HUDSON- BERGEN CHEMICAL SOCIETY

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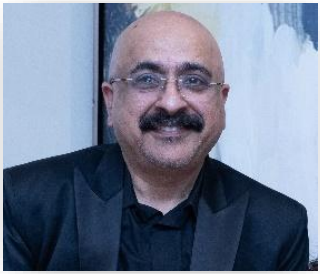
THE DEPARTMENT OF CHEMISTRY, BIOCHEMISTRY, AND PHYSICS, FAIRLEIGH DICKINSON UNIVERSITY

26th Annual Student Research Symposium and Awards Night

April 18, 2025

Hudson-Bergen Chemical Society
Subsection of the New York Section of
the American Chemical Society



Dr. Ish Kumar, Ph.D.
April 18, 2025
Chair 2025
Hudson Bergen Chemical Society

Welcome to the 26th edition of the Undergraduate Research Symposium and Student Awards Night of the Hudson-Bergen Chemical Society. This is a forum for students and their faculty mentors from high schools, colleges, and universities that participate in the subsection's activities to present the results of their research. Outstanding graduating undergraduate students, chemistry or biochemistry majors are also recognized by the Hudson-Bergen Chemical Society.

Congratulations to all the presenters and all the Student Award recipients! We are proud of you. We hope you enjoy being with us this evening, sharing your results, and discussing your work. We also hope that this event will encourage you to continue your journey into the magnificent world of science.

An event of this size cannot be organized without the help of many people, including the Hudson Bergen Chemical Society officers, the students involved, and the section members. Together, we can continue to advance the frontier of knowledge and make meaningful contributions to our field and society. Warm thanks to all.

The Hudson-Bergen Chemical Society is proud to recognize outstanding graduating students, the students presenting their work, and their mentors. Welcome everybody!

The chemistry programs of the following colleges are members of the Hudson-Bergen Chemical Society

Bergen Community College
Fairleigh Dickinson University
New Jersey City University
Ramapo College of New Jersey
St. Peter's University
Stevens Institute of Technology

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HUDSON-BERGEN CHEMICAL SOCIETY

2025 STUDENT AWARDS

The following students have been recognized for their academic achievements by the chemistry departments of their respective schools:

Abigail Garcia
Bergen Community College

Ryan Holt
Fairleigh Dickinson University

Besime Aslan
New Jersey City University

Alessandro Vicidomini
Ramapo College of New Jersey

Alyssa Gamlanga
St. Peter's College

HUDSON-BERGEN CHEMICAL SOCIETY

26th ANNUAL
STUDENT RESEARCH SYMPOSIUM

Fairleigh Dickinson University – Metropolitan Campus
April 18, 2025

Times:

Student presentations:	4:30 pm
Dinner and Awards:	6:00 pm
Plenary lecture:	6:45 pm

Place: Dickinson Hall, Room 4468

This year's symposium also features the lecture:

Targeted protein degradation concepts and approaches to discover small-molecule drugs

presented by

Dr. Sudeep Banjade
SK Life Science Labs

Abstract: In the last decade, targeted protein degradation (TPD) concepts have been widely used in the pharmaceutical and biotechnology sectors to discover drugs targeting various cancers, neurological diseases, and immunological diseases. TPD, in particular, has been utilized to discover molecules targeting those proteins that have been difficult to inhibit by traditional inhibitor-like drugs. This talk will provide a general overview of the concept behind TPD and the approaches taken to degrade specific proteins that are responsible for inducing various diseases. Specific efforts of SK Science Labs to screen for small molecule drugs that induce complex formation between two proteins - an E3 ligase and a protein of interest (POI) – will also be discussed. The E3 ligases are responsible for tagging the POI with a small protein called ubiquitin, which ultimately leads to the destruction of the POI in the cell. The speaker and

his colleagues are interested in discovering those small molecule drugs that can bring the E3 together with the POI so that these disease-causing POIs can be destroyed by the normal machinery of the cell.

Bio: Dr. Banjade completed his undergraduate degree at Fairleigh Dickinson University in Biochemistry and then obtained a Ph.D. in Molecular Biophysics at UT Southwestern Medical Center in Dallas. After a cell-biology post-doctoral fellowship at Cornell University, he is a drug-discovery scientist at SK Life Science Labs, right outside Philadelphia.

