2026 Undergraduate STEM Poster Symposium

Friday, July 31, 2026

10 AM – Noon

Burge Union

Featuring participants in the following programs:

Chemistry NSF-REU Program (CHE-2349329)

A Summer Experience for Undergraduates Integrating Research, Education, and Career Development in an Interdisciplinary Environment

Biology NSF-REU Program (DBI-2447584)

The Stressed Life of Cells

NSF Engineering Research Center EARTH (Environmentally Applied Refrigerant Technologies Hub) (EEC- 2330175)

FROST: Fostering Research Opportunities in Sustainable Technologies

BioPATH REU Program (USDA 2025-38502-45540)

Biobased Products and Technology Hub

Pharmaceutical Chemistry Department

Summer Undergraduate Research Program

Financial and Logistical Support for the Symposium provided by the Madison and Lila Self Graduate Fellowship Program

Session 1

10:00 AM – 11:00 AM

Click on the poster number to view titles and abstracts

Poster	Presenter	Home Institution	REU Program
P1	Niki Ahmadian	Johnson County Community College	Chemistry
P3	Jonathan Davis	Rockhurst University	Chemistry
P5	Pandora Freeman	Bethel College	Chemistry
P7	Andrew Jacobs	University of Kansas	Chemistry
P9	Dermot O'Connor	St. Olaf College	Chemistry
P11	Jaden Riddle	University of Kansas	Chemistry
P13	Aubrey Sanchez	University of Kansas	Chemistry
P15	Ian Anderson	Washburn University	Biology
P17	Sarah Hebert	Louisiana State University	Biology
P19	Tara Martin	Drake University	Biology
P21	Jessie Price	Goshen College	Biology
P23	Lillian Schmitt	The College of Wooster	Biology
P25	Natalie Winters	Auburn University	Biology
P27	Kelsie Che	Texas State University	FROST
P29	John McCarthy	University of Tulsa	FROST
P31	Cooper Rehm	University of Idaho	FROST
P33	Frank Abbeduto	University of Oklahoma	BioPATH
P35	Elenore Broderick	University of Kansas	BioPATH
P37	Jane McNevin	College of Marin	BioPATH
P39	Marshall Mosier	Kansas State University	BioPATH
P41	Katelyn Page	University of Kansas	BioPATH
P43	Hamza Habib	Wesleyan University	Pharm Chem
P45	Naomi Nance	University of Maryland Baltimore County	Pharm Chem
P47	Rujula Puranik	University of Kansas	Pharm Chem

A floor map showing poster locations by program and by number can be found on page 4

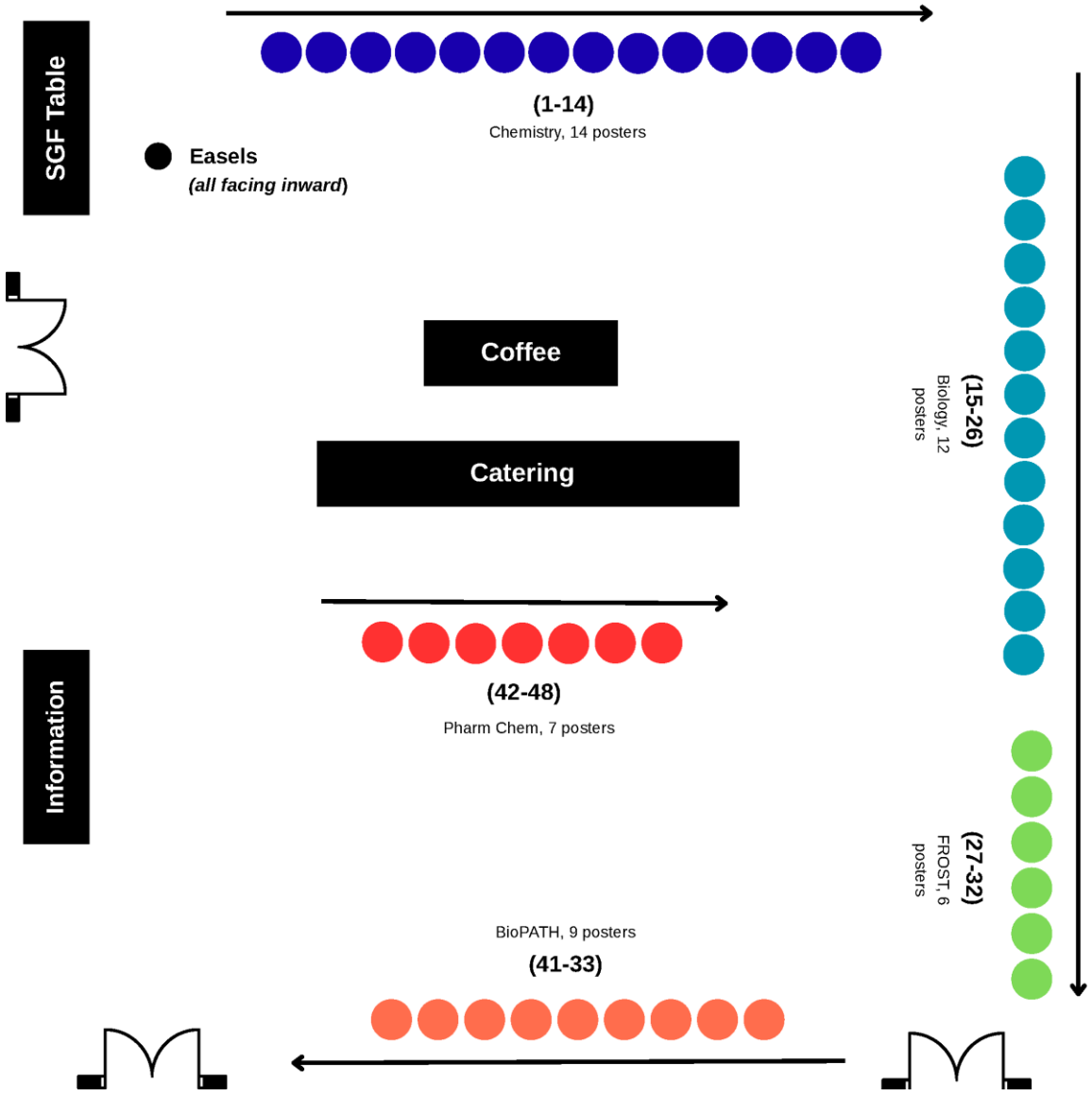
Session 2

11:00 AM – Noon

Click on the poster number to view titles and abstracts

Poster	Presenter	Home Institution	REU Program
P2	Sarah Beard	Murray State University	Chemistry
P4	Marcus Fiedler	Bethel College	Chemistry
P6	Kessler Hackenberger	Ohio Northern University	Chemistry
P8	Maya Lozano	Austin College	Chemistry
P10	Zoe Precup	Wisconsin Lutheran College	Chemistry
P12	Owen Ross	University of Kansas	Chemistry
P14	Jeffrey Sieck	Luther College	Chemistry
P16	Caitlin Crum	Centre College	Biology
P18	Noah Lanyi-Lari	The College of Wooster	Biology
P20	Mariana Mullarney	University of Kansas	Biology
P22	Larissa Rockenbach	University of Kansas	Biology
P24	Margaret Watson	University of Dallas	Biology
P26	Oli Wood	The Ohio State University	Biology
P28	Michael Conklin	University of Illinois	FROST
P30	Jayla Morgado-Derilus	Stevens Institute of Technology	FROST
P32	Muskan Taori	University of Arkansas	FROST
P34	Arthur Benson	University of Kansas	BioPATH
P36	Halley Laurent	University of Kansas	BioPATH
P38	Reid Minto	University of Kansas	BioPATH
P40	Nneka Ossai	University of Oklahoma	BioPATH
P42	Sydney Connors	University of Virginia	Pharm Chem
P44	Faraz Mirza	University of Georgia	Pharm Chem
P46	Julia Remiszewski	Western New England University	Pharm Chem
P48	Ava Scanlon	University of Kansas	Pharm Chem

A floor map showing poster locations by program and by number can be found on page 4


SGF Table
(1-14)
Chemistry, 14 posters
Easels
(all facing inward)
Coffee
Catering
(15-26)
Biology, 12 posters
Information
(42-48)
Pharm Chem, 7 posters
(27-32)
FROST, 6 posters
BioPATH, 9 posters
(41-33)

P1_Peptide Identification from Exopeptidase-Generated Amino Acids

Niki Ahmadian,[1,2] Pramodi Vithanage,[1,3] and Steven A. Soper[1,3,4,5,6]

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[3]Center of Bio Modular Multiscale Systems for Precision Medicine, Lawrence, KS
[4]Department of Mechanical Engineering, University of Kansas, Lawrence, KS
[5]Bioengineering Program, University of Kansas, Lawrence, KS
[6]Department of Cancer Biology, University of Kansas Medical Center, Kansas City, KS

Proteins carry out nearly every biological process, making accurate peptide and protein characterization essential for understanding biological function, identifying disease biomarkers, and developing new diagnostic technologies. Conventional protein sequencing methods, including Edman degradation and Liquid Chromatography–Mass Spectrometry (LC-MS), provide high-quality sequence information but require specialized instrumentation, extensive sample preparation, and can be limited for certain peptide analyses. To address these challenges, our laboratory is developing a peptide fingerprinting strategy that combines exopeptidase digestion with Resistive Pulse Sensing (RPS) detection of released amino acids as a foundation for future nanopore-based protein sequencing. In this approach, carboxypeptidases sequentially remove C-terminal amino acids, generating amino acid profiles that can be used for peptide identification. Carboxypeptidase Y (CPY) and Carboxypeptidase A (CPA) were evaluated using the model peptide Met-enkephalin. Digestion conditions and Fmoc-Cl amino acid derivatization were optimized, and the released amino acids were identified by HPLC and LC-MS, which served as orthogonal analytical techniques to validate the observed digestion kinetics. Under the optimized conditions, CPY demonstrated greater digestion efficiency than CPA, achieving complete cleavage of Met-enkephalin within one minute of digestion time, establishing an optimized solution-phase workflow that provides the foundation for future solid-phase digestion and integration into nanofluidic peptide fingerprinting platforms.

