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SPERM NUCLEAR VACUOLES: NATURE'S INDICATOR OF SPERM DNA INTEGRITY

Danielle Berkowitz, Junior, Chemistry, University of Kentucky

Abstract:

Chromatin within somatic cells is packaged by histone proteins. Within sperm nuclei, chromatin is remodeled, and DNA histones are replaced with short arginine rich peptides known as protamines. These protamines condense the DNA into a near crystalline packaging density. This tight packaging serves not only to condense the DNA into an extremely compact space, but also protect the paternal genome from damaging agents. Within sperm chromatin, small cytoplasmic inclusions are sometimes visible, these inclusions are known as sperm nuclear vacuoles The exact etiology of these vacuoles has yet to be conclusively proven. Prior studies have suggested that the presence of these vacuoles is indicative of either defects in sperm chromatin integrity or as a result of high levels of DNA damage to the paternal genome. In this study, the goal was to better characterize these sperm nuclear vacuoles and offer a potential explanation for their presence within sperm nuclei. Recent developments by the DeRouchey group have determined that sufficient DNA condensation is dependent on disulfide bond formation within eutherian protamines. Using Small Angle X-Ray Scattering (SAXS) techniques as well as DNA damage assays, this study will show that sperm nuclear vacuoles form as a result of poor disulfide bond formation within sperm protamines. This poorly condensed DNA is more susceptible to damaging agents, explaining the link between sperm nuclear vacuoles greater incidences of DNA damage.

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5 ANALYZING AND DEFINING CARBOHYDRATE BINDING MODULES FOUND IN GLUCAN WATER DIKINASE OF THE RED ALGA, CYANIDIOSCHYZON MEROLAE

Abstract:
Objective: This project is based on the biochemical characterization of a putative Glucan Water Dikinase (GWD) orthologue that has been identified in a unicellular, thermophilic red alga, Cyanidioschyzon merolae (Cm). The goal of this experiment is to study the functioning of three carbohydrate binding modules (CBM) of family 45 contained in the sequence of CmGWD.
Significance: Glucan water dikinase is involved in starch metabolism through phosphorylation. The carbohydrate binding modules are thought to be critical for the enzyme s ability to efficiently phosphorylate starch. The role of CmGWD in starch metabolism is of interest because of potential industrial applications.
Methods: Bioinformatics to design primers to mutate certain tryptophan, tyrosine, or phenylalanine residscccccccccccc

8 COLLOIDAL SILVER NANOPARTICLES: A MORE EFFECTIVE BACTERIOCIDAL AGENT THAN CHLORINE AGAINST WATERBORNE GRAM NEGATIVE BACTERIA

Abstract:

The main aim of this study was to determine the antimicrobial and bactericidal activity of unfunctionalized, silver nanoparticles (eAg) of ~10 nm in diameter against well-established water indicator organisms: Escherichia coli, Klebsiella variicola, and Pseudomonas aeruginosa. This was achieved by determining the Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC) of eAg, which were synthesized electrochemically, size-selected, concentrated, and purified by tangential flow filtration. The MIC values for E. coli, K. variicola, and P. aeruginosa were 0.75-4.02, 1.09-4.08, and 1.55-5.39 mg L-1, respectively. The MBC values for the same bacteria were 1.51-3.96, 1.55-5.39, and 2.18-4.99 mg L-1, respectively. When tested against chlorine, the MIC values increased 1000-

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CHARACTERIZATION OF NANOMATERIALS AND SOLAR CELL ELECTRODES BY ATOMIC FORCE MICROSCOPY

Abstract:
As one of the most powerful tools in nanoscience and nanotechnology, atomic force microscopy (AFM) has been widely used in many fields including biology, chemistry, physics and materials. In this poster, we first introduce AFM principle, i.e., how AFM can image surface morphology, and continue to describe the procedure of how to carry out an AFM experiment in our lab. Then, we will present some experimental data on the characterization of different nanomaterials (such as NiWO4, TiO2) and solar cell electrodes using taping mode AFM imaging technique. The high

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ON THE ASYMMETRIC SYNTHESIS OF EXO-1-ACETAMIDOPYRROLIZIDINE

David Harris, Senior, Chemis } Uor] T ’

Abstract:

Previous attempts at the asymmetric synthesis of exo-1-acetamidopyrrolizidine (AcAP) have been unsuccessful due to the racemization of a synthetic intermediate. Using the precursor of enantioenriched endo -1-hydroxypyrrolizidine generated by way of a chiral ruthenium-BINAP catalyst as characterized by Genet et al, it could be possible to substitute the tosylate for an exo-azide. Reduction via Curtius rearrangement and acetylation could yield enantioenriched AcAP for use in characterization of the enzymatic oxidation to form the 2,7 ether bridge in the conversion to N-acetylnorloline (NANL).

