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Annual Research Session - 2022

NATURE CONCERNED SCIENTIFIC ENGAGEMENT FOR SUSTAINABLE DEVELOPMENT

Abstracts of the Proceedings of ARS-FOS-2022

Faculty of Science,
Eastern University, Sri Lanka

Abstracts of the Proceedings

of

Annual Research Session
Faculty of Science
ARS-FOS-2022

"Nature Concerned Scientific Engagement for Sustainable Development"

4th October 2022
Faculty of Science
Eastern University, Sri Lanka

Annual Research Session, Faculty of Science 2022 (ARS-FOS-2022)

ARS-FOS-2022, 4th October 2022

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Annual Research Session, Faculty of Science 2022 (ARS-FOS-2022)

The Annual Research Session-2022 of the Faculty of Science (ARS-FOS-2022) is held on 4th October 2022, under the theme of ***"Nature concerned scientific engagement for sustainable development",*** focusing on research tracks that are dedicated to Life Sciences, Physical Sciences, Mathematics, Computer Science & ICT, and Social Sciences. The ARS-FOS-2022 provides opportunities for the undergraduate and postgraduate students to disseminate their research findings particularly that address nature friendly solutions to societal needs and environmental issues in the regions. The conference is poised to provide students a professional environment to deliberate on their research experiences and receive constructive and timely feedback from participating scholars and industrialists. Moreover, through this exercise it is expected to disseminate findings to related public and private organizations in the region, and open avenues towards community wellbeing.

Editor-in-Chief

Professor A. G. Johnpillai

Message from the Vice-Chancellor

Professor V. Kanagasingam
Vice-Chancellor
Eastern University, Sri Lanka

I am delighted to pen this message for the Annual Research Session - 2022 (ARS- FOS - 2022) under the theme of *"**Nature concerned scientific engagement for sustainable development**"* organized by the Faculty of Science on the 4th of October 2022.

University should be a centre for knowledge production and dissemination of the same to the outer world. I believe that the Faculty of Science has such eminent scholars who facilitate and to be motivators for younger scientists and the researchers to create a new culture in the Faculty, University, and the whole academic community. This forum will be another opportunity for the students and staff of Faculty of Science to move forward sustainable development.

Teaching, research, and scholarship are the fundamental constituents that reveal the quality and relevance of any seat of higher learning. Particularly, research generates the kind of knowledge that makes innovations possible and it has a clear potential to make significant contributions to the quality of higher education. It is open for the publication of Research Articles, Reviews, and Research Communications in all disciplines.

This year's Annual Research Session of the Faculty of Science provides the perfect platform to celebrate the 42nd anniversary of the Eastern University, Sri Lanka. Therefore, the Annual Research Session falls during university week is one of the most significant events in the history of the Faculty of Science, and gives us an opportunity to truly celebrate our university day and its potential. The Annual Research Session provides an ideal opportunity to highlight the research capability and potential of our academic staff and students.

I hope that this Annual Research Session would prove to be a productive research forum that will facilitate the exchange of new ideas and make a substantial contribution towards the advancement of research culture nationally and internationally.

I would like to appreciate the entire Organizing Committee for their untiring and innumerable efforts in organizing this Annual Research Session. Finally, I wholeheartedly wish all the presenters to deliver their research findings and disseminate knowledge among the community of the Eastern University, Sri Lanka.

Message from the Dean

Senior Professor P. Vinobaba
Dean, Faculty of Science
Eastern University, Sri Lanka

It gives me great pleasure and honor to express my heartfelt congratulations on a key event of the faculty ARS-FOS-2022, organized under the theme "Nature-Concerned Scientific Engagement for Sustainable Development". The United Nations has endorsed science as a universal public good that would contribute to the establishment of a sustainable world while simultaneously being a tool for achieving the 2030 Agenda for Sustainable Development. From that perspective, sustainability is focused on becoming the cornerstone for future research both in pure and applied sciences. The contributions of science at a broader level in and across various disciplines are expected to be effective, unleashing the full potential of discipline while strengthening investments and productive outputs globally. I strongly believe that this is a standard platform to produce, present, and strengthen ideas to collaborate toward the sustainable development of our region and nation.

A conference of this magnitude relies on the efforts of many. First and foremost, on behalf of the faculty, I would like to express my sincere gratitude to the keynote speaker, Prof. A. Prasanna de Silva, Professor of Organic Chemistry, Queen's University, Belfast, Northern Ireland, for accepting our invitation and sharing his knowledge and experience amidst his busy schedule. I am also pleased to thank the Vice-Chancellor of the University, Prof. V. Kanagasingam, for his advice and assistance in bringing this into compliance with the approved research policy of the research council. I would also like to thank Prof. F. C. Ragel, Chair of ARS-FOS-2022, members of the Organizing Committee, reviewers, panel of chairs and students, as well as a large number of supporting staff for your commitment and contribution to research and development of the faculty. I would like to express my heartfelt gratitude to the esteemed researchers and presenters who contributed scientific articles to the session. I firmly believe that your collective participation and support will add glamour to this occasion.
My compliments, a very successful ARS-FOS-2022!

Message from the Chairperson

Professor F. C. Ragel,
Chairperson
ARS-FOS-2022

On behalf of the Organizing Committee, I am delighted to convey my message for the Annual Research Session-2022 (ARS-FOS-2022), conducted by Faculty of Science, Eastern University, Sri Lanka, which is a scholarly forum that primarily aims on disseminating the undergraduate research findings to relevant stakeholders on issues that are significant to the region, the environment and the local community.