P2_Decarboxylative Elimination to form Vinyl Ethers for Cycloadditions

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[2]Department of Chemistry, Murray State University, Murray, KY

Vinyl ethers have broad applications in organic chemistry, including uses in cycloadditions and polymerization. Additionally, these compounds have synthetically useful functional groups that are utilized in the pharmaceutical industry. To date, the most common methods to synthesize these compounds include Ullmann and Chan-Lam coupling reactions. However, they often require harsh reaction conditions, multi-step substrate synthesis, and fail for electron-rich aromatics. To address these limitations, a two-step mechanism was utilized to synthesize a series of vinyl ethers; beginning with the Bargellini reaction to yield the starting acid followed by a decarboxylative elimination to form the aryl vinyl ether. This method allows for the synthesis of electron rich aromatic products, while operating at milder conditions. Further, the synthesized compounds were subjected to cycloaddition reactions to assess their reactivity and synthetic utility. To study their reaction kinetics, the vinyl ethers were reacted with tetrazine via an Inverse Electron Demand Diels-Alder mechanism to release a phenol. Out of the three vinyl ethers tested, the cyclobutene cycloaddition proceeded at a much faster rate relative to other substrates. These results show potential for further application, including targeted drug delivery. The cyclopropanation of the vinyl ethers following the Furukawa Simmons-Smith mechanism led to the formation of new bioisosteres, compounds that are more metabolically stable than their acyclic counterparts. The formation of a deuterated analog of one of the compounds allows for further application in pharmaceuticals.

P3_Measuring Hammett Substituent Constants with a Sensitive Organometallic ^{13}C NMR Reporter

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Hammett parameters (σ constants) provide the most widely used quantitative measure of substituent electronic effects in aromatic compounds. Originally developed to describe the influence of *meta*- and *para*-substituents on the ionization equilibria of benzoic acids, they continue to serve as a fundamental framework for understanding structure–property relationships. Recent experimental and computational studies have renewed interest in refining these parameters, yet significant ambiguities persist. For example, reported σ_p values for the –NMe_2 substituent range from −0.21 to −1.05. Moreover, the most authoritative experimental compilation assigns σ_p values of −0.83 for –NMe_2 and −0.72 for –NEt_2, an ordering that is chemically counterintuitive, whereas a recent machine-learning approach assigned an identical σ_p value of −0.75 to both substituents. In this poster, we report the synthesis and characterization of a series of new azulenes bearing –NHMe, –NMe_2, or –NEt_2 substituents at the 6-position and a [–NCCr$(CO)_5$] spectroscopic handle at the 2-position of the azulenic scaffold. The [–NCCr$(CO)_5$] moiety serves as a remarkably sensitive ^{13}C NMR reporter through its $\delta(^{13}CO)$ and $\delta(^{13}CN)$ chemical shifts, thus enabling not only quantitative measurement of electronic communication across the 2,6-azulenic π-system but also extraction of effective Hammett constants for dialkylamino and other substituents. The resulting σ_{eff} values resolve the long-standing discrepancies surrounding dialkylamino substituents. In contrast to both previous experimental assignments and the machine-learning model, our ^{13}C NMR reporter unambiguously differentiates –NMe_2 and –NEt_2 on the basis of their net electron-donating abilities and places them on the conventional Hammett scale in a manner consistent with chemical intuition.

P4_Fabrication, Characterization, and Reactivity Study of an Fe^{III}-OMe Complex

Marcus L. Fiedler,[1,2] Zahra Aghaei,[1] and Timothy A. Jackson[1]

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[2]*Department of Chemistry, Bethel College, North Newton, KS*

Current synthetic methods heavily utilize precious metals in their oxidative steps, which are very costly and environmentally toxic. An intriguing alternative to these are earth-abundant transition metals, which are much cheaper and more environmentally friendly. Lipoxygenase is an enzyme that utilizes an Fe^{III} or Mn^{III} center to conduct proton-coupled electron transfer (PCET) reactions to oxidize polyunsaturated fatty acids. Currently, literature exists that examines this reaction via the $[Fe^{III}(OH)(dpaq)]^+$, $[Mn^{III}(OH)(dpaq)]^+$, and $[Mn^{III}(OMe)(dpaq)]^+$ model complexes. However, the $[Fe^{III}(OMe)(dpaq)]^+$ complex has not been previously studied. Examining this complex could help to better understand the effects of the metal center and the methoxide ligand upon the reactivity of the complex. Metalation of the H-dpaq ligand was achieved by reacting it with $Fe(OTf)_3$ under basic conditions in methanol. This complex was then characterized with UV-Vis spectroscopy, mass spectrometry, and nuclear magnetic resonance (NMR) spectroscopy. Subsequently, the reactivity of the complex was studied by monitoring its PCET reaction with 1,2diphenylhydrazine (DPH) by UV-Vis spectroscopy. This complex was found to react with DPH at a rate exceeding that of the $[Fe^{III}(OH)(dpaq)]^+$ complex.

P5_Expression and Purification of Recombinant Monoclonal Antibody Fabs in *E. coli*

Pandora G. Freeman,[1,2] Caitlin R. McEntee,[1] and Rebecca J. Whelan[1]

[1]*Department of Chemistry, University of Kansas, Lawrence, KS*
[2]*Department of Chemistry, Bethel College, North Newton, KS*

Cancer Antigen 125 (CA125) is the gold standard biomarker for tracking ovarian cancer. The clinical assay for CA125 relies on two antibodies: OC125 and M11. Current methods of obtaining these antibodies are expensive and labor intensive. Additionally, the antibodies lack a spectroscopic handle to enable direct detection through fluorescence. The focus of this work was to obtain a functional antigen-binding fragment (Fab) of the OC125 antibody that also contains a 6-Histidine tag for purification and immobilization and, a Green Fluorescent Protein (GFP) tag to allow detection in fluorescence-based assays. A pET21b(+) plasmid encoding the OC125 heavy and light chains was transformed into SHuffle® T7 competent *E. coli* cells and expressed in suitable media. Cells were lysed and proteins were purified via Ni^{2+} chromatography and characterized via sodium dodecyl-sulfate polyacrylamide gel electrophoresis (SDS PAGE), western blotting, enzyme linked immuno-absorbent assay (ELISA), and fluorescence anisotropy. Results indicated the presence of free GFP present in addition to the intended product. Examination of the plasmid sequence revealed the presence of a Shine-Dalgarno sequence in the linker between the heavy chain and GFP-His sequences, rationalizing the production of free GFP. Next steps will be focused redesigning the plasmid for higher yields of the intended product followed by characterization of the GFP-Fabs. Once produced, GFP-Fab will be used in novel fluorescence-based assays for CA125.

P6_Expanding Anion Relay Polymerization

Kessler Hackenberger,[1,2] Alec Lininger,[1] and Aaron J. Teator[1]

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[2]*Donald J. Bettinger Department of Chemistry and Biochemistry, Ohio Northern University, Ada, OH*

Modern polymerization techniques often require the use of alkene groups to initiate and propagate the polymerization process. This limits the functional groups that can be incorporated into the polymer and results in a two-carbon backbone repeat unit. The physical and thermal properties of the polymers are thus restricted due to these limitations in molecular structure. Previous work by the Teator lab has used anion relay chemistry to overcome this challenge, which allows for the expansion of the carbon backbone and diversification of functional groups incorporated into the polymer. To further investigate the possibilities of anion relay polymerization, a library of monomers was synthesized for anion relay polymerization. Multiple of these monomers showed characteristics of successful polymerization and potential for optimization in future work.

P7_Electronic Properties of Heterobimetallic Complexes Incorporating Vanadyl and Uranyl Ions

Andrew D. Jacobs, Grant A. Arehart, Alex C. Ervin, and James D. Blakemore

Department of Chemistry, University of Kansas, Lawrence, KS

Heterobimetallic complexes offer the opportunity to understand how metals influence each other's properties when placed in close proximity. However, the properties of complexes containing both uranium and one or more redox-active transition metal have received less attention than they deserve. In this presentation, the synthesis and study of heterobimetallic complexes featuring both vanadyl, $[VO]^{n+}$, and uranyl, $[UO_2^{m+}]$ moieties will be reported. Particular to this study, the use of the redox-active vanadyl cation in the complexes provides unique spectroscopic handles and enables exploration of the influence that changing the oxidation state of uranium can have on nearby species. Findings from cyclic voltammetry as well as optical and vibrational spectroscopies suggest that significant interactions are possible between the $[VO]^{n+}$ and $[UO_2^{m+}]$ moieties, and evidence regarding the nature of these interactions will be discussed.

