of Secretary, Treasurer and Chairman of the Royal Society of Chemistry, Sri Lanka Section.

His contributions to the Institute of Chemistry are noteworthy. He was a member of the Admission and Ethical Practices Committee. He has been the Chairman of the Board of Trustees, a member of the Building Committee and the Academic Board of the College of Chemical Sciences. He was the Vice President in 1978 and the President of the Institute in 1979. He was responsible for getting the 40 years History of the Chemical Society of Ceylon. He also served the College of Chemical Sciences. He was the Coordinator for Environmental Chemistry unit of the GIC programme. He was involved in drawing up of the syllabus for the optional unit "Food Science & Food Technology unit.

In recognition of his long and dedicated services to the Institute of Chemistry Ceylon and to the College of Chemical Sciences, the Council of the Institute of Chemistry Ceylon unanimously decided to award Mr. T. Kandasamy the "Honorary Fellowship".

ICHEMC Gold Medal - Ms Purnima Medini Jayasinha, *CCChem*



Ms Purnima Jayasinha enrolled for the Graduateship Programme of the Institute in 1983 and was one of the fourth batch of five Graduate Chemists to pass out in 1986. Ms. Jayasinha joined the Open University of Sri Lanka as a Demonstrator in 1987 and read her M.Phil. in Organic Chemistry-Natural Products in 2000 at the same university. After the completion of M. Phil., she joined the Information Services of the Industrial Technology Institute (ITI) in 2000 and presently work at the same institute as a Senior Research Scientist attached to the information services. Ever since she joined the Information Services at ITI, she has been conducting library orientation and information searching for research at the ITI for the College of Chemical Sciences students.

Ever since her graduation, Ms. Jayasinha had a deep sense of obligation towards her alma mater and from early 1988, she undertook the post of Teaching Assistant for the Physical Chemistry practical course. She continued to serve the Institute in this capacity until 2007 thus providing an unbroken service for 19 years. She was admitted to the Institute as a Graduate member in 1987 and as a Member in 1991.

She was elected as a member of the Academic Board in 2000, and from 2001-2005 she functioned as Assistant Secretary. In 2005 she was appointed as Secretary for Educational Affairs, a post she continues to hold with great responsibility and diligence. She has been a Council member of the Institute since 2005. She has also assisted in the development of the library services of the Institute by, *inter alia*, serving as Secretary to the Library Committee from 2001. She is also a member of the Social Affairs committee from 2007 and Editorial Assistant for the CCS News Letter from December 2002 to March 2006.

In recognition of her long and dedicated services to the Institute of Chemistry Ceylon and to the College of Chemical Sciences, the Council of the Institute of Chemistry Ceylon unanimously decided to award Ms Purnima Jayasinha the "Institute of Chemistry Ceylon Gold Medal".



Dr. C L de Silva Gold Medal - Prof Sagarika Ekanayake, C.Chem, F.I.Chem.C.

Prof Sagarika Ekanayake, Professor in Biochemistry and currently the Head, Department of Biochemistry, Faculty of Medical Sciences, University of Sri Jayewardenepura has been teaching Biochemistry to undergraduates and postgraduates of her university, many other Sri Lankan universities and higher education institutes for the past 21 years. She is also involved in conducting nutrition related research on indigenous, typical Sri Lankan foods, natural products and clinical biochemical research on problems related to Sri Lanka in addition to her teaching and other commitments. She is the author of over 40 peer-reviewed national and international publications and over 95 conference papers and writeups. She has also authored and edited biochemistry teaching materials for paramedical courses of the Open University of Sri Lanka. She has been the supervisor of over 10 successful postgraduate degrees. Her work has won many National Research Awards and Fellowships including several Presidential Awards, Young Scientists Research Excellence (2009) by NASTEC and Awards for successful supervision by NSF (2010). Her research has also brought funds from many national and international granting agencies to the university. She is a past Council member of the Institute of Chemistry Ceylon and a past President of Section A and is currently a Council member of the Sri Lanka Association for the Advancement of Science.

Abstract of the Dr. C L De Silva Gold Medal Award

Sri Lankan Foods: Glycaemic indices and physico-chemical factors affecting the glycaemic indices

Sagarika Ekanayake

Department of Biochemistry, Faculty of Medical Sciences, University of Sri Jayewardenepura, Nugegoda

Glycaemic index (GI) ranks carbohydrate rich foods according to their potential to raise the blood glucose and depending on the blood glucose raising potential classified as low ($GI \leq 55$), medium ($56 \leq GI \leq 69$) or high ($GI \geq 70$) GI foods. Glycaemic load (quantity) of an edible portion of starchy food is calculated using GI. Aim of the project was to build a database of GI of starchy Sri Lankan foods.

Raw (*kekulu*) rice (samba, sudu or red *kekulu* or basmati) produced high/medium GI and high GL. Parboiled (*nadu*) rice elicited the lowest GI (low GI) due to high fibre as it contained retrograded starch and a mixed rice meal elicited a low GI indicating the suitability in the dietary regime of individuals with chronic NCDs. White/brown bread elicit high GI and high GL. However, the actual edible portion size contained a less carbohydrate load (GL). Brown bread given with a dhal curry produced a medium GI indicating the importance of mixed meals in lowering GI.

GI & GL of hoppers was high and the portion size considered not adequate and thus is not suitable for daily consumption. *Roti*, irrespective of the flour elicited low or medium GI due to less starch gelatinization due to dry processing. Kurakkan *roti* elicited the lowest GL due to high dietary fibre which decreased the digestible carbohydrate in a portion and induced satiety. The particle size of flour was shown to affect GI. Irrespective of flour (red or white rice) used in preparation and when given as a mixed meal string hoppers elicited a high GI and high GL which was due to the high starch gelatinization/disintegration due to wet processing. *Pittu*

when prepared using wheat or rice flour elicited high GI and a high GL even for a normal portion. In kurakkan *pittu*, GI and GL decreased due to the high dietary fibre making normal edible portion smaller by inducing satiety and decreasing digestible carbohydrate.

Raja ala, consumed with coconut scrapings elicited low GI in contrast to manioc which gave high GI and contained more protein (9%) and polyphenols. Jackfruit and breadfruit eaten with coconut as a meal elicited lower GI. Boiled legumes, chickpea, cowpea and mung beans had low GI and a low glycaemic load leading to lower insulin demand. Incorporation of mung beans when making milk rice decreased the GI (medium). High fibre and protein in legumes contributes to lower GI. Increased consumption of legumes should be encouraged as a healthy option among public. Porridge made with different green leaves elicited a low GI and low or medium GL and good satiety proving the health benefits in the dietary management. Studies with diabetic rats showed that *wal kotthamalli* porridge to be superior in controlling diabetic parameters and led to produce a marketable product (patent applied).

Knowledge of GI would help nutritionists, dieticians or individuals to plan meals utilizing low or medium GI regularly or to mix high GI foods with low or medium GI foods so the glycaemic responses can be brought lower and help prevent/reduce the increasing incidence of NCDs.

Database at <http://www.nrc.gov.lk/SAG/index.html>

THEME SEMINAR
ROLE OF CHEMISTRY IN SUSTAINABLE AGRICULTURE

Thursday, June 20, 2013

Venue: Sri Lanka Foundation Institute, Colombo 07

8.30-9.00	Registration
9.00 - 9.05	Welcome address Dr. S Mohanadas President, Institute of Chemistry Ceylon
9.05 - 9.10	Lighting of the traditional oil lamp
9.10 - 9.15	Playing National Anthem
9.15 - 10.15	<i>Keynote address - "Agriculture for greater economic growth"</i> Mr. B R L Fernando Chairman, CIC Group of Companies
10.15 - 10.35	Tea Break
10.35 - 11.20	"Hazardous pesticides in agriculture and its impact on human health" Professor Ravindra Fernando Faculty of Medicine, University of Colombo.
11.20 - 12.05	"The positive contribution of agrochemicals in agriculture" Mr. Anushman Rajaratnam Chairman, Lankem Plc
12.05 - 12.50	"Safe use of genetic engineering in agricultural production" Emeritus Professor Athula Perera University of Peradeniya
12.50 - 1.00	Discussion
1.00 - 1.45	Lunch Break
1.45 - 2.30	"Nanotechnology for greater agricultural productivity" Dr. Asitha Siriwardena Sri Lanka Institute of Nano Technology
2.30 - 3.15	"Management of soil chemistry and water, in agriculture" Professor K A Nandasena Faculty of Agriculture, University of Peradeniya
3.15 - 3.20	Discussion
3.20 - 3.45	Tea Break
3.45 - 4.30	"Environmental impact on agriculture" Professor Priyani Paranagama Department of Chemistry, University of Kelaniya
4.30 - 4.40	Discussion

Technical Session 1

Venue: Adamantane House, Rajagiriya

Time : 2.00 p.m. – 4.30 p.m.

Date: June 19, 2013

Time	Title	Authors
2.00pm-2.30pm	Absorption and Emission Properties of Lycopene, β -Carotene, Norbixin and Their Chemically Oxidized Species	D D D H Alwis, U G Chandrika and P P M Jayaweera
2.30pm-3.00pm	In-vitro antioxidant activity, flavonoids and total phenolic content of <i>Atalantia ceylanica</i> and <i>Eriocaulon quinquangulare</i>	S C D Fernando and Preethi Soysa
3.00 pm – 3.30 pm	TEA	
3.30pm-4.00pm	Qualitative & quantitative analysis of amino acids & peptides of digested curd in selected curd brands produced in Sri Lanka	L V Athiththan, M C Dabarera and P P R Perera
4.00pm-4.30pm	New Heterocyclic Compounds from the Reaction of 4,7-Dioxononanoic acid with hydrazine	Ajita M Abeysekera, G M K B Gunaherath, C Padumadasa, U A Rathnayake and Amila M Abeysekera
4.30pm-5.00pm	Ethanol Production by Microbial Fermentation using Over-Ripe Bananas	R S Hewawasam, R G S C Rajapakse, U S K Weliwegamage and S Sotheeswaran

Technical Session 2 (Parallel Sessions)

Venue: P P G L Siriwardene Auditorium, Adamantane House, Rajagiriya

Time : 9.00 a.m. – 5.00 p.m.

Date: June 21, 2013

Session Chair -: Prof.S.Sotheeswaran

Time	Title	Authors
9.00am-9.20am	Studies on the Essential Oil and the Absolute of <i>Nyctanthes arbortristis</i> L. Flowers	K A V S Siriwardena and L S R Arambewela
9.20am-9.40am	Fatty acid profiles, oxidative and hydrolytic stability of some commonly utilized cooking oils	R Sanjeevan and S Ekanayake
9.40am-10.00am	Helvolic acid, an antibacterial nortriterpenoid from an endophytic <i>Xylaria</i> sp. associated with the orchid <i>Anoectochilus setaceus</i> endemic to Sri Lanka	P B Ratnaweera, R L C Wijesundera and E D de Silva
10.00am-10.30am	Tea	
Session Chair -: Dr.Lakshmi Arambewela		
10.30am-10.50am	Physico-chemical and bio-chemical characterization of Sri Lankan <i>Annona muricata</i> L	S M P C Padmini, R Samarasekera and D K N G Pushpakumara
10.50am-11.10am	Antibacterial activity and Preliminary phytochemical screening of decoction of <i>Indigofera aspalathoides</i> whole plant	S Kathirgamanathar, T Thayalini, V Thevanesam and T Gamage

Time	Title	Authors
11.10am-11.30am	Investigation of coumarin levels in different grades of Ceylon cinnamon	H D Weeratunga, G A S Premakumara and K R Dayananda
11.30am-11.50am	Total Phenolic content and antioxidant activity of <i>Eichhornia Crassipes</i> ethanolic extract	D C Senevirathna, R D Senevirathne and C Udawatte
11.50am-12.10pm	Purification and characterization of thermostable α -amylase from <i>Bacillus licheniformis</i> NMS-6 isolated from Nelumwewa hot water spring in Sri Lanka	C D Mathew and B M P H Marasinghe
12.10pm-12.30pm	Purification and characterization of a thermostable extracellular lipase from <i>Pseudomonas thermotolerance</i> NMS 3 isolated from a hot water spring in Sri Lanka	C D Mathew and R Thatparan
12.30pm-12.50pm	The response of the low country live wood termite <i>Glyptotermes dilatatus</i> to extracts of tea stems decayed by various fungi	P D Senanayake, F F Pary, K Mohotti and P A Paranagama
12.50pm-1.10pm	Proximate nutrient composition and glycaemic responses of godamba and kottu roti	K B W M R A I Wathupola, S Ekanayake and J Welihinda
1.10pm-2.10pm	Lunch	
Session Chair -: Dr.Nandani Ediriweera		
2.10pm-2.30pm	Extract of <i>Gmelina arborea</i> attenuates the oxidative stress in STZ induced diabetic rats	A P Attanayake, K A P W Jayatilake, C Pathirana and L K B Mudduwa
2.30pm-2.50pm	Determination of the quality and stability of coconut oil extracted by a modified extraction process	N M S Hettigedara, N A K P J Seneviratne and L M K Tillekeratne
2.50pm-3.10pm	Comparative chemical analysis of composition of edible oils, particularly coconut oil, available in Sri Lankan market	R Fernando, N M S Hettigedara, N A K P J Seneviratne and L M K Tillekeratne
3.10pm-3.30pm	A Green way to produce Biodiesel from Palm olein oil	N A Pannilawithana and H M K K Pathirana
3.30pm-4.00pm	Tea	
Session Chair -:Prof.Sukumal Wimalasena		
4.00pm-4.20pm	Development of a Herbal Snake repellent Product	N H P De Silva and L S R Arambewela
4.20pm-4.40pm	Antioxidant and antifungal activities of secondary metabolites of the endolichenic fungus, <i>Penicillium pinophilum</i> isolated from the lichen <i>Pseudocyphellaria</i> sp. available in Sri Lanka	C N Kulasekera, S Wickramarachchi and P A Paranagama
4.40pm-5.00pm	Preliminary investigation of isolation of bioactive secondary metabolites produced by <i>Penicillium citrinum</i> , inhabiting the lichen <i>Pamotrema</i> sp. available in Haggala montane forest in Sri Lanka	U Samanthi, C Kulasekera, S Adihetti, S Wickramaarchchi and P A Paranagama

Venue: J N O Fernando Lecture Hall, Adamantane House, Rajagiriya

Time : 9.00 a.m. – 5.00 p.m.

Date: June 21, 2013

Time	Title	Authors
Session Chair -:Prof.M.D.P de Costa		
9.00am-9.20am	Synthesis of cyclometallated Pt(II) complexes of a bipyridyl ligand	Sarath D Perera
9.20am-9.40am	Fabrication of Cadmium Sulfide (p-type) thin film semiconductor <i>via</i> electrodeposition	H D Kiriarachchi, L H S N S Lamaheewage, K A S Pathiratne, D S M De Silva and I M Dharmadasa
9.40am-10.00am	Fabrication of CdS (n-type) and CdTe (p-type) thin film semiconductor materials <i>via</i> electrode position	K A I Sandaruwan, P S Athukorala, K A S Pathiratne, D S M De Silva and I M Dharmadasa
10.00am-10.30am	Tea	
Session Chair -:Prof. K.A.S Pathirathna		
10.30am-10.50am	The study on the effect of Sodium Adsorption Ratio (SAR) to the ion exchange properties of soil	J A D I Niranga and H D Gunawardhana
10.50am-11.10am	Use of <i>curcuma longa</i> as a metallochromic indicator for the titration of iron(III) with EDTA	H R C Chinthana and H D Gunawardhana
11.10am-11.30am	Development of a fluorescence method to analyze Benzodiazepines	M D P De Costa and J M W M Jayasekera
11.30am-11.50am	Studies on the bioavailability of added of fluoride in toothpaste	M D P De Costa, D Gunasekera and K D P Hemalal
11.50am-12.10pm	A study of variation of humic substances and cation exchange capacity of humins during composting process	H A G Hathurusinghe and S D M Chinthaka
12.10am-12.30	Semi – micro dispersive liquid - liquid extraction of low level toxic metal cations and the determination by uv – visible spectrometry	S A Athukorale and S D M Chinthaka
12.30pm-12.50pm	Accumulation of mercury in fish inhabiting in selected water bodies located in urban areas	N S Suwandaratne, B A Perera, S Liyanage, J G P S Ubesena and S P Deraniyagala
12.50pm-1.10pm	Analysis of heavy metals (Arsenic, Lead and Cadmium) in Infant and Full cream milk powder (adult) available in the Sri Lankan market	K K D A Wijesekara, S Liyanage, J G P S Ubesena, S D M Chinthaka and S P Deraniyagala
1.10pm-2.10pm	Lunch	
Session Chair -:Prof.H.D Gunawardhana		
2.10pm-2.30pm	Ayurvedic medicinal oils: Development of a method for HPLC fingerprinting and quantification of anthraquinones in 'Pinda oil'	C Ranasinghe, A M Abeysekera and G M K B Gunaherath
2.30pm-2.50pm	Selenium content in rice consumed by Sri Lankans	S Mahagama, D S M De Silva and S Wimalasena
2.50pm-3.10pm	Synthesis and characterization of Rhenium(I) tricarbonyl ferene complexes for fluorescence imaging	P V H K Ranasinghe, S M Handunnetti, I C Perera and T Perera

Time	Title	Authors
Session Chair:- Dr. G.Bandarage		
3.30pm-4.00pm	Tea	
3.10pm-3.30pm	GRADUATESHIP PROGRAMME IN CHEMISTRY – Analysis of Student data, Class of 2012	P U A I Fernando, C Udawatte and J N O Fernando
4.00pm-4.20pm	Graduateship Programme in Chemistry - Research Course, and the newly introduced Literature Survey Course	P U A I Fernando, C Udawatte and J N O Fernando
4.20pm-4.40pm	Evaluating Problem Solving Skills of Students	C Udawatte

Abstracts of Research Papers to be presented at the 42nd Annual Sessions 2013

Technical Sessions : A - 01

Absorption and Emission Properties of Lycopene, β -Carotene, Norbixin and Their Chemically Oxidized Species

D D D H Alwis^{1,3}, U G Chandrika² and P M Jayaweera^{1*}

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²Department of Bio-Chemistry, University of Sri Jayewardenepura, Nugegoda.