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OPTICAL ENHANCEMENT OF CDSE AND INP QD/ CINNAMATE LIGAND COMPLEXES

Abstract:

The effect of surface ligands on the molar absorptivity of InP and CdSe quantum dots (QDs) was studied. InP QDs were synthesized via a green synthesis with oleylamine ligands, while CdSe QDs were synthesized with oleic acid ligands and exchanged for a series of cinnamate ligands. Cinnamate ligands with a wide range of electronic structures were selected to probe the relationship between the ligand optical gap and QD molar absorptivity. UV-Vis spectroscopy was used to determine the enhancement in absorptivity relative to the native ligand/QD system. The results can be used to further increase our knowledge of the ligand/QD system

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SYNTHESIS OF PHOSPHINE-BEARING TRICOORDINATE AU (I) COMPLEXES AND EVALUATION OF CHEMOTHERAPEUTIC POTENTIAL

William Jennings, Senior, Chemistry, University of Kentucky
Tyler Mertens, Chemistry, University of Kentucky
Sean Parkin, Chemistry, University of Kentucky
Samuel Awuah, Chemistry, University of Kentucky

Abstract:

Since the advent of cis-diamminedichloroplatinum(II) (Cisplatin), transition metal complexes have been critical in the effective treatment of a variety of cancers. However, this field has been traditionally dominated by Pt(II) based drugs. The presence of cancer lines resistant to Cisplatin and similar Pt(II) compounds makes the consideration of non-platinum anticancer metal complexes highly important. Recently, Au(I) and Au(III) based complexes have been investigated as potentially effective chemotherapeutics, especially for cisplatin-resistant cancers. However, the physiological stability of gold complexes has typically been problematic. Here, we report the synthesis and chemotherapeutic potential of a class of tricoordinate Au(I) complexes bearing N,N-bidentate and tertiary phosphine ligands. X-ray crystallographic studies reveal interesting structural properties of these compounds including variable Au-N bond lengths likely attributable to a second order Jahn-Teller distortion. MTT assays reveal appreciable cytotoxicity which may be related to the unique structural features of this class of compounds, though, solution stability remains an issue. This work provides insights into the relationship between the structure, stability, and cytotoxicity of tricoordinate Au(I) anticancer agents.

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ENZYMATIC TREATMENT OF BOURBON BARRELS TO AFFECT AROMA AND TASTE OF SPIRITS

John Klein, Senior, Chemistry, University of Kentucky

Abstract:

American white barrels are used in the production of aged spirits. The barrel s biopolymers are released into a solution during whiskey maturation and influence the aroma and taste of the distilled spirit. The biomass enzyme xylanase can be added to a barrel to amplify the degradation of the hemicellulose present in the barrel by creating more biopolymers. Model whiskey solutions of wood chips treated with xylanase were created to test for increased biopolymer production over a maturation period. To evaluate chemical changes in the model solutions, solid phase microextraction (SPME) and gas chromatography–mass spectrometry (GC-MS) were used to determine if aroma was affected by measuring and identifying volatile compounds in the model solutions.

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EFFECTS OF SMALL MOLECULE INHIBITORS ON NITRIC OXIDE SYNTHASE

Alysia Kohlbrand, Senior, Chemistry, University of Kentucky

Abstract:

Nitric Oxide Synthases (NOS) are enzymes used in the body to catalyze the production of nitric oxide (NO), a very important signaling molecule which plays a central role in human biology. There are three types of NOS expressed in mammals, endothelial NOS (eNOS), involved in vascular tone and blood flow, inducible NOS (iNOS), involved in inflammation and immunity, and neuronal NOS (nNOS), involved in signal transduction in the brain. The regulation of each of these types of NOS is very important and can have serious health consequences when the proper balance of these enzymes is unachievable, for example, iNOS is involved in many autoimmune inflammatory diseases such as multiple sclerosis, rheumatoid arthritis, and asthma. Inhibitors could be used to stop or slow down the production of NOS if inhibitors specific to individual forms of NOS can be identified it would provide new avenues of treatment for diseases associated with nitric oxide production. In order to visualize NOS and NO activity, reporters are a necessity. Dendra2 is a fluorescent protein that can be used to examine the half-life of NOS in mammalian cells through photo-switching, the protein fluoresces green and irreversibly switches to fluoresce red when exposed to blue or UV light. Using Dendra2 as a technique to monitor NOS and NO production provides a quick, cheap, and high throughput assay to assess small molecule inhibitors of NOS.

