Doc Kieft Summer 2017 Research Program

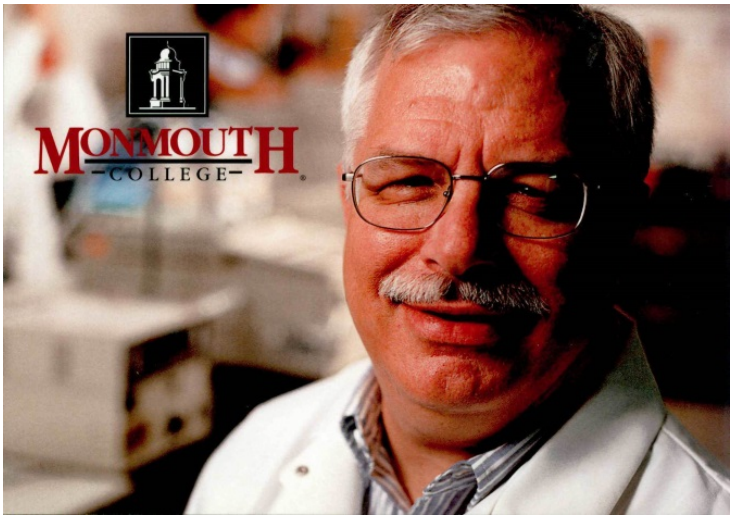
Undergraduate Research Talks

July 12, 2017

Pattee Auditorium

Monmouth College

8:45am-2:30pm



Brandon Allen (MC ’19) –Chemistry Major – Sostarecz Lab

Rachel Book (MC ’19) – Biochemistry Major – Sostarecz Lab

Ali Gustafson (MC ’19) – Biochemistry Major – Prinsell Lab

Selene Housnve (MC ’19) – Chemistry Major – Sturgeon Lab

Mohammad Kanbar (MC ’19) – Biochemistry Major – Moore Lab

Sobhi Kazmouz (MC ‘19) – Biochemistry Major – Moore Lab

Eric Oliphant (MC ’19) – Biochemistry Major – Prinsell Lab

Samy Monies Salah Elsa (MC ’19) – Biochemistry Major – Moore Lab

Stephanie Saey (MC ’18) – Biochemistry/Biopsychology Double Major – Sturgeon Lab

Kate Saulcy (MC ’19) – Biochemistry Major – Sostarecz Lab

Schedule of Events

8:45am-9:00am – Talk Setup - Refreshments

9:05am-11:00am – Morning Session of Talks *There will be 10 minutes between talks for questions

9:05am-9:25am – **Eric Oliphant and Ali Gustafson**
"*A New Method of N-N Bond Synthesis"*

Molecules that contain a bond between two nitrogen atoms not only exhibit remarkable biological activity, but are relatively rare in nature. Only 200 of these molecules have been found in nature, and not all of their properties and functions are fully understood. Quite commonly, a six step process is used to synthesize these molecules, starting with a hydrazine derivative, and adding the corresponding functional groups in a series of linear steps. This synthetic method, although relatively simple, is quite inefficient and results in a low overall yield. A new method of synthesizing these molecules would decrease the number of steps by carrying out two separate reactions. First a nucleophilic nitrogen compound and an electrophilic nitrogen compound are synthesized. Then these two could then be combined in a substitution reaction to synthesize our desired N-N bond.

9:35am-9:55am – **Sobhi Kazmouz**
"*The Importance of the Arginine 140 Residue on FNR Activity*"

Fumarate Nitrate Reductase (FNR) transcription factor is the universal anaerobic switch in *Escherichia coli* bacteria. In the absence of oxygen, FNR exists as a dimer with a [4Fe-4S] cluster and binds to DNA to regulate transcription of genes needed for anaerobic respiration. When oxygen is present, however, the [4Fe-4S] cluster degrades causing FNR to return to its inactive monomeric form. Previous research suggested that the dimerization and, thus, activation of FNR is dependent upon a salt bridge interaction between the Asp 130 residue and the Arg 140 residue. As a continuation of the study, site-directed mutagenesis was used to analyze how various mutations at those two particular residues can affect FNR activity. The mutations aimed to replace the salt bridge interaction with hydrophobic interactions and hydrogen bonding as potential interactions to regulate FNR dimerization. Data from β – galactosidase assays carried out on an *E. coli* reporter strain tomeasure FNR activity indicate that only Arg 140 is essential for regulating dimerization. Single mutants in which Asp 130 was replaced displayed significant FNR activity relative to the wild type while mutations that replaced Arg 140 resulted in almost no FNR activity.

10:05am-10:25am – **Rachel Book**
"*Analysis of a Myelin Sheath Model Membrane System - Preparation for the Examination of the Effect of Flavonoids in Ginkgo Biloba on the System"*

The lipid bilayer of the cellular membrane is a selectively permeable system that regulates what can enter and leave a cell. Every cell has a different composition of lipids, proteins, and sterols that affect the fluidity; a shift in the composition of the components can cause an unfavorable environment and potentially kill a cell. The cell membrane of the myelin sheath is an important component when it comes to investigating Multiple Sclerosis. A model myelin sheath cell membrane was analyzed in preparation for determining the effect of flavonoids found in the Ginkgo balboa tree on the function of the myelin sheath.