The ARS-FOS-2022 with theme ***"Nature concerned scientific engagement for sustainable development"***, aimed to focus on research on tracks dedicated to Life Sciences, Physical Sciences, Mathematics, Computer Science & ICT, and Social Sciences, giving opportunities to disseminate research findings that also include multidisciplinary approach to address solutions to societal needs and environmental issues. The conference is poised to provide students a professional environment to deliberate on their research experiences and receive constructive and timely feedback from participating scholars and industrialists. Moreover, through this exercise it is expected to disseminate findings to related public and private organizations in the region, and open avenues towards community wellbeing.

The ARS-FOS-2022 is uniquely enriched by the keynote speech of world-renowned scientist, Professor A. Prasanna de Silva, Professor of Organic Chemistry, Queen's University, Belfast, Northern Ireland, United Kingdom, who won the first international award for Molecular Sensors and Molecular Logic Gates in 2012. With his co-workers, he had the chance to introduce molecular logic as an experimental field and to establish the generality of the luminescent PET (photoinduced electron transfer) sensor/switch principle. I express my sincere gratitude to Professor de Silva for accepting our invitation to share his cutting-edge research experience with us, despite his heavy schedules. I also thank the Vice Chancellor, Professor V. Kanagasingam, for accepting our request to be the Chief Guest and enriching this event. I greatly admire the support, cooperation and encouragement by the Dean, Faculty of Science, Senior Professor P. Vinobaba. I also express my sincere gratitude to the Reviewers, Track-Chairs and Judges for their progressive assistance.

I thank with resounding appreciation the enthusiasm and hard work of Editor-in-Chief of ARS-FOS-2022, Professor A. G. Johnpillai, the Secretary Dr. A. J. M. Harris and Organizing Committee members, and the Working Committees for striving to make this event a grand success. My indepthness and thanks to the IT Committee for their expertism and efforts in bridging all activities on a virtual meeting platform.

Finally, I express my appreciation to the presenters for enriching the conference, and congratulate them for successfully disseminating their research findings. I yearn that the ARS-FOS-2022 will provide a stimulating platform for resounding deliberations.

Message from the Editor-in-Chief

Professor A. G. Johnpillai
Editor-in-Chief
ARS-FOS-2022

It is a great pleasure to share with you all on behalf of the Editorial Board my gratifying experiences on the process of peer reviewing submissions from the authors for presentation at the Annual Research Session 2022 of the Faculty of Science (ARS-FOS-2022), Eastern University, Sri Lanka (EUSL) for the second time in succession.

The contributions were the results of the research work accomplished by the undergraduate and postgraduate students as well.

Four Full Papers and six Extended Abstracts were accepted for presentation at the ARS-FOS-2022 on the advice of the internal and external reviewers assigned for each submission, and the appropriate reviewers' selection was based on their expertness in the specific area of research.

Internal reviewers were selected from the EUSL and the external reviewers were chosen from University of Sri Jayewardenepura, University of Moratuwa, University of Jaffna, The Open University of Sri Lanka and South Eastern University of Sri Lanka.

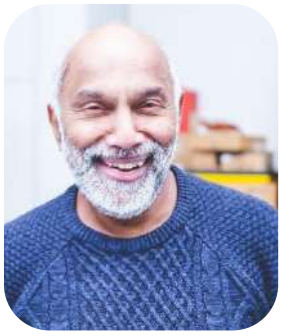
I express my sincere thanks and profound gratitude to each one of the reviewers whose cooperation and timely efforts were extremely valuable to make the final decision to confirm the suitability for publication of the submissions and ensuring the success of the ARS-FOS-2022.

I would like to thank the Editorial Board Members for their advice in reviewing the submissions.

I express my thanks to the Chairman/ARS-FOS-2022, Prof. F. C. Ragel for his support and his appreciation and initiative to foster a vibrant research culture at the EUSL.

Finally, I like to thank all the authors who have contributed to the ARS-FOS-2022 and wish you all a happy and delightful reading.

Brief Biography of the Keynote Speaker



Professor A. Prasanna de Silva
School of Chemistry and Chemical Engineering, Queen's University, Belfast, Northern Ireland, United Kingdom.

"A. Prasanna de Silva's learning and teaching experiences occurred at the University of Colombo, Sri Lanka and at Queen's University of Belfast, Northern Ireland. He introduced molecular logic as an experimental field and established the generality of the luminescent PET (photoinduced electron transfer) sensor/switch principle. He also contributed to the chemistry module of the market-leading point-of-care blood gas/electrolyte analyzer, which has sales of 150 M USD for human use (OPTI^{TM}) and 400 M USD for veterinary use (Vetstat^{TM}) so far. He wrote the book ***'Molecular Logic-based Computation'***, which is also available in Chinese and in Japanese. One of his papers (*Chemical Reviews* 1997, **97**, 1515) has gathered over 6500 citations up to now."

Keynote Speech

From Chemistry to Medical Diagnostics and Information Processing

Professor A. Prasanna de Silva
School of Chemistry and Chemical Engineering, Queen's University,
Belfast, Northern Ireland, United Kingdom.