P8_Quantifying DNA Loading Density on Biolayer Interferometry Probes using Quantitative PCR

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[1]*University of Kansas, Department of Chemistry, Lawrence, KS*
[2]*Austin College, Department of Chemistry, Sherman, TX*

Functional nucleic acid-based biosensors have significant potential for health monitoring and early disease detection. Aptamers are particularly promising recognition element as they have a wide target range, high stability, easy modification, and are cost-effective. However, aptamer surface density can strongly affect target binding, association and dissociation kinetics, response time, and sensor sensitivity. Despite the widespread use of biolayer interferometry (BLI) for aptamer characterization, the number and surface density of aptamer molecules on these probes remain poorly understood. In these experiments, we developed a quantitative PCR-based method to determine DNA loading density on streptavidin-coated BLI probes. Desthiobiotin-modified DNA was immobilized on BLI probes and subsequently displaced using biotin wash. The recovered DNA was then quantified by real-time quantitative PCR. The threshold cycle from the BLI wash was then compared to a standard curve to determine the starting amount of aptamer on the probe. This was then used to calculate the density of aptamer on the probe at varying starting concentrations. Establishing the relationship between solution concentration, probe loading, and surface density will improve the interpretation of BLI binding measurements and support more controlled optimization of aptamer-based biosensors.

P9_Experimental studies of platinum heterobimetallic complexes to probe Lewis acid effects

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Incorporation of secondary, effectively Lewis acidic metal cations into heterometallic complexes is a useful strategy for tuning chemical properties and reactivity, but the origins of metal-driven tunability and quantitative correlation of metal-focused data have not received the attention they deserve. Prior work has shown a relationship between the properties of macrocyclic platinum(II) complexes and the charge states of the incorporated cations, but in prior work, the measured tuning could not be directly attributed to Lewis acidity as only a limited set of cations were studied. Here, the synthesis and characterization of an expanded series of diamagnetic complexes containing platinum(II) and secondary cations are reported, along with nuclear magnetic resonance (NMR) measurements of ^{195}Pt chemical shifts. Spectroscopic and electrochemical studies of the complexes demonstrate linear trends that depend on the Lewis acidity, or charge density, of the secondary cations. Such trends are maintained when comparing among mono-, di- and tri-valent cations, enabling the measured trends to be attributed to Lewis acid effects and not charge state alone.

P10_Fabrication of Nickel Nanodot Arrays for Enhanced Biosensing

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[2]Department of Chemistry, Wisconsin Lutheran College, Milwaukee, WI

Biosensors are devices utilized for detecting various biochemical substances. Metal nanoarrays have the potential to significantly enhance biosensing abilities through increased sensitivity and surface area. Researchers have successfully fabricated gold and silver nanodot and nanotriangle arrays for biosensing purposes. However, other metals, such as nickel, may also be utilized for biosensing. The benefits of nickel nanofabrication include its magnetic properties, resistance to corrosion, and high electrical conductivity. These properties have the potential to enhance biosensors in ways that silver and gold cannot. The primary goal of this research project was to fabricate nickel nanodot arrays using nanosphere lithography and electroless deposition for biosensing applications. The effectiveness of nickel nanodot fabrication was evaluated using atomic force microscopy (AFM). It was determined that nickel plating conditions are optimized at alkaline pH (8-9), elevated temperatures (90°C), and one minute of deposition time. Under these conditions, nickel nanodot arrays were successfully fabricated using 500 nanometer silica spheres. This was confirmed through cross-sectional data analysis on AFM images obtained. The average width of a nickel nanodot was around 80 nm, with its average height around 40 nm. Future work will focus on creating nickel nanodot arrays with smaller silica spheres (100-200 nm) and testing the sensing capabilities of these arrays using histidine-tag immobilization.

P11_Transient Absorption Spectroscopy of Deprotonated 4,4'-Dihydroxyazobenzene

Jaden Riddle, Weston Henning, and Christopher Elles

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Azobenzene derivatives boast unique isomerization dynamics that vary based on solvent and substituent effects. This inherent versatility of azobenzene makes it an appealing parent compound for fields requiring kinetic and energetic specificity, such as pharmacology and solar energy harvesting. Although many substituent and solvent effects on azobenzene isomerization are well documented, little literature is available on the effect of high pH on isomerization for azobenzenes with ionizable, electron-donating substituents, including hydroxyl moieties (-OH). In pursuit of quantifying and describing the effects of electron-rich ionized azobenzenes, an initial experiment was conducted using transient absorption (TA) spectroscopy to examine the trans to cis isomerization of a pH-sensitive azobenzene derivative, 4,4'-dihydroxyazobenzene (DHAB), in basic conditions. A pump-probe TA setup utilized femtosecond laser pulses at two distinct wavelengths to excite DHAB to the first and second excited states, followed by a whitelight probe to record absorption data of the transient species. The resulting data indicate the presence of a long-lived, unstable intermediate species formed during molecular relaxation. Quantum calculations were performed to estimate the molecular orbitals and transition energies of basic DHAB and may support the presence of an atypical isomerization pathway induced by the electron-donating effects of the deprotonated para-hydroxyl moieties. This result could suggest the possibility of manipulating azobenzenes to achieve longer-lived, more reactive excited states when excited by high-energy photons, expanding the possibilities of azobenzene applications.

P12_Characterizing the effect of sample stacking on affinity interactions studied by capillary electrophoresis

Owen A. Ross, Samson Aruna, and Rebecca J. Whelan

Department of Chemistry, University of Kansas, Lawrence, KS

Affinity characterization of precious biological samples is useful for improving existing and future bioassays for clinical disease diagnostics. Affinity probe capillary electrophoresis (APCE) is a useful technique for characterizing affinity interactions. It is currently unknown how sample stacking can be used for APCE. A method has been developed to study the effects of large volume sample stacking (LVSS) on APCE. Simulation guided experiments were used to optimize buffer concentrations and sample injection parameters. These optimized LVSS parameters were applied to APCE using thrombin and the 29mer aptamer as a model system. Change in apparent K_a was used to determine the effect of sample stacking and large volume sample stacking on binding affinity characterization using APCE. Future work will involve applying this method to the study of low abundance biological samples relevant to disease identification and diagnostics.

P13_Solid-Phase-Enabled Bioengineering of Extracellular Vesicles for Targeted Drug Delivery

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Cancer remains a major health threat that is difficult to treat without affecting healthy cells, as anti-cancer therapies often suffer from poor target selectivity and significant side effects. To address these limitations, extracellular vesicles (EVs) have emerged as a promising drug delivery platform, offering advantages over synthetic nanoparticles such as biocompatibility, low immunogenicity, and inherent targeting capabilities. These cell-derived nanoparticles, composed of a lipid bilayer enclosing proteins and nucleic acids, naturally facilitate intercellular communication by delivering their internal cargo. To improve the delivery specificity of EVs to cancer cells, we engineer their surface with affinity agents that target cancer-specific surface markers. This isolation and bioengineering is performed using a solid-phase microfluidic chip, which offers several advantages: excess reagents can be removed while EVs remain immobilized on the surface, the chip's small internal volume enables economically and environmentally friendly reagent use, and the on-chip format is well suited to automation and high-throughput processing. Therapeutic cargo is loaded into the EV lumen via electroporation, after which the electroporated EVs are affinity-captured on-chip for further modification of the lipid bilayer or surface proteins, followed by purification. To assess functional delivery, we monitor changes in cancer cell mRNA transcript expression via RT-qPCR before and after incubation with the engineered EVs and quantify cellular uptake of the modified EVs using flow cytometry. We will present data comparing EVs sourced from orthogonal cell phenotypes, *i.e.* epithelial and mesenchymal, and demonstrate how EV origin influences functional effects on recipient cells.

P14_Investigating Cooperative C–F Bond Activation Using a Ni–Mg Heterometallic Complex

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The activation and functionalization of carbon–fluorine (C–F) bonds is motivated by the presence of partially fluorinated aromatics in pharmaceuticals, agrichemicals, and select material applications. Both stoichiometric and catalytic reactivity remain a significant challenge due to the high bond dissociation energy associated with the C–F bond alongside challenges in selective hydrodefluorination. Developing effective strategies for C–F bond activation of fluorinated arenes using Earth-abundant metals are needed as they could provide more sustainable alternatives to currently available precious-metal systems capable of selective functionalization. This study investigates cooperative reactivity in a well-defined Ni–Mg heterometallic complex supported by a bis(phosphine) ligand with site-specific binding sites. The platform combines a transition metal (Ni) and a Lewis acidic metal (Mg) that remain coordinatively accessible, providing an opportunity for selective and cooperative bond activation. Reactivity studies with fluorinated *N*-heterocycles demonstrate selective C–F bond activation under mild conditions. Specifically, reactions with 2,4difluoropyridine and pentafluoropyridine produce new organometallic species consistent with selective *ortho* C–F activation. Catalytic studies using 2-fluoropyridine as a model substrate demonstrate turnover with HBPin as a dual hydredefluorinating and reducing reagent, producing hydroborated pyridine products. These results demonstrate the potential of Earth-abundant heterometallic complexes for C–F bond activation and catalytic functionalization. Future studies will focus on expanding the substrate scope, further characterizing C–F activation products, and improving catalytic turnover and understanding of selectivity.

P15_Effects of temperature and sex on survival of the pantry moth, *Plodia interpunctella*

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[2]*Washburn University, Topeka, KS*

In the pantry moth*, Plodia interpunctella,* males are homogametic while females are heterogametic. In general, across animals the heterogametic individuals have shorter lives than homogametic individuals in the same species. However, sex chromosomes do not entirely determine survival; environmental factors play a large role, especially in insects. Particularly increased temperatures have an accelerating effect on insect development. We hypothesize that temperature difference will cause differential changes in sex specific survivorship. To test this hypothesis, we reared 240 moths tracking eclosions and deaths. Half were kept at 25°C and the rest at 30°C. We found that temperature impacted sex-specific survivorship to a significant extent (p=<2e-16). Temperature doesn't affect both sexes the same, while both males and females find a decrease in survival from increased temperatures, males face a larger decline than females. We hypothesized there would be significant impact of temperature and sex on survival, but the strength of the effect was stronger than expected.