10:35am-10:55am – **Stephanie Saey**
"*Extraction, Purification, and Characterization of Curcuminoid Derivatives"*

Curcumin is a secondary plant metabolite of the turmeric herb *Curcuma Longa.* The term "curcumin" has been used to refer to the bioactive molecule, but in reality curcumin has three derivatives of different molecular structures: curcumin I, demethoxycurcumin, and bisdemethoxycurcumin. Together, the aforementioned structures are known as curcuminoids. A review of curcumin studies suggest curcuminoids have chemotherapeutic, antioxidant, and anti-inflammatory activity, among other uses to be discovered. However, difficulty arises when seeking to study the derivatives individually. Curcumin I is only available in small amounts, while demethoxycurcumin and bisdemethoxycurcumin remain unavailable commercially. The focus of my research project is to successfully isolate, purify, and characterize the curcuminoid derivatives in amounts great enough for further investigation.

11:05pm-12:00pm – Lunch in the Nutrition Lab

12:05pm – Group Picture in front of CSB

12:15pm-2:30pm – Afternoon Session of Talks

12:15pm-12:35pm – **Kate Saulcy**
"*Aggregation of Insulin on Langmuir Monolayers"*

Insulin is known to aggregate into a hexamer in the presence of zinc. The Langmuir monolayer technique can be used to examine the transition between active monomeric insulin molecules and the hexameric form which is more difficult for the body to use. Zinc (II) chloride is added to the model membrane system to create hexamers of insulin. Conditions of the system are altered to learn about the dependence of insulin's molecular conformation on factors such as pH and concentration. Chelating agents, such as EDTA and citrate are added to effectively remove the zinc ion from the solution and observe the behavior of the insulin molecules.

12:45pm-1:05pm – **Brandon Allen**

"Brewster Angle Microscopy and Langmuir Monolayer Films: Construction of an Instrument and Basic Software Development"

Brewster Angle Microscopy is a useful tool for the analysis of surface characteristics of films at the air-water interface in a Langmuir trough due to its ability to obtain images while simultaneously collecting isothermal data. The goal of this research was to construct a relatively low-cost Brewster Angle Microscope (BAM) using LEGO Mindstorms pieces, a laser, a 10x microscope objective, and a CCD camera. This BAM was then used to obtain images of a dipalmitoylphosphatidylcholine (DPPC) film at various pressures throughout a compression. Future work will include imaging a DPPC/Cholesterol film at various pressures throughout a compression analysis. The basics of Brewster Angle Microscopy as well as the fundamental components of a BAM will be discussed in addition to a brief overview of two basic data manipulation programs written for handling the procedure for graphing isotherms and ideal mixing.

1:15pm-1:25pm **Samy Monies Salah Esa**
"*The Solubility of Zein Protein Found in Corn"*

Zein is a storage protein found in Maize, and consists of α, β, γ, and δ. Zein is insoluble in aqueous solutions; however it is soluble in alcohol solutions. Different concentrations of the alcoholic solutions change the zein structure and can cause aggregation. Aggregation can make it difficult to isolate zein on the industrial scale. The four classes of zein (α, β, γ, and δ) have different solubility depending on the concentration of the solvents. In this research, zein was studied to find the best concertation of alcoholic solutions for dissolving all four classes of the zein. A turbidity sensor was used to monitor the solubility of zein. We found that zein protein would be best dissolved in 90% ethanol. A sonicator was used to break up the aggregates as sonication decreased the turbidity over time. We will also investigate other properties and applications of zein during this research.

1:35pm -1:55pm – **Mohammad Kanbar**

"Aggregate Formation of Zein and the Change of its Secondary Structure"

Zein is a natural storage protein in corn. The original fraction of zein composed of a series of disulfide linked oligomers that have different molecular weights and intermolecular disulfide-bonded peptides. In fact, zein is classified according to its solubility and sequence homology into α, β, γ, and δ zein. The major component is α-zein as analyzed in Sodium dodecyl sulfate- polyacrylamide gel electrophoresis (SDS-PAGE) has two major bands Z19 and Z22, named according to their molecular weights. SDS PAGE gels were run on reduced and unreduced zein protein. The unreduced α-zein consisted of a series of oligomers in SDS-PAGE. This study shows that the intermolecular disulfide bonds are important in modifying the properties of zein polypeptides and therefore changing the particles size of zein aggregates. Moreover, zein aggregates have been the major bottleneck of zein industry; therefore in this work the effects of various factors such as temperature, concentration, and pH on the secondary structure of zein were studied. The IR spectroscopy results show as the ethanol content increases from 60% to 90%, the amount of a-helical content (as opposed to b-sheet) is increased. This result suggests that aggregated particles contain more b-sheet secondary structure. Also IR shows that both temperature and pH change the secondary structure of zein, yet the effects of that change still unknown.

2:05pm-2:25pm – **Selene Hounsve**

"Extraction and Characterization of Essential Oils from Basil Varieties"

Herbs are utilized for their distinctive fragrance and flavors. This flavor and smell stems from the essential oils, which get their name for embodying the essence of the plant's smell. Essential oils are synthesized via secondary metabolic pathways and have a role in plant defenses against pathogens and herbivores, in plant reproduction, attraction of pollinators, and in thermotolerance. Essential oils from basil differ depending on specific variety and other factors including growing conditions. Extractions of basil varieties are characterized by GC-MS and NMR to determine the chemical composition of each variety.