A fluorescent sensor produces a light signal in response to the presence of a chosen chemical target, such as a sodium ion (Na^+). Just like in the classical flame test, atomic species like Na^+ are counted by these sensor molecules via a visualization process so that communication of atomic/molecular information to humans is made across size-scales differing by 9 orders of magnitude.[1] A popular design tool for constructing fluorescent sensors was developed at the University of Colombo, Sri Lanka in the 1980's. It was the fluorescent PET (photoinduced electron transfer) sensor principle.

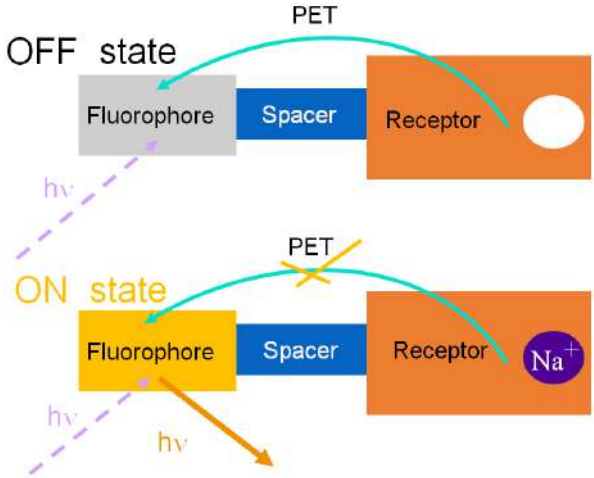
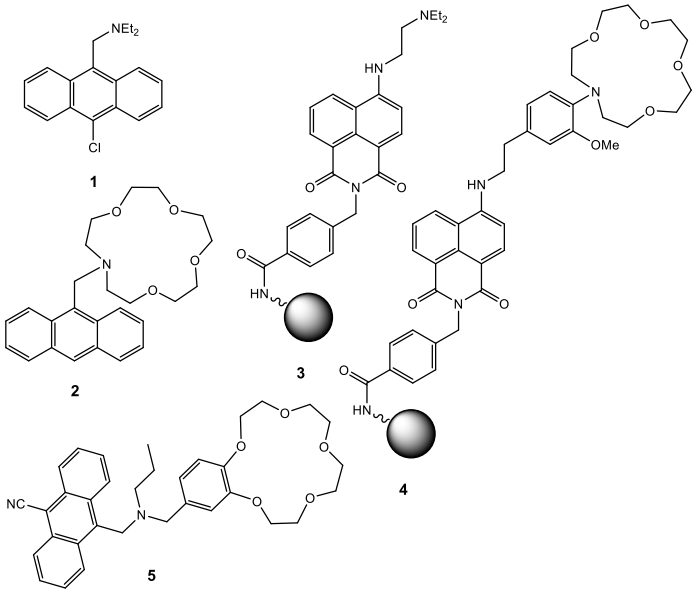


Figure 1. Controlling the competition between fluorescence and electron transfer.

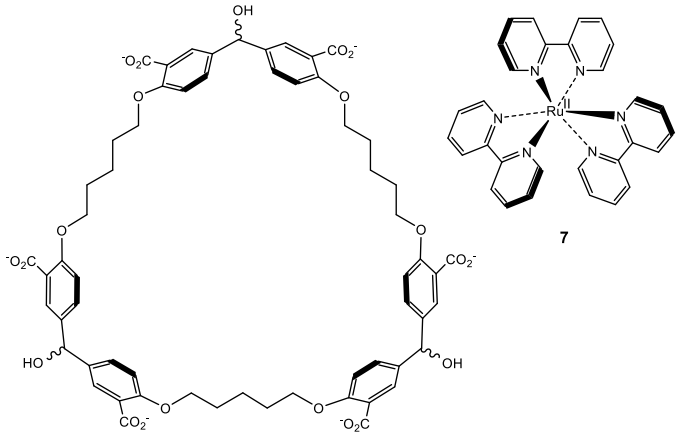
Here, the photo-excited state of a molecule is offered two pathways for de-excitation. The first is a physics pathway of photon emission (i.e., fluorescence) and the second is a chemistry pathway of electron transfer. The latter could involve an electron moving from a receptor to a fluorescent dye (a fluorophore) as one option. Receptors are molecules which can reversibly capture other atoms or molecules and are commonly available in coordination chemistry, biochemistry and supramolecular chemistry. In fact, every second of our lives require many receptors to capture and release various targets during thinking, seeing and moving, plus many other background operations. The electron transfer from the receptor to the fluorophore means the receptor is oxidized and the fluorophore is reduced. Since we learn about such oxidations and reductions in foundational chemistry courses, it is not difficult to locate redox potentials in the literature to calculate whether a PET process would be thermodynamically feasible or not for a given 'fluorophore-spacer-receptor' structure.[1-3] So we can select suitable molecules with the 'fluorophore-spacer-receptor' format where PET would occur, so that the fluorescence is quenched internally or switched 'off'. When the receptor captures Na^+ as its target, electrostatic attraction of Na^+ prevents the negatively charged electron from leaving. Since PET is stopped in this way, fluorescence becomes the dominant de-excitation pathway again. Fluorescence is switched 'on' now (Figure 1).