PROGRAM

4:30 Opening of the symposium.
Welcome - DH 4468

STUDENT PRESENTATIONS

ROOM: DH-4468

4:35 ADSORPTION OF CARBON DIOXIDE AND BENZOIC ACID ON ACTIVATED CARBONS PRODUCED FROM CASHEW NUT SHELLS BY UREA MODIFICATION AND POTASSIUM CARBONATE ACTIVATION
Maame Adwoa Asamoah Duodu, Danela Sadikaj, Hellen Ladino, Wanlu Li, *Dr. Svetlana Bashkova*

4:45 ENCAPSULATION OF SPIRULINA AND CATALASE IN CHITOSAN-BASED NANOPARTICLES FOR USE IN TOPICAL ANTI-INFLAMMATORY APPLICATIONS
Ryan Holt, Malak Elkafafi, Antonio Ocampo, Nirmalbhai Kachhadiya, *Dr. Mihaela Leonida, Dr. Ish Kumar*

4:55 A BIOLOGICAL AND CHEMICAL ASSESSMENT OF THE HACKENSACK RIVER, Kylie Chalfant, *Dr. LoPinto*

5:05 GREEN SYNTHESIS OF ZEIN-BASED NANOPARTICLES ENCAPSULATING SPIRULINA EXTRACT AND CATALASE FOR SKIN CARE APPLICATIONS
Nirmalbhai Kachhadiya, Antonio Ocampo, Malak Elkafafi, Ryan Holt, *Dr. Mihaela Leonida, Dr. Ish Kumar*

5:15 ANTIMICROBIAL ACTIVITY OF ECO-FRIENDLY ZEIN/SPIRULINA AND CHITOSAN/SPIRULINA NANOPARTICLES
Dharani Sri Reddy Vippala, Bhagyasri Sugasani, *Dr. Alice Benzecry*

5:25 EXPLORING MECHANISMS OF BINDING OF CATECHOL DERIVATIVES TOWARDS CATALYTIC DOMAINS OF MMP-9
Manoj Kumar Depuru, Priyanka Meda, Prachet Trivedi, Dr. *Ish Ku*mar

5:35 TARGETING AN ENZYME-FREE GLUCOSE SENSOR USING A RUTHENIUM MOLECULAR COMPLEX AND POYL(ANILINE) (PANI) FOR DIABETES MANAGEMENT
Allysa Gamlanga, Hiba Zahoui, *Dr. Yosra Badiei*

5:45 POLYMER BRUSH BIOCOATINGS AS ANTI-INFECTION SURFACES

Jonathan Nunez, Kyle Richards, Katrina Cabinian, *Dr. Christian Traba*

5:55 QUATERNARY AMMONIUM MONOMERS AS BACTERIOSTATIC NANOCOATINGS
Janeen Darwish, Camila Mafla-Gonzalez, *Dr. Christian Traba*

ROOM: DH-4469

4:35 THE EFFECTS OF HALOPERIDOL ON CRAYFISH MOVEMENT IN RESPONSE TO FOOD STIMULI
Jade Castro, Gulianna Eggart, Niurka Castro, *Dr. Josh Stout*

4:45 THE EFFECTS OF DOPAMINE AND HALOPERIDOL ON DAPHNIA HEART RATE.
Mahasin Izquierdo, Janeen Darwish, Kyle Richards, *Dr. Josh Stout*

4:55 DOPAMINE ACTING TO INHIBIT MOVEMENT IN MARBLED CRAYFISH PROCAMBARUS VIRGINALIS
Christopher Jean, Tommy Villegas, Jelani Richards, Mira Sarabamon, and Purnima Sengupta, *Dr. Josh Stout*

5:05 THE P38 MAP KINASE FAMILY GENE, PMK-1, REGULATES ACTIN NUCLEATION DURING DEVELOPMENT
Avery LaRusso, *Dr. Andre Wallace*

5:15 AN RNAi SCREEN TO IDENTIFY CELL MIGRATION REGULATORS IN *C. elegans*
Johnna Mainhart, *Dr. Andre Wallace*

5:25 THE EFFECTS OF LONG TERM VERSUS SHORT TERM HALOPERIDOL EXPOSURE ON CRAYFISH MOVEMENT
Maram Alhaddad, Nancy Patel, Christopher Jean, Nya Blades, Bikramijit Singh, Yamanni Tay, Mariselle Morillo, Grace Alex, *Dr. Josh Stout*

5:35 CONVENTIONAL SCREENING OF ANTIMICROBIAL ACTIVITIES OF NCI NATURAL PRODUCT V LIBRARY
Bhagyasri Sugasani, Dharani Sri Reddy Vippala, *Dr. Alice Benzecry*

ABSTRACTS

ADSORPTION OF CARBON DIOXIDE AND BENZOIC ACID ON ACTIVATED CARBONS PRODUCED FROM CASHEW NUT SHELLS BY UREA MODIFICATION AND POTASSIUM CARBONATE ACTIVATION