³Department of Chemistry, The Open University of Sri Lanka, Nawala.

Carotenoids and apocarotenoids can undergo chemical oxidation with anhydrous ferric chloride in dichloromethane solutions to produce their radical cations, dications and dimers as intermediates during the process.^{1,2} UV-Visible absorption, fluorescence and fluorescence excitation spectra of lycopene (I), β -carotene (II) and norbixin (III) in CH_2Cl_2 were recorded to understand their ground and excited state properties of neutral and intermediate species. Light absorption of all three neutral carotenoids takes place in the visible region of 460-480 nm. Electronic absorption spectra of (I), (II) and (III) revealed that when reacted with anhydrous FeCl_3 , neutral carotenoids chemically oxidized to produce carotenoid radical cations which gives a strong D_0D_3 absorption band³ in the 700-1100 nm region (Fig. 1) with an observed color change from yellow to dark blue. The initial oxidation/reduction reactions can be written as $\text{CarCar}^+ + \text{e}$ and $\text{Fe}^{3+} + \text{e} \rightarrow \text{Fe}^{2+}$ respectively. Addition of carefully controlled amounts of FeCl_3 can be used to generate the other unstable species like Car^{2+} , and Car_2 . Lycopene and β -carotene radical cations absorption appear at a higher wavelength ~ 1000 nm whereas, for norbixin radical cation peak is observed around ~ 800 nm. Addition of excess FeCl_3 causes the transition to blue shift for all three carotenoid molecules. This is due formation of dicationic species, appearing near 850 nm, 800 nm and 720 nm for I, II and III, respectively. Furthermore, UV-Visible absorption spectrum of

oxidized lycopene shows a shoulder near 700 nm which is most likely to be due to the dimeric form of lycopene. The data do not show such shoulders for β -carotene and norbixin, suggesting dimer formation is restricted, possibly due to steric hindrance (see Fig. 1).

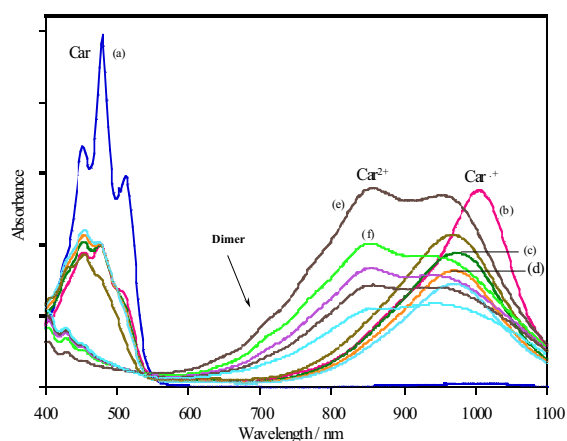


Fig. 1 UV-Vis/NIR spectra of (a) neutral lycopene (b) just after adding FeCl_3 (c) after 4 minutes (d) after 8 minutes (e) with excess FeCl_3 and (f) after 4 minutes with excess FeCl_3 in CH_2Cl_2 .

Fluorescence and fluorescence excitation spectra were obtained in dichloromethane at room temperature, for (I), (II) and (III) as well as for their intermediate species. Data revealed that a dominant⁴ emission $\text{S}_2 \rightarrow \text{S}_0$ ($1^1\text{B}_u \rightarrow 1^1\text{A}_g$) for all three neutral carotenoids, observed around ~ 550 nm. When (I), (II) and (III) molecules are chemically oxidized with

anhydrous FeCl_3 the fluorescence emission wavelength shows a significant blue shifted with a maximum appearing at ~ 490 nm for (I) and (II).

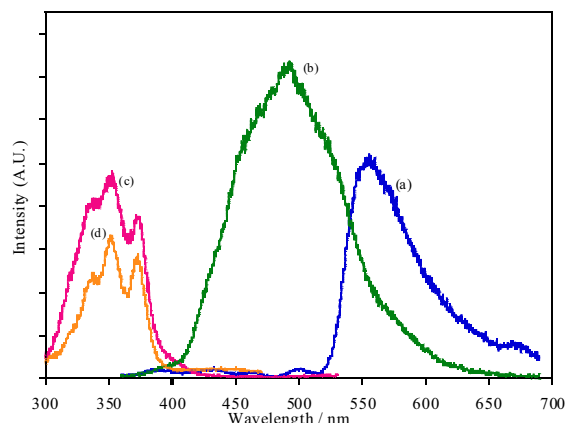


Fig.2 Fluorescence spectra of (a) neutral lycopene (b) lycopene with excess FeCl_3 . Fluorescence excitation spectra of (c) neutral lycopene and (d) lycopene with excess FeCl_3 . Solvent CH_2Cl_2 , Excitation: 350 nm

Whereas for molecule (III) at 500 nm. However, fluorescence excitation spectra remain unchanged with the addition of anhydrous FeCl_3 . It is still unclear the exact nature of this emission, perhaps originating from a transient species like dimer or from an intermediate

entity that form during chemical oxidation process. Both theoretical and experimental work is currently in progress to fully understand and identify this emission.

Key words

Lycopene, β -carotene, norbixin, chemical oxidation, radical cation, dication

References

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Technical Sessions : A - 02

In-vitro antioxidant activity, flavonoids and total phenolic content of *Atalantia ceylanica* and *Eriocaulon quinquangulare*

S C D Fernando* and P Soysa

Department of Biochemistry & Molecular Biology, Faculty of Medicine, University of Colombo

Decoctions prepared from leaves of *Atalantia ceylanica* and the whole plant of *Eriocaulon quinquangulare* are used in traditional medicine in Sri Lanka for the treatment of various liver ailments since ancient times. Lyophilized powders of the water extracts of *A. ceylanica* leaves and the whole plant of *E. quinquangulare* were investigated for their phytochemical constituents and antioxidant activities *in-vitro*.

The total phenolic and total flavonoid contents were determined using Folin Ceocalteu method and aluminium chloride colorimetric assay respectively. The antioxidant activities of the decoctions were investigated using 1,1-Diphenyl-2-picrylhydrazyl (DPPH), hydroxyl radical, nitric oxide scavenging assays and ferric ion reducing power assay.

The mean $\pm$ SD for the levels of total phenolics were 4.87 ± 0.89 and 10.32 ± 1.63 w/w % of gallic acid equivalents for *A. ceylanica* and *E. quinquangulare* respectively. The total flavonoid contents were $16.48 \pm$

0.63 and 45.55 ± 3.77 w/w % (-)-Epigallocatechin gallate equivalents for *A. ceylanica* and *E. quinquangulare* respectively. Both of the decoctions demonstrated high antioxidant activities. The mean $\pm$ SD values of EC_{50} for *A. ceylanica* were 131.2 ± 36.1 , 48.4 ± 12.1 , 263.5 ± 28.3 and 87.70 ± 6.06 $\mu\text{g/ml}$ where as the values for *E. quinquangulare* were 37.18 ± 1.69 , 170.54 ± 6.63 , 31.85 ± 2.22 and 35.12 ± 0.60 $\mu\text{g/ml}$ for DPPH, hydroxyl radical, nitric oxide scavenging assays and ferric ion reducing power assay respectively.

The results obtained suggest that both decoctions prepared from *A. ceylanica* and *E. quinquangulare* extracts possess strong antioxidant properties with relatively much higher antioxidant activity observed for *E. quinquangulare*.

Acknowledgement: Financial assistance by Department of Biochemistry & Molecular Biology, Faculty of Medicine, University of Colombo

Qualitative & quantitative analysis of amino acids & peptides of digested curd in selected curd brands produced in Sri Lanka

LV Athiththan, MC Dabarera and PPR Perera

Department of Biochemistry, Faculty of Medical Sciences, University of Sri Jayewardenepura, Nugegoda.

Curd contains bioactive peptides that have antihypertensive effects through inhibition of Angiotensin Converting Enzyme (ACE), probiotic effect, immunomodulant properties and anticancer activity⁽¹⁾. Peptides and amino acids in curd vary with the bacterial species used and milk type. A preliminary study was carried out to analyze amino acids and peptides qualitatively and quantitatively after digesting with peptidases in two commercially available curd brands produced in Sri Lanka.

Curd samples were subjected to sequential enzymatic digestion with pepsin, trypsin and carboxypeptidase-A⁽²⁾. Liquid fractions were separated using high speed centrifugation and analyzed using paper chromatography with the solvent system n-butanol, ethanol and ammonia in 7:3:4 ratios. Amino acids and peptides present were identified against the standard amino acids and peptides. Concentrations of each amino acid were calculated by measuring the absorbance at 570 nm⁽³⁾ against amino acid standard. Proline containing peptides and amino acids were analyzed at 440 nm. Peptides in digested curd were purified using HPLC and concentrations were calculated by calculating area under the curve of peaks.

Digested curd of both brands had two peptides and five amino acids. Amino acids matched with alanine, tyrosine, proline, valine and isoleucine standards. One peptide and one amino acid gave yellowish purple colour with maximum absorbance at 440 nm indicating the presence of proline. But the concentrations of amino acids and peptides were different in the two brands. Total amino acid concentration was 18.8 mg/mL in brand 2 and 17.2 mg/mL in brand 1. Proline concentration was higher in brand 2 (7.9 mg/mL) than brand 1 (6.7 mg/mL). Both brands had similar patterns of HPLC elution profiles. Highest concentration was obtained for a

dipeptide, 8.4 mg/mL in brand 2 and 8.1 mg/mL in brand 1. Proline containing tri peptides was similar in both with brand 2 (5.8 mg/mL) and brand 1 (5.6 mg/mL). Suggesting that amino acids and peptides concentration varies with different brands and hence contribute to different extents of bioactive properties. Proline, proline containing peptides and other dipeptides in digested curd were higher than studies conducted on whey suggestive of higher ACE inhibition than whey⁽⁴⁾. In addition studies have also proven that di and tri peptides which can be easily absorbed in human intestine and contribute to the health beneficiary effects⁽⁵⁾. Therefore curd would be a good source of peptides after *in vivo* digestion.

Acknowledgement: Financial assistance by the university grant (ASP/6/R/2010/8).

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Cover Page

The cover page shows the Graduate Chemists after the graduation at the 9th Convocation of the College of Chemical Sciences at Waters Edge. The photograph was taken by Mr. S D Gunasinghe, Graduate Chemist (2012). More formal photographs of the Convocation are on inner & outer cover pages. Convocation Address and the Hony. Rectors report will be published in the Vol. 30 No. 3.

New Heterocyclic Compounds from the Reaction of 4,7-Dioxononanoic acid with hydrazine

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² SW Center for Natural Products Research and Commercialization, School of Natural Resources and the Environment, University of Arizona

4,7-Dioxocarboxylic acids can be synthesized from furfural, which is a readily available, versatile and cheap organic compound that can be derived from a variety of agricultural byproducts such as rice hull.¹ Although these acids with two keto carbonyl groups in a 1,4-relationship as well as a carboxyl carbonyl group and keto carbonyl group in a 1,4-relationship are potentially good precursors for the synthesis of 5- and 6-membered heterocyclic and fused heterocyclic compounds,² their chemistry has not been studied in detail. 5- and 6-Membered heterocyclic and fused heterocyclic compounds have found many applications most importantly in the pharmaceuticals industry.³

Here, we report the synthesis of two new heterocyclic compounds from the reaction of 4,7-dioxononanoic acid with hydrazine in aqueous ethanol. A possible reaction pathway is depicted in Figure 1.

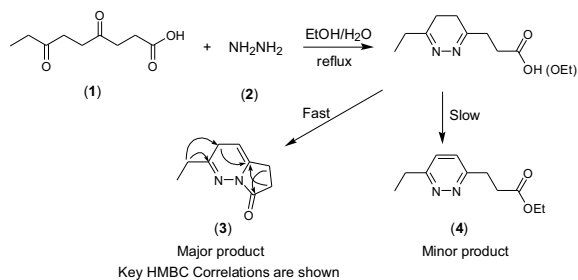


Figure 1. A possible pathway for the formation of compounds (3) and (4) from 4,7-dioxononanoic acid (1) and hydrazine (2).

The major product (3), a pyrrolopyridazine, was characterized by NMR and GC-MS spectroscopy. In the ¹³C NMR spectrum, all 9 carbons were present and the three quaternary carbons appeared at δ 170.3, 158.9 and 135.5 while the signal at δ 92.7 represented the methine carbon. The signals for the methylene carbons were in the range δ 10.5 – 30.9. The ¹H NMR spectrum showed the presence of the ethyl group and a single methine proton at δ 4.63 (multiplet) coupling with the adjacent methylene protons at δ 2.91. The four protons

from the two methylene groups in the pyrrole ring occur as a multiplet at δ 2.55. All these assignments were confirmed by COSY, HSQC and HMBC spectra. The molecular ion peak was observed in the GC-MS at m/z 164.0. Very few compounds containing the pyrrolopyridazine ring system have been reported in the literature, and their biological and chemical properties are yet to be explored. The structure of minor product (4) was assigned as 3-(pyridazin-3-yl)-propionioic acid ester on the basis of its GC-MS and UV spectrum. The GC-MS gave the molecular ion at m/z 208.0 with strong fragment ions at m/z 163.0 (M – OEt)⁺ and 135 (M – OEt – CO)⁺. A typical pyridazine UV spectrum with λ_{max} at 261 and 321 nm was observed. The NMR spectral analysis is pending. Phenyl propionioic acids have been reported to have anti-inflammatory properties and synthesis of pyridazinyl propionioic acids is of interest as pyridazine is considered a privileged structure in drug discovery.⁴

Acknowledgements

We thank Prof. Leslie Gunatilaka, University of Arizona, for spectroscopic facilities and the University of Sri Jayewardenepura for financial support.

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Ethanol Production by Microbial Fermentation using Over-Ripe Bananas

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¹College of Chemical Sciences, Institute of Chemistry Ceylon, Rajagiriya

²Department of Molecular Biology and Biotechnology, University of Peradeniya, Peradeniya.

Sri Lanka is a major country which produces huge quantities of banana from many different banana varieties throughout the year. Post-harvest loss of bananas account for about 30%¹ of the production. Therefore over-ripe bananas are economically effective to be used as the raw material for ethanol production. Ethanol is a very useful compound which can be mainly used as a fuel, and in the beverage industry. Environmental pollution can be prevented by using bio ethanol as a fuel. It is more cost effective than ethanol produced from petroleum sources.

In this study, ethanol was produced by fermenting over-ripe bananas by varying several factors; pH, fermentation duration, microbial type used and different banana varieties under anaerobic conditions. Rotten Embul, Seeni, Anamaalu varieties were used as the substrates. *Saccharomyces cerevisiae*, *Aspergillus niger* and a bacterium called *Zymomonas mobilis*, which was isolated from sugar cane sap (ZM) were used as inoculums. pH (4.2, 7, 8) and fermentation duration (1, 3, 5, 7) days were varied in

this study. Fractional distillation was carried out for effective purification of ethanol. Ethanol concentration was obtained by gas chromatography for each sample.

The best yield of ethanol 95% (v/v) was obtained with ZM bacterium at pH 4.2 and five days of fermentation after the distillation when over ripe Anamaalu was used.

The pH of 4.2 was found to be the best pH for all the microbes used. Period of five days was the optimum fermentation duration for bacterium and three days was the optimum period for fungi. Other time durations and pH values investigated gave lower ethanol concentrations. The fermented beverage had ethanol as found in the wine and beer ranges and the distilled product can be used to produce an alcoholic beverage. Bioethanol can be used as a biofuel blending with gasoline in suitable proportions.

1. Ekanayaka S, Bandara A, Development of Banana Fruit Leather, *Annals of the Sri Lanka Department of Agriculture*, 2002,4: 353-358.

Studies on the Essential Oil and the Absolute of *Nyctanthes arbortristis* L. Flowers

K A V S Siriwardena and L S R Arambewela

College of Chemical Sciences, Institute of Chemistry, Rajagiriya, Sri Lanka

Extracts of *Nyctanthes arbortristis* L. have been shown to possess medicinal applications in traditional medicine. Its curative values are well documented in Ayurveda, Sidha and Unani systems of medicine. The constituents of the essential oil and antioxidant activity of these flowers grown in India and Bangladesh have been reported. The present study aims to characterize the volatile constituents of the essential oil and absolute of *N. arbortristis* flowers from Sri Lanka as well as study their antioxidant activity.

Fresh flowers were hydro-distilled for five hours using a Clevenger type apparatus. Hydro-distillation of flowers of *N. arbortristis* yielded a light yellow colored essential oil (0.77%, w/w, dry basis) with a strong floral odor. Absolute was obtained by extracting the hexane extract of fresh flowers with ethanol and removing the

fat by refrigeration. GC/MS analysis of essential oil showed that it contained phytol (32.2%), methyl palmitate (14.7%), cis-9-tricosene (3.6%), geranylgeraniol (2.7%), n-nonadecane (2.2%), phytone (1.4%), methyl stearate (1.1%), n-pentacosane (1.6%) and benzyl salicylate (1.1%) as major compounds. Linalool oxide, terpineol, eucarvone, methyl salicylate and geraniol were minor compounds detected. A range of alkanes starting from n-decane to n-heptacosane were also detected in the essential oil. Butyl acetate (80.8%) was the major compound detected in the absolute while 2-butoxyethyl acetate, phenethyl acetate and linalool oxide were also present.

Essential oil of *Jasminum* species and *N. arbortristis* flowers contained linalool, methyl palmitate, phytol, benzaldehyde, methyl salicylate,

methyle benzoate, linalool oxide, terpineol, geraniol, geranyl linalool and methyl octadecanoate, thus *N. arbortristis* could be used instead of jasmine. The essential oil and the absolute did not indicate

antioxidant activity for DPPH radical scavenging assay, whereas the water extract of the fresh flowers had moderate antioxidant capacity with an IC_{50} value of 1160 $\mu\text{g/ml}$ in comparison to BHT ($IC_{50} = 84 \mu\text{g/ml}$).