Compound **1** was our first contribution in 1985 which uses polycyclic aromatic anthracene as the fluorophore, a tertiary amine as a receptor for H^+ and a methylene unit as a spacer which separates the p-electrons of anthracene from the lone electron pair of nitrogen. This was a new type of fluorescent pH indicator which was different in design and different in some of the properties[4] when compared to classical phenolic pH indicators from our schooldays.[5] Compound **2** was our next contribution in 1986 which was a rational extension of the tertiary amine into an aza-15-crown-5 ether so that Na^+ could be targeted in alkaline solution.[6] This compound tapped into the popularity of crown ether-based supramolecular chemistry whose originators were awarded a Nobel Prize in 1987.



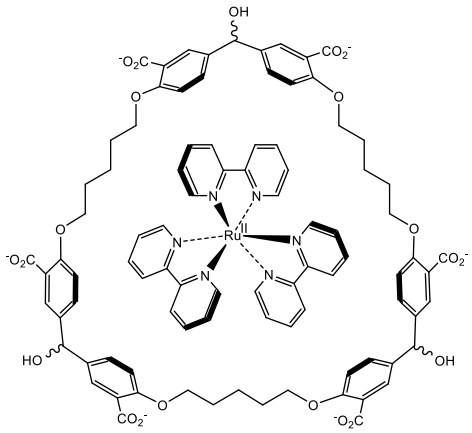
Tertiary amines and crown ethers can be recognized as receptors for H^+ and Na^+ within compounds **3**[7,8] and **4**,[8,9] which lie at the heart of blood sensor systems which serve every day in hospitals and in ambulances worldwide.[10,11] This is a powerful example of chemistry originating in Sri Lanka being used for personal, social, national and global development.

Thanks to an introduction to electronic devices given to us by a physicist friend at the University of Colombo, Satish Namasivayam, we were later able to extend and amalgamate compounds **1** and **2** into compound **5** whose fluorescence signal responded specifically to the simultaneous presence of H^+ and Na^+. This was the first experimental demonstration of a molecular AND logic gate[12] which emulated some aspects of semiconductor electronic devices and started off a new sub-field in chemistry and molecular biology. [13,14] Much molecular information processing occurs during everyday living, and we contend that this is the most critical information technology, in contrast to semiconductors devices in our computers and telephones.



6 **7**

Most recently, we have gone back to the foundations of supramolecular chemistry by unveiling a new class of receptors, e.g., compound **6** to capture large molecules such as metal complex **7**.[15,16] The resulting supercomplex can be shown as structure **8**.[15] We are hopeful that younger researchers will apply these receptors to sensing and information processing systems in the near future, just like we exploited classical receptors when we began our research. We also hope that younger researchers will join the thousands of laboratories around the world who have followed up so far on the concepts in sensing and logic which we began in the University of Colombo 40 years ago.



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ANNUAL RESEARCH SESSION-2022
FACULTY OF SCIENCE
EASTERN UNIVERSITY, SRI LANKA

Technical Session Schedule – ARS-FOS-2022 (04.10.2022)

SESSION 1: PHYSICAL SCIENCES (11.00am)

Meeting Link: https://tinyurl.com/4n5h33av
Meeting ID: 640 4792 3965
Meeting Passcode: Ars@2022
Chairperson: Dr. (Mrs.). Q. Y. Soundararajah
Evaluator for Best Presenter: Dr. P. Iyngaran

Time	***Abstract ID***	***Abstract title and authors name***
11.00 – 11.20 am	*ARS-2022-FS-CH-01*	*Synthesis and Characterization of Chitosan Based Schiff Base and Metal Complex from Shrimp Shells and Application on Catalysis and Biosorption* ***Ekanayake, E. M. B. M.**, Arasaretnam, S., Sithambaresan, M. and Premkumar, S.*
11.20 – 11.40am	*ARS-2022-FS-CH-02*	*Synthesis, Characterization and Metal Adsorption Properties of Tannin-Urea-Formaldehyde Resins from Azadirachta Indica (Neem)* ***Disanayake, K.G.D.S.**, Arasaretnam, S. and Premkumar, S.*
11.40 – 12.00 noon	*ARS-2022-FS-CH-03*	*Removal of Heavy Metals (Chromium and Cadmium) using different Plant Materials: -Atomic adsorption spectrophotometric study* ***Sabrina S.T.F**, Arasaratnam, S and Premkumar, S*
12.00 – 12.20 pm	*ARS-2022-FS-CH-04*	*A Study on Heavy Metal Ions Adsorption and Antibacterial Activities of Cashew Nut Shell Based Activated Carbon* ***Tharanga C**, Koneswaran, M and Mathiventhan, U*
12.20 – 12.40 pm	*ARS-2022-FS-CH-05*	*Synthesis, Characterization and Evaluation of Antibacterial Activity of a Dimedone Derivative and its Nickel (II) Complex* ***Kumarasinghe, K.H.A.J.S.S**, Sithambaresan, M, Mathiventhan, U and Premkumar S*

SESSION 2: LIFE SCIENCES (1.30 pm)

Meeting Link: https://tinyurl.com/4n5h33av
Meeting ID: 640 4792 3965
Meeting Passcode: Ars@2022
Chairperson: Dr. (Mrs.). M. Vinobaba
Evaluator for Best Presenter: Prof. T. Eswaramohan