Maame Adwoa Asamoah Duodu[1], Danela Sadikaj[2], Hellen Ladino[2], Wanlu Li[2], *Dr. Svetlana Bashkova*[1]

[1]Department of Chemistry, Biochemistry, and Physics, Fairleigh Dickinson University, Florham Campus

[2]Department of Chemistry and Biochemistry, Montclair State University

Activated carbons were produced from cashew nut shells using varying urea modification and potassium carbonate (K_2CO_3) activation ratios, with activation temperatures between 700°C and 900°C. The aim was to assess the adsorption capacities of benzoic acid (BA) and carbon dioxide (CO_2) and investigate how modification parameters impact adsorption, surface chemistry, and porosity. Langmuir modeling determined BA adsorption, while thermogravimetric analysis assessed CO_2 adsorption. Potentiometric titration analyzed surface chemistry, and the iodine test evaluated microporosity. The results showed that the sample

activated at 900°C had the highest BA adsorption, attributed to increased microporosity, enhanced graphitization, and a negatively charged surface, which facilitated BA adsorption through π–π stacking and electrostatic interactions. The study also found that increasing the urea ratio and lowering the activation temperature to 700°C enhanced CO_2 adsorption through hydrogen bonding and electrostatic interactions by increasing microporosity and surface acidity. Conversely, a higher K_2CO_3 ratio led to greater microporosity but lower surface acidity, reducing CO_2 adsorption. These findings indicate that activation temperature and the ratios of urea and K_2CO_3 significantly influence the surface chemistry, microporosity, and adsorption performance of activated carbons, offering valuable insights for optimizing these materials in environmental and industrial applications.

ENCAPSULATION OF SPIRULINA AND CATALASE IN CHITOSAN-BASED NANOPARTICLES FOR USE IN TOPICAL ANTI-INFLAMMATORY APPLICATIONS

Ryan Holt, Malak Elkafafi, Antonio Ocampo, Nirmalbhai Kachhadiya, *Dr. Mihaela Leonida, Dr. Ish Kumar*
Department of Chemistry, Biochemistry & Physics, Fairleigh Dickinson University, Metropolitan Campus

Spirulina (S) has been noted for its vast array of health benefits, both when ingested and in topical applications. A potent antioxidant, S has anti-inflammatory and antimicrobial properties. To further the applications in which S can be used, we studied its encapsulation in chitosan-based nanoparticles (CNP). Nanosized particles display increased penetration into the skin and the possibility of controlled release of encapsulated molecules. Chitosan (C), derived from chitin from shrimp, was chosen due to its properties: cationic, inexpensive, antioxidant, and antimicrobial. CNP-encapsulating spirulina was prepared by ionotropic gelation using sodium tripolyphosphate (TPP) as a crosslinker. Catalase (CAT), a strong antioxidant, was also encapsulated in some of the CNP-S matrices.

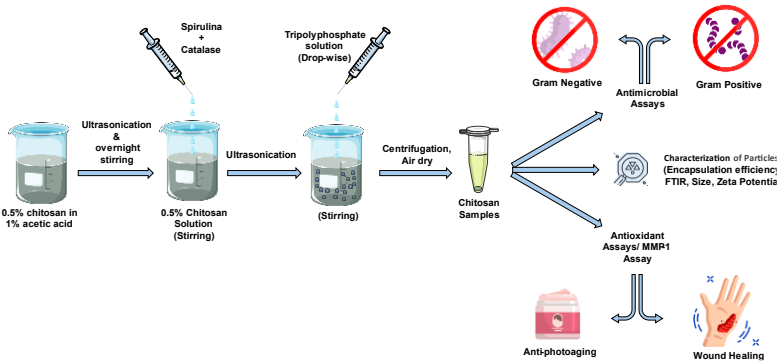

Figure 1. Flow chart of C/S/CAT/TPP composite nanoparticle

Nanomatrices containing different ratios C:S:CAT were prepared and then characterized by FTIR, encapsulation efficiency, and loading capacity of S, size, zeta potential, and kinetics of S release. The CNPs displayed high encapsulation efficiency and sustained release. The influence of encapsulation on CAT activity and the antioxidant effect of the composites were assessed using spectrophotometric assays. The residual activity of encapsulated CAT was remarkably stable over 120 days. The modulatory effect of CNP-S-CAT on the activity of matrix metalloproteinase-1 (collagenase, MMP-1) was assessed using enzymatic assays. All samples displayed antioxidant and anticollagenase activity.