Chemical constituents of the absolute of *N. arbortristis* flowers of Sri Lanka

Retention Time	Compounds Identified	% Composition in the Absolute
4.05	Butyl acetate	80.8
10.92	2-Butoxyethyl acetate	1.4
13.34	Linalool oxide	1.4
15.62	Phenethyl acetate	1.7

Technical Sessions : A - 07

Fatty acid profiles, oxidative and hydrolytic stability of some commonly utilized cooking oils

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Sri Lankans utilize many different types of oils in the day to day cooking. Coconut oil, palmolein, sunflower oil, corn oil and soybean oil are some such commonly used oils. However, no study has been carried out to study the fatty acid profiles and the stability of these oils during storage.

The present study was under taken to determine the fatty acid profiles, oxidative stability and hydrolytic stability of above mentioned oils. Another objective was to observe if the oils are adulterated.

Fatty acid profiles of coconut, soybean, palmolein, sunflower and corn oils were analyzed using gas chromatography. The individual peaks in chromatographs were identified using standard fatty acid methyl esters [FAME] (linoleic acid, oleic acid, palmitic acid, stearic acid), and those fatty acids in oils were quantified. Above oils stored in open beakers and closed bottles were studied for 4-6 months, to determine the oxidative stability of oils under different storage conditions. The peroxide values determined by the volumetric method were used to study the oxidative stability. Acid value was determined to study the potential of oils to hydrolysis by volumetric method¹.

The fatty acid methyl esters of different oils were expressed as a mass fraction in percent (Table 1). Soybean, sunflower and corn oils had 39.3%, 57.46% and 34.5% linoleic acid with sunflower oil having the highest. The oleic acid content was highest in palmolein followed by sunflower, corn and soybean oils.

Palmolein had the highest palmitic acid content.

The peroxide values of the oils stored in open beakers for 6 months ranged from 1.81-76.36 with coconut oil having the lowest and soybean oil having the highest values respectively. Soybean, sunflower, corn, palmolein and coconut oil had peroxide values of 76.36, 67.27, 31.81, 22.72 and 1.81 respectively. The auto-oxidation of soybean oil was found to be the highest among the oils studied. Oils stored in closed bottles for 6 months had peroxide values ranging from 1.81- 44.31. Soybean, sunflower, corn and palmolein had peroxide values of 44.31, 33.86, 33.63 and 20.99 respectively by the end of 6th month. Coconut oil was stable for a longer period than other oils followed by palmolein oil. However, acid value was found to be highest in coconut oil and palmolein oil, which had more saturated fatty acids and therefore are more susceptible to hydrolyses. Coconut, soybean, palmolein, sunflower and corn oil acid values were 1.51, 0.39, 1.59, 0.30 and 0.36 respectively.

Sunflower oil is the best source of both mono and poly unsaturated fatty acids followed by corn and soybean oils. Palmolein oil is a rich source of palmitic acid (saturated FA) and oleic acid (mono unsaturated FA). From studying the peroxide value for a period of 4-6 months it was apparent that if the oil is exposed to air and sunlight continuously the oxidation of oils increases. Therefore oils should be stored in dark (dark bottles) in air tight containers, which will reduce free

radical formation. Once the oil bottles are opened the oils should be used during a period of 4-4.5 months. If oil is being used sparingly then small volume oil bottles should be used. As coconut oil is highly susceptible to hydrolysis than other oils, long term

storage should be avoided. All oils in the present study contained fatty acid values within reported values (according to codex standard for named vegetable oils cx-stan 210 – 1999 volume 8-2001) indicating that none of the oils have been adulterated.

Table 1. The FAME content of different oils expressed as a mass fraction in percent (%)*

Fatty acids Oils	Palmitic acid C16:0	Stearic acid C18:0	Oleic acid C18:1	Linoleic acid C18:2
Coconut	6.49 (R.V=7.5-10)	2.09 (R.V=2-4)	4.89 (R.V=5-10)	1.66 (R.V=1-2.5)
Soya bean	9.60 (R.V=8-13.5)	4.04 (R.V=2-5.4)	20.31 (R.V=17-30)	39.03 (R.V=48-59)
Palmolein	29.73 (R.V=38-43)	3.39 (R.V=3.5-5)	33.07 (R.V=39.8-46)	8.95 (R.V=10-13.5)
Sunflower	6.05 (R.V=5-7.6)	3.32 (R.V=2.7-6.5)	23.78 (R.V=14-39)	57.46 (R.V=48-78)
Com	9.03 (R.V=8-19)	1.79 (R.V=0.5-4)	22.52 (R.V=19-50)	34.50 (R.V=34-65)

*R.V- reference value of codex standard

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Technical Sessions : A - 08

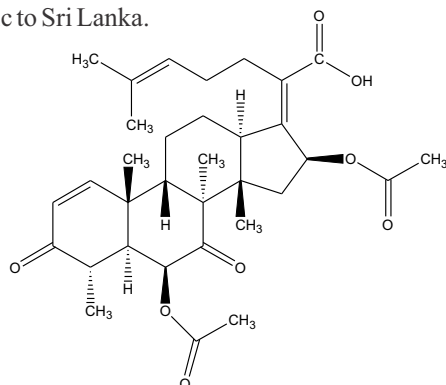
Helvolic acid, an antibacterial nortriterpenoid from an endophytic *Xylaria* sp. associated with the orchid *Anoectochilus setaceus* endemic to Sri Lanka

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Fungal endophytes are widespread in nature and recent studies have shown that they are prolific producers of secondary metabolites having diverse structures and useful biological activities. Although, increasing attention is presently being paid to the chemistry and the bioactivities of endophytic fungal metabolites, a vast majority of the Earth's endophytic fungal biodiversity still remains completely unexplored. In a program designed to investigate antimicrobial potential of endophytic fungi associated with endemic plants of Sri Lanka we have recently isolated and characterized the antibacterial nortriterpenoid helvolic acid (1) from a *Xylaria* sp. endophytic in the orchid *Anoectochilus setaceus* endemic to Sri Lanka.



The endophytic fungal strain isolated from the leaves of *A. setaceus* collected from the Kanneliya Forest Reserve was identified as *Xylaria* sp. by DNA sequencing (NCBI Genbank accession number, JX523620). The agar disc diffusion assay results revealed that the crude ethylacetate extract of the endophytic *Xylaria* sp. showed antibacterial activities against the Gram positive, *Bacillus subtilis* (UBC 344) and Methicillin Resistant *Staphylococcus aureus* (MRSA, ATCC33591), but inactive against Gram negative bacteria, *Escherichia coli* (UBC 8161), *Pseudomonas aeruginosa* (ATCC 27853) and against the fungus *Candida albicans* (ATCC 90028). In order to isolate the active metabolites, the *Xylaria* sp. was grown on PDA (150 Petri dishes, diameter of 100 mm × 20 mm) and after 28 days growth the fungal mycelium together with the PDA medium was extracted into EtOAc to yield 400 mg of the crude extract. This was next chromatographed sequentially on Sephadex LH 20 first with methanol and thereafter with EtOAc : methanol : H₂O (20:5:2 ratio) as the eluting solvents. The resulting active fraction (15 mg) was next subjected to silica gel chromatography using gradient elution (1-20 % methanol : dichloromethane)

to obtain 3 mg of the pure active compound 1 which gave a molecular mass of m/z 567.4 ($M - 1$ ion) in the low resolution electrospray ionization mass spectrum, consistent with the molecular formula $C_{33}H_{44}O_8$ for 1.

The structure elucidation of 1 was done by extensive analysis of NMR spectroscopic data (1D and 2D) to reveal the structure as the known nortriterpenoid metabolite helvolic acid and was confirmed by comparison with published data.¹ The MIC values for helvolic acid were determined to be 2 $\mu\text{g/mL}$ for *B. subtilis* and 4 $\mu\text{g/mL}$ for MRSA. The observations we obtained from the current study, the helvolic acid is active against gram positive bacteria and inactive against gram negative bacteria are in agreement with previous records.²

A. setaceus is currently listed as a vulnerable species in Sri Lanka facing a high risk of extinction in the wild. Up to now there have been no reports of biologically active chemical constituents of *A. setaceus* or the fungal

endophytes associated with it. Our study suggests that helvolic acid produced by the fungal endophyte in the natural environment helps *A. setaceus* to survive the competitive and unique environmental pressures in the rainforest ecosystem.

Acknowledgment:

Financial assistance by Higher Education for Twenty First Century (HETC) project scholarship (UWU/O-ST/N3) to PBR.

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Technical Sessions : A - 09

Physico-chemical and bio-chemical characterization of Sri Lankan *Annona muricata* L.

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Annona muricata L. (Annonaceae) is a tropical fruit tree in Sri Lanka and the ripened fruits are consumed as fresh fruits but commercial utilization of fruits is uncommon in Sri Lanka, hence categorized as an under-utilized fruit tree species. Fruits of *A. muricata* provide nutrients, phyto-chemicals and antioxidants which are vital to human health as well as bioactive substances. There were no previous researches on physico-chemical and bio-chemical properties of *A. muricata* fruits in Sri Lanka. Consequently, the objective of the study was to determine physico-chemical and bio-chemical properties of Sri Lankan *A. muricata* fruits.

The mature fruits were collected from the germplasm collection center at Makadura, Regional Agricultural Research and Development Center. Fruits were allowed to ripe 2-3 days at room temperature prior to analysis. Juice of fruit pulp was prepared without adding water. Brix value and pH measurement of fruit juice was done in triplicates using hand refractometer and pH meter at room temperature. Moisture content of the fruit pulp was determined by using Dean and Stark method and Vacuum oven method. Reducing sugars, total ash, water insoluble ash, and acid insoluble ash

sulfated ash content, fat content, and crude fiber contents were determined following Standard protocols.

The pH of the fruit pulp was recorded as 3.72 which indicated acidic nature of the fruits. Brix value was recorded as 14.0° Brix which showed that the fruit contained high amount of sugars. Results obtained from this study confirmed the values reported in literature (brix value and pH value ranges were reported as 5.6 - 14.9° Brix and 3.7 - 4.9 in *A. muricata* collected from Nigeria, Colombia and Malaysia).

The percentage of moisture content obtained by Dean and Stark method was 82.6% and 74% by Vacuum oven method. The previously recorded moisture content of fruit pulp was in the range of 77-91.8%. The fruit of *A. muricata* showed high moisture content due to its fleshy nature and this also indicates that the fruits are highly susceptible to degradation.

Reducing sugar content obtained for fat free pulp of *A. muricata* was 43 mg g⁻¹ equivalent to 4.3%. The reported reducing sugar content of fruit pulp are 2.3 - 2.9% of glucose, 1.8 - 3.6% of fructose and maltose whereas 1.0 - 6.6% of sucrose which is recorded as non-

reducing sugar present in the fruit pulp.

Total ash content obtained for the fruit pulp was 0.44% which indicated the level of mineral deposit in the pulp. Sulfated ash content was also 0.45% in the fruit pulp. Reported ash contents in Nigerian *A. muricata* are ranged between 0.5 – 0.9%. Water insoluble ash and acid insoluble ash were not present which indicated the absence of impurities in the sample. The impurities such as phosphates and silicates do not dissolve in water or acid. Previous literature reported that certain *A. muricata* fruit do not contain fat but 0.3 - 0.9% fat contents were reported for Nigerian *A. muricata* fruit pulp. The fat content recorded for Sri Lankan *A.*

muricata fruits was 0.4%. Crude fiber content in Nigerian varieties of *A. muricata* fruit pulp was recorded in the range 0.4-0.95%. The crude fiber content obtained for the Sri Lankan *A. muricata* fruits was 0.76%.

Physio-chemical and bio-chemical analysis indicated total soluble solids, reducing sugars and crude fiber contents in Sri Lankan *A. muricata* fruits are in the higher part of the respective ranges relative to Nigerian *A. muricata* fruits.

Acknowledgement: Sri Lanka Council for Agricultural Research Policy for the financial support

Technical Sessions : A - 10

Antibacterial activity and Preliminary phytochemical screening of decoction of *Indigofera aspalathoides* whole plant

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Indigofera aspalathoides is a medicinal plant belongs to the family Leguminosae known as Shivanarvembu in Tamil and Rathkohomba in Sinhala. In Traditional medical system this plant is used as a treatment for several diseases. A decoction of the whole plant is given for secondary syphilis and psoriasis. The leaves are applied on abscess and the root oil is used for skin diseases (Itching, Scabies, Karappan, Kuddam). The decoction of the leaves and flowers are used for skin diseases. A preparation made from the ash of the burnt plant is used to clean dandruff. In Siddha medical system, “Sivanar vembu thylam”, “Sivanarvembu kuliththylam” are the special preparations for skin disorders. The whole plant was collected from Jaffna, cleaned and ground into coarse powder to prepare the decoction (40 g of whole plant coarse powder in 480 ml distilled water boiled until the volume was reduced to 60 ml and further concentrated to obtain 30 ml using a reduced flame). The decoction was screened against eight bacterial isolates (*Staphylococcus aureus* – NCTC 6571, *E. coli* – NCTC - 10418, *P. aeruginosa* – NCTC – 10662 and five wild strains of Methicillin resistant *Staphylococcus aureus* (MRSA). This was performed by the cut well diffusion using Mueller – Hinton Agar (MHA) and agar dilution methods. The activity of the decoction was carried out in cut well method. The inhibition zone was 17.00 ± 1.00 to 18.67 ± 0.58 against *Staphylococcus aureus* (MSSA and five different strains of MRSA). In agar dilution method this decoction showed activity against *Staphylococcus aureus* (MSSA and five different strains of MRSA) at 1/20 dilution and against *Pseudomonas*

aeruginosa at 1/10 dilution. The decoction showed potent activity (18.67 ± 0.58 for MSSA and 17.00 ± 1.00 - 18.33 ± 0.58 for five MRSA) in cut well method and potent activity in agar dilution method. *E. coli* did not show any activity in both, agar dilution and cut well methods. In order to check the active ingredients phytochemical screening was carried out and the results revealed the presence of alkaloids, tannins, steroids, flavonoids, glycosides and triterpenoids in this plant. The ability of the decoction of *Indigofera aspalathoides* to inhibit the growth of bacteria is an indication of its antibacterial potential which may be employed in the management of bacterial infections.

Key words: Antibacterial activity, phytochemical screening, decoction, *Indigofera aspalathoides*

Acknowledgements: Financial assistance for HETC Project (JFN/Sidda/N2) from the Ministry of Higher Education is acknowledged.

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Investigation of coumarin levels in different grades of Ceylon cinnamon

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Coumarin is reported to cause hepatotoxicity in rats and mice and there are isolated incidents of similar hepatotoxicity in humans. Further, there are evidences for carcinogenicity in experimental animals¹. The German Federal Institute for Risk Assessment (BfR) has set the tolerable daily intake (TDI) as 0.1 mg of coumarin per unit body mass per day, which is 5 mg of coumarin per day (Assuming the body weight is 50 kg)². For food and beverages in general, the maximum levels is 2 mg kg⁻¹, with the exception for alcoholic drinks and some caramels where it is 10 mg kg⁻¹. These levels include coumarin from all sources: natural flavouring such as essential oils, spices and synthetic flavours.³

There is no comprehensive study has been conducted to study the coumerin levels in Ceylon cinnamon. Therefore the objective of this study was to study the coumerin levels in Ceylon cinnamon. The extraction methodology was optimized to meet maximum extraction of coumarin from cinnamon. A powdered sample was extracted into aqueous ethanolic solution by agitation followed by sonnication. The separation system consisted of a C₁₈ reverse phase column, a gradient elution system of methanol/ acetonitrile and acetic acid and a photodiode array detector at 280 nm wave length.

Coumarin content in 10 different grades of Ceylon cinnamon (n=6x10) analyzed is given in table 1.

Table1: Coumarin content in different grades of Ceylon cinnamon.

Cinnamon Sample	Coumarin/ ppm (mg/kg)	Coumarin/ %, W/W
Alba	15.90 ± 1.87	0.0015 ± 0.00018
C-5 sp	30.45 ± 5.25	0.0030 ± 0.00052
C-5	35.61 ± 3.67	0.0035 ± 0.00036
C-4	5.93 ± 1.52	0.0006 ± 0.00015
M-5 sp	2.89 ± 0.29	0.0003 ± 0.00002
M-5	9.76 ± 1.17	0.0010 ± 0.00015
M-4	17.81 ± 2.11	0.0017 ± 0.00021
H-1	2.46 ± 0.33	0.0002 ± 0.00003
H-2	12.21 ± 4.58	0.0012 ± 0.00045
H-3	10.18 ± 2.96	0.0010 ± 0.00029

Data were represented as mean ± SD (n=6):

C- Continental, M- Maxicon, H- Hamburg, sp- Special

The results clearly indicate that different grades of Ceylon cinnamon have different levels of coumarin which is in the range of 2- 35 mg kg⁻¹ (0.0002 – 0.0035 % w/w). However there is no significant difference of coumarin levels among the different grades of Ceylon cinnamon. The HPLC chromatogram of Ceylon cinnamon extract (Fig. 1) shows considerably small peak for coumarin. Therefore each analysis was confirmed by spiked sample of coumarin (Fig. 2).

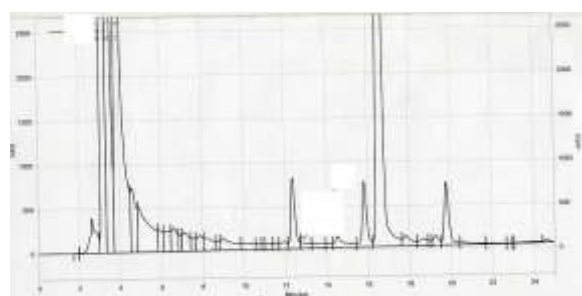


Fig. 1: HPLC chromatogram of ethanolic extract of Ceylon cinnamon (Without spiking of coumarin)

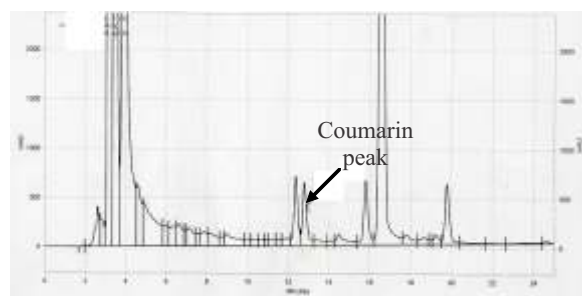


Fig. 2: HPLC chromatogram of ethanolic extract of Ceylon cinnamon with spiking of coumarin

According to F. Woehrlin, et al. coumarin levels in cinnamon ranges from 1740 to 7670 mg/kg in Cassia powder and from below the limit of detection to 297 mg/kg in Ceylon cinnamon powder⁴. Since coumarin content is very high in cassia compared to Ceylon cinnamon, the coumarin level can be used to differentiate Ceylon cinnamon from cassia. Further coumarin content could be a very significant factor in the process of branding Ceylon cinnamon against the major competitor Chinese cassia.