Time	***Abstract ID***	***Abstract title and authors name***
1.30 -1.50 pm	*ARS-2022-FT-BST-01*	*Effect of Planting Date on Days to Flowering Among Selected Traditional Rice Accessions* ***Pushpakumari W.H.D.U.**, Jayasekera L.A.L.W., Gamini Senanayake, D.M.J.B and Sudarshanee G.*
1.50 – 2.10 pm	*ARS-2022-FAS-SM-01*	*Immune-Enhancing Potentials of Anti-Microbial Plants in Siddha System: A Review* ***Jesintha. J***
2.10 – 2.30 pm	*ARS-2022-FS-Z-01*	*Biodegradability of Plastic and Polythene by Bacteria isolated from Sathurukondan Mangrove Soil* ***Vithurshika, J.**, Vinobaba, P. and Harris, A.J.M.*

SESSION 2: MATHEMATICS (2.30pm)

Meeting Link: https://tinyurl.com/4n5h33av
Meeting ID: 640 4792 3965
Meeting Passcode: Ars@2022
Chairperson: Prof. A.G. Johnpillai
Evaluator for Best Presenter: Dr. T. Mathanaranjan

Time	*Abstract ID*	*Abstract title and authors name*
2.30 – 2.50 pm	*ARS-2022-FS-M-01*	*Study of Problems Faced by the Grade Eleven Students of Paddiruppu Education Zone ln Learning Mathematics* ***Mayurika, S.,** Paramadevan, P and Arulmoli, C.*

2.50 - 3.10 pm	*ARS-2022-FS-M-02*	*Continuous Functions and Separation Axioms in Ideal Topological* ***Rajitha, M** and Elango, P*

CONCLUDING REMARKS (3.15pm)

Meeting Link: https://tinyurl.com/4n5h33av
Meeting ID: 640 4792 3965
Meeting Passcode: Ars@2022
Time: 3.15pm

Synthesis And Characterization of Chitosan Based Schiff Base and Metal Complex from Shrimp Shells and Application on Catalysis and Biosorption

Ekanayake, E. M. B. M.[1*], Arasaretnam, S.[1], Sithambaresan, M.[1] and Premkumar, S.[1]

Abstract. The main purposes of this study were to find out whether Copper (II) complex of Chitosan Salicylaldehyde Schiff Base {CSSB-Cu (II)} complex can act as an efficient catalyst in hydrogen peroxide decomposition reaction and which raw absorbent {Chitin (CT), Chitosan (CS), Chitosan Salicylaldehyde Schiff Base (CSSB)} has the highest Cadmium ion removal Efficiency. Chitosan Salicylaldehyde Schiff Base ligand (CSSB) was synthesized by means of the Schiff condensation reaction between the amino group of Chitosan and the Carbonyl compound of Salicylaldehyde with elimination of water molecules and it was complexed with copper to produce CSSB- Cu (II) complex. Catalytic effect of the CSSB- Cu (II) complex on the kinetics of the decomposition of hydrogen peroxide was investigated and compared with CSSB. CSSB- Cu (II) complex shows better catalytic effect than CSSB. The catalytic decomposition with respect to H_2O_2 was pseudo-first order. Raw absorbents made from shrimp shells (CT, CS, and CSSB) were investigated as adsorbents for removal of Cd^{2+} to determine the cadmium removal efficiencies. Removal efficiencies were calculated for a given metal ion concentration. The study concluded that the removal efficiency of CSSB found to be greater than CS and CT. The CSSB ligand has the highest removal efficiency than CT and CS due to the availability of more active metal binding sites with the introduction of immine group and the hydroxyl group. The Langmuir and Freundlich adsorption models were applied to describe the isotherms and isotherm constants. Equilibrium data agreed very well with the Langmuir model. The maximum adsorption capacity of the Langmuir isotherm equation was 94 mg/g and the Langmuir adsorption equilibrium constant was 1.6×10^{-3} dm^3/ mg at 31°C. The complexes obtained were characterized by UV-visible spectral studies, FT-IR spectral studies, and solubility studies. The solubility studies showed the heterogeneous CSSB- Cu (II) complex not soluble in most solvents. Therefore, it was proved that CSSB- Cu (II) complex acts as an efficient heterogeneous catalyst for the decomposition of hydrogen peroxide. The compounds were confirmed by the presence of an imine bond stretching in the 1630-1640 cm^{-1} and v Metal- N and v Metal – O at $<600cm^{-1}$. Electronic spectra revealed that CSSB-Cu (II) complex exists in square planar geometry.

Keywords: *Cadmium ion removal efficiency, Catalysis, Chitin, Chitosan, Chitosan Salicylaldehyde Schiff base (CSSB), Cu (II) complex of Chitosan Salicylaldehyde Schiff base (CSSB- Cu(II) complex), Hydrogen peroxide decomposition.*

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*Corresponding author. bhagi1995feb@gmail.com

Synthesis, Characterization and Metal Adsorption Properties of Tannin-Urea-Formaldehyde Resins from *Azadirachta indica* (Neem)

Disanayake, K.G.D.S.[1*], Arasaretnam, S.[1] and Premkumar, S.[1]

