22nd Annual Illinois Student Research Conference

April 1, 2011

Hosted by

Eastern Illinois University

Charleston, IL
A message from the conference steering committee

April 1, 2011

This is the twenty second annual program in a continuous series of Student Research Conferences that begun in 1990. We believe that the lasting success of the conference is due to its focus on its student participants and its dedication to its original objectives:

1. To provide students with an opportunity to practice their research talks and presentations before an audience of their peers, and to use the comments they receiver to improve their presentations.

2. To provide a forum for highlighting the research efforts of students in our educational institutions.

3. To promote and strengthen collaboration in research among science students and faculty at our colleges and universities.

4. To provide opportunities for students to begin learning the value of networking research ideas and information as part of their research training.

5. To foster and support students’ desire to continue to pursue careers in scientific research.

6. To encourage students to pursue graduate study in science and to enable them to learn about graduate study opportunities at our member institutions.

The committee hopes that you enjoy the conference, that you make new friends, that you share in the excitement of doing research, and that you will look forward to participating in the 23rd Annual Illinois Student Research Conference in 2012.

The 22nd conference steering committee
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TWENTY SECOND ANNUAL
ILLINOIS STUDENT RESEARCH CONFERENCE

PROGRAM

Friday, April 1, 2011

Conference Registration

3:00 pm Physical Science Building 2131

Program Commencement

4:00 pm Welcome
Dr. Douglas Brandt
President of ISAAPT and Professor,
Department of Physics
Eastern Illinois University

Student Platform Presentations
Dr. Michael Mimnaugh presiding

Physical Science Building 1205

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<td>1. “TRANSITION METAL-THIORIDAZINE COMPLEXES: SYNTHESIS AND FREE RADICAL SCAVENGING ACTIVITIES” Madhuri Gundameedi, Swetha Puram, and Netkal M. Made Gowda, Department of Chemistry, Western Illinois University</td>
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<td>4:25 pm</td>
<td>2. “GLYCINE OXIDATION BY MANGANESE(III) IN SULFURIC ACID SOLUTIONS: KINETICS AND MECHANISM” Vikram Akita, Bharat K. Palakurthi, Sridhar Poloju, Gilles Kouassi, and Netkal M. Made Gowda, Department of Chemistry, Western Illinois University</td>
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<td>4:40 pm</td>
<td>3. “GENERATION OF THREE AMINO ACID RESIDUE SUBSTITUTION MUTANT PROTEINS OF A NOVEL SECONDARY ALCOHOL DEHYDROGENASE” Nicholas Shoger, Vamshi Takkalpalli, Lisa Wen, and Jenq-Kuen Huang, Department of Chemistry, Western Illinois University</td>
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4:55 pm  4. “MODELING DIFFUSION THROUGH A FINITE COMPOSITE MEDIUM” 
Julienne Cabell and Robert LeSuer, Department of Chemistry and Physics, 
Chicago State University

Refreshments  
Physical Science Building 2170

5:30 pm  SOCIAL TIME  
University Ballroom 
Martin Luther King Union

6:30 pm  BANQUET  
University Ballroom 
Martin Luther King Union

7:30 pm  Keynote Speech  
Physical Science Building 1205

“Citizen Science: Unmanned Space Exploration by You!”
Pamela Gay 
Southern Illinois University, Edwardsville, IL

Modern instrumentation allows scientists to acquire astronomical images at a rate greater than any team can process in a timely manner. At the root of this problem is the still prevalent need to use human eyes and human pattern recognition skills at one or more steps in the data analysis process.

In the past, faculty asked students and post doctoral fellows to slave away at classifying images, but it has been recognized that many of their tasks, from classifying the morphology of galaxies to tracing lunar craters, can be done by members of the public. Today, through projects such as Moon Zoo and the Planet Hunters, scientists are relying on this aid to produce published data catalogues that have so far yielded more than two dozen publications.

Poster Research Presentation  
Physical Science Building 2490

Dr. Jenq-Kuen Huang Presiding

8:30 pm- 10:00 pm

5. “TRANSITION METAL COMPLEXES OF PROMAZINE: SYNTHESIS AND CHARACTERIZATION” Dayakar R. Gouru, Yakubreddy Naini, Tarab J. Ahmad, and Netkal M. Made Gowda, Department of Chemistry, Western Illinois University
6. “SYNTHESIS AND CHARACTERIZATION OF TRANSITION METAL COMPLEXES OF ETHOPROPAZINE” Varun Debbeti, Tarab J. Ahmad, and Netkal M. Made Gowda, Department of Chemistry, Western Illinois University

7. “RUTHENIUM(III) CATALYZED OXIDATION OF INDIGO CARMINE BY MANGANESE(III) IN ACID MEDIUM: A KINETIC AND MECHANISTIC STUDY” Vishnuvardhan R. Thakkalapally, Vikram Akita, Kishore Cholkar, Gilles Kouassi, and Netkal M. Made Gowda, Department of Chemistry, Western Illinois University

8. “TRANSITION METAL COMPLEXES OF CHLORPROMAZINE: SYNTHESIS AND CHARACTERIZATION” Yakubreddy Naini, Dayakar R. Gouru, Tarab J. Ahmad, and Netkal M. Made Gowda, Department of Chemistry, Western Illinois University

9. “KINETICS OF ACETYLCHOLINE OXIDATION BY MANGANESE (III) IN SULFURIC ACID SOLUTIONS” Bharat K. Palakurthi, Vikram Akita, Gilles Kouassi, and Netkal M. Made Gowda, Department of Chemistry, Western Illinois University

10. “THE EFFECT OF 1-METHYL, 3-BUTYLIMIDAZOLIUM TETRAFLUOROBORATE BMIMBF4 IONIC LIQUID ON THE RETENTION BEHAVIOR OF NITROAROMATICS AND NITROANILINES” Craig Utterback, Deon Perkins, Ashlie Heagy, Stephanie Sharp, and Tarab, Ahmad, Department of Chemistry, Western Illinois University

11. “INVESTIGATION OF THE EFFECT OF 1-BUTYL 3-METHYL IMMIDAZOLIUM TERTAFLUOROBORATE IONIC LIQUID ON THE SEPARATION OF BASIC DRUGS” Kishore Kumar R Aluguvelli, Sahar Salam, Ahlam Alalwaiat, and Tarab Ahmad, Department of Chemistry, Western Illinois University

12. “THE EFFECT OF THE CONCENTRATION OF 1-METHYL,2,3 IMETHYL IMADZOLIUM TETRAFLUOROBORATE MDMIM BF4 IONIC LIQUID AS A MOBILE PHASE ADDITIVE ON THE PEAK PROFILES AND ADSORPTION ISOTHERMS OF TRYPTOPHAN” Kishore Kumar R Aluguelli, Ahlam Alalwiat, and Tarab Ahmad, Department of Chemistry, Western Illinois University

13. “SEARCHING FOR ANTIPROLIFERATIVE ACTIVITY OF ANTRODIA CAMPHORATE, A CHINESE MEDICINAL MUSHROOM EXTRACT: EVALUATION OF ISOPROPONAL FRACTIONS” Karl R. Freyer, Terri L. Tobias, Martha L. Johnson, Lisa Wen, Chi-Tsai Lin, and Jenq-Kuen Huang, Department of Chemistry, Western Illinois University, Institute of Bioscience and Biotechnology, National Taiwan Ocean University, Keelung, Taiwan