A BIOLOGICAL AND CHEMICAL ASSESSMENT OF THE HACKENSACK RIVER

Kylie Chalfant, *Dr. LoPinto*
Department of Biological Sciences, Fairleigh Dickinson University, Metropolitan Campus

An integral part of the Fairleigh Dickinson University Metropolitan Campus is the Hackensack River, flowing through the two parts of campus. The Hackensack River is an estuary, meaning that as the tides change, the chemical and biological components of the river may change as well. This study was performed over the course of the Fall 2024 semester, recording several chemical characteristics as well as performing assessments on the benthic organisms present. Data was recorded twice a day when the tide was near its highest and lowest depths, and five days a week. The Meadowlands Environment Center had previously recorded data from 2009 to 2014, which was used as a comparison to determine whether or not the Hackensack River's characteristics have changed. All chemical parameters changed with the tide aside from pH, which was relatively constant. Barnacle fragments and scuds were found in the biological analyses. In comparison to legacy data, there have been no major changes in the estuary's chemistry or biology. More consistent and long-term studies

should be performed in the future to continue to monitor a crucial estuary in the Northeastern region.

GREEN SYNTHESIS OF ZEIN-BASED NANOPARTICLES ENCAPSULATING SPIRULINA EXTRACT AND CATALASE FOR SKIN CARE APPLICATIONS

Nirmalbhai Kachhadiya, Antonio Ocampo, Malak Elkafafi, Ryan Holt, *Dr. Mihaela Leonida*, *Dr. Ish Kumar*
Department of Chemistry, Biochemistry & Physics, Fairleigh Dickinson University, Metropolitan Campus

The demand for sustainable and bioactive ingredients in skincare has driven the exploration of nanotechnology-based delivery systems. This study presents a green synthesis approach for zein-based nanoparticles encapsulating spirulina extract and catalase, designed to enhance skin health and protection. Zein (Z), a biodegradable and biocompatible protein derived from corn, provides a stable delivery matrix, while spirulina (S) extract, rich in antioxidants and essential nutrients, helps combat oxidative stress and promotes skin rejuvenation. Catalase (CAT) further enhances the formulation by breaking down hydrogen peroxide, reducing oxidative damage, and mitigating signs of

aging. The nanoparticles were synthesized using an antisolvent method that replaced flammable ethanol with aqueous propylene glycol. Zein solution was maintained under continuous stirring while the spirulina extract and catalase were added. Subsequently, the mixture was poured into water, and particles precipitated (antisolvent method, Figure 1). The addition of anionic GA stabilized the positively-charged zein-based particles. The composites were characterized by FTIR, composition, encapsulation efficiency and loading capacity for spirulina, size, zeta potential, antioxidant effect, and modulatory effect on MMP-1 (collagenase I, matrix metalloproteinase-1) activity. All showed antioxidant and anticollagenase activity. The activity of encapsulated CAT was remarkably stable over 120 days.

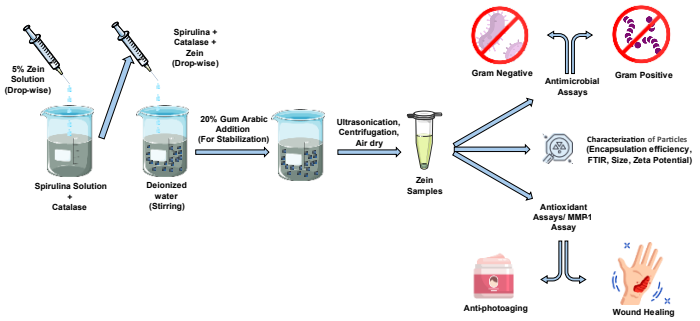

Figure 1. Synthesis of the Z-S-CAT-GA particles

These bioactive nanoparticles offer promise for applications in anti-aging formulations, where their antioxidant properties can protect skin cells from free radical damage and improve overall skin resilience. Additionally, they have the potential for use in wound healing and post-inflammatory hyperpigmentation treatment, helping to accelerate skin repair/discoloration. The controlled release of encapsulated bioactives ensures prolonged efficacy, making this nanocarrier system an ideal candidate for next-generation skincare products.