Abstract. Tannins are a class of bitter and astringent compounds that can be found in abundance in nature. Tannins extracted from *Azadirachta indica* (Neem) were used in this study to create renewable tannin-based cation exchange resin systems. Tannin was identified using ferric chloride and bromine water tests. The total polyphenolic content of *Azadirachta indica* was calculated using the Folin-ciocalteau method and was 30.72% (w/w). Essentially, the applicability of these resin systems as an ion exchange resin was considered, and the resin with the highest IEC (Ion Exchange Capacity) was chosen. It was sulfonated to improve its properties even further. The ion exchange capacity of a Tannin-Formaldehyde resin was measured. The Tannin-Formaldehyde resin was then sulfonated by refluxing it with concentrated H_2SO_4 (98% V/V) to increase its ion exchange capacity. The resin's ion exchange capacity was then increased further by modifying it with the incorporated urea content. Different valent cations, such as Na^+, Cd^{2+} and Cr^{3+}were used to estimate the adsorption properties of both unsulfonated and sulfonated resins. The resins were characterized by spectral analysis using Fourier-transform infrared (FTIR) spectroscopy. Sulfonated tannin-urea-formaldehyde resin with a tannin/urea ratio of 1:1 had the highest ion exchange capacity for the metal ion used (Na^+), which was 0.9784 meq/g. The tannin/urea ion ratio of 1:1 demonstrated the highest adsorption capacity for all metal ions tested. For different metal ion concentrations, the sulfonated tannin–urea–formaldehyde resin with the tannin/urea ratio of 1:1 had the highest adsorption capacity.

Keywords: *Azadirachta indica (Neem), FTIR, Cation exchange resin, Sulfonation, Ion exchange capacity.*

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Removal of Heavy Metals (Chromium and Cadmium) Using Different Plant Materials: Atomic Adsorption Spectrophotometric Study

Sabrina, S.T.F.[1*], Arasaratnam, S.[1] and Premkumar, S.[1]

Abstract. Two different plant materials Water hyacinth (*Eichhornia crassipes)* and Rice husk were used to produce the biochars after chemical treatment, which were investigated to evaluate the removal of Chromium (Cr) and Cadmium (Cd) metals from metal aqueous solutions. Wide range of pyrolysis temperature from 500°C to 1000°C was examined. Series of metal solutions of Cd and Cr were prepared. Adsorbates (Metal solution after adsorption) and series of metal solution were investigated by Atomic Adsorption spectrophotometer (AAS) at wavelength 396 nm. The adsorption capacity of both biochars (Water hyacinth and Rice husk) were increased with pyrolysis temperature. The adsorption capacity of water hyacinth biochars varied from 0.01444270 mg/g to 0.05211930 mg/g (Cr metal adsorption), from 0.018182 mg/g to 0.057955 mg/g (Cd metal adsorption). Whereas for Rice husk biochars from 0.04584 mg/g to 0.095447 mg/g (Cr metal adsorption), from 0.052273 mg/g to 0.099621 mg/g (Cd metal adsorption). Adsorption process is interpreted in terms of Langmuir equation. Langmuir models fitted with experimental data with coefficient R^2 higher than 0.900. (Cr (WH): 0.9172, Cd (WH):0.9392, Cr (RH):0.9772, Cd (RH):0.9866). Rice husk biochar seemed to have the best metal removal capacity (Cr: 0.03067, Cd: 0.07633) whereas water hyacinth had the least removal capacity (Cr: 0.00014, Cd: 0.0003). These results have demonstrated that the use of biochars obtained from water hyacinth and rice husk in heavy metal removal could provide an alternative way to manage and utilize this highly problematic invasive species (water hyacinth) and pollutant (Rice husk). Further it was found that Water hyacinth biochar and rice husk biochar can be used as suitable adsorbent for the removal of Cr and Cd from Metal aqueous solution.

Keywords: *Water hyacinth, Rice husk, Atomic Adsorption Spectrophotometer, Activated Carbon, Langmuir adsorption, Chemical Treatment*

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A Study on Heavy Metal Ions Adsorption and Antibacterial Activities of Cashew Nut Shell Based Activated Carbon

Tharanga C.[1], Koneswaran, M.[1*] and Mathiventhan, U.[2]

Abstract. Activated carbon is most commonly used as an adsorbent for the adsorption of many pollutants from the water and an antimicrobial agent. The aim of this research is to utilize inexpensive cashew nut shell waste for the preparation of activated carbon by chemical activation using phosphoric acid as an activation agent and this activated material use for the metal adsorption from the aqueous solution and for the antimicrobial agent. In this work, the activated carbon of cashew nut shell was prepared by pyrolysis of raw cashew nut shell powder, treated with 50 wt% phosphoric acid. The activated carbon was characterized using different analytical techniques such as Fourier Transform Infrared (FT-IR) spectroscopy, Powder X-ray Diffraction (XRD), Thermogravimetric Analyzer (TGA) and UV-Vis Absorption Spectroscopy. FT-IR spectra show that the peaks observed in 1156.38 cm^{-1} and 1034.34 cm^{-1} confirmed that the phosphoric acid activation is successfully carried out in this carbon material. XRD profiles displayed two peaks centered around 2θ = 24.18˚, 42.8˚ and 46.2° which are associated with diffraction from the 002 and 100/101 set of planes in a weak graphitic structure respectively. This activated carbon was prepared through the pyrolysis method with different pyrolysis temperature. This prepared activated carbon was used to study its adsorption efficiency of different metal ions using Atomic Absorption Spectroscopy (AAS). This study reveals that the activated carbon produced in 550°C shows the optimum adsorption of Na(I) (9.98%), Mg (II) (64.7%), Cd (II) (22.1%) and Fe (III) (98.8%) ions. The adsorption isotherm study on this system was performed using Freundlich and Langmuir adsorption models. The results show that adsorption of Cd (II) is well fit to the Langmuir adsorption isotherm whereas the adsorption of Na(I), Mg (II), and Fe (III) ions were fitted to the Freundlich adsorption isotherm. The antimicrobial activity of this synthesized in these materials such as raw cashew nut shell, impregnated cashew nut shell, and activated carbon were studied using an agar well diffusion method for the bacteria species such as *Escherichia coli*, and *Staphylococcus aureus* with amoxicillin as standard. The results reveal that the activated carbon produce in 600°C show better antibacterial activity against *Escherichia coli* and S*taphylococcus aures compare to* raw cashew nut shell, and impregnated cashew nut shell. Moreover, activated carbon produced in 600°C shows better antibacterial activity against *E. coli* than *S. aures*