14. “SEARCHING FOR ANTIPROLIFERATIVE ACTIVITY OF ANTRODIA CAMPHORATE, A CHINESE MEDICINAL MUSHROOM EXTRACT: EVALUATION OF UNBOUND FRACTIONS” Terri L. Tobias, Martha L. Johnson, Karl R. Freyer, Lisa Wen, Chi-Tsai Lin, and Jenq-Kuen Huang, Department of Chemistry, Western Illinois University, Institute of Bioscience and Biotechnology, National Taiwan Ocean University, Keelung, Taiwan
15. “RECOMBINANT HUMAN PROCATHEPSIN D” Ryan Keefer, Brianna Norris, Shawn Leland, Nick Saichek, Matthew McConnell, Alice Ye, Jennifer Chmielowski, Laura Berryman, Lisa Wen, and Rose McConnell, Department of Chemistry, Western Illinois University

16. “VIABILITY EVALUATION OF CATHEPSIN INHIBITOR-TREATED CELLS” Danielle Cobb, Brittany Petentler, Sarah Veen, Lisa Wen, Jenq-Kuen Huang, Rose McConnell, Department of Chemistry, Western Illinois University

17. “GENERATION OF AMINO ACID SUBSTITUTION MUTANT PROTEINS OF A SECONDARY ALCOHOL DEHYDROGENASE FROM MICROCOCCUS LUTEUS WIUJH20” Ian Kopp, Jennifer Leonhard, Janice Mondragon, Lisa Wen and Jenq-Kuen Huang, Department of Chemistry, Western Illinois University

18. “SUBCLONING OF A HUMAN L(S)-3-HYDROXYACYL-COA DEHYDROGENASE FOR GENERATION OF MUTANT PROTEINS” Vamshi Takkalapalli, Joseph Lucas, Lisa Wen, and Jenq-Kuen Huang, Department of Chemistry, Western Illinois University

19. “USING MAGNETIC FORCE MICROSCOPY (MFM) TO STUDY MAGNETIC ORDERING OF FUNCTIONALIZED DOPED MULTI-WALL CARBON NANOTUBES (MWCNT)” Kamal Chapagain, Mahendra D.C., Brandon S. Selph, Hsun Jen Chuang, Joseph L. Wiewel, Departments of Physics and Chemistry, Western Illinois University

20. “A SIZE DETERMINATION OF NANOSCALE FOOD CAPSULES USING ATOMIC FORCE MICROSCOPY (AFM)” Mahendra D.C., Hsun Jen Chuang, Joseph L. Wiewel, Kamal Chapagain, Brandon S. Selph, Departments of Physics and Chemistry, Western Illinois University

21. “HELMHOLTZ EQUATION AND LAGUERRE GAUSSIAN BEAMS” Jacob Brown and Kishor T. Kapale, Department of Physics, Western Illinois University

22. “NON-HOLONOMIC CONSTRAINTS AND CONSTRAINT FORCES” Yuan Sang and Kishor T. Kapale, Department of Physics, Western Illinois University

23. “ARE FORMALDEHYDE MASERS EXCLUSIVE TRACERS OF MASSIVE STAR FORMATION?” Jacob Brown and Esteban D. Araya, Department of Physics, Western Illinois University

24. “COMPUTATIONAL MODELING OF FORMALDEHYDE MASERS IN SPACE” Aaron T. Schye and Esteban D. Araya, Department of Physics, Western Illinois University

25. “DETECTION OF THERMAL FORMALDEHYDE EMISSION IN THE MASSIVE STAR FORMING REGION NGC 7538” Liang Yuan and Esteban D. Araya, Department of Physics, Western Illinois University
26. “INVESTIGATING THE LOCATION OF THE SOLAR SYSTEM ABOVE THE GALACTIC PLANE BASED ON MOLECULAR CLOUDS AND HII REGIONS” Abdelsalam M Talafha and Esteban D. Araya, Department of Physics, Western Illinois University

27. “ANALYZING A DYE SENSITIZED SOLAR CELL DATABASE TO IDENTIFY QUANTITATIVE STRUCTURE PROPERTY RELATIONSHIPS TO IMPROVE OVERALL DYE PERFORMANCE” Adam O. Zayed, Seri P. Kamari, Robert LeSuer, and Kristy L. Mardis, Department of Chemistry and Physics, Chicago State University

28. “WHERE ARE THE ELECTRONS IN FULLERENE-POLYMER COMPLEXES?” Brian P. Banks and Kristy L. Mardis, Department of Chemistry and Physics, Chicago State University

29. “NEW PROTON CONDUCTIVE POLYMER MEMBRANES BASED ON POLYSTYRENE” Grace Nono, Asare Nkansah, Department of Chemistry and Physics, Chicago State University

30. “FABRICATION AND CHARACTERIZATION OF COPPER-BASED DYE SENSITIZED SOLAR CELLS” Amanda Timmons, Brittany Johnson, Gilbert Mbah and Robert LeSuer, Department of Chemistry and Physics, Chicago State University

31. “DEVELOPMENT OF NEW DENDRIMER-BASED DRUG ENCAPSULATION POLYMERIC MATERIALS” Stephanie Fox, Asare Nkansah, Department of Chemistry and Physics, Chicago State University

32. “ROLE OF BRASSINOSTEROIDS IN SALT STRESS TOLERANCE OF SWEET POTATO UNDER IN VITRO CONDITIONS” Lawal, L., McClure, B., Ekoì, Y. and Potluri V, Department of Biological Sciences, Chicago State University

33. “THE EFFECT OF SIMVASTATIN ON TAU POLYMERIZATION IN VITRO AND IN ALZHEIMER’S DISEASE” Markeutta McCollough, Chris Humes, Tanika McCants and Aida Abraha, Department of Chemistry and Physics, Chicago State University

34. “PHOTOACTIVATED RIBOFLAVIN AND PHYLLOQUINONE AS PHOTODYNAMIC ANTIMICROBIAL CHEMOTHERAPEUTIC AGENTS” Joy Blain and Patty K. Fu, Department of Chemistry, Governors State University

35. “NANOENCAPSULATED DRUG-CARRYING SYSTEM FOR PHOTODYNAMIC ANTIMICROBIAL CHEMOTHERAPY (PACT)” Gopala K. M. Kalapala and Patty K. Fu Division of Science, Governors State University

Refreshments Physical Science Building 2170

10:10 pm CONFERENCE STEERING COMMITTEE MEETING
Abstract of papers

Twenty second annual

STUDENT RESEARCH CONFERENCE

April 1, 2011

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The 22nd conference steering committee

April 1, 2011
PLATFORM PRESENTATION
ABSTRACTS
TRANSITION METAL-THIORIDAZINE COMPLEXES: SYNTHESIS AND FREE RADICAL SCAVENGING ACTIVITIES

Madhuri Gundameedi, Swetha Puram, and Netkal M. Made Gowda

Department of Chemistry, Western Illinois University, One University Circle, Macomb, IL 61455, E-Mail: GN-Made@wiu.edu

N-alkylphenothiazines (NAPTZs) are biologically active heterocyclic compounds. The NAPTZ ligands such as thioridazine hydrochloride (TR.HCl) are used as psychotherapeutic and antihistaminic drugs. Considering the fact that platinum (II)-NAPTZ complexes are used as antitumor agents, several other transition metal-TR.HCl complexes have been synthesized with the assumption that they would behave as more potent and/or less toxic anticancer drugs than the free NAPTZ ligands.

The present research project involves the following studies: 1) transition metal complexes of Zn(II), Cod(II), Cu(II) and Hg(II) with thioridazine hydrochloride have been synthesized. The synthesized complexes have been characterized based on their elemental analysis, molar conductance, magnetic susceptibility, IR, NMR, and mass spectral data. The molecular formulations and structures will be proposed; and 2) the new transition metal-TR.HCl complexes have been screened for their antioxidant and free-radical scavenging abilities in vitro in comparison to a positive control, butylated hydroxyanisole (BHA), using the following standard assays: i) ferric ion reducing assay ii) total antioxidant capacity assay iii) hydroxyl radical scavenging assay iv) superoxide radical scavenging assay and v) nitric oxide radical scavenging assay. The observed experimental data will be presented.