P16_Activity-guided fractionation of molecules produced by *Cutibacterium acnes* with antibiofilm and antimicrobial activity against *Staphylococcus lugdunensis*

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Staphylococcus lugdunensis is an occasional skin commensal that can cause several severe infections, such as endocarditis and skin and soft tissue infections. The ability of *S. lugdunensis* to form biofilms is a major contributor to its virulence. *Cutibacterium acnes*, a predominant colonizer of the skin microbiome, plays a role in protecting the host from pathogens. Our lab has previously found that *C. acnes* cell-free conditioned media (CFCM) inhibits *S. lugdunensis* biofilm formation, indicating that *C. acnes* produces molecules with antibiofilm effects. The goal of this project was to identify the molecules released by *C. acnes* responsible for inhibiting *S. lugdunensis* biofilm formation. For that, *C. acnes* CFCM was boiled and filtered to less than three kilodaltons. The CFCM was fractionated using high performance liquid chromatography (HPLC) on a HILIC column. Fractions were tested against *S. lugdunensis* in a biofilm formation assay. Fractions with antibiofilm and antimicrobial activity were observed after boiling and filtering, indicating that active molecules are smaller than three kilodaltons and resistant to boiling. Most active fractions were eluted after 19 minutes, indicating that the molecules are highly polar. HPLC fractionation showed peaks at different times and sharpness between CFCM batches. Inconsistency between batches of CFCM is likely a result of the boiling and filtering process. Future research will focus on optimizing *C. acnes* CFCM preparation to exclude inactive molecules without the uncertainty introduced by boiling and filtering.

P17_Understanding the role of a novel ferroportin allele in iron trafficking in *C. elegans*

Sarah Hebert,[1,2] Tara Martin,[1] Sutton Stegman,[1] and Lisa Timmons[1]

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[2]*Louisiana State University, Baton Rouge, LA*

Iron is a key nutritional element needed for the proper functioning of all cells and organisms, yet iron can also be toxic at high levels. Iron trafficking within the body is a highly regulated process that is essential to maintaining iron homeostasis. Ferroportin (FPN) is the only known transmembrane protein that transports iron from intestinal stores to other cells through the bloodstream. While mammals only have a single ferroportin gene, *Caenorhabditis elegans*, a species of nematode, has two functional ferroportin genes. Our interest in ferroportin stemmed from our identification of a novel *fpn-1.1* allele within a *haf-6* mutant strain. *haf-6* mutants have been found to display transposon silencing defects, while the *haf-6 fpn-1.1* double mutant did not display transposon silencing defects. From this, we hypothesize that the *fpn-1.1(yy6)* mutation is a suppressor of *haf-6.* However, the novel allele of *fpn-1.1(yy6)*, contains a three amino acid deletion within the C-terminal protein coding region, so the first set of experiments performed helped ascertain if this allele is defective for protein function. These biochemical and iron-based phenotype experiments demonstrated that the allele encodes a defective protein. To supplement this data and to investigate the nature of the *fpn* interaction with *haf-6*, we used phenotypic assays such as ferritin-GFP reporter expression and Nile Red lipid staining and, as there is a known correlation between the iron-storage ferritin protein and fat with iron levels. With this information, we can learn more about how iron is distributed, specifically within the germline, as active transposons within oocytes could lead to heritable mutations and diseases.

P18_Structural Characterization and Solution of mTryP

Noah Lanyi Lari,[1,2] Anne Cooper,[1] and Scott Lovell[1]

[1]*Department of Molecular Biosciences, The University of Kansas, Lawrence, KS*
[2]*The College of Wooster, Wooster, OH*

Trypanosoma brucei, the causative agent of African sleeping sickness, relies on the trypanothione-peroxidase pathway for reactive oxygen species detoxification, lacking the catalase and glutathione peroxidase systems present in mammalian hosts. The mitochondrial tryparedoxin peroxidase (mTryP) is a 2-Cys peroxiredoxin essential for parasite survival under oxidative stress, making it a compelling drug target with no human ortholog. Despite this, no structure of *T. brucei* mTryP currently exists, prompting the need for biochemical characterization and structure determination. Size exclusion chromatography of both the oxidized and reduced tryparedoxin reveals a stable decameric assembly in both redox states,confirmed independently by mass photometry, which identifies a predominant species of 233 kDa consistent with the decameric structure. CryoEM and X-ray crystal structures for both oxidized and reduced states reveal the decamer of ring structure architecture and the intermolecular disulfide bond between the two cysteines. These structures will provide the first view of *T. brucei* mTryP and a framework for structure-guided inhibitor design.

P19_Investigating the role of HAF- 6 in *Caenorhabditis elegans* iron trafficking

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ATP-binding cassette (ABC) transporters are one of the largest superfamilies of membrane proteins, using energy from ATP to transport substrates across cellular membranes. HAF-6 is an ABC transporter in *Caenorhabditis elegans* located in the endoplasmic reticulum, expressed primarily in the intestine and germline. Strains with a deletion in HAF-6 cause defects in transposon silencing. The role of HAF-6 in this process is unknown as the precise substrate trafficked by HAF-6 is unidentified. A suppressor strain of *C. elegans* was isolated with no transposon silencing defects. The suppressing mutation was identified in ferroportin, which transports iron from inside intestinal cells into the bloodstream. Based on this genetic interaction between ferroportin and HAF-6, we hypothesize that HAF-6 has a role in iron trafficking. Ongoing laboratory experiments support this hypothesis as HAF-6 mutants survive the stress of high iron much better than wild-type and the survival phenotype is dependent on ferroportin. Since the role of HAF-6 in iron trafficking may be indirect, we are using other iron-dependent phenotypic assays as additional tests of our hypothesis. Both fat and ferritin accumulation have a well-known relation to iron levels in the body. Assays such as Nile Red staining and ferritin-GFP reporter genes were used to analyze levels of fat and ferritin in HAF-6 mutants. Our work reveals potential roles for the conserved ABC transporter, HAF-6, in iron homeostasis which is altered in many disorders such as severe bacterial infections, anemia, hemochromatosis, and cancer.

P20_Using publicly available data to assess the genetic variation and evolution of iron homeostasis genes in *C. elegans*

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Iron is necessary for many metabolic processes in all organisms, yet an excess of iron causes oxidative stress due to the formation of free radicals. Because of this, organisms rely on tightly regulated pathways and proteins that regulate the storage and export of iron. Experiments that induce stress in *C. elegans* may select for specific genetic variations in transport proteins that improve iron homeostasis in specific conditions. If present, these variations would act as a confounding factor in *C. elegans* studies by altering *C. elegans* metabolic pathways. Here, we examine the genetic variation of three transmembrane transport proteins that likely affect iron metabolism in *C. elegans*: Ferroportin-1.1, Haf-6, and Eri-6. Previous research suggests a specific deletion in each gene prevalent in some C. elegans strains. Using computational alignment tools, paired WGS reads from a large set of publicly available *C. elegans* samples were aligned to a reference genome, and the presence of previously identified segregated deletions was quantified using pysam, then, this data was grouped by the genotype of each strain and the treatment used. Deletion in Ferroportin-1.1 was mostly absent, while deletions in Haf-6 and ERI-6 were present in a significant number of common strains. For example, strains of *C. elegans* exposed to a mutagen or with an experimentally produced genotype were also more likely to were significantly more likely to exhibit deletion in Haf-6 or ERI-6. Our results suggest that certain experimental conditions could cause unintended changes in metabolic homeostasis genes in *C. elegans*.

P21_Creating mitochondrial tRNA synthetase disease models to test the effectiveness of repurposed drugs in *Drosophila melanogaster*.

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Mitochondrial aminoacyl tRNA synthetases (mt-aaRSs) are important enzymes that attach amino acids to tRNAs for mitochondrial protein translation. Mutations in these enzymes lead to multi-systemic disorders in humans. Due to these defects in mitochondrial translation, the main systems affected are high energy -requiring tissues such as muscle or the central nervous system. There are currently no curative treatments for any of mt-aaRS disorders. We hypothesize that by creating *Drosophila melanogaster* (fruit fly) models for these disorders, we can then test the models with repurposed drugs to identify potential therapeutics. We created these models using RNA interference (RNAi) to reduce the expression of each mt-aaRS gene in a specific tissue. First, using the eye, we used mt-aaRS RNAi to knockdown each mt-aaRS gene. Eye area was then measured to quantify the phenotype. Four of the ten mt-aaRS models had a decrease in eye size, indicating a negative effect and showing successful modeling of the disorder. Using these models, I tested a repurposed antibiotic previously successful in a different mt-aaRS model. I determined if the drug can rescue each model by mixing the drug into their food. Four mt-aaRS models showed an increase in eye size. To validate this finding, we created additional whole-body models to determine if the phenotype improvement is possible in tissues other than the eye. The new knockdown models of four mt-aaRS disorders will be further tested using repurposed drugs. These findings will further the research currently being done on mt-aaRS pathways and provide a steppingstone for future therapeutic work for mt-aaRS disorders.