In conclusion the coumarin content of Ceylon cinnamon is extremely low and well below the recommended tolerable daily intake (TDI).

Acknowledgment

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Technical Sessions : A - 12

Total Phenolic Content and antioxidant activity of *Eichhornia Crassipes* ethanolic extract

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Eichhornia crassipes is an aquatic water hyacinth that has spread to over 70 countries. It has a very fast growth rate, and can double in size and biomass in less than three days. Due to its rapid growth, it is considered to be an invasive plant. Therefore, a large sum of money is spent in clearing *Eichhornia crassipes* from waterways, and the harvested vegetation is burnt. However, its fast growth rate and ability to grow in waste water and remove nutrients from high strength organic waste water makes *Eichhornia crassipes* a good candidate for phytoremediation. Additionally, *Eichhornia* contains polyphenols, alkaloids and other compounds of interest. The aim of this study is to isolate compounds of pharmacological interest from *Eichhornia crassipes*.

Eichhornia crassipes is the predominant species of water hyacinth in Sri Lanka. The *Eichhornia crassipes* plants were collected from streams and canals in Rajagiriya area. Stem parts of the plants were cut in to small pieces and placed in the Soxhlet apparatus. Hot extraction was carried out with 80% ethanol until the extraction of oil was complete.

Total Phenolic contents (TPC) of extracts were assessed using the Folin-Ciocalteu Assay^[1] with modifications. Extract solution (0.6 ml) was mixed with 2 ml of 10% Folin-Ciocalteu reagent and 2.0 ml of 7.5% sodium carbonate. The mixture was agitated and allowed to stand at room temperature for 30 min in the dark room. The absorbance of extracts and prepared blank were measured at 617 nm using a Hitachi U2910 UV-vis spectrophotometer. The TPC in plant extract

were $16.66 \mu\text{g ml}^{-1}$ Gallic Acid Equivalents (GAE).

Evaluation of antioxidant activity- The ability of the plant extract to scavenge $0.025 \text{ mmol dm}^{-3}$ of di(phenyl)-(2,4,6-trinitrophenyl)iminoazanium (DPPH) free radicals was assessed by the method of Tekao *et al.* (1994)^[2], with modifications and percentage inhibition was calculated after 1 hour incubation. IC_{50} values were estimated from a plot of % inhibition vs Phenolic concentration (Figure 2). Gallic acid was used as the positive control. The IC_{50} value for the ethanolic extract of *Eichhornia crassipes* was $3.73 \pm 0.05 \mu\text{g ml}^{-1}$ and the IC_{50} value for the positive control (Gallic acid) was $0.285 \pm 0.03 \mu\text{g ml}^{-1}$.

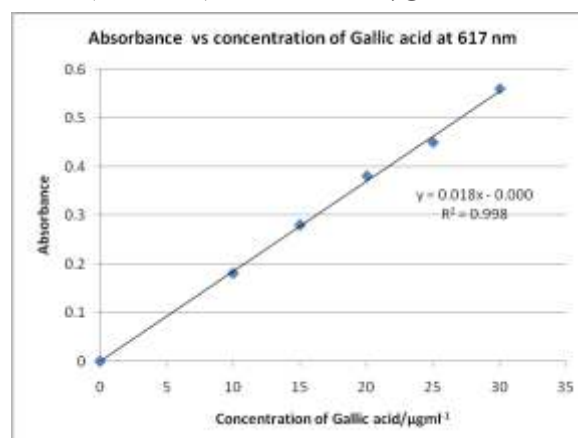


Fig. 1: Absorbance vs Concentration of Gallic acid at 617 nm

Eichhornia crassipes is considered to be an invasive plant and an effort is being made to remove and destroy it from water ways. Our studies show that the ethanolic

extract of *Eichhornia crassipes* contains appreciable amounts of phenolic compounds and antioxidants.

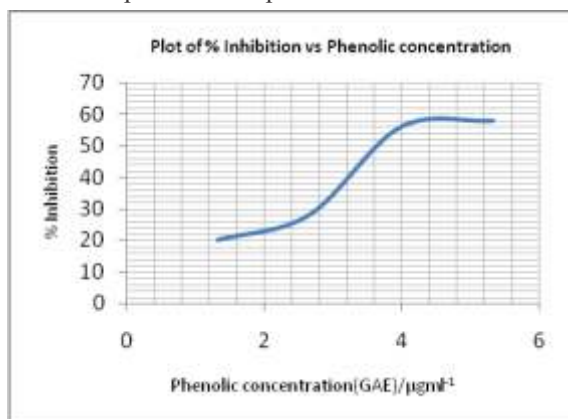


Fig. 2: Plot of % Inhibition vs Phenolic Concentration

Technical Sessions : A - 13

Purification and Characterization of Thermostable α -amylase from *Bacillus licheniformis* NMS-6 isolated from Nelumwewa hot water spring in Sri Lanka

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Thermophile microorganisms produce thermostable enzymes which have a high potential for applications in biotechnology¹. Thermostable α -amylases are commercially important extracellular enzymes and are used in many industries². It has applications in starch saccharification, textile, food, brewing and distilling industries³. Each application requires unique properties with respect to temperature, pH, specificity and stability⁴.

Nelumwewa hot water spring in Sewanapitiya, in the Polonnaruwa district of Sri Lanka has a water temperature of 61 °C and the out flow temperature close to the well of 56 °C. The pH of the water is 4.8. The Nelumwewa hot water spring has the highest recorded temperature among the hot springs in Sri Lanka. Water and soil samples were collected under sterile conditions and they were inoculated in to culture medium containing peptone 0.5%; yeast extract 0.2%; Sodium chloride 0.5%; Starch 1% and a salt solution containing KCl 0.5%; MgSO₄·7H₂O 0.5%; MnSO₄ 0.04%; FeSO₄ 0.3%; K₂HPO₄ 0.87%; Soluble Starch 2%; CaCl₂ 0.022% and pH was maintained at 6.9. Cultivation was done at 50 °C at 150 rpm and bacteria were isolated by streak plate and dilution plate methods. The bacteria having the highest alpha amylase activity was identified by morphological and biochemical tests and 16S rRNA analysis as *Bacillus licheniformis* strain NMS-6.

Therefore, it is economically significant if pharmacologically important compounds can be extracted from it.

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Incubation at temperatures of 37 °C, 50 °C, 60 °C and 70 °C showed that the maximum α – amylase activity of 58 U /ml at 50 °C at 12 hours of incubation. The extracellular α – amylase enzyme was purified by extraction, acidification and ion exchange chromatography. The specific activity of the purified α – amylase was 2321 U/mg with the folds purification of 3 and percentage recovery of 70 %. The enzyme was shown to be homogeneous by polyacrylamide gel electrophoresis. The purified enzyme had a maximum activity at 50 °C and was stable up to 80 °C. Maximum activity was observed at pH 7 and maximum stability was also observed at pH 7. K_m and V_{max} calculated from Lineweaver –Burk plot were 2 mg/ml and 950 μ mol/min/mg respectively.

This study has shown that α – amylase produced by *Bacillus licheniformis* NMS-6 have practical applications in the biotechnology industry on account of high enzyme activity, the stability at 50 °C and neutral pH.

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Technical Sessions : A - 14

Purification and characterization of a thermo stable extracellular lipase from *Pseudomonas thermotolerance* NMS 3 isolated from a hot water spring in Sri Lanka

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Lipases are a commercially important group of enzymes and are used in a variety of biotechnological applications¹. In recent years there has been a great demand for thermostable enzymes for use in industrial fields. The importance of thermostable lipases for different applications has been growing rapidly². Nelumwewa hot water spring situated in Sewanapitiya in the Polonnaruwa district of Sri Lanka has a water temperature of 61 °C and the out flow temperature close to the well is 56 °C. The pH of the water was 4.8. Nelumwewa hot water spring has the highest water temperature reported in Sri Lanka. Water samples from the hot wells and soil samples from the bottom of the hot wells of Nelumwewa were collected under sterile conditions and they were inoculated in to the culture medium containing Peptone 2%, Yeast extract 1% and a salt solution containing 0.1% MgSO₄ · 7H₂O, 1% KH₂PO₄, 0.3% CaCl₂, 0.05% (NH₄)₂SO₄, 0.1% K₂HPO₄. 2% V/V olive oil was added to promote the growth of lipase producing bacteria and pH was maintained at 7. Cultivation was done at 50 °C, in an orbital shaker at 120 rpm and bacteria were isolated by streak plate and dilution plate methods. From the bacteria isolated the highest lipase producing bacteria was identified by morphological and biochemical tests and 16S rRNA analysis as *Pseudomonas*

thermotolerans strain NMS 3. Incubation at temperatures of 50 °C, 60 °C and 70 °C showed that the maximum activity of 33 Units/ml was obtained at 50 °C after 36 hours of incubation. Enzyme activity was determined by spectrophotometric method using Para nitro phenyl laurate as the substrate.

The extracellular enzyme was purified by extraction, ammonium sulphate fractionation and DEAE chromatography. The specific activity of the purified enzyme was 304 Units / mg with a 59 purification fold and a recovery of 4%. The recovery was low as DEAE chromatography showed the presence of four isoenzymes, of which only one was used for this study. The enzyme was shown to be homogenous by the presence of a single protein band in polyacrylamide gel electrophoresis. The purified enzyme had a maximum activity at 50 °C and was stable up to 50 °C. Maximum activity was observed at pH 9. The Km and Vmax were 1.97 × 10⁻¹ mM and 710 µmoles / min / mg respectively.

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Technical Sessions : A - 15

The response of the low country live wood termite *Glyptotermes dilatatus* to extracts of tea stems decayed by various fungi

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Low country live wood termite *Glyptotermes dilatatus* is the major pest of tea cultivation in low elevation. Field observations indicated that they are attractive to rotted stumps and initiate the colony in the rotted stump. Bush debilitation and dyeing of tea plants

are the major symptoms of termite infestation. In the present study, role of fungi present in the rotted tea stems to attract termite on tea plant was investigated.

Responses of alates to rotted tea stems, healthy tea stems and tea leaves were studied and the results

revealed that the alates of *G. dilatatus* were more attractive to rotted tea stems than the healthy tea stems and tea leaves of susceptible cultivar, TRI 4042. Percentage response of alates to rotted stems, healthy stems and leaves of tea cultivar TRI 4042 were 41 ± 3.3 , 16 ± 0.8 and 19 ± 0.8 respectively. Since alates were attractive to the rotted tea stems, the responses of alates to ethyl acetate extracts of rotted tea stems and healthy tea stems were studied. The results further confirmed that the constituents' presents the rotted tea stems were more attractive than that of the healthy tea stem extracts. The extracts of rotted stems of four tea cultivars, TRI 2023, TRI 2027, TRI 4042 and TRI 4049 were tested and the percentage responses of alates to the extracts were 86 ± 1 , 80 ± 1 , 75 ± 3 and 67 ± 1.7 respectively. Since wood rot fungi are the main causal organism for wood decay in the tea plant the fungi present in the rotted stems, termite galleries and living termites were isolated and identified using identification keys (Barnett, 1960; Domsch, *et al.*, 1993). The results obtained showed that number of fungal strains isolated from the rotted stumps, termite galleries and living termites were 15, 08 and 09 respectively. In order to investigate whether these fungi induce the decaying of the tea stem, selected

fungi were tested for their substrate utilization abilities using pure substrates of starch, cellulose, pectin and lignin. The substrate utilization ability of the individual fungal species was determined for substrates which are commonly present in wood.

Evaluation of substrate utilization potentials of the wood rot fungi using cellulose, starch, pectin and lignin, revealed that all the fungal strains utilized starch. The cellulose utilization ability was demonstrated by *Acremonium* sp. 1, *Acremonium* sp. 2, *Penicillium* sp., and *Aspergillus* sp. 1. All the test fungi were able to produce pectate lyase enzyme except *Aspergillus* sp. 3 and *Mortierella* sp. The polygalacturonase enzyme was produced by *Acremonium* sp. 2, *Acremonium* sp. 2, *Penicillium* sp., *Nectria* sp. and *Aspergillus* sp. 3 to break pectin molecules. The ability to produce lignases by the test fungi was also studied. All the fungi showed ability to produce peroxidase enzyme, tyrosinase was produced by *Acremonium* sp. 2, *Nectria* sp. and *Aspergillus* sp. 3. The results indicated that none of the test fungi can produce laccase to break lignin (Table 2). Results revealed that there is a potential to induce decay of heart wood of tea plant by *G. dilatatus*.

Table 1: Fungi isolated from rotted stumps, termite galleries and termites.

Fungi from rotted stumps	Fungi from termite galleries	Fungi from living termite
Black sterile sp.	<i>Acremonium</i> sp.1	<i>Acremonium</i> sp. 1
<i>Acremonium</i> sp.1	<i>Acremonium</i> sp.2	<i>Acremonium</i> sp. 2
White sterile sp.1	<i>Fusarium</i> sp.	<i>Penicillium</i> sp.
<i>Trichoderma</i> sp.	<i>Trichoderma</i> sp.	<i>Nectria</i> sp.
<i>Acremonium</i> sp.2	<i>Penicillium</i> sp.	<i>Mortierella</i> sp.
<i>Mortierella</i> sp.	<i>Aspergillus</i> sp.	<i>Aspergillus</i> sp.1
<i>Fusarium</i> sp.	white sterile sp.	<i>Aspergillus</i> sp.2
<i>Nectria</i> sp.	<i>Nectria</i> sp.	<i>Aspergillus</i> sp.3
<i>Cylindrocarpon</i> sp.		
<i>Penicillium</i> sp.		
<i>Aspergillus</i> sp.		
White sterile sp.2		

Table 2. Substrate utilization patterns of the selected fungi, isolated from surface sterilized *G. dilatatus*

Fungal species	Cellulose	Starch	Pectin		Lignin		
			Polygalacto Uronase	Pectate Lyase	P	L	T
<i>Acremonium</i> sp. 1	+	+	+	+	+	—	—
<i>Acremonium</i> sp. 2	+	+	+	+	+	—	+
<i>Penicillium</i> sp.	+	+	+	+	+	—	—
<i>Nectria</i> sp.	—	+	+	+	+	—	+
<i>Mortierella</i> sp.	—	+	—	—	+	—	—
<i>Aspergillus</i> sp.1	+	+	—	+	+	—	—
<i>Aspergillus</i> sp.2	—	+	—	+	+	—	—
<i>Aspergillus</i> sp.3	—	+	+	—	+	—	+

Replicates =3 L = Laccase P = Peroxidase
T = Tyrosinase

Conclusions

Low country live termite is more attractive to decayed wood over the healthy wood. It could be due to the constituents produce during process of decay.

There is a potential to induce decay of heart wood of tea plant by infestation of Low country live wood termite *G. dilatatus*.

Acknowledgements

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Technical Sessions : A - 16

Proximate nutrient composition and glycaemic responses of godamba and kottu roti

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Godamba roti is a commonly consumed food item made of wheat flour and kottu roti is a popular novel variation of godamba roti made with addition of vegetables, chicken, eggs etc depending on consumer preference. The present study aimed to determine the proximate composition, glycaemic responses and glycaemic indices (GI) of these two starchy food items consumed by Sri Lankans as these data are not available.

Godamba and kottu roti were prepared according to standard recipes following a market survey. Digestible carbohydrate, protein, fat, soluble and insoluble dietary fibre, moisture and ash contents were determined using standard methods. GI was evaluated as a random cross over study. Healthy volunteers (6 males and 6 females; 20-30 years; BMI 18.5-23.5) were participated in the study. Glucose (55g) was the standard food. Six finger prick capillary blood samples were obtained from the subjects following an overnight fast (8-10hrs) and serum glucose analyzed. The Incremental are under the blood glucose curve (IAUC) for standard and the test foods for each individual was calculated. Glycaemic index and glycaemic loads were determined for each food.

Kottu roti had significantly high ($p < 0.001$) protein ($18.4 \pm 0.9\%$), insoluble dietary fibre (IDF) ($5.0 \pm 0.1\%$), soluble dietary fibre (SDF) ($7.0 \pm 0.1\%$),

fat ($10.7 \pm 0.1\%$) and ash ($3.4 \pm 0.1\%$) on dry weight basis (DM). Digestible carbohydrate content of godamba roti (67.8 ± 0.7) was significantly higher ($p < 0.001$) compared to kottu (53.5 ± 0.8). Incorporation of vegetables, chicken, eggs and other ingredients in kottu had increased the nutrients other than carbohydrate. Kottu had a significantly lower ($p = 0.004$) GI (67 ± 10) than plain godamba (81 ± 21). Peaking time for kottu was 30 minutes and godamba was 45 minutes following the meal. The mean peak reductions against glucose for godamba (18%) and kottu (15%) were not significant. A significant ($p < 0.001$) negative correlation was observed between mean GI values and protein ($r = -0.599$), insoluble dietary fiber ($r = -0.936$) and soluble dietary fibre ($r = -0.886$) contents. Fat content showed a non significant negative correlation ($r = -0.317$) with GI.

Godamba roti was categorized as high GI (81 ± 21) and kottu was categorized as medium GI (67 ± 10). Both had high glycaemic load (godamba; 41 ± 11 and kottu; 34 ± 5). Kottu roti with a medium GI and lower glycaemic response would be more beneficial than consumption of plain godamba roti for individuals seeking glycaemic control in addition to being more nutrient dense. However, the high fat in both godamba and kottu makes these foods unsuitable for frequent consumption.