Acknowledgement: We thank the Western Illinois University Research Council and the National Cancer Institute-NIH (AREA grant # 1R15 CA115404-01) for support.
GLYCINE OXIDATION BY MANGANESE(III) IN SULFURIC ACID SOLUTIONS: KINETICS AND MECHANISM

Vikram Akita, Bharat K. Palakurthi, Sridhar Poloju, Gilles Kouassi, and Netkal M. Made Gowda,

Department of Chemistry, Western Illinois University, One University Circle, Macomb, IL 61455 and Department of Studies in Chemistry, University of Mysore, Mysore 570 006, India, E-Mail: GN-Made@wiu.edu

Glycine or Gly (NH$_2$CH$_2$COOH) is the smallest of the 20 amino acids commonly found in proteins. It is unique among the proteinogenic amino acids. In this study, manganese(III) has been generated by a standard electrochemical method of anodic oxidation of 0.20 M manganese(II) sulfate in 3.0 M H$_2$SO$_4$ solution and used as a stock solution. Under pseudo-first-order conditions of [Gly] >> [Mn(III)], the Gly-Mn(III) reaction has been spectrophotometrically monitored at the Mn(III) $\lambda_{\text{max}}$ of 491 nm and at constant temperature. The experimental rate law for the redox reaction is, rate = $k' [\text{Mn(III)}][\text{Gly}]^x[H^+]^y$, where x and y are fractional orders. The effects, on the reaction rate, of the reduction product, Mn(II), and ionic strength of the reaction medium have been found to be negligible. Activation parameters, $E_a$, $\Delta S^\neq$, $\Delta H^\neq$, and $\Delta G^\neq$, have been evaluated using Arrhenius and Eyring plots. Consistent with the experimental data, a mechanism and a suitable derived rate law will be presented.

Acknowledgement: We thank the Western Illinois University Research Council and the National Cancer Institute-NIH (AREA grant # 1R15 CA115404-01) for support.
Soapstock is the by-product of caustic refining of fatty acids and contains an amount of oleic and linoleic acids (~15%), which are sold in low cash value to feed industry as an ingredient for chicken feed. Therefore, it is attractive to carry out biotransformation of oleic and linoleic acids in soapstock to value-added hydroxyl fatty acid derivatives. To develop an economically feasible process for the production of oleic acid to 10-HSA, strain improvement of \textit{N. cholesterolicum} NRRL 5767 to block 2°-ADH activity is required; another approach was to isolate new microbial that posse the desired properties. During the process of screening for such microbial, a novel secondary alcohol dehydrogenase (2°-ADH), \textit{M. luteus} WIUJH20, was isolated that possesses 2°-ADH enzyme activity, but doesn’t have oleate hydratase activity. The isolated 2°-ADH is categorized as secondary alcohol dehydrogenase based on its biochemical reactions, but it belongs to the NAD⁺-dependent short-chain L-3-hydroxyacyl-CoA dehydrogenase (SCADH) family based on amino acid sequence homology.

In literatures, 2°-ADH and SCADH’s are distinguished in terms of their primary structure and substrate specificities. SCADH has tight substrate specificity; it only catalyzes L-3-hydroxyacyl-CoAs with various hydrocarbon chain lengths. In comparison the 2°-ADH has low substrate specificity; it can catalyze hydroxyl fatty acids with hydroxyl group in either D or L form on a number of carbon positions. However, the enzyme cannot use hydroxyacyl-CoA as a substrate. The original objective of this research was to obtain an industrial microorganism; however considering that the isolated 2°-ADH is an excellent model system to study structure-function relationship and determine what distinguishes their substrate specificity the research priority was shifted to the isolation of 2°-ADH as the aforementioned system instead.

In this presentation we report the processes to generate and purify three amino acid residue substitution mutant proteins of a novel secondary alcohol dehydrogenase (D60S, A67K, and D60S/A67K) via protein engineering and the preliminary kinetics results.

This research is supported in part by the College of Arts and Sciences and WIU Foundation.
MODELING DIFFUSION THROUGH A FINITE COMPOSITE MEDIUM

Julienne Cabell and Robert LeSuer

Department of Chemistry and Physics
Chicago State University
Chicago, IL

Dye Sensitized Solar Cells (DSSCs) are alternative methods of converting Solar light into electrical energy. Unlike traditional silicon based solar cells, DSSCs contain liquid Redox electrolytes. Understanding diffusion of these electrolytes is key in designing an efficient solar cell. We modeled the DSSC as a finite composite medium. Numerical method is used to generate theoretical current transient that can be compared to experimental results and determine an effective diffusion coefficient. Progress on developing an analytical solution will also be discussed.
POSTER PRESENTATION
ABSTRACTS
TRANSITION METAL COMPLEXES OF PROMAZINE: SYNTHESIS AND CHARACTERIZATION

Dayakar R. Gouru, Yakubreddy Naini, Tarab J. Ahmad, and Netkal M. Made Gowda

Department of Chemistry, Western Illinois University, One University Circle, Macomb, IL 61455, E-Mail: GN-Made@wiu.edu

Phenothiazines find applications in medicine as neuroleptic, antipsychotic, antihistaminic, and inodilation drugs. Derivatives of N-alkylaminophenothiazine (NAPTZ), such as promazine hydrochloride (C\textsubscript{17}H\textsubscript{20}N\textsubscript{2}S.HCl or P.HCl), are prominent members of this class of drugs. Some NAPTZs have an electron-withdrawing group such as a halogen or CF\textsubscript{3} in position-2. In this project, we have studied the synthesis, purification, and characterization of several P.HCl complexes of transition metal halides, such as ZnBr\textsubscript{2}, CdI\textsubscript{2}, CdBr\textsubscript{2}, and HgBr\textsubscript{2}. The new metal-P.HCl complexes have been characterized based on the elemental analysis, melting point, magnetic susceptibility, and molar conductance, IR, NMR, and mass spectral data. Tentative molecular structures for the new complexes will be presented in the conference. Additionally, plans are underway to study the in vitro antioxidant and free radical scavenging activities of these complexes.

Acknowledgement: We thank the Western Illinois University Research Council and the National Cancer Institute-NIH (AREA grant # 1R15 CA115404-01) for support.
Derivatives of phenothiazine, including ethopropazine (C_{19}H_{24}N_{2}S or EP), are tricyclic compounds that are used as antihistaminic and antipsychotic drugs. The present project involves the synthesis and characterization of transition metal complexes of the EP.HCl ligand. Several transition metal complexes have been prepared using EPHCl as the main ligand and the starting metal salts, such as ZnBr_2, CdBr_2, CdI_2, and HgBr_2, and purified by recrystallization in a suitable solvent. These products have been characterized based on their elemental analysis, molar conductance, magnetic susceptibility, IR, NMR, and mass spectral data. The molecular formulations and structures of the complexes will be discussed. Plans are also underway in our laboratory to study the antioxidant and free radical scavenging activities of these new complexes.