P22_Respiration Rate as a Proxy for Hypoxia Tolerance in the Three Major Groups of Different Lineages of Copepods (Harpacticoid, Cyclopoid, Calanoid)

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Multicellular eukaryotes rely on tightly coordinated physiological mechanisms to maintain oxygen homeostasis, particularly in environments where oxygen availability fluctuates. Copepods, major contributors of global zooplankton communities, often encounter hypoxic conditions, making their respiratory strategies central to understanding ecological resilience. One major regulatory system for oxygen homeostasis is the Hypoxia Inducible Factor (HIF) pathway, historically thought to be conserved across all animals. However, recent work shows that the HIF pathway has been independently lost in multiple marine invertebrate lineages, including two major copepod groups: Cyclopoida and Harpacticoida. This study investigates whether copepods with and without the HIF pathway differ in their physiological tolerance to low-oxygen environments. Specifically, it tests whether respiration rate can serve as a proxy for hypoxia tolerance across Harpacticoid, Cyclopoid, and Calanoid copepod lineages by quantifying size-adjusted oxygen consumption in six species using Loligo MicroResp™ microrespirometry. (Results sentence). Comparing respiration rates across species reveals how copepods may compensate for the loss or modification of established hypoxia response pathways. These patterns help clarify whether hypoxia tolerance is primarily driven by lineage specific adaptations or shared physiological constraints across Copepoda. Understanding variation in hypoxia tolerance is increasingly important as marine oxygen levels decline globally. These findings contribute to broader predictions about copepod community shifts and ecosystem stability under future ocean conditions.

P23_Quorum-sensing signal identification in *Chromobacterium* species

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Many bacteria use quorum sensing to sense and respond to changes in population density. Quorum sensing activation often results in the secretion of virulence factors and other products that aid survival and competition in polymicrobial communities. One type of quorum sensing common to many proteobacteria relies on the production and response to diffusible signals via a diffusible signal and a signal-responsive transcription regulator. The signals are acyl-homoserine lactones (AHLs) that vary in the acylated side groups, which confer specificity of each system. We are interested in understanding how cognate AHL synthase and receptor pairs co-evolve and confer signal specificity. Prior studies suggested that AHL synthase and receptor pairs have rapidly diversified in members of the *Chromobacterium* genus, and we see studies of AHL synthase-receptor pairs in this genus as an ideal model for understanding quorum sensing evolution. Using a protein sequence similarity network analysis, we identified five distinct subgroups of AHL synthases in the *Chromobacterium* genus. Structural determination of the AHL has been done for a member of one of these (*C. subtsugae*), with AHLs from the other four subgroups remaining uncharacterized. We isolated and detected the AHL produced by a representative species of one of those (*C. violaceum*) and tentatively determined that it produces an AHL that is distinct from that of the previously determined *C. subtsugae* AHL. We intend to apply the same complementary AHL bioassay and mass spectrometry approach to determine the AHLs of the remaining three groups. The results will further our understanding of AHL synthesis and detection in the *Chromobacterium* genus and are an important step towards establishing this genus as a model for studying the co-evolution of quorum sensing synthase and receptor pairs.

P24_The human gut metabolome protects host cells from the cytopathic effect of *Clostridioides difficile*

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The human body contains more bacterial cells than human cells. Microorganisms that colonize the human body and coexist peacefully with the host are termed ‘microbiome’. Most of this colonization occurs in the gut. One critical role of the gut microbiome stems from its ability to protect the host from enteric infection. The leading cause of nosocomial infectious diarrhea is the bacterium *Clostridioides difficile*. Approximately 90% of *C. difficile* infections occur after the administration of broad-spectrum antibiotics, and the gut microbiome is known to play an important role in protection against this disease. *C. difficile* enacts toxicity through the disruption of the actin cytoskeleton, causing a characteristic cytopathic effect that can be easily visualized as cell rounding in cultured Vero epithelial cells. Previous research by our group demonstrated that small molecules extracted from fresh feces from healthy donors can inhibit this cell rounding phenotype. However, it is unknown whether the gut microbiome produces the protective compound or which species are responsible. To investigate this, we isolated bacterial strains from human feces. We then tested the ability of small molecule extracts from pure cultures to protect Vero cells from cell rounding when administered alongside *C. difficile* toxin supernatants. None of the isolates tested thus far showed activity. Future work will focus on testing additional isolates and characterizing the molecule responsible through High Performance Liquid Chromatography. Results from this research will generate a deeper understanding of the organismal and chemical makeup of the human gut microbiome, revealing potential new avenues for the treatment of *C. difficile* infection.

P25_The role of the YesLMN two-component system in high-mannose glycan utilization of *Enterococcus faecalis*

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One of the most significant stressors that microorganisms experience in a host environment is the lack of readily available nutrients. *Enterococcus faecalis*, a Gram-positive commensal organism that primarily colonizes the gastrointestinal track, has emerged as one of the leading causes of hospital-associated infections. One attribute that facilitates *E. faecalis'* survival in a host environment is its ability to utilize alternative carbon sources under glucose-limiting conditions. Previous studies in the lab identified a six gene operon encoding a predicted sugar ABC transporter and two-component regulatory system up-regulated under glucose-limiting conditions. We are investigating regulatory control of the YesLMN two-component system in *Enterococcus faecalis*, particularly its role in the uptake of host glycans to utilize as a carbon source. Mutants were constructed for each component of the YesLMN system. The expression of the first gene in this operon, *ef2223*, was examined by introducing a luciferase reporter and performing a bioluminescence assay with the mutant constructs to measure signaling. Our preliminary data indicate that the histidine kinase YesM is required for optimal signaling through YesN. We hypothesize that mutating a key histidine residue, His387, in YesM will alter its ability to phosphorylate the response regulator YesN. A site-directed mutant was constructed, and its activity was examined to investigate the significance of His387 in the kinase activity of YesM.

P26_Hypoxia tolerance in experimental and natural populations of *Drosophila melanogaster*

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Inhabiting high-altitude environments requires organisms to adapt to the stress of low oxygen levels, low temperatures, and high UV conditions. While recent work has found convergent reductions in olfaction genes and organs in high-altitude mammals, it is unknown whether invertebrates also adapt to low oxygen environments through modifications to sensory systems. This project investigated hypoxia tolerance (i) specifically in olfactory receptors of *Drosophila melanogaster*, and (ii) broadly in wild *D. melanogaster* populations collected from high/low altitudes in Peru and Ethiopia. We hypothesized that by knocking out an ionotropic receptor (IR) gene using *UAS-GAL4* RNA interference, flies would have reduced hypoxia tolerance. In parallel, we hypothesized that high-altitude populations of D. melanogaster would be more hypoxia tolerant than their low-altitude counterparts. To test these hypotheses, we subjected flies to 3 hours of anoxia, then tracked mortality and negative geotaxis (climbing ability) for 5 days afterward. Mortality was analyzed using a log-rank test, while a binomial generalized linear mixed model was used to analyze climbing abilities. Flies with knocked down expression of an IR gene exhibited lower survivorship ($p < .014$) and worse climbing abilities shortly after hypoxia. Fly populations from low-altitude environments also had higher mortality than high-altitude flies from both Peru and Ethiopia – with females from high-altitude driving the signal. These findings indicate a more universal role of chemosensory systems in hypoxia adaptation than was previously understood and confirm that adaptation to high-altitude environments in wild populations involves hypoxia tolerance.

P27_Demand-Flexible Data Center Cooling with AI Physics-Informed Digital Twins and Thermal Energy Storage (TES)

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Rapid development of artificial intelligence (AI) drives unprecedented thermal management challenges such as higher rack power densities, dynamic workloads, and constraints on electric grid and water resources. Up to 5 million gallons can be consumed per day by large data cooling centers to prevent hardware degradation from system heat rejection. Centers that currently utilize TES integrated with air, liquid, or hybrid cooling systems often fail due to the inability to navigate through the flexibility of storage systems. Optimal charging/discharging energy processes are also unlikely to occur using traditional controls like Proportional-Integral-Derivative (PID) controllers and do not account for complexities such as thermal inertia and uncertain future boundary conditions. Subsequently, purely AI-driven models lack the application of governing physics and require massive datasets that are rarely available. With the goal of transforming standard cooling into a predictive, grid-interactive infrastructure, a physics-informed hybrid AI digital twin framework for system-level optimization is proposed. Future models aim to capture the thermodynamics of chilled water loops, TES, hybrid heat rejection while dynamically responding to fluctuating conditions of compute demand, weather conditions, and electricity pricing. The proposed framework intends to reduce peak demand, improve energy efficiency and reliability, minimize water consumption, reduce capital costs (CAPEX) and operational expenses (OPEX), precisely supporting the objectives of the U.S Department of Energy Genesis Initiative.

P28_Difluorophosphate Ionic Liquid Shows Promise as Entrainer for Refrigerant Separations

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Refrigeration and air conditioning are vital components of modern life, but these processes rely on chemicals called refrigerants, which contribute significantly to global warming. In response, there is a global demand to eliminate the production and use of harmful refrigerants. Unfortunately, many of these refrigerants exist in mixtures, so to effectively recycle or repurpose the mixtures already in use, they must first be separated into their individual components. These separations pose a major challenge in the refrigerant industry because conventional flash distillation, which relies on differences in boiling point, often cannot be used due to the refrigerants' azeotropic behavior. For this reason, different separation techniques must be developed, such as extractive distillation. This method uses an entrainer, which is often an ionic liquid for refrigerants, to perform the separation. Using physical property data and the solubility data of five refrigerants in a difluorophosphate ionic liquid (1-ethyl-3-methylimidazolium difluorophosphate, $[C_2C_1im][PO_2F_2]$), this research proposes extractive distillation processes for three binary, azeotropic mixtures (R-410A, R-507, and R-513A), modelled in Aspen Plus. Each process includes two steps: extractive distillation and flash separation. These separation processes were optimized to meet EPA standards with maximum efficiency. Ultimately, this approach modelled the successful separation of all three refrigerant mixtures into 99.5% pure components with complete recycling of ionic liquid. Each process was further evaluated for general efficiency, and it was determined that the separation of R-513A using $[C_2C_1im][PO_2F_2]$ shows the most promise for application. Further investigations will include comparisons with other difluorophosphate ionic liquids and potentially pilot-scale testing.