Extract of *Gmelina arborea* attenuates the oxidative stress in STZ induced diabetic rats

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Medicinal plants have long been considered as valuable sources of medicine for treating variety of diseases and ailments. The therapeutic potential of medicinal plants is often attributed to their antioxidant properties.¹ Further, herbal medicines are believed to have preventive effects on chronic diseases due to their antioxidant properties.² They are claimed to reduce the cellular damage caused by reactive free radical species which is currently suggested as one mechanism underlying diabetes and its complications.³ As in many diseases including diabetes, biomarkers of oxidative stress are elevated in the liver at an early stage. Thus, the effect of a claimed antidiabetic agent on the antioxidant status of hepatic tissue of diabetic rats has been widely studied and is a recognized approach for the determination of possible *in vivo* antioxidant potential. *Gmelina arborea* (Etdemata, Family: Verbenaceae) has been widely used in traditional medicine for the treatment of diabetes mellitus in Sri Lanka. The *in vivo* acute antihyperglycaemic effect of aqueous leaf extract of *G. arborea* has been scientifically proven by our group. The aim of the present study was to investigate the effect of aqueous bark extract of *G. arborea* on liver enzymes, hepatic oxidative stress markers in streptozotocin induced (STZ) diabetic rats through biochemical and histopathological parameters.

Wistar rats were divided into four groups (n=6/group); healthy untreated rats, STZ - diabetic untreated rats, diabetic rats receiving the aqueous bark extract of *G. arborea* (1.0 g/kg) and diabetic rats receiving glibenclamide (0.50 mg/kg). The treatment continued for 30 days. At the end of the study, blood was collected for the estimation of serum activities of liver enzymes [alkaline phosphatase (ALP), alanine aminotransferase (ALT) and aspartate aminotransferase (AST)]. The livers of all rats were excised for the estimation of total protein, reduced

glutathione (GSH), activities of glutathione reductase (GR), glutathione peroxidase (GPx) and glutathione -S- transferase (GST). Histopathological assessment of liver tissue was done on haematoxylin and eosin stained sections. Results were compared with untreated diabetic rats.

The bark extract of *G. arborea* decreased the activities of liver enzymes; ALP, ALT and AST by 5%, 32%, and 13% respectively. The liver GSH, activities of GR, GPx and GST of plant extract treated diabetic rats increased to , 606.4 ± 8 µg/g liver tissue, 8.0 ± 1, 8.6 ± 1, 9.8 ± nmol/min/mg protein (statistically significant at $p < 0.05$, ANOVA followed by Dunnett's test) respectively. The extract was more effective than glibenclamide in restoring the values of the above biochemical parameters. Histopathological examination showed reduced number of microvesicular fatty changes and no congestion or necrosis in the liver tissue as compared to healthy untreated rats and provided supportive evidence for the biochemical analysis.

The results revealed that administration of aqueous bark extract of *G. arborea* markedly improves hepatic antioxidant status, reduces the oxidative stress and thus possesses an *in vivo* antioxidant activity in STZ - diabetic rats.

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Determination of the quality and stability of coconut oil extracted by a modified extraction process

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The most popular edible oil used by Sri Lankans from ancient days in the preparation of meals and in Ayurvedic medicines for both internal and external applications is coconut oil obtained by expelling oil from coconut kernels dried in a kiln, known as copra. A number of reviews are available for different types of extraction and processing methods for the preparation of coconut oil, such as dry processing, wet processing, enzymatic process, solvent extraction etc.

Before eighties coconut oil was used in Europe and USA for frying foods without apparent medical complaints. In early eighties, Centre for Science in the Public Interest of USA (CSPI) launched a campaign to discourage the use of all saturated vegetable oils including coconut oil, claiming that all saturated oils are unhealthy. Hence, even doctors, dieticians and health professionals were in ambiguity as to whether coconut oil is safe to be prescribed as a healthy food. However, even very early reports indicate that short and medium chain fatty acids such as lauric acid present in coconut oil are healthier than their long chain counterparts. Recent studies also indicate that virgin coconut oil and some other types of coconut oil have beneficial effects on lipid parameters. Due to these recent research findings, coconut oil is gaining popularity again in the local as well as foreign markets.

However, the nutritional quality of coconut oil heavily depends on method of extraction of coconut oil. Hence, there is a need for the doctors and dieticians to identify harmful chemical components present in edible oils commonly available in Sri Lankan markets and to look for modified extraction methods to improve the quality of coconut oil.

Most of the white coconut oils available in the market having SLS mark, are either produced by traditional method or some of them are further refined by chemical means. A reputed edible oil manufacturing company in Sri Lanka recently gave publicity in news papers to a new dehumidifying device they developed to dry coconut kernels by maintaining the temperature below 40 °C to produce physically extracted white oil. Further, they refine this oil by bleaching with 0.5% of activated bleaching earth and deodorizing the oil at the

temperature of 180 °C, which is a much lower temperature than the boiling point of coconut oil, under the vacuum of less than 0.5 mmHg. No chemicals involve in this process for refining. By using this relatively low temperature and high vacuum, harmful peroxide (PV), free fatty acid (FFA) and other impurities can easily be removed. Due to the extremely high thermal stability of coconut oil, the damage to the structure of the lauric acid ester and the possibility to produce radicals within the process are negligible at the used temperature. Further, they claim that the white coconut oil extracted by this Modified Extraction Method (MWCO) is devoid of tar contamination caused by smoke drying copra, or of dangerous fungal-derived aflatoxins. Due to the dehumidifying process used in this modified extraction method the possibility of (Poly Aromatic Hydrocarbons) PAH contamination of MWCO is also minimum.

To verify these claims by the producers we analyzed quality parameters of the coconut oil produced by the modified method. The samples directly taken from the online process and after three months from the production were compared and the stability of coconut oil was also tested under frying conditions. There are many number of standards available in the world for the determination of quality of coconut oil, such as Ceylon –Standards ; CS 32;1968, Indian –Standard; IS : 6220-1971 and Codex Standards for coconut oil.

According to the results obtained, there is a no significant deviation of the results of the online analyses of samples and the variation between the quality parameters of online samples and three months old samples was extremely low. Analysis of the results of coconut oils made by the modified process at low temperature and high vacuum, suggests that MWCO may be far more health safe compared to white oils available in the market. Hence coconut oil manufactured through this modified extraction method is very much safe for human consumption.

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Comparative Chemical Analysis of Composition of Edible Oils, Particularly Coconut oil, Available in Sri Lankan Market

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The most popular edible oil used by Sri Lankans from ancient days in the preparation of meals and in Ayurvedic medicines for both internal and external applications is coconut oil obtained by expelling oil from coconut kernels dried in a kiln, known as copra.

The doctors and dieticians and health professionals were in ambiguity as to whether coconut oil is safe or harmful to health. Most of the doctors in Sri Lanka and in Asia did not recommend heart patients to have even a little coconut oil in their meals. Hence, there was a need for the doctors and dieticians to identify harmful chemical components present in edible oils commonly available in Sri Lankan markets for the benefit of the people.

A reputed edible oil manufacturing company in Sri Lanka recently gave publicity in news papers to a new dehumidifying device they developed to dry coconut kernels by maintaining the temperature below 40 °C to produce physically extracted white oil. They claimed that harmful peroxide (PV), free fatty acid (FFA) and Poly

Aromatic Hydrocarbon (PAH) values of this oil are extremely low compared to white coconut oil available in the market, mostly with SLS mark, produced by the well known traditional process starting from copra. Some of which are further refined by chemical means to bleach the yellow colour and also to eliminate the odour. Further, they claimed that the oil produced by this physical process is devoid of tar contamination caused by smoke drying copra and of dangerous fungal-derived aflatoxins.

This research program was carried out to analyze the presence of peroxides, free fatty acid levels and chemical residues in edible oils in the market made by both the physical refining process and by the traditional RBD process; some of which are even chemically refined, and sold in super markets in Sri Lanka with the SLS mark. Further, the levels of those parameters in coconut oil made available to village consumers in contaminated steel drums, which are most of the time kept in the hot sun in open shop yards, were also subjected to this survey.

Table 01: Analysis results of various coconut oil samples collected from local market

Test Unit	Sample A	Sample B	Sample C	Sample D	Sample E	Sample F	Sample G	Sample H	Sample I	Sample J
Aflatoxin B1	1.2	Not Detected	1.7	Not Detected	1.4	Not Detected	Not Detected	1.0	Not Detected	1.1
Aflatoxin B2	Not Detected	Not Detected	Not Detected	Not Detected	1.9	Not Detected	Not Detected	Not Detected	1.0	1.4
Aflatoxin G1	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected
Aflatoxin G2	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected

According to the results obtained in this project, there is a definite variation in the FFA values, PV values, pH and aflatoxin values in coconut oil samples selected for testing. Further the results indicated that, in the case of samples of coconut oils made by the physical process at low temperature, values obtained for the above parameters for the oil samples were very low. The quality of coconut oil available in village shops in contaminated metal drums is far inferior to the quality of even RBD oils and hence they carry a greater health risk to consumers. Our results also showed the presence of a fair amount of tar and chemical residues in RBD oils, which were not present in physically extracted oils.

Further, it was observed from these results that the samples which are claimed to be made by the physical refining process are health wise low risky than the RBD oils.

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A Green way to produce Biodiesel from Palm olein oil

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Environmental concerns and limited availability of fossil fuels have promoted the use of biofuels such as bioethanol and biodiesel during the past few years. Fatty acid methyl esters are called biodiesel and commonly used industrial method for production of biodiesel is transesterification of plant oils or animal fats using a basic catalyst such as NaOH or KOH in a homogeneous phase. This method is not a green method because of the corrosive nature of the catalyst, formation of large amount of waste water and soap etc. Transesterification using a heterogeneous catalytic phase would not create such problems, and therefore can be considered as a greener method. The disadvantage of this method is that most of the reported such reactions are slow. Present study was carried out to develop a high efficient heterogeneous catalytic method to produce biodiesel from palm olein oil.

In the present study the catalyst (mixture of calcium methoxide and calcium glyceroxide) was prepared according to a literature method ⁽¹⁾ and was used in a heterogeneous catalytic phase for the transesterification of palm olein oil. Methanol was used as the alcohol and sodium carbonate was used to prevent the leaching of Ca^{2+} ions into biodiesel. The effect of amount of the catalyst, oil: Methanol molar ratio, reaction temperature (65°C) and the reaction period on the % yield of biodiesel were studied to

identify optimum conditions required. The results showed that a yield of 92 % of biodiesel could be obtained at 65°C , reaction period of 3h., catalyst: oil 0.5% (by weight) and MeOH: oil ratio of 12:1. According to the GC analysis, Myristic acid (1.31 %), Palmitic acid (38.23 %), Stearic acid (3.40 %), Oleic acid (36.86 %) and Linoleic acid (15.78 %) are present in the biodiesel. The minimum value recommended in ASTM D 975 for flash point of the biodiesel is 130°C and the flash point of the biodiesel produced is $>176^\circ\text{C}$. The acid number of biodiesel was $0.23 \text{ mg KOH g}^{-1}$ and it is in the recommended range in ASTM D664 standards. The freezing point of the biodiesel was $15-16.5^\circ\text{C}$ and therefore it can be used as a biofuel in Sri Lanka.

Keywords: Biodiesel, transesterification, palm olein oil

Acknowledgements

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Development of a Herbal Snake Repellent Product

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Snake bite is a common occupational hazard in various parts of Sri Lanka. Therefore there is a need for the development of proper snake repellent substances which could be applied to skin, clothing, or sprayed near human habitations to protect the people.

In this study plant based snake repelling substances were combined in appropriate ratios to develop a snake repellent product. Plants which are more commonly found in Sri Lanka and local essential oils which were used to prepare the product are *Eryngium foetidum* (S. Andu), *Acorus calamus* (S. Wadakhaha), *Pinus caribaea* (Pine oil) *Cymbopogon nardus* and *Cinnamomum zeylanicum*. The essential oils of *Eryngium foetidum*,

Acorus calamus, and *Pinus caribaea* were obtained by water distillation using a Clevenger-arm distillation apparatus a mixture of Pentane and Hexane was used as the solvent. *Cymbopogon nardus* (citronella oil) & *Cinnamomum zeylanicum* (S. Kurundu) leaf oils were purchased from a reliable source. Snake repellent strengths of 10% concentrations of each essential oil in Hexane were checked individually and the Repellency Indexes (RI) were recorded against three different snake species, *Naja naja* (Cobra), *Bungarus ceylonicus* (Mudu karawala) and *Daboia russelli* (Thith polonga) All were adults measuring more than 1m in length and used within one week from the time they were captured

from the wild and brought to the zoological garden. The snake studies were done in a special cage following the design of Dorris Gove and Burghardt¹ (figure 1 and figure 2).



Figure 1

Figure 2

The snake was allowed to rest in the cage for 15 minutes before the introduction of each plant extracts (10% in Hexane). Amongst all the individual essential

oils which were tested, *Eryngium foetidum* exhibited the highest response for all three snake species followed by *Acorus calamus*, & *Pinus caribaea*. However, it was observed that the final product (gel), which contained a total of 10% essential oil content, was more effective than any individual plant material.

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Technical Sessions : A - 22

Antioxidant and antifungal activities of secondary metabolites of the endolichenic fungus, *Penicillium pinophilum* isolated from the lichen *Pseudocypherllaria sp.* available in Sri Lanka.

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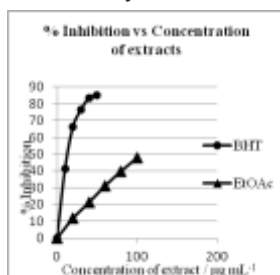
Since the bioactivity directed exploration of secondary metabolites from endolichenic fungi is a most recent trail for the discovery of effective pharmaceuticals, the objective of this study is to isolate secondary metabolites from endolichenic fungus *Penicillium pinophilum* and to investigate their bioactivity. *Penicillium pinophilum* was isolated from the lichen genus; *Pseudocypherllaria*, available in Haggala mountain forest, Sri Lanka and its identity was confirmed using morphological characters and molecular identification (DNA sequencing). *In vitro* large scale cultures of the particular fungus were prepared, inoculating a spore suspension of it into Petri dishes containing potato dextrose agar medium and incubating at 30 °C (room temperature) for 14 days, for the extraction of secondary metabolites into ethyl acetate. The crude extract was then subjected to two types of bio assays, for the investigation of antifungal and antioxidant activities. Antifungal activity assays were carried out according to the well diffusion method, using 500 µL of a 1 mg/mL crude EtOAc extract dissolved in DMSO/methanol 1:1 mixture, with a positive control of Bavistin and DMSO/methanol 1:1 mixture as a negative control. Both of the antifungal activity assays; one against a

common banana pathogen *Colletotrichum musae* and the other against an aflatoxin producing fungus *Aspergillus flavus*, did not show any prevention or a significant inhibition of the growth of pathogens by the test extract. Antioxidant activity of the same extract was explored by carrying out DPPH free radical scavenging assay and Ferric Reducing Antioxidant Power (FRAP) assay, varying the concentration (100-500 µg/ mL) of the extract and the results were compared with the activity of the standard antioxidant, BHT (Butylated Hydroxy Toluene) (figure 1).

As it was positive for both assays, the extract was partitioned into hexane, chloroform and aqueous methanol fractions and the antioxidant activity of each fraction was tested using above two assay methods (figure 02).

Antioxidant active methanol and chloroform fractions were subjected to further purification through chromatographic techniques and nine pure compounds were isolated. One of the pure compounds (CK/01/47/02) with strong antioxidant activity shows that the molecular weight 391 and indicates that it is a dimer. ¹H, ¹³C NMR, HSQC, HMBC and DQF-COSY spectra of those compounds are being analyzed for elucidation of structure.

DPPH assay



FRAP assay

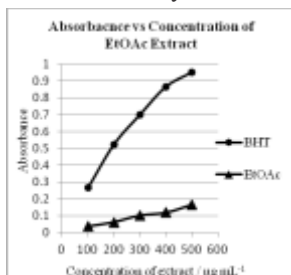


Figure 01. Antioxidant activity of ethyl acetate extract of *Penicillium pinophilum* with DPPH free radical scavenging assay and Ferric Reducing Antioxidant Power (FRAP) assay

Acknowledgements : Financial Assistant by National Research Council, the research grant NRC-O8-13. We thank Dr. D. Senevirathna and Mr. Ishara Herath (Gene Tech Pvt Ltd.) for assisting to identify the fungal strain

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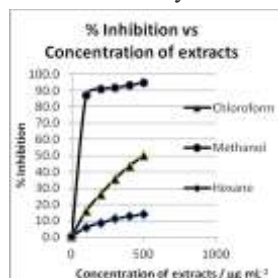
Preliminary investigation of isolation of bioactive secondary metabolites produced by *Penicillium citrinum*, inhabiting the lichen *Pamotrema sp.* available in Haggala montane forest in Sri Lanka.