**Acknowledgement:** We thank the Western Illinois University Research Council and the National Cancer Institute-NIH (AREA grant # 1R15 CA115404-01) for support.
Reactions of porphyrin-manganese(III) systems have been reported as possible models for closely related and biologically significant systems. In the present project, the manganese(III) sulfate stock solution has been prepared using a standard electrochemical method of anodic oxidation of manganese(II) in 3.00 M H$_2$SO$_4$ solution. The indigo carmine (IC)-Mn(III) redox reaction catalyzed by Ru(III), under pseudo-first-order conditions of [Mn(III)] >> [IC], has been spectrophotometrically monitored at the $\lambda_{\text{max}}$ of IC (610 nm) at constant temperature. The experimental rate law for the reaction is, rate = $k_1$ [IC][H$^+$]$^{x}$[Ru(III)]$^y$, where $x$ and $y$ are fractional orders. The reaction rate shows a zero-order dependence on the concentration of the oxidant, Mn(III), indicating its involvement in fast steps following the slow step. Additionally, the effects on the rate of adding the reduction product, Mn(II), and the oxidation product of IC (isatin sulfonate, IS) have been found to be negligible. Variations of the ionic strength and the dielectric constant of the reaction medium have negligible effect on the rate. Activation parameters, namely, $E_a$, $\Delta S^\neq$, $\Delta H^\neq$, and $\Delta G^\neq$, have been evaluated using Arrhenius and Eyring plots based on the effect of temperature. A suitable mechanism consistent with the experimental data and a derived rate law will be presented.

Acknowledgement: We thank the Western Illinois University Research Council and the National Cancer Institute-NIH (AREA grant # 1R15 CA115404-01) for support.
TRANSITION METAL COMPLEXES OF CHLORPROMAZINE: SYNTHESIS AND CHARACTERIZATION

Yakubreddy Naini, Dayakar R. Gouru, Tarab J. Ahmad, and Netkal M. Made Gowda

Department of Chemistry, Western Illinois University, One University Circle, Macomb, IL 61455 and Department of Studies in Chemistry, University of Mysore, Mysore 570 006, India, E-Mail: GN-Made@wiu.edu

N-alkylphenothiazine (NAPTZ) derivatives, including chlorpromazine (CP), are biologically active heterocyclic compounds. Research work on these compounds was stimulated by the discovery of their antihelmintic action. In recent years coordinating behavior of NAPTZs has gained much importance due to their extensive applications in industry, medicine, and chemical analysis. Chlorpromazine is used in medicine as an antipsychotic, antiemetic, antihistaminic and inodilation drug.

In the present project, the synthesis of the transition metal complexes of the CP.HCl ligand with metal salts such as ZnBr$_2$, CdBr$_2$, CdI$_2$, and HgBr$_2$ has been carried out. Products have been characterized based on their elemental analysis, melting point, conductance, magnetic susceptibility, IR, NMR, and mass spectral data. The available results along with suitable molecular structures will be presented. Furthermore, plans are underway in our laboratory to study the antioxidant and free radical scavenging activities of these complexes.

Acknowledgement: We thank the Western Illinois University Research Council and the National Cancer Institute-NIH (AREA grant # 1R15 CA115404-01) for support.
KINETICS OF ACETYLCHOLINE OXIDATION BY MANGANESE(III) IN SULFURIC ACID SOLUTIONS

Bharat K. Palakurthi, Vikram Akita, Gilles Kouassi, and Netkal M. Made Gowda
Department of Chemistry, Western Illinois University, One University Circle, Macomb, IL 61455, E-Mail: GN-Made@wiu.edu

In many organisms including humans, acetylcholine (ACh) is a neurotransmitter in both the peripheral nervous system (PNS) and central nervous system (CNS). It is an ester of acetic acid and choline with the chemical formula, CH₃COOCH₂CH₂N⁺(CH₃)₃. Acetylcholine is the only neurotransmitter used in the motor division of the somatic nervous system. In this study, manganese(III) has been generated by a standard electrochemical method of anodic oxidation of 0.20 M manganese(II) sulfate in 3.0 M H₂SO₄ solution and used as a stock solution.

The ACh-Mn(III) reaction in acid medium, under the pseudo-first-order conditions of [ACh] >> [Mn(III)], has been spectrophotometrically monitored at 491 nm [λ_max of Mn(III)] and at constant temperature. The experimental rate law for the redox reaction is, rate = k' [Mn(III)] [ACh]₀ / [Mn(II)]^x [H^+]^y, where x and y are fractional orders. Effects of adding salts, including sodium sulfate, and MeOH to the solvent medium have been studied. Activation parameters, Eₐ, ΔSᵦ, ΔHᵦ, and ΔGᵦ, have been evaluated using Arrhenius and Eyring plots. Consistent with the experimental data, a mechanism and a suitable derived rate law will be presented.

Acknowledgement: We thank the Western Illinois University Research Council and the National Cancer Institute-NIH (AREA grant # 1R15 CA115404-01) for support.
THE EFFECT OF 1-METHYL, 3-BUTYLMIDAZOLIUM TETRAFLUOROBORATE BMIMBF4 IONIC LIQUID ON THE RETENTION BEHAVIOR OF NITROAROMATICS AND NITROANILINES

Utterback, Craig; Perkins, Deona; Heagy, Ashlie; Sharp, Stephanie and Ahmad, Tarab, Department of Chemistry, Western Illinois University, One University Circle, Macomb, IL 61455, E-Mail: tj-ahmad@wiu.edu

The identification of explosives and their degradation products is important in forensic and environmental applications. Complete separation of these structurally similar compounds using reversed-phase liquid chromatography has proven to be a challenge. The 8330 EPA method for the trace analysis of explosives includes isocratic HPLC separations of 14 components using C18 columns. These separations typically take over 30 min and are unable to separate all the compounds and a second column is usually needed leading to an increase in the analysis time and sample handling complexity. These disadvantages have led to the search for alternative LC for the separation of explosives. Room temperature ionic liquids RTILs are salts with melting points at or close to room temperature. They are good solvents, highly polar, environmentally benign, nonvolatile, nonflammable, and stable in air or water. RTILs can be used to adjust the selectivity as well as to enhance the resolution by improving the peak shapes. In the present work we will investigate the effect of using BMIM salts as a mobile phase additives on the retention behavior, peak shapes and resolution of the nitroaromatic and nitroaniline compounds using two C18 reversed phase columns; prevail C18 and Grace smart C18.
INVESTIGATION OF THE EFFECT OF 1-BUTYL 3-METHYL IMIDAZOLIUM TERTAFLUOROBORATE IONIC LIQUID ON THE SEPARATION OF BASIC DRUGS

Kishore Kumar R Aluguvelli, Sahar Salam, Ahlam Alalwaiat and Tarab Ahmad

Department of Chemistry, Western Illinois University, One University Circle, Macomb, IL 61455, E-Mail: tj-ahmad@wiu.edu

Room temperature ionic liquids have recently gained recognition as environmentally “green” solvents because of their extremely low volatility as compared to traditional volatile organic compounds (VOCs). RTILs possess other properties like low melting point (<100°C), Chemical and thermal stability, No flammability, high ionic conductivity, high heat capacity, high thermal conductivity and wide electrochemical potential window. Because of their favorable properties they are currently investigated in analytical chemistry application and in liquid chromatography.

In this study the effect of the ionic liquid 1-butyl,3 methyl imidazolium tetrafluoroborate on and retention behavior and the resolution of two basic compounds Nortyptiline and Amitryptiline is investigated. It is found from this study that retention of the two compounds decrease by increasing the ionic liquid concentration in the mobile phase. The resolution of the two compounds was the best when 20 mM of the [BMIM]BF₄ was used in the mobile phase. It was noticed that the elution order of the two compounds is reversed when BMIM]BF₄ was added to the mobile phase compared with the retention of the two compounds when phosphate buffer was only used in the mobile phase without using the ionic liquid.
THE EFFECT OF THE CONCENTRATION OF 1-METHYL, 2,3 DIMETHYLIMADZOLIUM TETRAFLUOBORATE MDMIM BF₄ IONIC LIQUID AS A MOBILE PHASE ADDITIVE ON THE PEAK PROFILES AND ADSORPTION ISOTHERMS OF TRYPTOPHAN

Kishore Kumar R Aluguveli, Ahlam Alalwiat, and Tarab Ahmad

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Room temperature ionic liquids have recently gained recognition as environmentally “green” solvents because of their extremely low volatility as compared to traditional volatile organic compounds (VOCs). RTILs possess other properties like low melting point (<100°C), Chemical and thermal stability, No flammability, high ionic conductivity, high heat capacity, high thermal conductivity and wide electrochemical potential window. Because of their favorable properties they are currently investigated in analytical chemistry application. ILs have been explored as functional stationary phases for gas chromatography (GC), additives for high-pressure liquid chromatography (HPLC), and electrolytes for capillary electrophoresis (CE).