Keywords: *Activated carbon, H_3PO_4 -activation, Adsorption, Isotherm, Antibacterial activity, Cashew nut shell*

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Synthesis, Characterization and Evaluation of Antibacterial Activity of a Dimedone Derivative and its Nickel (Ii) Complex

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Abstract. Schiff bases are an important class of ligands in coordination chemistry and they are potentially capable of forming stable metal complexes. Schiff base metal complexes are very much important and widely studied due to their potential applications on antibacterial, antifungal, antiviral and herbicidal activities. Schiff base ligand was synthesized by the condensation reaction of dimedone with o-toluidine, and its nickel (II) complex was also synthesized by refluxing the ethanol solution of Nickel (II) chloride hexahydrate with the ligand. The spectroscopic characterization by using FTIR and UV visible spectroscopy, physicochemical characterizations and conductivities reveal that the ligand behaves as a bidentate ligand and coordinated to Ni (II) with two chloride ions having a four-coordination geometry around the central metal atom. Antibacterial activity of samples at different concentrations (125 ppm, 250 ppm, 500 ppm and 1000 ppm) were tested against two bacterial strains (*Escherichia coli* and *Staphylococcus aureus*). The synthesized metal complex (zone of inhibition in mm with *E. coli* 8.000±1.41, 12.667±0.577, 16.333±1.528, 20.000±1.000 and with *S. aureus* 8.667±1.155, 9.667±0.577, 12.333±0.577, 14.667±0.577) showed considerable inhibition capacity when compared to the synthesized ligand (zone of inhibition in mm with *E. coli* 7.000±1.000, 7.000±1.000, 6.667±0.577, 6.667±0.577 and with *S. aureus* 8.000±1.000, 9.000±1.000, 9.333±0.577, 9.667±0.577). However, both the ligand and the Ni (II) complex showed less inhibition than the standard antibacterial agent.

Keywords: *antibacterial activity, dimedone, nickel complex, o-toluidine, Schiff base*

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Effect of Planting Date on Days to Flowering of Selected Traditional Rice Accessions

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Abstract. Sri Lankan traditional rice is an important genetic resource for breeding. Most the traditional rice accessions are affected by the planting date for flowering initiation. Determination of response to growing season defined by planting date is important to identify promising accessions for specific planting dates in *Yala* and *Maha* seasons. This experiment was conducted to determine the effect of planting date on selected agronomic characters (days to flowering (DF) and plant height and total tiller number at flowering stage) of selected 10 traditional rice accessions (4132 and 5530 of *Masuran*, 4387 and 4237 of *Ma wee*, 4290 of *Kurumawee*, 4145 and 4772 of *Mudukirial*, 4731 of *Hondarawala*, 6412 of *Herath* and 2170 of *Kuruluthuda*) of different DF in previous experiments. Accessions were planted in 12 monthly planting dates for a period of 12 months from November 2018 to October 2019. DF varied among accessions from 52 $\pm$1.65 to 90$\pm$1.3, 67 ± 0.35- 81 ± 0.5, 58 ± 0.6 – 79 ± 0.21, 69 ± 2.6 -116 ± 2, 48 ± 4.16 -84 ± 3.2, 56 ± 0.15 119 ± 0.35, 81 ± 0.37-130 ± 0.44, 60 ± 6.32 - 130 ± 2.28, 71 ± 3.56-122 ± 1.2, 61 ± 1.81-115 ± 0.74 and 66 ± 1.85-93 ± 0.73 for 12 planting dates. Three patterns of DF variation could be observed among accessions and DF values increased during the months of the *Yala* season. Significant differences were observed due to the interaction effect of accession and planting date on days to flowering, plant height, and total tiller number at the flowering stage ($P \leq 0.05$). The interaction between rice accession and planting date was significant indicating that there are diverse accessions for different seasonal changes for ecological adaptation.

Keywords: *Flowering time, Traditional Rice, Seasonal Sensitivity*

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Study of Problems Faced by the Grade Eleven Students of Paddiruppu Education Zone in Learning Mathematics

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Abstract. This article studies the problems faced by the grade eleven students of the Paddiruppu education zone, which is one among the four education zones in the Batticaloa district in Sri Lanka, in learning Mathematics and suggests remedies to overcome certain findings. The study focused on four research objectives which are to find the general factors affecting students in learning mathematics, to find factors which support to develop mathematics knowledge and skills, to find ways to provide favorable environment for students to learn mathematics and to find necessary factors to improve teaching techniques of mathematics teachers. This study carried out at 6 schools in the Paddiruppu education zone and the data collected by the simple random sampling technique from 9 mathematics teachers and 253 students. Data collection process done by using questionnaires, interviews and discussions. For analyzing and presenting data, Ms Word and Ms Excel were used. This study was intended to identify the problems such as students' interest, quality of teaching, teaching environment, family income and evaluation methods.