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Endolichenic fungi continue to be a source for novel natural products and they produce an array of metabolites of varied structural groups such as terpenoids, steroids, xanthenes, chinones, phenols, isocoumarins, benzopyranones, tetralones, cytochalasines, and enniatines^{1,2}. More than 15 endolichenic fungi were isolated from the lichen *Pamotrema sp.* collected from Haggala montane forest. The identity of isolated fungi confirmed through morphological and molecular identifications. One of them was identified as *Penicillium citrinum* and was grown in large scale by inoculating a spore suspension of it on to potato dextrose agar. After 14 days incubation at room temperature (30 °C), the secondary metabolites were extracted into ethyl acetate (EtOAc). The crude EtOAc extract obtained were tested for antioxidant and antifungal activity assays. According to the DPPH radical scavenging assay and FRAP (Ferric Reducing Antioxidant Power) assay the EtOAc extract has a satisfactory antioxidant activity. The concentration series of EtOAc extract (100-500 µg/mL) was tested for DPPH scavenging assay. The radical scavenging activity of 500 µg/mL solution of the EtOAc extract was 68.4%. The standard synthetic antioxidant, BHT was used for the comparison of the results. The ferric reducing power of the antioxidant was proportional to the increase of absorbance of a Fe^{2+} solution resulted by the reduction of 1% $\text{K}_3[\text{Fe}(\text{CN})_6]$. The absorbance for 500 µg/mL solution of BHT and EtOAc extract were (0.953 ± 0.001) and (0.225 ± 0.001) respectively. The antifungal bio assays against *Colletotrichum musae* (causes banana anthracnose

DPPH assay



FRAP assay

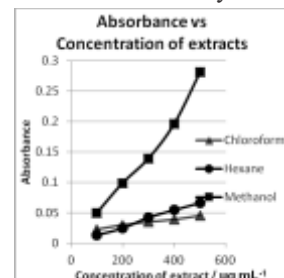


Figure 02. Antioxidant activity of hexane, chloroform and methanol extracts of *Penicillium pinophilum* with DPPH free radical scavenging assay and Ferric Reducing Antioxidant Power (FRAP) assay.

lesions) and *Aspergillus flavus* (afalotoxigenic) were carried out according to the well diffusion method and were compared with positive control, Bavistin and negative control, DMSO:MeOH (1:1). The EtOAc extract (500 µg) did not show any significant inhibition of the growth or sporulation of both fungi. Since the crude extract was antioxidant active it was partitioned into hexane, chloroform and methanol fractions. The DPPH scavenging activities of 500 µg/mL of hexane, chloroform and methanol fractions are 61.5, 45.0 and 63.4 % respectively. And for the FRAP assay, absorbance of 500 µg/mL solution of hexane, chloroform and methanol extracts were (0.210 ± 0.001) , (0.383 ± 0.001) and (0.105 ± 0.001) respectively. Therefore these three fractions were further subjected to bio assay guided fractionation and a total of 06 pure compounds were isolated and the antioxidant activity of two compounds was confirmed by FRAP assay. For FRAP assay, absorbance of 50 µg/mL solution of the pure compounds US//01/18/02 and US//01/30/01 were (0.182 ± 0.001) and (0.250 ± 0.001) respectively. NMR and MS spectra of the pure compounds have been obtained and characterization of those compounds and anticancer activity of these pure compounds will be further investigated.

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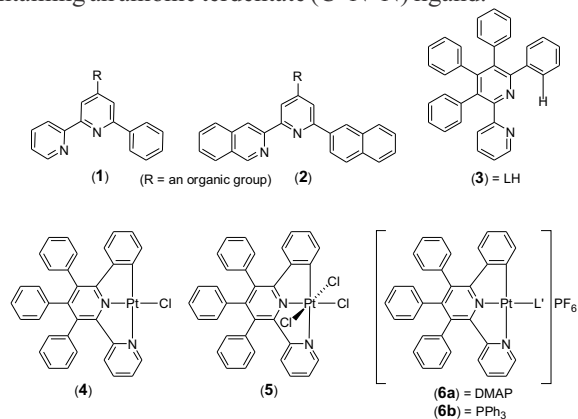
Synthesis of cyclometallated Pt(II) complexes of a bipyridyl ligand

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The interest on cyclometallated terdentate complexes of the type $(C^{\wedge}N^{\wedge}N)M$ of platinum, ruthenium and iridium has risen recently as they are capable of harvesting light. Cyclometallated platinum(II) complexes $[(C^{\wedge}N^{\wedge}N)PtX]$ derived from aromatic N-donor ligands of the type (1) and (2) display a variety of emissive excited states, including ligand-field and metal-to-ligand charge transfers. The relative energy of these excited states is strongly affected by the groups attached to the $(C^{\wedge}N^{\wedge}N)$ ligand and the ancillary ligand X bonded to Pt(II) centre. In 2008, the synthesis of a bulky pyridyl-centred polyphenylene (3) and its coordination chemistry particularly with rhodium was reported. It is of interest to explore the chemistry of this pyridyl-centred polyphenylene ligand (3) with platinum centres in order to prepare photoactive luminescent complexes of the type $[(C^{\wedge}N^{\wedge}N)PtX]$ and $[(C^{\wedge}N^{\wedge}N)Pt(L')]Y$ (X and Y are anionic groups and L' is a neutral ligand). In this communication we report the preliminary studies carried out to devise synthetic routes to such complexes.

The ligand (3) was prepared in 95% yield by the Diels-Alder [4+2] cycloaddition reaction between tetraphenylcyclopenta-2,4-dien-1-one and 2-cyanopyridine according to a literature procedure. Treatment of (3) with $[PtCl_2(dmsO)_2]$ in boiling chloroform resulted in the formation of a mixture of ortho-metallated square-planar platinum(II) complex $[(L)PtCl]$ (4) and an octahedral platinum(IV) complex $mer-[(L)PtCl_3]$ (5), both containing an anionic terdentate $(C^{\wedge}N^{\wedge}N)$ ligand.



The orange complex (4) was not very soluble in common deuterated solvents and in the proton NMR

thank Dr. D. Senevirathna and Mr. Ishara Herath (Gene Tech Pvt Ltd.) for assisting to identify the fungal strain used in this study. Prof A. A. Leslie Gunatilaka and Dr. E. M. Kithsiri Wijerathne (University of Arizona) for providing NMR data of the pure compounds in this study

spectrum, the proton (H6) on the carbon adjacent to nitrogen was most deshielded and appeared as a multiplet at 9.37 ppm. The complex (5) was characterised by X-ray crystallography and confirmed the presence of *mer*-geometry around the platinum centre. In the proton NMR spectrum of (5), the H6 proton appeared as a multiplet at 9.51 ppm. One can argue that the complex (5) could have formed by the replacement of the platinum hydride of the intermediate $[(L)PtHCl_2]$ formed due to oxidative addition of phenyl C-H bond by a chloride ligand formed during the course of the reaction. It is clear that the intermediate $[(L)PtHCl_2]$ undergoes reductive elimination of HCl to produce the square-planar platinum(II) complex $[(L)PtCl]$ (4). It is known, in the presence of a base, one could readily remove HCl from a platinum(IV) system containing $PtHCl_2$ moiety. As expected, addition of triethylamine to the above reaction mixture improved the yield of $[(L)PtCl]$ (4). In coordination chemistry, square-planar platinum(II) complexes are being used to study substitution reactions. It was interesting to study the substitution of the chloride by amine and phosphine ligands to make the less soluble platinum(II) complex (4) more soluble in the form of a salt. Replacement of somewhat labile chloride ligand with an amine such as 4-dimethylaminopyridine (DMAP) in the presence of NH_4PF_6 resulted in the formation of the salt $[(L)Pt(DMAP)]PF_6$ (6a). In its 1H -NMR spectrum, the methyl proton resonance of NMe_2 group appeared as a singlet at 3.25 ppm. Replacement of the labile chloride ligand by triphenylphosphine gave the salt (6b) as a yellow solid. ^{31}P - $\{^1H\}$ NMR spectrum of (6b) showed a singlet at 27.6 ppm with platinum satellites, $^1J(PtP) = 4144$ Hz, for PPh_3 and a septet at -143.2 ppm for the PF_6^- group.

In conclusion, we have devised synthetic routes to prepare cyclometallated platinum complexes of the type $[(L)PtCl]$, *mer*- $[(L)PtCl_3]$, and $[(L)Pt(L')]PF_6$ where $L' = DMAP, PPh_3$.

Author wishes to thank the Trinity College Dublin for a Research Fellowship and Professor S. M. Draper for laboratory facilities and other support.

Fabrication of Cadmium Sulfide (p-type) Thin Film Semiconductor via Electrodeposition

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First ever electrodeposited p-type cadmium sulfide (CdS) semiconductor was witnessed in the previous research which was conducted at the Department of Chemistry, University of Kelaniya. This research is a continuation which could produce more stable p-type CdS semiconductor material. Several growth parameters namely; electrolyte concentration, growth temperature and deposition time were optimized while the rest of the parameters like deposition voltage (-700 mV, w.r.t. Ag/AgCl electrode), ratio between the cadmium and sulfur sources (3 : 4), pH (2.1) and stirring rate (125 rpm) were kept constant. Cadmium chloride and thiourea were used as cadmium source and sulfur source respectively.

Obtained p-type semiconductors were further characterized by I-V analysis, PEC characterization, Band gap measurements and X-ray diffraction. Also the stability of the obtained p-type CdS semiconductors was investigated.

Keywords: *p-type CdS semiconductor; electrodeposition; electrolyte concentration; growth temperature; deposition time; deposition voltage; source concentration ratio; pH; stirring rate; Cadmium chloride; thiourea; I-V analysis; PEC characterization; Band gap measurements; X-ray diffraction*

Fabrication of CdS (n-type) and CdTe (p-type) Thin Film Semiconductor Materials via Electrodeposition

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Technologically, the electrodeposition (ED) method through the influence of potential, temperature, pH and composition of the reactants offers an excellent control over the properties of semiconductors. Using a potentiostatic approach, the thin films of CdS and CdTe were deposited on glass/ITO or glass/FTO substrates. CdS thin films were deposited in baths of cadmium chloride and ammonium thiosulphate at pH 1.40 at room temperature (28 – 30 °C) at the growth voltages ranging from -700 mV to -1500 mV (Best at -1100 mV), with respect to standard Ag/AgCl electrode. CdTe thin films were deposited in a bath of cadmium sulphate, cadmium chloride, and tellurium dioxide at pH 2.00 at 85 °C at -1570 mV growth voltage with respect to standard Ag/AgCl electrode. Resulted films were characterized by XRD for the determination of the bulk structure, Optical absorption for band gap energy measurements, photoelectrochemical cell

(PEC) measurement and I-V characteristics for the determination of conductivity type of the thin films. ED-CdS was found to be n-type belonging to hexagonal crystal system with the highest V_{oc} value of -148.0 mV and J_{sc} value of 314.5 $\mu A cm^{-2}$ with respect to photo-electrochemical cell measurements made with 0.1 mol dm^{-3} $Na_2S_2O_3$. Band gap of ED-CdS was 2.54 eV. ED-CdTe was found to be p-type with the highest V_{oc} value of +56.8 mV and J_{sc} value of 35.8 $\mu A cm^{-2}$ with respect to photo-electrochemical cell measurements made with 0.1 mol dm^{-3} redox couple. Band gap of ED-CdTe was 1.73 eV.

Keywords: *Electrodeposition(ED), Potentiostatic approach, XRD, Optical absorption, Photoelectrochemical cell(PEC), I-V characteristics, Open circuit voltage (V_{oc}), Short circuit current density (J_{sc}), Band gap energy*

The study on the effect of Sodium Adsorption Ratio (SAR) to the ion exchange properties of soil

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Sodium Adsorption Ratio (SAR) is defined as a theoretical model to indicate the relative proportions of calcium and magnesium in water. This investigation was carried out to highlight the interactive effect between SAR and the Cation exchange properties of the soil in a top soil of three cities (Rajagiriya, Ragama, Wellampitiya) in Sri Lanka.

In recent years, SAR has become a topic of lively debate. The main reason for this is the amount of sodium ions present in the irrigation water directly affects the properties of the soil. The dispersion of soil particles result to form hard aggregates, thereby reduce the infiltration ability of the soil. As a consequence this leads to the abandoning of paddy fields. The study of ion exchange reactions in soil is important to predict the tolerance of soil to the SAR. This is widely applied in treatment of salt affected soils which is a major concern in modern agriculture.

Throughout the investigation soil samples were

treated with distilled water and equilibrated 30 min with a solution of known SAR. Then the solution was filtered off and the determination of Na, Mg and Ca in the filtrate was carried out. The study of the rate of ion exchange was done by increasing the concentration of Na in the standard solutions. The study of ion exchange properties was done as a function of each component (Ca, Mg and Na) in the standard solution.

From the investigation that has been carried out it was figured out that the amount of sodium ions in the irrigation water directly affects the ion exchange properties in soil and all the soil samples and cation exchange resin shows similar behavior of rate of ion exchange. SAR and the ionic concentration affect to the type of diffusion (pore diffusion or mass transfer diffusion) that takes place in the soil and that leads to the distinct deviation of the ion exchange properties in soil. It was detected that the soils that were investigated behave as strong cation exchange resins.

Use of *curcuma longa* as a metallochromic indicator for the titration of iron(III) with EDTA

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Metallochromic indicators are used to determine the concentration of metal ion by complexometric titrations. All metallochromic indicators in use are expensive synthetic organic compounds and have anthropogenic effects on the environment. A natural indicator with a low cost and a higher accuracy can be used as a good substituent for a synthetic organic indicator.

Acetone extract of *curcuma longa* showed positive results with iron(III) at pH values less than 3. Presence of a colour change was confirmed by

examining their $\lambda_{\max}$ values obtained from UV/visible spectra. The value of pK_{in} was determined for *curcuma longa* and it showed a positive response for acid base indicator properties. The pK_{in} value of turmeric extract was 8. It reflected accurate and precise readings in EDTA titrations carried out using standard solutions below pH 3. Results were treated statistically. Limits of interference of the indicator from other metal ions were determined as it is important for analytical purposes. Metal ions Ca^{2+} , Mg^{2+} ,

Development of a Fluorescence Method to Analyze Benzodiazepines

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Benzodiazepines are widely used in today as hypnotics, sedatives, anxiolytics, anticonvulsants, muscle relaxants, etc. They act by inhibiting the effect of neurotransmitter Gamma Amino Butyric Acid. Due to sedative and anxiolytic effects and the drug dependence, it is highly vulnerable to be a major cause of death. People end up with death due to benzodiazepines not only because of drug overdose and toxicity, but also as a suicidal agent. In the clinical management of Benzodiazepines toxication, it is crucial to investigate the drug level qualitatively and quantitatively. This type of investigation which is fast and sensitive may help in the diagnosis as well as the treatment process. Many researches have been conducted in developing such a method all over the world. But most of these methods are not feasible for the developing countries as the technology cannot be made available as necessary and the cost may not be bearable. Therefore it is important to develop a method which is accessible and cheap. As Benzodiazepines have a structure with several rings including at least one hetero cycle they can act as chromophores. Therefore developing a fluorescence method is possible. All of them have a similar core structure and differ from each other slightly. Therefore their absorption and emission tends to lie in a very narrow range of wavelength. Despite of that, different drugs shows differed spectroscopic characteristics may be due to the effects those slight changes bring. Different intensities of the emission peaks will help to measure the drugs quantitatively.

For the analysis, concentration series from each drug type was prepared. Emission spectra for all the samples in each concentration series were obtained and a standard curve was prepared using that data. As

this was done for individual samples, the analysis was continued with the all different types of mixtures to detect the presence of any effect created by the other drug types. Firstly the two drugs were mixed, then three drugs and then four drugs. Mixtures of two drugs were done by keeping concentration of one drug constant. Mixtures of three drugs were done by keeping concentration of one drug constant and then by keeping concentration of two drugs constant. Mixtures of four drugs were done by keeping concentration of one drug constant, then by keeping concentration of two drugs constant and by keeping concentration of three drugs constant.

Diazepam, Clobazam, Midazolam and Bromazepam can be identified qualitatively by exciting at their corresponding wavelengths investigated which are 244 nm, 286 nm, 252 nm and 236 nm respectively. To prove this method, each of these drugs were also excited at excitation wavelengths of others and confirmed that they are not emitting at them. All of them emitted at one particular wavelength which was about 330 nm. Standard curve was plotted using the concentration series and it was a straight line and therefore it was investigated that concentration is linearly proportional to the intensity. So that these drugs can be analyzed quantitatively using this method. However this linearity was not observed for every concentration and it lays straight only for a certain range. By repeating this method with all possible mixtures of four drugs, it was proved that the method is not affected by the presence of several drugs.

An analytical method has been developed to analyze Benzodiazepines qualitatively and quantitatively using fluorescence technique under certain limitations.

Studies on the bioavailability of added fluoride in toothpaste

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Toothpaste plays an important role in human dental health. Fluoride is added to some toothpaste to improve the quality of toothpaste. Fluoride is very essential for the improvement of tooth enamel. Fluoride binds to the coated layer of hard material in

enamel, mainly hydroxylapatite ($\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$) and leads to strength the enamel. Because of its unique features, fluoride is added to some toothpaste since 1914. Initially sodium fluoride was added as fluoride source then sodium monofluorophosphate added. Even

though fluoride is essential for the dental health, excess may cause problems. Excess fluoride may cause Dental Fluorosis. Therefore it is important to find out the amount of available fluoride at the time when the consumer is used the toothpaste. Thus the study was carried out to determine the fluoride level in the toothpaste and mainly focused on the determination of factors that affect the lost of bio available fluoride in toothpaste. The study was further expanded to develop a new method to increase bio available fluoride in toothpaste.

Fluoride ion selective electrode was used for the determination of fluoride content. This electrode is only responsible for detection of free fluoride ions in the solution under experimental conditions used.

Even though at the manufacturing level correct amount of fluoride (900-1000ppm) was added to the toothpaste, with the time the content was decreases gradually. (According to the data obtained from the study the content of fluoride in the sample was 686.88ppm). This effect may be due to the formation of fluoride bound compounds, which leads to decrease of free fluoride in toothpaste.

Calcium carbonate, which is the main abrasive ingredient in toothpaste, caused to decrease of fluoride ions by forming insoluble calcium fluoride. The determination of the effect of calcium carbonate in fluoride was carried out by detection of the concentration of fluoride ions in calcium carbonate-fluoride system. Concentration of fluoride was detected in every week for 3-months. The results clearly showed that the concentration decreased with time.

Sodium monofluorophosphate is commonly used by manufactures instead of sodium fluoride. The effect

of calcium carbonate in sodium monofluorophosphate was carried out in the same way done for the sodium fluoride. The decreasing rate of sodium monofluorophosphate - calcium carbonate system is less than that of sodium fluoride- calcium carbonate system. That is the reason for the use of sodium monofluorophosphate, even though it is expensive than sodium fluoride.

Sodium chloride has ability to recover fluoride ions from solution by decreasing the co-precipitation of fluoride ions with calcium carbonate as calcium fluoride. The effect of Sodium chloride was determined by adding equal volume to each newly prepared sodium fluoride and sodium monofluorophosphate systems. All systems were subjected to contact with calcium carbonate. The concentration of fluoride was detected in every week for 55 days. The results clearly showed that, with the addition of sodium chloride the decreasing rate of fluoride level is significantly less. The lowest rate was detected in the sodium chloride and sodium monofluorophosphate, which were contact with commercial grade calcium carbonate.

The percentage of hydroxide ions in the calcium carbonate is very important factor in lowering the bioavailable fluoride levels in toothpaste. The high percentage of hydroxide ions leads to higher decreasing rate of fluoride ions. Hydroxide ions have more tendencies to replace with fluoride ions, rather than carbonate ions in the medium. Therefore, the concentration of free fluoride ions in the solution is decreased with time. Thus, the concentration of hydroxide should be measured correctly, before it used for the manufacturing process.