In this study the ionic liquid 1-methyl, 2, 3 dimethylimidazolium tetraflouroborate (MDMIMBF₄) is investigated as a mobile phase additive for the elution of tryptophan using reversed phase liquid chromatography. The adsorption isotherms were determined by the frontal analysis method and by the inverse method. The adsorption data are fitted to a Langmuir model. An excellent agreement was found between the experimental overloaded band profiles and the calculated profiles.
SEARCHING FOR ANTIPROLIFERATIVE ACTIVITY OF *ANTRODIA AMPHORATE*, A CHINESE MEDICINAL MUSHROOM EXTRACT: EVALUATION OF ISOPROPONAL FRACTIONS

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*Antrodia camphorate* is a unique mushroom found solely in Taiwan on its host the Bull Camphor Tree. *A. camphorate* has been used for centuries in traditional Chinese remedies for influenza, itchy skin, liver diseases, drug intoxication, and abdominal pain. Recently the anti-proliferative effects of *A. camphorate* on cancer cells has become a focus of researchers. The purpose of this research is to isolate and characterize the active pharmacological compounds of *A. camphorate*.

The extracts used in this research will be taken from fruiting bodies provided by Dr. Chi-Tsai Lin, Institute of Bioscience and Biotechnology, National Taiwan Ocean University, Keelung, Taiwan. These crude extracts were taken with organic solvents, refined through a solid phase extraction resin. The compounds eluted from the solid-phase extraction resin by isoproponal were separated using High Performance Liquid Chromatography (HPLC) on a C18 column. The chromatography fractions were tested for their ability to affect cell proliferation of HepG2 cells, a human liver carcinoma cell line. The effect of the fractions on cell proliferation was measured through the MTT Cell Proliferation assay to determine cell growth. In the assay the presence of the active mitochondrial reductase enzyme is determined and correlates to the number of viable cells in the sample. The identity and characteristics of the compounds in the fractions will be identified by Gas Chromatographic-Mass Spectrometric and Infrared Spectroscopic techniques.

This work is supported by WIU University Research Council.
SEARCHING FOR ANTIPROLIFERATIVE ACTIVITY OF *ANTRODIA CAMPHORATE*, A CHINESE MEDICINAL MUSHROOM EXTRACT: EVALUATION OF UNBOUND FRACTIONS

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*Antrodia camphorate* is a species of mushroom native to only the forests of Taiwan. The host plant is a large evergreen broad-leaf tree commonly known as the Bull camphor tree. The Bull camphor tree is endemic to only Taiwan and its’ status has recently become protected as it is relatively rare in the wild.

*A. camphorate* has been used for centuries as a traditional Chinese medicinal mushroom. It has been used for a variety of illnesses such as influenza, itchy skin, liver diseases, drug intoxication, and abdominal pain. More recently however, researchers have become interested in *A. camphorate* potential anti-proliferative effect on various cancers including liver cancer. The purpose of this research involves the isolation and characterization of the pharmacological active compounds from *A. camphorate*.

The objective of this research includes preparation of extracts from *A. camphorate* with organic solvent. Metabolites in the extracts were separated by solid-phase extraction followed by high performance liquid chromatography (HPLC). The antiproliferative activity in the extracts and chromatography fractions were tested for their ability to affect cell proliferation. A MTT assay was used to measure the induction and inhibition of cell proliferation. In this colorimetric assay, the cells take up the positive charge of the MTT. It is reduced to purple formazan in the mitochondria. This reduction only takes place when the mitochondrial reductase enzymes are active and is therefore correlated with the number of viable living cells.

This work is supported by WIU University Research Council.
Cathepsin D is an aspartyl lysosomal protease that catalyzes protein cleavage. It is synthesized as zymogens composed of a signal peptide, a pro-peptide, and mature protein. The signal peptide is cleaved in the ER and the pro-protein is activated by proteolytic removal of the pro-peptide. Cathepsin D is involved in the process of tumor invasion and metastasis. It has been considered as a potential target for cancer therapy. The objective of this research is to prepare functional recombinant cathepsin D enzyme which will be used in the development and evaluation of new cathepsin D inhibitors. Previously human procathepsin D cDNA has been subcloned into pET15b. Although high level expression of the protein was achieved, the activation efficiency of the proenzyme into functional cathepsin D has been very low. In the present research we attempted to optimize the activation conditions by adding cathepsin B or ATP or both. The results will be discussed.
VIABILITY EVALUATION OF CATHEPSIN INHIBITOR-TREATED CELLS

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Cathepsins, originally identified as lysosomal proteases, play a fundamental role in intracellular protein turnover in lysosomes. Cathepsins have been shown to involve in the process of tumor invasion and metastasis and have been linked to many types of cancer as well as osteoporosis, rheumatoid arthritis, Alzheimer’s disease, and cardiovascular disease. Human cysteine proteases have been recognized as potential drug targets for several diseases. Our on-going research on development and evaluation of new cathepsin B and K inhibitors have resulted in several new synthetic potent inhibitors. These inhibitors are found to be effective at reducing cathepsin B or K’s activity in MCF-7 breast cancer cells. The present research is to evaluate the effect of these inhibitors on cell proliferation by MTT cell proliferation assay. In this assay method, MCF-7 breast cancer cells were cultured for 1-2 days in the presence of cathepsin inhibitors. The cell viability was then tested with the MTT solution. Viable cells reduce yellow MTT to a purple metabolite. The intensity of purple metabolite is proportional to the cell viability.
The enzyme, 2°-ADH is categorized as a secondary alcohol dehydrogenase based on its biochemical reactions, but belongs to NAD$^+$-dependent short-chain L(S)-3-hydroxyacyl-CoA dehydrogenase (SCADH) based on the amino acid sequences alignment. In the literature, SCADH has tight substrate specificity, while 2°-ADH has low substrate specificity. The 2°-ADH and SCADHs are characterized by their primary structure and substrate specificities. SCADH only catalyzes L(S)-3-hydroxyacyl-CoAs with various hydrocarbon chain-length; whereas 2°-ADH can catalyze hydroxyl fatty acids with the hydroxyl group in either D or L configuration on a number of carbon positions and without having a hydroxyacyl-CoA substrate. The amino acid sequences and three-dimensional structures of SCADHs from various species and their important binding sites (CoA binding sites, NAD$^+$ binding sites, and enzyme active site) have been known. Our 2°-ADH provides another model system to look into the mechanism governing substrate specificity.

Two single amino acid substitution and one double amino acid substitution mutant proteins of 2°-ADH (D60S, A67K, and D60S/A67K) have been generated in our lab recently for enzyme kinetic studies. Generating of more mutant proteins are needed.

In this poster, we report the preliminary results of the construction of two amino acid residue point mutation from aspartic acid to alanine (D60A) and serine to aspartic acid (S127D), respectively, of 2°-ADH using polymerase chain reaction (PCR) and overlap extension in the presence of four different primers. Future research is also included for discussion.