P29_Experimental Interfacial Tension of Refrigerants HFC-32, HFC-125, and HFC-134a in a Mixture with Ionic Liquid [EMim][Tf_2N]

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The interfacial tensions (IFT) of three pure refrigerants HFC-32 (difluoromethane – CH_2F_2), HFC-125 (pentafluorethane - CHF_2CF_3), and HFC-134a (tetrafluoroethane - CF_3CH_2F) have been measured in a mixture with the ionic liquid [EMim][Tf_2N] (1-ethyl-3-methylimidazolium bis(trifluoromethane-sulfonyl)imide - $C_8H_{11}F_6N_3O_4S_2$) as a function of temperature, pressure, and refrigerant mole fraction. The measurements were conducted under equilibrium conditions between the liquid mixture and saturated vapor. The pendant drop method was applied in a high-pressure, high-temperature view cell with needles of various diameters to create a suspended drop from which the IFT is measured. IFT measurements were conducted over temperatures from 298.15 to 348.15K and pressures of 0.1 to 3 MPa, typical of industrial separations. The accuracy of the IFT measurement corresponds to the extent to which the measured drop profile satisfies the Young-Laplace equation. Surface tension data measured in this work for the pure refrigerants (HFC-32, HFC-125, and HFC-134a) match literature values, verifying the reliability of our methodology. Interfacial tension results from the three binary mixtures show consistent trends: IFT decreases with both increasing temperature and increasing mole fraction of HFC in the mixture. In addition, the HFC-32/[EMim][Tf_2N] mixture data exhibit positive deviation from a linear ideal mixing approximation, while the HFC-125/[EMim][Tf_2N] mixture shows negative deviation from the linear mixing approximation and the HFC-134a/[EMim][Tf_2N] fits the linear ideal mixing rule approximation very well. Experimental results align with the PCP-SAFT cDFT thermodynamic model predictions. These measurements provide new interfacial property data for refrigerant/ionic liquid systems and further validate model predictions for use in the design of industrial separation processes.

P30_Environmental and Socioeconomic Drivers of Air Conditioning Prevalence

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Comprehensive data on the prevalence of residential air conditioning in the United States from the 1980s to the present remain limited, posing a challenge for research on refrigerant phase-outs and the broader environmental and socio-economic patterns associated with air conditioning use. This study uses RStudio and spatial data analysis to examine the factors most closely associated with air conditioning prevalence across U.S. census tracts, distinguishing between environmental drivers, such as regional climate, and socio-economic drivers, including median income, total population, housing units, tenure status, urban/rural classification, and historical redlining designations. Total population captures the growth and redistribution of the U.S. population between 1980 and 2020; median income serves as a proxy for the disposable income needed to purchase and maintain air conditioning; housing units and tenure status help identify homeowners who had both the means and the incentive to install central air; and redlining designations allow us to examine whether historically disinvested neighborhoods show different patterns of air conditioning access today. Using data from the National Historical Geographic Information System (NHGIS), we compare these variables across 1980 and 2020 to assess how the relationship between air conditioning prevalence and its environmental and socio-economic drivers has shifted over four decades. By bridging this information gap, we aim to identify the factors that most strongly contribute to air conditioning prevalence and to inform future work on equitable and environmentally sound cooling infrastructure as climate change increases cooling demand nationwide.

P31_Upper Flammability Limits for Low GWP Refrigerants

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Refrigerants are a common and often overlooked aspect of daily life in the modern world, despite the concerns associated with them. Refrigerants with high global warming potential (GWP) are being phased out due to environmental regulations, and this is producing an increased demand for refrigerants with lower GWP. However, flammability is a major concern in the development of these alternatives, and many of the new refrigerants provide lower GWP at the cost of being more flammable. Mixing refrigerants offers an opportunity to better balance these risks by taking advantage of refrigerants with lower flammability classifications to reduce the flammable nature of low GWP refrigerants. This work specifically analyzed the flammability of refrigerant components and blends, including HFC-32, HFC-134a, and HFO-1234yf refrigerants through flammability testing in accordance with ASTM E681 and ASHRAE Standard 34. The upper flammability limits (UFLs) of HFC-32 and HFO-1234yf were found to be 27.0 $\pm$ 0.1 volume percent and 13.2 $\pm$ 0.1 volume percent, respectively. The research also demonstrated a correlation between the measured pressure rise and observed flame angle of combusted refrigerants and showed agreement with Le Chatelier's mixing rule. Further research using binary mixtures of these refrigerants will be used to validate the test method and evaluate the agreement with Le Chatelier's mixing rule.

P32_Characterizing the Thermal Conductivity of ChCl:EG (1:3) Deep Eutectic Solvents

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Concerns over the high global warming potential (GWP) of hydrofluorocarbons (HFCs) have led to the implementation of laws and regulations that mandate the phasing out of HFCs. These HFCs exist in refrigerant mixtures and are often destroyed using energy inefficient and environmentally harmful processes. To ensure a sustainable lifecycle for HFCs, they must be separated into their individual components before recycling. However, these mixtures are azeotropic, making separating them using fractional distillation is challenging. Recent research has demonstrated that deep eutectic solvents (DESs) have the potential to selectively separate HFC blends like HFC-410A, composed of HFC-32 (difluoromethane) and HFC-125 (pentafluoroethane), and HFC-407C, composed of HFC-32, HFC-125, and HFC-134a (tetrafluoroethane), via an extractive distillation system. However, DESs have not been fully studied, and a more complete understanding of their thermal transport properties, such as thermal conductivity, is required to optimize the design of the various unit operations involved in the refrigerant separation process. In this study, a DES composed of choline chloride (ChCl) and EG in a 1:3 molar ratio was examined. The thermal conductivity of the pure ChCl:EG DES mixture decreased linearly with increasing temperatures ranging from 25.2–75.3℃. The change in thermal conductivity for the ChCl:EG DES in combination with the HFC-32 at 25℃ ranges from 209.51–210.65 mW/m•K at pressures from 4.78–15.25 bar (mole fractions of 3.96–13.91%). Further study will include measuring the thermal conductivity of the ChCl:EG DES in combination with HFC-125 and HFC-134a.

P33_Reduction of Disulfides into Thiols using Homogeneous Rhodium Catalysis

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The linkage of monoclonal antibodies and a toxic payload is a core element for making an Antibody-Drug Conjugate (ADC). Linking these chemically by oxidizing thiols into disulfides is a process that has been proposed for this. Antibodies contain disulfide bonds that can cleaved into thiols for this linkage method. Previously, this cleavage could only be performed with toxic and unselective reagents. Our goal is to perform a reaction by which the catalyst $RhH(PPh_3)_4$ can reduce disulfides instead. The disulfide we selected is a cystine-type molecule with benzene and carboxylic acid groups attached for its moiety to what a biological reactant would be like. Our reaction takes place in a series of continuously stirred batch reactors in a high-pressure environment, and the results were analyzed in a High-Performance Liquid Chromatography machine. The reactors are treated to 40 atmospheres of hydrogen gas for an hour to reduce into thiols. The resulting absorbance data from the HPLC machine determined that no reaction had occurred; a second spike appeared but it does not match the expected values of our desired product. There are multiple possible explanations for this: the reaction was limited by the mass transfer of hydrogen into the solution, another functional group in the cystine compound negatively impacted the catalyst, or a reaction occurred and the HPLC could not distinguish the product. By adjusting our process by changing the temperature or solvent used for this reaction, a novel catalytic process for ADC production could be developed.

P34_Molecular Modeling of Lignin–Ion Interactions for Advanced Materials

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Lignin, the most abundant aromatic biopolymer on Earth, is generated in enormous quantities as a byproduct of the pulp, paper, and biorefinery industries. Yet over 98% of this resource is burned on-site for low-value heat rather than being upgraded into advanced materials. Naturally occurring lignin has a variety of aromatic units which provide its structural rigidity, primarily *p*-hydroxyphenyl (H), guaiacyl (G), syringyl (S). In addition to the methoxy and hydroxyl groups already present, refining processes introduce several new functional groups, including carboxylic acids, ketones, aldehydes, and sulfonic acids. This diverse array of groups underpins lignin's high potential in the design of advanced membrane technologies, enabling tunable ion binding, transport behavior, and hydrophilicity. Although lignin-based membranes show promising ion transport behavior, the molecular mechanisms driving separation remain poorly understood. To bypass the inherently trial-and-error nature of membrane formulation, we use a hybrid computational approach. In this work, we begin by conducting quantum mechanical (QM) potential energy surface (PES) scans to benchmark the interactions between lignin model compounds and representative ions (Li^+, Na^+, and K^+). We then conduct molecular mechanical (MM) PES scans of each system, starting with existing force field parameters for lignin and guiding targeted refinements via atom pair–specific Lennard–Jones parameters. The results of this work provide a foundation for characterizing ion transport properties of lignin via molecular dynamics (MD) simulations. Ultimately, we aim to develop a machine learning model to identify molecular design rules linking lignin chemistry to ion transport performance.