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A study of variation of humic substances and cation exchange capacity of humins during composting process

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In Sri Lanka, composting is carried out with little or no scientific knowledge. But recent interest is organic farming and home gardening opens the avenues to consider composting in a more scientific manner. Composting organic matter mainly consists of humic substances such as humins, humic acids and fulvic acids. All these substances act as chelating agents for many cations. Therefore compost mainly

immobilizes essential micronutrients so that plants can absorb effectively. However, the relative amounts of humin, humic acid and fulvic acids in compost fertilizers play a vital role in determining the quality of compost because their chelating ability is markedly different.

Variation of humic substances in compost materials during composting process was investigated.

The pH dependent solubility of humic substances was employed for the separation of humic substances into humins, humic acids and fulvic acids¹. The variation of cation exchange capacity of humins during composting process was also investigated using a standard technique². The common raw materials generally used for compost making in Sri Lanka were selected for this study. They included hard materials that consist of rice straw, saw dust, and coir dust and soft materials that consist of cut grasses, cattle manure, and gliricidia leaves. In this study, individual raw materials as well as mixtures of different combination of hard and soft materials were allowed for composting for about three months.

Humin fractions of high lignin materials depolymerize at the early stage of composting process while the low lignin materials (soft) degrade easily and concentrates the more complex materials at the early stage. At the last stage of the composting process (after 75 days), the increase humin substances suggested that low degradability of harder plant tissues.

Humic acids formation is correlated with the humin degradation and the depletion of easily degradable organic matter. The maximum level of humic acids appeared for most compost types at the middle stages of composting process and rapid decrease observed at later stages of composting. High fulvic

acids levels were observed for most of the softer materials at around 50 days of digestion. However in mixed composts, this maximum level appeared at later stages of digestion. This suggests the synergistic effect among compost materials. This was further confirmed by the behavior of rice straw. Composted rice straw itself produced high level of humic acids at early stages of composting and high level of fulvic acid at the middle stage. When mixed with other materials, rice straw inhibited degradation of other materials. Therefore compost made entirely of rice straw or with high levels of rice straw and soft materials can be suitable for the crops that have short crop cycle. One of the major objectives of this research was to determine the cation exchange capacity (CEC) of humin fraction in humic substances. The results indicated that gradual increase of CEC towards the later stages of digestion with short term fluctuations. This suggested the formation of more exchange sites when degradation proceeds.

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Technical Sessions : A - 32

Semi – micro dispersive liquid - liquid extraction of low level toxic metal cations and the determination by uv – visible spectrometry

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This study focuses on to adapting Dispersive Liquid-liquid Micro extraction (DLLME) of Pb^{2+} , Hg^{2+} and Cd^{2+} into semi micro level to enable them to be analyzed in spectrophotometry. The ppb level maximum allowed limits of these metal cations in drinking water requires for quantification, expensive analytical instrumentations such as atomic absorption spectrometry (AAS) and inductively coupled plasma mass spectrometry (ICPMS). In contrast spectrophotometric methods require a simple and low cost instrumentation as well as low maintenance cost but demands relatively high concentrations, usually in ppm levels. The semi micro extraction technique preconcentrates these metal cations into the levels that required for spectrophotometric analysis. The main benefit of this method is the minimum usage of toxic organic solvents. However, the microliter level solvent

extractions used in DLLME cannot be handled in conventional spectrophotometry which requires samples in milliliter range¹. In this study the extraction conditions that are generally used in DLLME were optimized to optimize conditions for semi micro extraction levels. Thus the conditions that were previously investigated for micro extraction techniques. Therefore the pH of the medium, volume of extracting solvent (chloroform), type and volume of disperser solvent, volume of chelating agent (dithizone) and the sample size were optimized for each metal cation and then the extraction was carried out under optimized conditions in order to determine the enrichment factor (EF).

The optimized pH was found to be 9.5, 4.5 and 8.0 for Pb^{2+} , Hg^{2+} and Cd^{2+} respectively. The 0.20 cm³ of chloroform was found to be the optimum volume for

extractor solvent for all three metal cations. The 0.40 cm³ dithizone solution was found to be the optimum chelating reagent volume for Hg²⁺ and Cd²⁺ whereas this volume for Pb²⁺ was 0.20 cm³. The 0.40 cm³ methanol was found to be the optimum disperser solvent volume for Hg²⁺ and Cd²⁺ whereas this volume for Pb²⁺ was 0.40 cm³. The optimum sample size is found to be 50.0 cm³ for all three metal cations. Under the optimum conditions, the enrichment factors of 116, 107 and 129 were obtained for the extraction of lead, Pb²⁺, Hg²⁺ and Cd²⁺ respectively. The subsequent analysis of these metal cations in spectrophotometry using standard techniques^{2,3,4} after preconcentration under optimum conditions produced extraction recoveries of 92.8%, 85.6% and 77.4% for Pb²⁺, Hg²⁺ and Cd²⁺ respectively. The main advantages of this

method are minimum usage of toxic organic solvents, simplicity, cost effectiveness, rapid analysis and ability to obtain a high enrichment factor and a high recovery.

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Technical Sessions : A - 33

Accumulation of mercury in fish inhabiting in selected water bodies located in urban areas

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As water pollution in urban areas of Sri Lanka is increasing and due to the adverse health effect of mercury, it is important to determine Hg levels in food fish inhabiting inland water bodies located in urban areas.

Bioaccumulation potential of mercury in muscle, gills and liver of food fish, *Oreochromis mossambicus* (Tilapia) inhabiting in Lunawa Lagoon, Dandugam Oya, and Boralessgamuwa Lake was analyzed. In addition, *Myxus gulio* (Anguluwa) in Dandugam Oya and *Estroplus suratensis* (Koraliya) in Boralessgamuwa Lake were assessed. The water and sediment samples were taken concurrently from the sampling locations for determination of mercury. The levels of mercury were analyzed by cold vapor atomic absorption spectrometry.

In any of sampling locations Hg was not detected in water. The sediment (in µg g⁻¹ dry weight) of Lunawa Lagoon contained the highest mean mercury (1.297±0.025) and the lowest mercury (0.272±0.025) in Borelasgamuwa Lake. In Dandugam Oya (0.761±0.056) showed middle level of mercury in sediment. All three locations had exceeded New York State Department of Environmental Conservation

(NYSDEC) Lowest Effect Level (LEL), but not Sever Effect Level (SEL). Accumulation of mercury in the tissues of fish followed the increasing order muscle < gills < liver. There were no statistically significant differences between mercury level and the fish species analyzed in the same location. (Tukey's test p > 0.05) The mean mercury concentration in the liver tissue of *O. mossambicus* was negatively correlated with body length of the fish but there was no correlation between the mercury level in fish muscle and their body length. The Hg concentration in the tissues of *O. mossambicus* followed the decreasing order in Lunawa Lagoon > Dandugam Oya > Borelasgamuwa Lake. Consumption at the average rate of 60 g day⁻¹ of *O. mossambicus*, in Lunawa Lagoon provide 0.1401 µg/kg body weight of Hg level per day which approximately 60% of the Provisional Tolerable Daily Intake (PTDI) of Hg. The results emphasize the importance of monitoring mercury in the food fish species in Lunawa Lagoon regularly for the safety of fish consumers; otherwise it will reach to alarming levels soon. The consumption of fish from Dandugam Oya poses little risk and Boralessgamuwa Lake poses negligible risk to human health.

Analysis of Heavy metals (Arsenic, Lead and Cadmium) in Infant and Full Cream Milk Powder (Adult) available in the Sri Lankan market

K K D A Wijesekara, S Liyanage, J G P S Ubesena, S D M Chinthaka and S P Deraniyagala

Department of Chemistry, University of Sri Jayewardenepura, Nugegoda

The main objective of this study is to analyze infant and Full cream milk powder (adult) available in the Sri Lankan market, for the presence of top hazardous heavy metals specifically Arsenic, Lead and Cadmium by Graphite Furnace Atomic Absorption Spectrometry (GFAAS) and to compare the results with the tolerable intakes recommended by the Food and Agriculture Organization / World Health Organization Joint Expert Committee on Food Additives (JECFA 2011). Calculation of daily intake of milk powder by an adult and infant was aided with a questionnaire prepared and distributed among different people.

Toxic heavy metals can be distributed from their natural deposits and incorporated to the food chain as consequences of urban, agricultural and industrial development of the world. Heavy metals are detrimental when ingested above tolerance levels, therefore their presence in daily consuming foods

significantly affecting the human health especially for the susceptible infant.

Toxicological guidance values recommended by FAO / WHO JECFA 2011 for arsenic, lead and cadmium are TDI (Tolerable Daily Intake) 3 µg, PTWI (Provisional Tolerable Weekly Intake) 73 µg, PTMI (Provisional Tolerable Monthly Intake) 25 µg per kilogram body weight respectively. Arsenic & Lead were not detected in all the adult and infant formula tested whereas three of adult & two of infant formula showed the presence of cadmium with the daily intake levels of (1.4283, 0.2801, 2.1720) and (10.8237, 1.9540) ng per kilogram body weight respectively, below the tolerable limit of 0.833 µg per kilogram body weight of daily intake. Therefore the risk of causing health effects from exposure to arsenic, lead and cadmium upon consumption of selected milk powder brands is insignificant.

Ayurvedic medicinal oils: Development of a method for HPLC fingerprinting and quantification of anthraquinones in 'Pinda oil'

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²*Department of Chemistry, The Open University of Sri Lanka, Nugegoda*

'Pinda oil' is a potent and widely used Ayurvedic medicinal oil.¹ HPLC fingerprinting and quantification of marker compounds have been used in the standardization of many complex herbal products. However, no Ayurvedic medicinal oils have been standardized using this method up to now.

HPLC requires extensive sample clean-up procedures and sample pre-concentration. We have developed a method to fingerprint the phenolic fraction of 'Pinda oil' and to quantify four major anthraquinones present in it as marker compounds for *Rubia cordifolia* which is one of the three plants used in the preparation of the oil.

'Pinda oil' was adsorbed on Polyamide CC 6 powder and non phenolic materials were first eluted with *iso*-octane. The phenolic fraction was then eluted with 2% formic acid in chloroform. This fraction yielded a clear fingerprint on reverse phase HPLC with acetonitrile: 1% formic acid (65:35) monitored at 254

nm.

The peaks for anthraquinones purpurin, alizarin, xanthopurpurin and rubiadin were identified by their retention times and UV spectra and quantified with the use of calibration curves constructed for pure compounds under the same experimental conditions. The calibration curves were constructed at the λ_{max} value for each anthraquinone. The precision of the method for the four anthraquinones as given by the relative standard deviations were 4.0% (purpurin), 4.5% (xanthopurpurin), 4.8% (rubiadin) and 6.5% (alizarin). Addition recovery experiments with purpurin gave recoveries of 104% -106% for up to 30% addition. The method discussed in this abstract has been used successfully by us to analyse commercial 'Pinda oil' samples.

1. Ayurveda Pharmacopoeia, 1976, Vol I, Part 1, Department of Ayurveda, Sri Lanka

Selenium content in rice consumed by Sri Lankans

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²*Department of Chemistry, University of Kelaniya, Kelaniya*

Selenium, a trace metal in the earth crust is essential to the human body as a micronutrient. In recent past research has revealed that the range of selenium required is narrow (26 µg/day as maximum for 65 kg person) and selenium has toxic effect in a broad range. As a result, the World Health Organization (WHO) has drawn their attention to establish the micronutrient range of selenium, required to the human body. Report from China has shown that an ecological correlation exists with the selenium content in soil and increased mortality due to cancer and cardiovascular diseases. This led to the interest in assessing the nutritional status of selenium. Studies on selenium content in food or soil from Sri Lanka are not available.

Since rice is the major food consumed by Sri Lankans, the uptake of selenium by paddy as the source for rice was studied, covering locations spreading across the island *i.e.* twelve districts namely Gampaha, Colombo, Matara, Hambantota, Kegalle, Matale, Anuradhapura, Pollanaruwa, Kurunegalle, Puttalam, Ampara and Moneragalle. Selenium content was determined, using Hydride Generation

Atomic Absorption (HGAAS) spectrometric method on acid digested samples of paddy, rice and soil. The Maha season of the year 2006 was considered for the present study and field survey was carried out before drawing the samples to identify the factors that contributed to the selenium content of paddy.

The present study revealed that the amount of selenium in rice and paddy showed a direct relation to selenium content in soil. Samples of rice, paddy and soil from Gampaha and Colombo districts did not contain selenium in detectable levels. Of the samples that showed the content of selenium in paddy ranged from 7.8 ppb (Matale) – 61.2 ppb (Pollanaruwa) while those in rice ranged from 7.5 ppb (Matale) – 56.9 ppb (Pollanaruwa). It was observed that range of incorporation of selenium into rice from paddy ranged from 93-98%. The content of selenium in soil ranged from 9.5 ppb (Matale) – 69.8 ppb (Pollanaruwa).

Statistical analysis by ANOVA and Tuckey's pairwise comparison revealed that the selenium content in paddy, rice and soil obtained from most of the districts were significantly different.

Synthesis and characterization of Rhenium(I) tricarbonyl ferene complexes for fluorescence imaging

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³*Department of Zoology, University of Colombo*

Re(I) tricarbonyl complexes exhibit immense potential both as therapeutic and diagnostic agents. The luminescent properties of rhenium complexes make them ideal candidates for use as fluorescent imaging agents. Furthermore, non radioactive Re complexes act as model systems for not only ^{99m}Tc, which is a radionuclide widely used in diagnostic medicine, but also for gamma emitting Re isotopes which are used in therapeutic medicine.

Two facial rhenium tricarbonyl complexes containing the disodium salt of ferene ligand (L = 5,5'(3-(2-Pyridyl)-1,2,4-Triazine-5,6-Diyl)-Bis-2-

Furansulfonic Acid Disodium Salt) have been synthesized by utilizing two different Re metal precursors, Re(CO)₅Br and [Re(CO)₃(H₂O)₃]OTf in an organic solvent mixture and water, respectively. The resulting complexes, Re(CO)₃LBr and [Re(CO)₃(H₂O)₃]OTf, which are highly water soluble have been characterized using different spectroscopic techniques. The purity of the obtained complexes was established using ¹H NMR spectra. The most deshielded peak (8.85 ppm) in the ¹H NMR spectrum of the ligand in D₂O, corresponding to the neighboring proton (H1, Figure 1) of pyridyl nitrogen resulted in

the highest down field shift to 9.25 ppm upon metal complex formation and confirms the involvement of the pyridyl N in metal-ligand bonding. FTIR spectra of metal precursors contain three strong peaks in the range of 2060 cm^{-1} to 1900 cm^{-1} which are characteristic for facial carbonyl ligands. Positional changes of these peaks upon metal-ligand bond formation further corroborate the results obtained from ^1H NMR spectroscopy. The additional absorption peak in the range of 400 nm to 420 nm in UV-VIS spectra of metal complexes compared to the ligand absorption spectrum is attributed to MLCT transitions. In acetonitrile and water solutions, the complexes display weak emission peaks in the range of 650 nm to 710 nm originating from MLCT states.

Cytotoxicity of $[\text{Re}(\text{CO})_3(\text{H}_2\text{O})\text{L}]\text{OTf}$ was tested using rat peritoneal cells at its maximum non toxic level of 20.00 mg/ml. Both plant cells (*Allium cepa* bulb cells) and rat peritoneal cells were stained using the maximum concentration level of the compound and observed under the epifluorescence microscope. In both cell lines, compound has concentrated specifically in nuclei region. Hence nuclei showed red fluorescence upon excitation at 550 nm. Remarkable enhancement of fluorescence upon binding with the cells demonstrates the suitability of the complex in biological applications. Furthermore, non cytotoxicity at higher concentrations and the ability to

fluoresce upon visible range excitation attest the eligibility of the complex for use as a biological imaging agent.

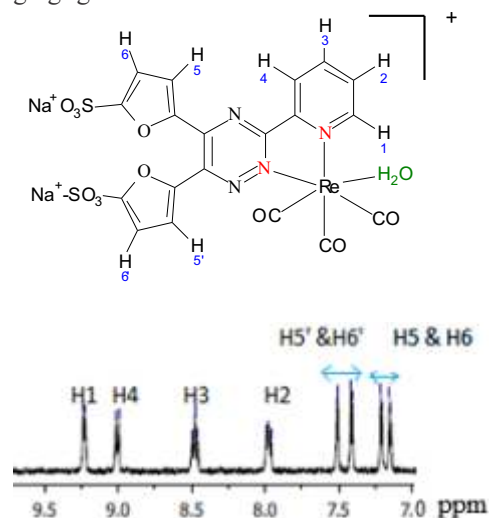


Figure . Chemical structure (left) and ^1H NMR spectrum of Complex B in D_2O (right)

References:

1. Lacowich, J. R., *Principles of fluorescence spectroscopy*. 3 ed.; springer, Science Business Media: New york, 2006; p 923.
2. Perera, T.; Marzilli, P. A.; Fronczek, F. R.; Marzilli, L. G., *Inorg. Chem.* **2010**, 49, 5560-5572

Technical Sessions : A - 38

Graduateship Programme in Chemistry– Analysis of Student data, Class of 2012

P U A I Fernando, C Udawatta and J N O Fernando

College of Chemical Sciences, Institute of Chemistry Ceylon, Rajagiriya

College of Chemical Sciences, Institute of Chemistry Ceylon, which conducts the Graduateship programme in Chemistry, is a leading institution in the tertiary education scenario in Sri Lanka. It has produced 905 Graduate Chemists with an annual average output of over 80 during the past two years. The College of Chemical Sciences is the largest producer of graduate chemists in Sri Lanka. The graduate Chemist qualification awarded after four years of study is recognized by the University Grants Commission of Sri Lanka and many other local and overseas institutions. The institute critically monitors the programme and takes necessary action to enhance its quality. The high standard of teaching at College of Chemical Sciences is made possible by regular modification and revision of course content, and by introducing new courses. The objective of this

research was to collect and analyze data from passing out Graduate Chemists and to obtain their feedback regarding the Graduateship Programme. Data was acquired by **distributing a questionnaire to the graduating class of 2012**. 83 students were given a questionnaire, and 48 responded.