This work is supported in part by the College of Arts and Sciences and WIU Foundation.
SUBCLONING OF A HUMAN L(S)-3-HYDROXYACYL-COA DEHYDROGENASE FOR GENERATION OF MUTANT PROTEINS

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A novel secondary alcohol dehydrogenase (2°-ADH) has been characterized in the lab previously. This 2°-ADH has been categorized into a 2°-ADH according to its biochemical reactions. However, it was categorized as an NAD⁺-dependent, human short-chain L(S)-3-hydroxyl-CoA dehydrogenase (hSCADH) according to another set of comparison, which is based on the amino acid sequences alignment of the 2°-ADH with other proteins in Protein Database (National Center for Biotechnology information).

In literatures, 2°-ADH and SCADHs are distinguished in term of their primary structure and substrate specificities. SCADH has tight substrate specificity; it only catalyzes L(S)-3-hydroxyacyl-CoAs with various hydrocarbon chain-lengths. Whereas 2°-ADH has low substrate specificity; it can catalyze hydroxyl fatty acids with hydroxyl group in either D or L form on a number of carbon positions, and hydroxyacyl-CoA was not a substrate. Judging from the available amino acid sequences and 3-D structures of hSCADHs and their important binding sites (i.e. CoA binding sites, NAD⁺ binding sites, and enzyme active site), this 2°-ADH provides a model system to look into what distinguishes their substrate specificity. Three amino acid substitution mutant proteins (D60S, A67K, and D60S/A67K) of 2°-ADH have been generated and mutant proteins been purified for enzyme kinetic studies.

We ran into a problem after three mutant proteins were purified for kinetic studies due to the fact that all substrates at least must be 3-hydroxyacyl-CoA derivatives. There is only one such chemical, acetoacetyl-CoA, which is commercial available; the rest of the substrates have to be synthesized in the lab. We were getting into an uncomfortable zone in research. To overcome this problem, we did the other way around to mutate hSCADH because there are many commercial available hydroxyl fatty acids.

In this poster, we report the preliminary results of swapping the hSCHAD gene from the pOTB7 chimerical plasmid into a pET28a protein expression plasmid. Future research is also included for discussion.

This work is supported in part by the College of Arts and Sciences and WIU Foundation.
USING MAGNETIC FORCE MICROSCOPY (MFM) TO STUDY MAGNETIC ORDERING OF FUNCTIONALIZED DOPED MULTI-WALL CARBON NANOTUBES (MWCNT)

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Carbon nanotubes are well-known for their superior chemical, mechanical, thermodynamic, and electrical properties, and many potential applications have been proposed for them due to these unique characteristics. These include specialized conductive and high-strength nano-composite materials, potential sensor and bio-molecular detection applications in forensic work, and medical applications such as targeted delivery of bio-active substances. The goal of this study was to determine the success of two different potential methods (functionalization and magnetite doping) of creating a patterned array of multi-wall carbon nanotubes (MWCNT). The technique used was magnetic force microscopy (MFM), which allows us to track the surface topography while also mapping the magnetic field gradient across the sample surface in a non-contact vibrational mode with a tiny probe of highly permeable magnetic material constructed in our laboratory.

Samples A, L and M were all prepared on highly surface-smoothed gold substrates, with the MWCNT in hexane solution spread as uniformly as possible over the gold surface and allowed to dry prior to measurement. Sample A was the control sample, possessing only the bare MWCNT, while sample L had the MWCNT functionalized with a carboxyl group (COOH) to improve their patterned orientation on the sample surface, which creates a small magnetic signal, and sample M had magnetite (iron oxide $\text{Fe}_3\text{O}_4$) particles doped in solution with the previously functionalized MWCNT, many of which attached to the MWCNT, and were then re-functionalized following the doping process, thus helping to improve the magnetic field gradient strength and the magnetic ordering and patterned orientation at the gold sample surface.

MFM scans were conducted at levels ranging from 20 by 20 microns down to 0.5 by 0.5 microns. The 2 by 2 micron scans were determined to be the optimal size for displaying the patterning of the magnetic ordering (in MFM mode) in samples L and M. It was expected that samples L and M would have the better patterning compared to the control sample A; however, the result images clearly showed that the patterning on samples L and M still needs improvement despite the definite enhancement of the magnetic field gradient signal strength that was observed in these samples.
A SIZE DETERMINATION OF NANOSCALE FOOD CAPSULES USING ATOMIC FORCE MICROSCOPY (AFM)

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In the present time, physicists and chemists are widely developing and using nano-technology to create tiny edible food capsules that release their medicinal or nutritional contents on demand. Nanoencapsulation is a process which prevents the food particles from oxidation and thereby improves stability. Omega-fatty acids are essential nutrients for human health and their stability can be dramatically improved by encapsulation into nano-size food polymer materials. The nano-size food polymers using in the encapsulation process are called nano-capsules or nano-scale food capsules.

In the larger study, the physical state, the size of the nano-capsules, and the long term stability of the nano-capsules were all investigated to evaluate their protective effect against oxidation. For our size determination study, which is herein reported and used atomic force microscopy (AFM), the nano-scale food capsules were immersed in a hexane solution, which was sufficient to bond them to our surface-smoothed gold substrate. Our current goal was to evaluate our success level in obtaining size enlargement of the food capsules. In this report, we present the size differences found by using atomic force microscopy (AFM) that were obtained with two different nano-encapsulation processes.

The sizes of the capsules produced in the first process ranged between 0.85 µm and 1.3 µm. Nevertheless, our recent results clearly show that the sample prepared by the second process has succeeded in enlarging the capsule size to a range of 10 µm to 15 µm. This study will have broad applications in the transport and marketing of food and nutritional materials, where long-term stability is of paramount importance.
HELMHOLTZ EQUATION AND LAGUERRE GAUSSIAN BEAMS

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In optical physics, orbital angular momentum (OAM) of light has been a topic of great research interest recently. This is because of both its fundamental importance in understanding light and novel applications it opens up. It is easier to understand light’s orbital angular momentum by looking at the motions of electrons orbiting around a nucleus or the motion of the earth around the Sun. Both the electrons and the earth have two aspects to their motion. They rotate (or spin) around an axis passing through their body and circle around the entity at the center of the orbit (nucleus for electron and the Sun for the earth). The spinning motion gives a body its spin angular momentum and the revolving motion around a center gives it an orbital angular momentum. Similarly for light, there can be both spin (same as polarization) and orbital angular momentum. Nevertheless, OAM of light has been elusive and only recently our theoretical and experimental understanding has matured so we can find applications for it. An Orbital angular momentum of light arises when a photon (particle equivalent of light) circles around the beam as it is projecting through the space.

The mathematical description of the laser beams and different spatial modes of laser beam in the plane transverse to the direction of propagation are described in terms of a differential equation called the Helmholtz equation. It is a partial differential equation that relates the spatial variation of the electromagnetic fields with the temporal variation and the variation along the direction of propagation. Normally the equation is solved in terms of the standard Cartesian coordinates to obtain the transverse spatial profile of the laser beams in terms of the so called Hermite Gaussian functions.

It turns out that the laser beams can carry orbital angular momentum and the orbital angular of light cannot be easily understood in terms of the Hermite Gaussian modes. The orbital angular momentum modes of light have cylindrical symmetry and it makes sense to look for solutions to the Helmholtz equation that are cylindrically symmetric. The cylindrically symmetric solutions turn out to be so called Laguerre Gaussian (LG) functions.

In this presentation we will discuss the character of the angular momentum of light and how it can be understood via the solution of the Helmholtz equations in the form of LG functions.
Within the Lagrangian approach to classical mechanics, constraints on the physical system can be handled easily using the Lagrange undetermined multipliers technique. However, the technique is known to work when the constraints are independent of the velocity that is are holonomic. Non-holonomic constraint systems are the ones that have the constraints equations as functions of velocity and may also be time dependent. There is still a debate going on the research community about appropriate generalized methods to mathematically handle non-holonomic constraints.