P35_Synthesis and Evaluation of NiOX-ZrOX/SiO2 Catalysts for improved Ethanol Conversion to C_{4+} Olefins

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As gasoline demand declines, ethanol's role as a gasoline component will cheapen, requiring new markets for ethanol such as sustainable aviation fuel. To produce aviation fuel, ethanol must be upgraded into higher-carbon olefin intermediates. Zeolites such as ZSM-5 are effective ethanol-conversion catalysts, but their controlled synthesis can be complex and costly. This research aimed to develop a simpler silica-supported catalyst with activity comparable to or greater than that of ZSM-5. Metal- and metal oxide-promoted silica catalysts have shown success in converting ethanol to higher olefins. Nickel oxide was selected to promote ethylene oligomerization to C_{4+} olefins, while zirconia was incorporated as a promoter to provide acid-base sites that facilitate C-C coupling through aldol condensation. Together, these complementary reactions were expected to increase the selectivity of higher-carbon products. A highly dispersed NiO_X-ZrO_X/SiO_2 catalyst was synthesized by impregnation with a zirconium precursor followed by ammonia-assisted deposition of nickel oxide. Catalytic performance was evaluated in a fixed-bed reactor from 250-500 °C using vaporized ethanol with a partial pressure of 2kPa and a total pressure of 101 kPa, and reaction products were quantified by gas chromatography. The NiO_X-ZrO_X/SiO_2 catalyst produced a greater total C_{4+} product yield than either NiOX/SiO_2 or ZrOX/SiO_2 alone. At 400 °C and complete ethanol conversion, NiO_XZrO_X/ SiO_2 achieved 46% carbon-based selectivity to C_{4+} products, compared with approximately 14% for ZSM-5. These results indicate that combining nickel oxide and zirconia on silica increases C_{4+} formation during ethanol conversion and may provide a promising alternative to zeolite catalysts for producing higher-olefin intermediates.

P36_The Use of Hierarchical H-Y Zeolite for the Production of Biofuel Precursors

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The aviation industry contributes about 2.5% of CO_2 emissions and 4% of global warming. Sustainable aviation fuels (SAFs) are a promising way to reduce these emissions. SAFs can be produced using hemicellulose derived compounds through hydroxyalkylation-alkylation (HAA) reactions. In this project 2-methyl furan was reacted with cyclohexanone using different modified H-Y zeolite catalysts to produce a C_{16} molecule. The modifications were made from commercial H-Y zeolites to increase the pore size and volume. The modifications produced much higher C_{16} yields then the parental H-Y zeolite. H-Y mod 3 produced the best results with a 72% yield of C_{16} under mild conditions (80 °C, 6 h, 500 rpm) This can be attributed to its larger pore opening size of 56.10 A and its higher acidity of 1.59. H-Y mod 3 was subsequently compared with other zeolite types and continued to produce the highest yield. These results demonstrate that the modifications significantly improved catalytic performance compared with the parent H-Y zeolite, with H-Y mod 3 being most effective modification.

P37_Controlling Crystal Size: Carbon Dioxide Induced Crystallization of Terephthalic Acid (TPA)

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Polyesters make up over 50% of all fibers produced worldwide. Currently, it is estimated that 60% of all plastics ever produced end up landfilled. One potential solution to improve plastic circularity is chemical recycling. PET chemical recycling by alkaline depolymerization produces disodium terephthalate. Disodium terephthalate is typically converted to terephthalic acid by acidification with mineral acids. However, this produces small TPA crystals that need further processing to meet the requirements of existent PET production plants. In this work, we investigate CO_2 acidification as an alternative. We performed a series of crystallization experiments conducted at 21 °C, 40 bar, and 1 wt% under different conditions: crystallization times, stirring rates (60, 100, and 300 RPM), crystal seeding amounts (0.06 g and 0.006 g), pressure cycling, and solution volumes (110 g and 210 g). Disodium terephthalate conversion and TPA yield were measured using NMR. TPA crystal size distributions were measured using a laser diffraction particle size analyzer. Stirring produced significantly smaller crystals while unstirred crystallization yielded larger TPA crystals, with 53 µm average particle size. Experiments conducted with crystal seeding produced the largest crystals (avg 70 µm), however these crystals were much less uniform than non-seeding and non-stirring trials. These findings demonstrate that crystallization conditions, particularly stirring, have a significant impact on TPA crystal size and uniformity. This confirms that CO_2 induced crystallization can be used to control TPA crystal size to appeal to industry, thus providing a more sustainable method to produce TPA for PET upcycling.

P38_Developing a Closed-Loop Organ Cooling System to Extend Preservation Capabilities

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The inability to keep donor organs preserved for more than 24–48 hours ex vivo is a serious limitation in providing lifesaving transplantations. Vitrification is a cryopreservation technique that uses high viscosity substances to reduce molecular mobility, allowing an amorphous solid to form after a transition temperature is reached. In biology, cryoprotective agents, rapid cooling rates, and extremely low temperatures are needed to vitrify cells, blocking the formation of damaging ice. Vitrification has preserved the function of rat kidneys in a transplant model after 30 days of storage. However, as sample volume increases, it becomes progressively harder to stay above the critical cooling rate that is required. It was thus our goal to develop a novel cooling system that could enable vitrification of human-scale organs to greatly extend preservation capabilities. A liquid bath cooling device of circulating refrigerant used to cool a kidney model was conceptualized and formed in COMSOL Multiphysics 6.4. Its ability to produce thermal conditions for vitrification was then analyzed by simulating the fluid dynamics and heat transfer of the cooling system. This study computationally determined the time it took for vitrification temperatures to be reached, the profile of cooling rates, and the thermal gradient throughout the kidney in the model. These results were comparable to or matched with what has experimentally been determined to induce successful vitrification. These findings support the ongoing development of a physical prototype which may result in successful human scale organ vitrification for the first time.

P39_Kinetic Study of Allergen and Polyphenol Decomposition in Pistachio Shells for Use in Animal Feed

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Pistachio shell powder (PSP) has been shown to provide nutritional benefits to swine, fish, and companion animals. In some applications such as companion animal feed (e.g., cats and dogs), the allergen content of the PSP needs to be reduced in case of accidental ingestion by humans. To reduce the allergen content, the shells and/or the powder can be heat treated, which denatures the allergen. The shells also contain polyphenols, which have been attributed to providing gut health benefits, but the polyphenols are temperature sensitive. In order to understand the temperature and time relationship for minimizing allergens and maximizing polyphenols, a kinetic study was conducted. This summer I ran experiments heat treating PSP at various temperatures and times, analyzed samples for allergens and polyphenols, and developed a kinetic model. My key findings show that the optimum temperature and time to reduce the allergen while maximizing the polyphenol content is approximately 150 °C for 2 hours. Higher temperatures are possible for shorter times, but additional data is needed to complete the study.

P40_The Use of Bifunctional Catalyst Systems for the Production of Sustainable Biofuel Precursors

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We focused on an aldol condensation pathway between furfural and cyclohexanone to create a C_{16} bio-precursor for Sustainable Aviation Fuels (SAFs), an alternative to regular jet fuel which can reduce up to 80% of the aviation industry's greenhouse gas emissions. We initially used a 2:1 molar ratio of cyclohexanone to furfural and carried out the aldol condensation reaction at 80 °C, stirring at 500 rpm for 6 hours. Using a bifunctional catalyst mixture of TiO_2 and our modified HY zeolite, we saw more conversion of furfural than if we were to use either catalyst alone at these conditions. Furthermore, when we increased the molar ratio to 10:1 while using our TiO_2-HY mixture, the furfural conversion increased almost threefold to over 90%; however, using only TiO_2 at this increased molar ratio only showed a 20% furfural conversion. These results emphasize the influence that our bifunctional catalyst system has on the aldol-condensation reaction, demonstrating its potential for achieving a renewable, cleaner jet fuel.

P41_Upgrading of Co-HTL Biocrude via Hydrotreatment

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Co-Hydrothermal Liquefaction (Co-HTL) can be a helpful tool to recycle waste into more valuable products, such as a renewable fuel source and fertilizer. However, products from HTL often need to undergo separation and purification processes before they can be effectively used. One type of purification process is hydrodeoxygenation (HDO), in which a crude oil is introduced to a catalyst, heat, and pressurized hydrogen to remove unwanted oxygen. Typically, crude will undergo separation into distinct fuel cuts prior to HDO due to the differing characteristics of each fuel cut. Alternatively, if crude could be treated before separation it would eliminate the need for specialized stream purification and new refineries. For this study, Co-HTL biocrude produced from a mixture of crude glycerin and corn stover was taken directly to a hydrotreatment process to determine if it could be effectively deoxygenated prior to fuel cut separation. A Nickel Zeolite catalyst was added to 2 g of the biocrude directly from HTL and left for 6 hours at 270°C with 3MPa of H_2. A variety of methods were used to characterize biocrude before and after hydrodeoxygenation, such as TGA, ICP-OES, GC-MS, CHNOS, and TOC/TN. Key findings show that this approach results in an upgraded fuel source that could potentially be used for sustainable aviation fuel (SAF) production while potentially reducing CO_2 emissions.