Total sample population: 48

Gender

Female - 30(62.5%); male - 18(37.5%)

Age at graduation

18-25 years – 42(87.5%); 26-30 years – 3(6.25%); 31-36 years – 2(4.16%); above 36 years – 1(2.08%)

GCE Ordinary Level and Advanced Level syllabi followed in school

Local O/L and local A/L – 46(95.83%); London O/L and local A/L – 0(0%); Local O/L and London A/L – 1(2.08%); London O/L and London A/L – 1(2.08%)

Analysis of O/Levels results

4 or more Distinctions – 40(83.33%); 1 – 3 Distinctions – 5(10.41%); No Distinctions, 4 or more Credits – 1(2.08%); Other–2(4.17%)

Analysis of A/Level Results

1 or more 'A' grades – 6(12.5%); No 'A's, 'B' and 'C' grades only – 15(31.25%); No 'A' or 'B' grades, only 'C' and 'S' grades – 21(43.75%); Simple passes only – 5(10.41%)

Medium of instruction in school

Sinhala – 45(93.75%); Tamil – 2(4.17%); English – 1(2.08%)

Followed/following post secondary/tertiary educational courses of 1 year or more duration

Yes – 22(45.83%); No – 26(54.17%)

Level of excellence in the GIC programme

1st class – 4(8.33%); 2nd class (upper and lower) – 22(45.83%); 3rd class – 16(33.33%); Simple pass – 2(4.17%)

1 or more scholarships – 4(8.33%); Merit bursaries – 11(22.91%); Dean's list – 7(14.58%); 1 or more prizes in levels 3 and 4 – 7(14.58%); 1 or more prizes in all levels – 2(4.17%); No prizes or awards – 32(66.67%)

Employment (before/ during / after graduation)

Employed full time before enrollment – 7(14.58%); Employed full time / part time during the programme – 6(12.5%); unemployed – 25(52.08%); Employed full time 3 months after completion – 17(35.41%)

Monthly income of employed

>Rs. 20,000.00 -7; Rs. 20,000.00–40,000.00 - 17; Rs.

40,000.00–99,000.00 – 0; Rs. 100,000.00 & above – 1

There was a positive response about the GIC programme from most students. The class of 2012 consisted of a diverse student population, representing different social and ethnic backgrounds. Majority were female students, 62.5%. About 50% of the students who participated in this survey have followed, or are following various other educational courses, e.g. MBBS, BSc. programmes (Universities of Wayamba, Colombo, Sri Jayawardenapura), Diploma courses (DLTC offered by IChemC), IT courses, Human Resources degrees, and Management degrees (NIBM). 27% of students were employed during and before enrolling in the GIC programme. 35% of students who participated in this survey found jobs after completing the GIC programme. Most employed students were well established at their work places. They are employed as teachers (Sussex College, other international colleges), trainee chemists, analysts, researchers (Dyanawash PVT. Ltd, Ceylon Tobacco Corporation), assistant HR managers, occupational therapists, and banking assistants. Authors conclude that the Graduateship Programme in Chemistry conducted by the College of Chemical Sciences produces Graduate Chemists of high calibre who are able to make a positive contribution to our society.

Technical Sessions : A - 39

Graduateship Programme in Chemistry - Research Course, and the newly introduced Literature Survey Course

P U A I Fernando, C Udawatta and J N O Fernando

College of Chemical Sciences, Institute of Chemistry Ceylon, Rajagiriya

College of Chemical Science, Institute of Chemistry, Ceylon, which conducts the Graduateship programme in Chemistry, is the largest producer of graduate chemists in Sri Lanka. The high standard of teaching at College of Chemical Sciences is made possible by regular modifications and revisions. High achieving students are given the opportunity to enroll in a research project. A new course, **Literature Survey**, was introduced to accommodate students who do not qualify for the research course. Both these courses are optional, and students select a supervisor and a project of their choice. The objective of this research was to identify difficulties and challenges faced by students who enrolled in the **Research Course** (3 credits) and the newly introduced

Literature Survey Course (2 credits). Data was acquired by distributing a questionnaire. The data presented were collected within the academic year 2012.

A. Research Course

Total sample population: 23

Reasons for choosing the Research Course:

Easier option than choosing a three credit theory paper –0; Develop a better foundation for post graduate studies –22; Get to know staff and academics –4; Get a good recommendation for post graduate studies –14; Personal skills development –18; Other reasons –0

Students' assessment of the Research Course:

Highly successful –13(56.52%); Successful

–6(26.08%); Successful to a certain extent - 4(17.39%);

Not successful –0(0%)

Improvements suggested by students were, increase credit weightage to 4 credits, increase availability of chemicals, improve computer literacy, arrangements to publish students' work, acquire instruments (XRD, FT-IR, MS, SEM, TGA), access to free journals and research papers, improve lab facilities, allow students to use the lab for two days in a week, repair malfunctioning instruments, and presence of an experienced research assistant in the lab. Most students performed satisfactorily. However some students did not perform well due to lack of instruments and chemicals, and insufficient time. None of the students were able to complete their research projects before 6 months. Institutions where research was carried out were Institute of Chemistry, ITI, SLINTEC, Universities of Peradeniya, Colombo and Kelaniya, TRI, and Zoological gardens.

B. Literature Survey Course

Total sample population: 9

Reasons for choosing the Literature survey course:

Easier option than attempting a two credit theory paper –7; Develop a better foundation for post graduate studies –3; Get to know staff and academics –2; Get a good recommendation for post graduate studies –7; Personal skills development –3; Other reasons -3

Other reasons were, a great opportunity for students

who are unable to do a research project, and interest in particular areas of study such as cosmetics, pesticides, cancer treatment etc.

Problems encountered by students were, little knowledge about how to conduct experiments which were discussed in the literature survey, deadlines clashed with final examinations, and absence of guide lines. Improvements suggested were, allocation of more time, arranging a series of lectures on how to conduct a literature survey, better organization, arrange monthly meeting/s to discuss problems, more skills development practices in scientific writing.

Students' opinion on status of problems they encountered:

Problems were solved –2(22.22%); Problems were not solved –4(44.44%); No comment –3(33.33%)

Students' assessment of the Literature Survey course:

Very successful –3(33.33%); Successful –2(22.22%); Not successful –1(11.11%); No comment –3(33.33%)

Most students were happy that they had a chance to take the Literature Survey course as they didn't qualify for the Research course, and they had a good experience. Some of the problems they encountered have been solved while others have not.

These courses were designed to increase the potential of students to carry out research. Addressing the issues discussed here will improve these courses for future students.

Technical Sessions : A - 40

Evaluating Problem Solving Skills - Case Study of Students in the First and Third Years of the Graduateship Programme in Chemistry

C Udawatta

College of Chemical Sciences, Institute of Chemistry Ceylon, Rajagiriya

Problem solving and critical thinking is not limited to Chemical Education, or even to Science Education. It is a skill that is applicable to all disciplines of education, and is an essential life skill. Developing problem solving skills are an essential component of education. A 'problem' is often looked on as an 'uncomfortable situation' at best. However, it does not have to be so. According to the definition of 'problem' in the Webster Dictionary, "a *problem* is a question raised for inquiry, consideration, or solution". When viewed in this manner, it is an opportunity to effect change, to improve a situation. We have to approach a situation where students are often not encouraged to think outside the curriculum / syllabus.

They are evaluated on their ability to remember, or more realistically memorize, material that are taught in class and reproduce it accurately during the examination. This approach to education can stifle innovation, since the student is not encouraged to think. Very often, there is no time allocated for thinking during the examination, and the student is expected to know the material before coming to the exam. There is time only to write what you know.

The focus of this study was on evaluating student performance in answering questions based on problem solving and comparing it with answering 'descriptive theory based' questions. The cohorts were first and third year students in the Graduateship Programme in

Chemistry conducted by the College of Chemical Sciences.

As an initial study, student performance in answering (A)C3162 Molecular Biology and Biotechnology, 2012, (B)C1052 Biology for Chemists, 2012, and (C)Part C, C1013, General and Inorganic Chemistry, 2012, (Radiochemistry), were analyzed.

The questions selected were categorized as (a) based on problem solving and (b) based on theory and descriptive. Selecting appropriate questions were not straightforward, as some questions contained parts that were descriptive and parts that were based on problem solving. The following guidelines were adhered to in categorizing the question as theory based, or problem solving;

(i) If the question contained such cognitive terms such as 'define', 'describe', 'explain' etc. it was categorized as a theory based descriptive question that tests a student's ability to remember and recall previously learned material. (ii) If a question contained cognitive words such as "compare", "contrast", "analyze", "write in your own words", it was categorized as a problem solving based question.

A. C3162 Molecular Biology and Biotechnology, 2012

Question Category	Average marks %
Part descriptive, part problem solving	60
Descriptive	63

B. C1052 Biology for Chemists, 2012

Question Category	Average marks %
Mostly descriptive, part problem solving	81.2
Part descriptive, mostly problem solving	34.7
Descriptive	51.7

C. C1013 General and Inorganic Chemistry, Part C, 2012

Question Category	Average marks %
Descriptive	60
Part descriptive, part problem solving	52.2
Problem solving	49.85

While there is no definite conclusion, the general observation is that there is a decrease in the average marks when the problem solving component of a question is significant. The evaluation is complicated due to the nature of the subject, degree of difficulty of the question, and general student performance in the subject discipline. Additionally, what is taught in class has to be taken into account. If, for example, a comparison was discussed during a lecture or a tutorial, then a problem solving based question would become a memory recall for most students. This analysis was based on marks scored by students, since it is the most widely used mode of evaluation at an exam. Since this is a preliminary study, student performance in a few selected subjects were analyzed. The author intends to carry out a more comprehensive study in the future.

Benevolent Fund Benefits for Members

- **Long life** Benefits: Rs. 10,000 (over 70)/Rs. 15,000 (over 75)/Rs. 20,000 (over 80)
- **Critical illness** benefits (upto Rs. 50,000)
- **International travel** for conferences (upto Rs. 50,000)
- **Balance 50% of Tuition fees** of any member's child following the Graduateship Programme (Since 50% concession is already by CCS, this will amount to a 100% waiver)

Any member who has paid membership fees for life (after 3 years of such payment) is entitled for these benefits. All members are advised to pay the membership fee for life and become beneficiaries.

Graduate Chemists Welfare Fund

This fund has been established with effect from 1-1-2012. The principal benefits towards CCS Graduate Chemists would be,

- To provide partial assistance towards international travel of those proceeding abroad for PG degrees (once a life time)
- To provide partial assistance towards registration fees in respect of IChemC/CCS events such as International Conferences (Preference for those presenting papers)
- To provide assistance towards registration fees for IChemC/CCS training seminars etc.
- To provide partial assistance towards activities of the Alumni Association.

Note: Depending on the demand, Graduate Chemists who maintain positive content and participate in IChemC/Alumni activities will get preference for the above mentioned benefits.

PUBLICATIONS OF THE INSTITUTE OF CHEMISTRY CEYLON

Monograph	Title	Author	Price
01	Textile Fibers	Mr T Rajasekeram	Rs.50/-
02	Principles of Food Preservation	Prof U Samarajeewa	Rs.75/-
03	Biotechnology	Prof C P D W Mathew	Rs.75/-
04	Recombinant DNA Technology	Prof J Welihinda	Rs.75/-
05	Natural Toxins in Foodstuffs	Prof E R Jansz & Ms A S Perera	Rs.50/-
06	Fat Soluble Vitamins	Prof E R Jansz & Ms S Malavidana	Rs.50/-
07	Nucleic Acid and Protein Synthesis	Prof J Welihinda	Rs.75/-
08	Extraction of Energy from Food	Prof J Welihinda	Rs.50/-
09	Corrosion of Materials	Dr A M M Amirudeen	Rs.75/-
10	Vitamin C-Have all its mysteries been Unravalled ?	Prof E R Jansz & Ms S T C Mahavithanage	Rs.75/-
11	*Environmental Organic Chemistry (second edition)	Prof S Sotheeswaran	Rs.150/- (US \$3)
12	Enzyme Kinetics and Catalysis	Prof (Mrs) S A Deraniyagala	Rs.100/-
13	Insecticides	Prof (Mrs) Sukumal Wimalasena	Rs.95/-
14	Organotransition Metal Catalysts	Dr S P Deraniyagala & Dr M D P De Costa	Rs.75/-
15	Some Important Aspects of Polymer Characterization	Dr L Karunanayake	Rs.75/-
16	Hard & Soft Acids & Bases	Prof (Mrs) Janitha A Liyanage	Rs.65/-
17	Chemistry of Metallocenes	Dr Sarath D Perera	Rs.65/-
18	Lasers	Dr P P M Jayaweera	Rs.65/-
19	*Life and Metals	Prof (Mrs) Janitha A Liyanage	Rs.75/-
21	*Silicones	Prof Sudantha Liyanage	Rs.65/-
22	Pericyclic Reactions: Theory and Applications	Dr M D P De Costa	Rs.65/-
23	Inorganic NMR Spectroscopy	Prof K S D Perera	Rs.65/-
24	Industrial Polymers	Dr L Karunanayake	Rs.75/-
25	*NMR Spectroscopy	Dr (Mrs) D T U Abeytunga	Rs.65/-
26	Mosquito Coils and Consumer	Ms D K Galpoththage	Rs.100/-
27	Atomic Absorption Spectrometry	Dr K A S Pathiratne	Rs.100/-
28	Iron Management on Biological Systems	Dr (Ms) R D Wijesekera	Rs.100/-
29	Nutritional Antioxidants	Prof. (Mrs) Sukumal Wimalasena	Rs.100/-
30	*f-Block Elements	Prof Sudantha Liyanage	Rs.65/-
31	Scientific Measurements and Calculations	Prof (Mrs) S A Deraniyagala	Rs. 80/-

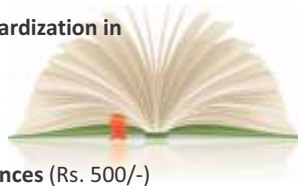
* - Second Edition /new print published on popular demand

CCS Publications

01	Functional Group Analysis in Organic Chemistry	Prof AAL Gunatilake	Rs. 175/-
02	Zinc Metalloproteins	Prof S Sotheeswaran Prof (Ms) R D Wijesekera	Rs. 175/-

General Publications

- ★ **Chemist & The Environment** (Rs.300/-)
- ★ **Infrastructure Support Services for Industrial Development** (Rs.200/-)
- ★ **Chemical Industries in Sri Lanka – Part II** (Members: Rs. 200/-, Non-members: Rs.275/-)
- ★ **Proceedings of the Workshop on the Technological aspects of the Production & Processing of Essential oils in Sri Lanka** (Rs.100/-)
- ★ **Proceedings of the Training Seminar on Towards a Cleaner Industrial Environment in the New Millennium** (Rs.150/-)
- ★ **A-Level Chemistry Facts, Patterns & Principles by Dr. Seetha I Rodrigo** (Rs.1500/-)
- ★ **Proceedings of the Prof R S Ramakrishna Memorial Training Seminar on Modern Analytical Methods**(Rs.200/-)
- ★ **Historical Accounts of the Educational Activities (1972 - 2004)** (Rs.350/-)
- ★ **Proceedings of the Training Seminar cum Workshop on Sampling, Statistics and Standardization in Chemical Analysis and Environmental Management** (Rs.150/-)
- ★ **Polymer Industries of Sri Lanka** (Rs. 200/-)
- ★ **Industry & Environment** (Rs. 200/-)
- ★ **Herbal Medicine Phytopharmaceuticals and Other Natural Products: Trends and Advances** (Rs. 500/-)
- ★ **Chemistry in Sri Lanka** (Rs. 150/-)





RSC NEWS

THE ROYAL SOCIETY OF CHEMISTRY SRI LANKA SECTION

1. Membership

According to the records sent to us from the parent body, a breakdown of the membership is as follows:-

Category	Number
CChem, FRSC	11
FRSC	05
CChem, MRSC	10
MRSC	20
AMRSC	08
Affiliate /Under Graduate.	06
Total Membership as at July 2012	60

2. Committee of Management

The following were elected to the Committee at the 51st Annual General Meeting held on 27th July 2012.

Chairman	- Dr. M P Deeyamulla
Vice Chairman	- Mr. W J P D Jayalath
Chairman Elect	- Mr. I M S Herath
Hony. Secretary	- Dr. Positha Premaratne
Hony. Treasurer	- Prof. W S Fernando

Committee Members - Prof. Sudantha Liyanage
Mr. W A P Silva
Mr. S Perasiriyan
Mr. R M G B Rajanayake
Mr. Sulith Liyanage

3. Committee Meetings

There were 12 Committee Meetings held during the period, July 2011 to July 2012. The venue of these meetings was the office of the Royal Society of Chemistry SL Section at the S L A A S Headquarters. These meetings were held to discuss the R S C SL Section's, new plans and strategies with regard to organizing the activities for the year 2011/2012 and thereafter.

4. Activities

4.1 Contributions to Activities of the Institute of Chemistry Ceylon

(a) Full page advertisement of "Chemistry in Sri Lanka".

(b) Contribution for the Interschool Chemistry Quiz

(c) Award for the Best Performance at the Graduate ship Examination in Chemistry Part II Theory Examination

(d) Contributions for the International Conference

4.2 All - Island Inter School Chemistry Essay Competition.

4.3 IYC Challenge project at Eastern Province.

4.4 Inter - University Chemistry Competition.

4.5 Teacher training program.

4.6 Advanced Level chemistry seminar.

4.7 Donation of teaching and learning resources for Chemical Society of selected University.

4.8 Book donation program.

4.9 Popular Lectures.

4.10 Industrial Visit.

4.11 Writing Monographs by few committee members.

4.12 Newton A. Dias Weerasinha Memorial Scholarship 2011/2012

4.13 Popularisation of Chemical Science and Teacher training programme and book donation programme at Trincomalee.

5. Web Site

The members are reminded of the web site of our Section, the address of which is as follows:-

www.rsc.org/Membership/Networking/InternationalSections/SriLanka/index.asp.

Dr. Positha Premaratne
Hony Secretary