In this presentation, we investigate methods to solve linear non-holonomic constraints (functions linearly dependent on velocity) by discussing certain problems such as a rotational system, for example cart wheel, and a particle sliding on a rough incline. We are going to explore application of Lagrange's undetermined multipliers technique to check whether it can consistently deal with the linear non-holonomic constraints and we would like to further investigate if they can be used to solve some non-linear non-holonomic problems.
ARE FORMALDEHYDE MASERS EXCLUSIVE TRACERS OF MASSIVE STAR FORMATION?

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Masers are the equivalent of lasers but at microwave frequencies. Masers have been detected in space, particularly in regions of star formation, (proto-)planetary nebulae, and evolved stars. Formaldehyde ($\text{H}_2\text{CO}$) is one of the molecules that emit maser radiation in space. At present, $\text{H}_2\text{CO}$ masers have been detected only toward regions of massive star formation. To explore whether $\text{H}_2\text{CO}$ masers are exclusive tracers of massive star formation, we conducted a survey with the 305 m Arecibo Telescope toward evolved stars, planetary nebulae, proto-planetary nebulae, and low-mass star forming regions. We detected no $\text{H}_2\text{CO}$ masers in our sample, which indicates that the physical conditions required for $\text{H}_2\text{CO}$ maser excitation are exclusive of massive star forming regions.
A greater understanding of astrophysical masers can give important information about the physical characteristics of the regions in which they exist and the conditions under which they operate. We present a computational model developed to explore the pumping mechanism of formaldehyde masers. Several sets of collision rates are available and the impact each set has on the model will be discussed. The model is able to predict thermalization of the molecular levels with the Cosmic Microwave Background at low densities, and with the kinetic temperature of the gas at high densities. The model also reproduces anomalous absorption of formaldehyde via collisional excitation. We show that formaldehyde masers cannot be explained by collisional excitation with hydrogen molecules. We also discuss how the model can be used to investigate the physical conditions responsible for the thermal emission of formaldehyde in NGC 7538.
DETECTION OF THERMAL FORMALDEHYDE EMISSION IN THE
MASSIVE STAR FORMING REGION NGC 7538

Liang Yuan and Esteban D. Araya

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NGC 7538 is an active massive star forming region in the Galaxy, and one of only a few regions known to harbor 6 cm formaldehyde (H$_{2}$CO) masers. Using the 100 m Green Bank Telescope, we detected 2 cm H$_{2}$CO emission toward this object. To investigate the nature of the 2cm emission, we conducted observations of the 1 cm H$_{2}$CO transition, and obtained a cross-scan map of the 2 cm line. We detected 1 cm emission and found that the 2 cm emission is extended (angular size greater than 30°), which implies brightness temperatures of ~0.2 K. Assuming optically thin emission and local thermodynamic equilibrium, both these detections are consistent with thermal emission of gas at ~30 K. We conclude that the 1 cm and 2 cm H$_{2}$CO lines detected with the GBT are thermal, which implies molecular densities above $10^5$ cm$^{-3}$. 
INVESTIGATING THE LOCATION OF THE SOLAR SYSTEM ABOVE
THE GALACTIC PLANE BASED ON MOLECULAR CLOUDS AND HII
REGIONS

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The Milky Way is a spiral galaxy composed of an inner bulge/bar, a spherical halo and a stellar
disk. In addition to stars, the disk contains atomic hydrogen gas, molecular clouds and star
forming regions. Based on the distribution of stars, the Solar System is approximately 30 pc (~9
light-years) above the galactic plane. In this work, we investigate the vertical position of the
Solar System with respect to the disk based on the distribution of massive star forming regions
(HII regions) and molecular clouds in the Galaxy. Our sample consists of 124 molecular clouds
and 168 HII regions with reliable kinematic distances within a galactic latitude range of +/- 1
degree. We discuss the implications of having a galactic-latitude limited sample of objects for
our determination, and our current efforts to select the best sub-sample of objects to measure the
vertical distance between the Sun and the galactic disk
ANALYZING A DYE SENSITIZED SOLAR CELL DATABASE TO IDENTIFY QUANTITATIVE STRUCTURE PROPERTY RELATIONSHIPS TO IMPROVE OVERALL DYE PERFORMANCE

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The dye-sensitized solar cell (DSSC) is a promising alternative to silicon for the creation of cost-effective solar cells. In fact, the design of such cells has resulted in multiple proposed scaffolds; however, none have reached outstanding efficiencies. In order to improve existing DSSCs, a better understanding of their structure property relationships is necessary. This research seeks to determine if quantitative structure property relationships (QSPR) similar to those used in drug design can be developed to predict and improve DSSC design. A database containing 426 structures was created from published DSSC reports. Other searches for QSPR have included only 70 structures. Mathematica, Chemaxon, and PClient are being used to search for structure property relationships. Current work is focused on investigating the effect of hydrophobicity on performance.
WHERE ARE THE ELECTRONS IN FULLERENE-POLYMER COMPLEXES?

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A key step in producing energy from photovoltaic (PV) cells is the separation of charge. Light induced charge separation has been demonstrated for fullerene-polymer systems. This research investigates the ability of computational methods to predict the electron paramagnetic resonance (EPR) of three fullerene derivatives with localized negative charges. Structures of C60-PCBM, C70-PCBM, and C70-DPM-OE were built using Spartan '04. These structures were then imported into PQSMol and optimized using Density Functional Theory (B3LYP) with a 3-21G* basis set. Further work will first focus on selecting a better basis set for the optimization. Following this, the EPR parameters will be calculated using ORCA and compared to experimental results to determine if a single negative charge is located on the fullerene cage or elsewhere.
NEW PROTON CONDUCTIVE POLYMER MEMBRANES
BASED ON POLYSTYRENE

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We have prepared new polymer membranes as suitable for application in polymer electrolyte
fuel cells. The new membranes have polystyrene backbone with acrylamido-propanesulfonic
acid (AMPS) as the conducting unit. Membranes with varying AMPS content and molecular
weights were prepared to determine the effect of AMPS and molecular weights on membrane
properties. Proton conductivity and resistance to methanol permeability of the polymeric
materials increased with increasing AMPS content. The membranes exhibited reasonable
swelling, good mechanical strength and flexibility. In addition, the amount of water pick-up by
the membrane could be controlled by the polymer design. NMR and IR were used to determine
the structure of the new materials.
Abstract: Dye sensitized solar cells (DSSCs) are next generation solar cells that convert solar irradiation into electrical energy through a photochemical process similar to photosynthesis. Currently, the major challenge in the fabrication of commercially viable DSSCs is the discovery of a cheap, stable photosensitizer (dye). The gold standard to date includes polypyridyl ruthenium complexes that boast solar efficiencies in excess of 10%. The significant drawback to these photosensitizers is their price. Copper based dyes hold promise as cheaper alternatives to ruthenium based dyes; however a number of design challenges must be addressed before copper-based systems can compete with the established ruthenium-based solar cells. Our work focuses on the investigation of copper coordination complexes and how ligand structure affects their photosensitizing performance. Recently, we have shown that sulfonated bathocuproine ligands can be used to attach copper onto titanium dioxide surfaces and the presence of thiocyanate ions in the dye soak solution improves the overall DSSC performance. Also, we have shown that the photosensitizing ability of alizarin red s is improved when coordinated to copper. Other ligand systems have been explored, including the development of synthetic pathways to generate heteroleptic coordination complexes which are predicted to outperform their symmetric analogues.
This paper describes a new approach to loading cisplatin onto dendrimer drug carrier. Hydroxy-functionalized dendrimer (Boltorn H20 and H30) was converted to acetoacetoxyl (AcAc) functionality by transesterification reaction. Cisplatin, an anticancer drug, was loaded onto the dendrimer using enamine chemistry. Enamine formation and chemical stability of cisplatin after encapsulation into the dendrimers was confirmed by FTIR and UV. X-ray diffractometer (XRD) studies were made on drug-loaded dendrimers to investigate the crystalline nature of drug after encapsulation. Scanning electron microscope confirmed smooth a relatively smooth surface morphology. Drug release studies were performed at low pH (gastric fluid environment), neutral pH (intestinal fluid environment). The release rate was monitored in order to estimate transport parameters. Swelling studies were performed in simulated fluid environment.
ROLE OF BRASSINOSTEROIDS IN SALT STRESS TOLERANCE OF SWEET POTATO UNDER IN VITRO CONDITIONS