P42_Simulating Subcutaneous Injection In Vitro: Predicting Lymphatic Uptake of Monoclonal Antibodies

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Monoclonal antibody (mAb) therapeutics have rapidly developed over the past decade, creating the need for precise methods to study different routes of administration. Subcutaneous injection offers convenience for patients over intravenous infusion, but the unique absorption and distribution of mAbs from the subcutaneous injection site requires validation of the bioavailability and exposure. In vivo rat studies have shown that mAbs are primarily absorbed through lymphatic uptake following subcutaneous injection, but these studies are expensive, slow, and inefficient. We have developed an in vitro model of the subcutaneous absorption of pembrolizumab using the Emulator of Subcutaneous Absorption and Release (ESCAR) system, to accurately predict mAb distribution after subcutaneous injection. After verifying the colloidal stability of pembrolizumab, we optimized the ESCAR test conditions. Our final method perfused media across semi-permeable membranes at approximately 1.5 psi between chambers that simulate the endothelial cell spacing of blood and lymphatic capillaries. Release of pembrolizumab was quantified using size-exclusion chromatography, and total recovery through 24 h of the mAb in the in vitro release tests was less than 30% compared to the 63% recovery in vivo data. However, normalizing the release profiles to their respective recoveries results in nearly identical absorption curves, providing support for the combined diffusion and forced advection model of subcutaneous absorption of pembrolizumab using ESCAR.

P43_Evaluating Surrogate Models for Bayesian Optimization of Spray Drying

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Spray drying is widely used to produce amorphous solid dispersions that improve the bioavailability of poorly water-soluble drugs, but its yield depends on interacting process parameters (solid loading, feed volume, pump rate). We assessed whether surrogate-model Bayesian optimization can guide spray-drying experiments at a realistic laboratory data scale (n=30). Five surrogates (Gaussian process, random forest, gradient-boosted trees, DNGO, and Bayesian neural networks) were compared on leave-one-out predictive accuracy, calibration, and cumulative optimization regret against a random-sampling baseline. The Gaussian process achieved the highest point accuracy and best calibration (LOO R^2=0.56, ECE=0.026, NLL=4.30) yet was not the best optimizer. Gradient-boosted trees gave the lowest cumulative regret and was the only surrogate to outperform random sampling, while the poorly calibrated Bayesian neural network (ECE=0.45) performed significantly worse than random. Critically, no surrogate produced uncertainty estimates that were informative for the acquisition function (Spearman correlation between predicted uncertainty and error ≈ 0 for all models). SHAP analysis was consistent across all models, identifying solid loading as the dominant driver of yield, followed by volume, with pump rate negligible. These findings show that at realistic pharmaceutical data scales, predictive-accuracy and calibration metrics do not determine optimization performance, and that uncertainty informativeness is one of the major limiting factors for surrogate-guided experimentation.

P44_Chemical Stability of Nifedipine Amorphous Solid Dispersions in Rodent Chow

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Amorphous solid dispersions (ASDs) are widely used to improve the oral delivery of poorly water-soluble drug candidates and offer a promising approach for long-term preclinical studies. However, their suitability for repeated oral administrations in animals depends on maintaining the physical and chemical integrity of the drug throughout formulation preparation, storage, and dosing. This study examined the chemical stability of nifedipine, a poorly water-soluble and light-sensitive drug, after it was formulated as an ASD and incorporated into rodent chow at a final nifedipine concentration of 0.25% w/w. Nifedipine ASDs containing the polymer HPMC-AS 912 were prepared by spray drying at drug loadings of 3%, 10%, and 50%. Chow containing crystalline nifedipine was also prepared for comparison. Samples were stored under 40 °C/75% RH and ambient laboratory light and analyzed at days 0, 3, 7, 14, and 28. Chemical stability was analyzed using HPLC after storage durations. After day 28, nifedipine retained at least 86.25 ± 1.14% of its initial chromatographic peak across all formulations and storage conditions, indicating limited chemical degradation.

P45_Rheological Characterization of Pluronic F-127-based Vaginal Gels Incorporating Lactoferrin Protein for the Prevention of Early-Onset Neonatal Sepsis

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Escherichia coli (E. coli) is a leading cause of neonatal early-onset sepsis, which is caused by vertical transmission of bacteria during pregnancy. While intrapartum antibiotic prophylaxis (IAP) is effective for preventing sepsis, maternal and fetal antibiotic exposure has adverse effects on neonatal microbiome. Lactoferrin, a naturally produced protein of the transferrin family, has demonstrated antibacterial activity against *E. coli*. Development of a thermosensitive Pluronic F-127 (Pf-127) vaginal gel incorporating lactoferrin for maternal administration during pregnancy serves as a novel preventive strategy while avoiding the adverse effects of IAP. Pf-127 aqueous solutions can transition from solution to gel at elevated temperatures, and the onset of gelation temperature can be tuned by varying the concentration of Pf-127. This thermosensitive property provides unique rheological properties, allowing for ease of administration at lower temperatures and enhanced retention in the vaginal tract at body temperature. The Discover Hybrid Rheometer with 40 mm parallel plate geometry was used to assess onset of gelation temperature of blank Pf-127 gels of varying concentrations made in lactate buffer (20 mM, pH 4.0). Methods were also developed for full rheological characterization of a preliminary Pf-127 formulation. Our results showed that as concentration of Pf-127 increased from 10% to 20% (w/w), onset of gelation temperature decreased from 36°C to 20°C. Additionally, the ideal concentration was determined to be 16% (w/w) Pf-127, where the onset of gelation temperature was 24°C and exhibited predominantly elastic behavior at 37°C ($\tan\delta<1$). Future studies will assess how addition of lactoferrin will affect gelation and rheological properties.

P46_Formulation of Poly(lactic-co-glycolic) Acid Nanoparticles for Enhanced Intracellular Delivery of Resiquimod

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Immunotherapy utilizes the body's immune system such as T cells and NK cells to attack cancer cells. Resiquimod (RESQ) a toll-like receptor (TLR) 7 and 8 agonist, can stimulate a potent adaptive immune response including the production of inflammatory cytokines. TLRs 7 and 8 are located within the endosomal membrane of antigen presenting cells, presenting a drug delivery hurdle and potential immune toxicity for RESQ-based cancer therapy. Poly(lactic-coglycolic) acid (PLGA) is a biodegradable polymer that can be formulated into polymeric nanoparticles (PNPs). Incorporation of polyethylene glycol (PEG) into the PNPs matrix increases the particle's stability. Encapsulation of RESQ within PEGylated PNPs allows for a platform for enhanced entrance into the endosomal membrane to active TLR7/8 and a decreased toxicity effect of free RESQ. In this study, we evaluated the efficacy of RESQ encapsulated PNPs formulated by nanoprecipitation using a macrophage (RAW 264.7) assay and measured the concentration of released cytokines, IL-10 and TNF-α, within each group. RAW 264.7 cells were incubated with a concentration of 100 ng/ml of RESQ for 24 hrs. Cell culture supernatant was collected to measure IL-10 and TNF-α using ELISA method. TLR 4 agonist, Lipopolysaccharide (LPS), was used as a control to compare the immune response produced by RESQ. Our results showed the concentration of TNF-α in RESQ solution and RESQ-PNP was 1.193 ng/ml and 1.503 ng/ml, respectively. This demonstrates that RESQ encapsulated PNPs have a similar immune response to RESQ alone, showing a need for further intracellular investigation.

P47_Hydrotropes strategies to mitigate cyclic peptide Lanreotide self-association for subcutaneous delivery

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Peptide self-association is one of the challenges in developing a short-acting subcutaneous formulation, as the larger size of associated peptides can prevent absorption into blood capillaries in the subcutaneous space. Hydrotropes such as nicotinamide (a form of vitamin B3) and caffeine have been reported to increase drug solubility and interfere with drug self-association. In this study, we used lanreotide - a cyclic peptide reported to self-associate and form nanotubes at high concentrations - as a model drug to investigate the effects of hydrotropes on peptide absorption and release in a simulated subcutaneous environment using an in vitro device called ESCAR (Emulator of SubCutaneous Absorption and Release). The results showed that peptides formulated with hydrotropes were released much faster than peptides in water. Specifically, nicotinamide was more effective than caffeine in terms of increasing the drug release rate over the 5-hour experimental time. Future experiments can explore longer experimental times that have a higher percentage of peptides released to better discriminate their effects.

P48_Encapsulating Caffeine with Taste-Masking Polymer Eudragit® EPO via Spray Drying for Oral Dissolving Strips

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Caffeine is the world's most widely consumed psychoactive substance. As an adenosine receptor inhibitor in the brain, caffeine promotes alertness and wakefulness. Oral dissolving strips provide rapid caffeine delivery through buccal absorption, offering a convenient alternative to traditional caffeinated beverages. However, formulation presents a challenge due to caffeine's inherently bitter taste, resulting in low patient acceptability. For this reason, many caffeine oral strips currently on the market use flavoring for taste masking. We hypothesize that encapsulating caffeine with a suitable polymer barrier using spray drying would effectively mask its bitter taste, thereby reducing the need for flavor additives during formulation. Eudragit® EPO is a pH-sensitive cationic polymer that is insoluble at the pH of saliva, but becomes soluble in stomach pH conditions, thus masking taste in the oral cavity but releasing the caffeine in the stomach. Particle size can influence drug dissolution and coating efficiency during spray drying, so "as-received" caffeine particle size was modulated using analytical sieving, jet milling, and mortar and pestle manipulation. Laser diffraction was used to characterize the resulting particle size distribution and uniformity. Subsequently, multiple caffeine-to-polymer ratios and caffeine particle size cuts were spray dried, and dissolution studies were performed to assess taste masking efficacy. Results showed that spray dried Caffeine-Eudragit® EPO formulations had a reduced release rate in dissolution testing compared to unprocessed caffeine; suggesting Eudragit® EPO is a promising taste-masking polymer for caffeine oral strips. Future studies will explore more drug-to-polymer ratios and other taste-masking polymers to evaluate their efficacy and suitability.