15 EFFECT OF SOLIDAGO NEMORALIS ON OXIDATIVE STRESS LEVELS IN FETAL ALCOHOL SYNDROME RAT MODEL

Abstract:

Fetal alcohol syndrome is caused by prenatal exposure to alcohol, and results in permanent mental and physical developmental abnormalities. Currently there are no approved drugs to treat or prevent fetal alcohol syndrome. Intermittent ethanol exposure with periods of binge drinking and periods of withdrawal are particularly harmful because of microglial activation during withdrawal. Extract from Solidago nemoralis, or Goldenrod, acts as a nicotinic acetyl choline receptor (nAChR) agonist. nAChR activation has been demonstrated in vitro to reduce neuroinflammation and excitotoxicity. Solidago nemoralis research may provide insight into potential treatment or prophylaxis when a fetus is exposed to ethanol. The human third trimester corresponds in rats to the first week after birth, allowing assignment of pups from a single litter to different treatment groups. We examined the oxidative stress levels in brain homogenate of rats treated with alcohol am

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HETEROGENEOUS OXIDATION OF PYROGALLOL BY OZONE

Abstract:
Natural and anthropogenic combustion emissions contribute precursors to the formation of atmospheric

17 IMPROVEMENTS TO THE PERFORMANCE AND STABILITY OF PEROVSKITE PHOTOVOLTAIC DEVICES

Abstract:
Photovoltaic devices are used to convert the sun s light into usable electricity. Research has revealed inorganic-organic halide perovskites as a low-

18 EVIDENCE OF PEROXIDASE CATALYSED FORMATION OF CYSTEINE-TYROSINE AND DITYROSINE CROSS-LINKING IN MAMMALIAN SPERM PROTAMINES

Abstract:
Spermatogenesis is the process in which germ cells develop into spermatozoa in the testis. Sperm protamines are small peptides (<50 amino acids) which mediate DNA condensation during the spermatogenesis process. The protamines of eutherian mammals have an arginine-rich region which binds to DNA and multiple cysteine residues which facilitate intramolecular folding and intermolecular bonding between protamines.

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UNDERSTANDING THE INFLUENCE OF ZINC ON SPERM CHROMATIN STRUCTURE

Abstract:

During spermatogenesis somatic chromatin is remodeled and DNA histones are replaced with short arginine rich peptides known as protamines. This tight packaging serves to condense the large paternal genome into a space 1/6th the volume of the somatic nucleus. This massive reduction in size results in the sperm chromatin existing at a near crystalline packing density. Prior studies have demonstrated that a significant fraction of zinc is present in both mature sperm and the seminal fluid, but the exact etiology of the zinc fraction has not yet been conclusively proven. Mammalian sperm typically contains two protamines, P1 and P2, which have disulfide bonds that allow them to function. In humans, each P2 protamine has been shown to chelate one zinc atom with its disulfide bonds. This study attempts to discern the role of zinc in sperm nuclei packaging with salmon protamine, which has no cysteine residues to cause disulfide bonds, and in bull sperm nuclei, which has only protamine P1. In this study, zinc levels within isolated bull and salmon sperm nuclei were

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PELTIER FREEZER APPARATUS

Abstract:

The freezing of water is a thermodynamically interesting phenomenon, with ice being capable of freezing into at least 20 different crystal structures. In particular, introducing salts with water can affect the type of freezing mechanism that the solution undergoes, allowing water to be supercooled well below its freezing point. I have created a Peltier freezing apparatus that can supercool water to -27 °C when in the presence of concentrated salts (calcium chloride for my research), with a focus on how the phase transition of water from a liquid to a solid is altered when salts are mixed with pure water. Additional concerns about the clarity of ice when salts are present was also a main highlight of my research. Several crystal structures of water have been observed depending on the rate of cooling applied. Variation of concentration in 5 calcium chloride st ˊ en. t ŕ

23 IRON-CATALYZED SUBSTITUTION OF SECONDARY ALCOHOLS

Abstract:
Alcohols are attractive electrophiles for alkylation as they are widely available, stable, and easy to prepare.

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SYNTHESIS OF 1,2- AND 1,2,6,7-SUBSTITUTED PYRENE MOLECULES

Caroline Thornbury, Senior, Chemistry, University of Kentucky
John Anthony, Chemistry, University of Kentucky

Abstract:

Organic semiconductors are compounds that have great value in organic materials, such as OLEDs, solar cells, and OFETS, due to their electronic and optical properties. That said, it is important develop semiconductors with higher charge carrier mobilities to increase efficiency of these devices. The purpose of this research is to develop a synthetic path for designing molecules that utilize pyrene from the 1,2 and 1,2,6,7 positions for extending chromophores. With these molecules, there are many hurdles to the synthetic process, most importantly scalability. As a result, the synthesis is extensive. This poster provides the synthesis to date of pyrene-based molecules, including to optimization of the synthetic process.