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Brassinosteroids are a class of plant steroid growth substances that regulate the growth and development of plants. These regulatory functions include elongation, cell division, proton pumping and source sink relationships along with modulation of stress. Sweet potato is an important crop plant that is useful not only as a food source but also as a source of bio-energy. In the present work, we report on the preliminary results on the effects of e-brassinolide on the tolerance of salt of sweet potato variety Commensal under in vitro conditions. Two salt levels—low (50) and high (200mM)—were used with 10nM 24-epibrassinolide. Eight week old plantlets were used for experiments. Initial results show that 10nM epibrassinolide alleviated salt stress both at low [50mM] and high [200mM] salt levels as evidenced by the morphological characters and proline levels. These results will be discussed in relation to overall salt tolerance in sweet potato.
THE EFFECT OF SIMVASTATIN ON TAU POLYMERIZATION IN VITRO AND IN ALZHEIMER’S DISEASE

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Alzheimer’s disease (AD) is a neurodegenerative disease characterized by intellectual decline, memory loss, and a gradual debilitation in performing daily activities. AD is characterized by the extracellular deposition of amyloid plaques and intracellular deposition of neurofibrillary tangles in the central nervous system (CNS). Neurofibrillary tangles are tau filaments comprised of paired helical filaments (PHFs) and straight filaments (SFs). Tau is a major regulator of microtubules in neuronal cells; therefore these deposits pose a malignancy to normal neuronal physiology and morphology. Hence, the aim of this project is to reduce or eliminate tau filament formation in the CNS. Statin is a drug used to lower cholesterol and it has also been shown to reduce amyloid plaque formation in vivo. Here we show that statin, at a very low concentration, reduces tau filament formation in vitro, suggesting potential therapeutic drug for AD.

The kinetics and morphology of ht40 tau protein (the longest tau isoform with exons 2 & 3 and the all four microtubule binding repeats) polymerization with and without statin are monitored using laser light scattering (LLS) and transmission electron microscope (TEM), respectively.
PHOTOACTIVATED RIBOFLAVIN AND PHYLLOQUINONE AS PHOTODYNAMIC ANTIMICROBIAL CHEMOTHERAPEUTIC AGENTS

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The objective of this study is to develop an innovative methodology to control the growth of microbes in chronic wounds. Chronic wounds are confined infections which are regarded as an epidemic health problem. Chronic wounds are leading to a substantial increase in the cost of health care worldwide. The cause of chronic wounds is due to the existence of biofilms. The complexities of the organisms which survive in the biofilms of the wounds are always changing. The biofilm is composed of a structured community of bacteria which are at a liquid interface. When the biofilms mature they become exceedingly resistant to antibiotics, due to the slow growth rate. Presently the most common treatment of chronic wounds is by actually removing the biofilm. However, the surgical removal of biofilms is not always the most effective treatment. Therefore, Photodynamic antimicrobial chemotherapy (PACT) has the potential to represent an alternative antibacterial and antifungal treatment for drug-resistant organisms. It is very unlikely that microbes would develop resistance to the reactive oxygen species (ROS) generated by the photosensitizers. Initial studies have revealed that Riboflavin (Vitamin B2) and Phylloquinone (Vitamin K1), which are both non-toxic to human, are able to yield singlet oxygen and free radicals after irradiation. Furthermore, our preliminary data have shown that both vitamins have great DNA binding constants ($K_b > 10^4 \text{ M}^{-1}$) and it can also cleave DNA under the irradiation of the visible light (λ > 395 nm). Owing to the human skin is especially suitable for PACT due to its relatively accessible to the irradiation; the final goal of this research is to investigate the in vitro impact of PACT on the chronic wound infections.
The purpose of this study is to develop nanoparticulate drug-carrying systems that are capable of directly delivering photodynamic antimicrobial agents to treat patients with chronic wounds. Chronic wounds are considered as a pandemic health problem. Approximately 1% to 2% of the population in developing countries has experienced a chronic wound during their lifetime. In the United States, according to the American Academy of Dermatology, the expense of treating chronic wounds constitutes over half of the total cost for all skin diseases, which exceeds $10 billion annually. For the last decade extensive basic science and clinical research in chronic wounds have suggested that pathogenic biofilm is the primary hindrance to the wound healing. Biofilms are highly organized, poly-species bacterial communities living within a protective extracellular matrix that they produce. They are difficult to detect and highly resistant to the host immune system or to antimicrobial elimination. Studies have shown that they can be up to 500 times more resistant to antibiotics than planktonic (unattached, freely living) cells.

Owing to bacterial species within biofilms being exceptionally resistant to many traditional therapies, Photodynamic Antimicrobial Chemotherapy (PACT) can provide an effective alternative for chronic wound treatment. The principle of PACT is derived from traditional photodynamic therapy, which is a technique that uses the combination of light and nontoxic drugs (photosensitizers) to destroy specific targeted cells. After the inactive, nontoxic drug is applied topically or injected, it can only be activated by irradiation with a certain wavelength of light. The light switches on the drug; once the drugs are activated they can produce highly reactive intermediates to destroy the targeted cells without damaging the surrounding healthy tissues. Once the irradiation is removed, the photosensitive drug will return to its stable, non-harmful state. The main advantage of PACT would be that it is very unlikely for bacteria to develop resistance to reactive oxygen species. However, the main limitation of this technique would be the uptake kinetics of the photosensitizers in microorganisms. Therefore, the main objective of this study is to find a nanoencapsulated drug-carrying system that can easily penetrate the polymicrobial species habitat within biofilms.
22nd Annual
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Abdelsalam M Talafha
Brianna Norris
Dayakar R. Gouru
Hsun Jen Chuang
Jacob Brown
Jennifer Leonhard
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<th>Name</th>
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<td>Jenq-Kuen Huang</td>
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<td>Mahendra D.C.</td>
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<td>Yakubreddy Naini</td>
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22\textsuperscript{nd} Annual
Illinois Student Research Conference

2011 STEERING COMMITTEE

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\textbf{Chicago State University}

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\textbf{Western Illinois University}
The Steering Committee would like to express its sincere thanks to the Illinois Section of the American Association of Physics Teachers (ISAAPT) for sharing the space with us for this event and our colleagues for continue supporting this student research conference. Special thanks go to Dr. David Renneke who makes the registration process easy for us and Dr. Douglas Brandt who makes it possible for us to attend the 22\textsuperscript{nd} Illinois Student Research Conference at Eastern Illinois University.

The committee would also like to acknowledge the assistance of Dr. Lisa Wen to assemble the conference booklet.
Please note that you may park without permit before 5:00 pm in lots E and J even though signs in the lots state that a permit is required. After 5:00 pm, you may park in any lot without a permit, except in specially designated spaces (handicap, reserved, loading zone, etc.).
NOTES