Keywords: *simple random sampling technique, mathematics.*

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Continuous Functions and Separation Axioms in Ideal Topological Space

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Abstract. In this paper, we study four types of generalized closed sets: pre-*I*-closed sets, semi-*I*-closed sets, α-*I*-closed sets and *b*-*I*-closed sets in an ideal topological space. Using their generalized open sets, we define the separation axioms: T_0-space, T_1-space and T_2-space and also de- fine the continuous functions. For *b*-*I*-closed sets, the T_0-space, T_1-space and T_2-space and the continuous functions were already defined in the literature. In this paper, we investigate the properties of T_0-space, T_1-space and T_2-space for all these generalized closed sets. Using the continuous functions, we also develop some further properties of these spaces. We show that if f is an injective and *I*-irresolute function from X to Y and if g is an injective and *I*-irresolute function from Y to Z, then for the composite function if Z is a T_i-space, then X is a T_i -space, for $i = 0, 1, 2$ for all these generalized closed sets.

Keywords: *Ideal topological spaces, Generalized closed sets, Separation axioms*

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Immune-Enhancing Potentials of Anti-Microbial Plants in Siddha System: A Review

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Abstract. Immunity plays a predominant role in protecting against microbes such as viruses, bacteria, fungus, and protozoa. The Siddha system reveals that several medicinal plants have an essential part in the management of infectious diseases for curative and preventive purposes. Hence, more and more studies are being conducted on herbal medicines for their anti-microbial activity to enhance the immunity of the human body. The purpose of this review is to provide scientific information on the immune enhancement potentials of ten identified antimicrobial plants derived from the *Siddha* system. *Data and information of Immune boosting properties of Ananas comosus*, *Justicia adathoda*, *Cassia tora*, *Solanum torvum*, *Acorus calamus*, *Euphorbia ligularia*, *Madhuga indica*, *Ficus hispida*, *Rhinacanthus nasutus*, and *Crotalaria retusa were collected* from Siddha texts, previous research journals, and authenticated textbooks were analyzed by the desk review on scientific evidence on anti-microbial herbs. Reviewed medicinal plants revealed the best immune-enhancing properties such as enhancing T cell receptors and B lymphocytes attaching to the antigen, increased neutrophil adhesion, secretion of lymphocyte proliferation, and neutralizing and inactivating toxins. Hence, selected medicinal plants improved both humoral and cellular immunity, intensifying host defense and revealing high immune-enhancing potential. Hence, these reviewed medicinal plants improve immune responses and cure and prevent infectious diseases. In the future to inaugurate single or polyherbal drug formulations for anti-microbial diseases. These medicinal plants would be subjected to a variety of clinical trials, and additional research on active principles and therapeutic efficacy would be conducted to identify the hidden bio-component.

Keywords: *Anti-microbial, Immune enhancing, Immunity, Medicinal plants,* Siddha *system.*

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Biodegradability of Plastic and Polythene by Bacteria Isolated from Sathurukondan Mangrove Soil

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Abstract. Plastic and polythene waste accumulating in the environment are posing an ever-increasing ecological threat. Low-density polyethylene (LDPE) and polystyrene (PS) are the synthetic polymers that is up till date nearly impossible to be degraded safely. However, considering their abundance in the environment and their specificity in attacking plastics, biodegradation of plastics by microbes seems to be the most effective process. In the present studies, soil sample were collected from mangrove zones in Sathurukondan mangrove area and three type of bacterial strain isolated by using the soil serial dilution, spread plate method and pure culture (Nutrient agar medium). the bacterial strain obtained was subjected to standard biochemical test result and their morphology showed the presence of *Staphylococcus* sp, *Micrococcus* sp and *Streptococcus* sp. The microbes identified further inoculated into starch agar culture media and their bio degradative ability on low-density polyethylene and polystyrene determined in terms of weight loss. Several days' interval (5 days) weight loss was measured. After 30days of inoculation, the biodegradation of low-density polyethylene and polystyrene per month measured. *Staphylococcus* sp, *Micrococcus* sp and *Streptococcus* sp showed respectively 16.681 ± 2.225%, 15.815 ± 3.799%, 17.329 ± 1.936% on low-density polyethylene and 2.624 ± 0.981%, 3.801 ± 0.778% and 3.416 ± 0.955 % on polystyrene (PS) mean degradation by weight loss in 30 days. Weight loss percentage among the low-density polyethylene and polystyrene was statistically significant (*P* value < 0.05%). But among the bacterial strains weight loss percentage on low- density polystyrene and polystyrene were not statistically significant. Further surface morphology of low-density polyethylene and polystyrene analysed by light compound microscope before and after biodegradation. Waste management the important process to protect the environment from pollution. Low- density polyethylene and polystyrene waste materials cause serious environment problems, so the waste materials removed by using the microbes. The method was cheap and effective, so it can be used widely for the treatment of low- density polyethylene and polystyrene.

Keywords: *Biodegradation, Low-density polyethylene (LDPE), Microbes, Polystyrene (PS)*

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