ANTIMICROBIAL ACTIVITY OF ECO-FRIENDLY ZEIN/SPIRULINA AND CHITOSAN/SPIRULINA NANOPARTICLES

Dharani Sri Reddy Vippala, Bhagyasri Sugasani, *Dr. Alice Benzecry*
Department of Biological Sciences, Fairleigh Dickinson University, Metropolitan Campus

This study aims to assess the antimicrobial potential of nanoparticulate materials towards possible usage in the cosmetic industry. Eco-friendly nanoparticles containing only Generally Recognized as Safe (GRAS) substances- zein, spirulina, and chitosan were tested against three common skin pathogens, *Staphylococcus aureus* (gram-positive bacterium), *Escherichia coli* and *Pseudomonas aeruginosa* (gram-negative bacteria). Zein, a

biodegradable corn protein, enhances moisture retention and cellular absorption, while spirulina, a blue-green algae, provides antioxidant, anti-inflammatory, and anti-aging benefits, improving skin elasticity and reducing wrinkles. Chitosan, a biocompatible polysaccharide, is a well-known antimicrobial agent and catalase (CAT) is a strong antioxidant. The minimum inhibitory concentration (MIC) was determined for each nanoparticulate containing different ratios of zein/ spirulina/CAT and chitosan/spirulina/CAT. Antimicrobial efficacy was evaluated using 96-well plates. Results demonstrated that the nanoparticles effectively inhibited bacterial growth, highlighting their potential as safe, effective ingredients in skincare formulations for mature skin. These findings support their use as a natural alternative to harmful synthetic chemicals in conventional topical products.

EXPLORING MECHANISMS OF BINDING OF CATECHOL DERIVATIVES TOWARDS CATALYTIC DOMAINS OF MMP-9

Manoj Kumar Depuru[1], Priyanka Meda[1], Prachet Trivedi[2], *Dr. Ish Kumar[1]*

[1]Department of Chemistry, Biochemistry & Physics, Fairleigh Dickinson University, Metropolitan Campus

[2]Monmouth County Academy of Health and Science

The catechol derivatives analyzed in this study include (-)-epinephrine, (±)-epinephrine, L-DOPA, norepinephrine, metanephrine, levodopa, and dopamine. Matrix metalloproteinases (MMPs) are zinc- and calcium-dependent enzymes essential for various physiological and pathological processes, including inflammation, wound healing, tissue remodeling, and embryogenesis. Due to their critical roles, identifying molecules that regulate MMP activity is a key focus in clinical research. Tissue inhibitors of matrix metalloproteinases (TIMPs) tightly regulate MMP activity to prevent excessive tissue degradation. However, dysregulation of MMP activity has been linked to conditions such as rheumatoid arthritis, cardiovascular diseases, and cancer metastasis. Our lab has recently reported active-site inhibitors and catechol-based exogenous activators of MMPs.

Docking studies with these modulators suggest the presence of at least one allosteric site within the catalytic domain, where an activator can bind to enhance enzyme activity. In this study, we investigate a broad range of catechol derivatives, with a focus on their interactions within both sites of the catalytic domain of MMP-9. Detailed kinetic analyses and curve fitting using Dynafit 4.0 indicate that these modulators bind to two distinct sites: the active site and the allosteric site. Binding to the active site leads to inhibition, whereas binding to an allosteric-site results in enzyme activation. We determined the binding constants for both sites, revealing that catechol derivatives with a charged side chain at position 4 exhibit a higher affinity for the active site, promoting inhibition. Conversely, derivatives with uncharged side chains display stronger allosteric effects due to their lower affinity for the active site.

TARGETING AN ENZYME-FREE GLUCOSE SENSOR USING A RUTHENIUM MOLECULAR COMPLEX AND POYL(ANILINE) (PANI) FOR DIABETES MANAGEMENT

Allysa Gamlanga, Hiba Zahoui, *Dr. Yosra Badiei*
Saint Peter's University

Diabetes management relies on continuous glucose monitoring (CGM) systems, but existing enzymatic glucose sensors face challenges such as high production costs and instability. This study explores the development of a non-enzymatic electrochemical glucose sensor for convenient, cost-effective, and sensitive glucose sensing. The electrochemical polymerization of aniline monomers and oxidation to poly(aniline) (PANI) was performed using fluorine-doped tin oxide (FTO) electrodes, the anode of the electrochemical cell. Bulk electrolysis at varying polymerization times and concentrations was performed to study the formation of the PANI polymer on the surface. Electrochemical characterization using cyclic voltammetry (CV), ATR-IR and UV/visible spectroscopy confirmed successful PANI deposition. The sensor will be further fabricated by incorporating Ru molecular complex, $[Ru(tpy)(bpy)(OH_2)]Cl_2$ (tpy = terpyridine, bpy = bipyridine ligand) into the polymer surface through

immobilization coating experiments. A comparative study through electrochemical testing will be shown to evaluate the performance of Ru-PANI-FTO compared to PANI-FTO and bare FTO (control) for sensing glucose in alkaline solutions.

POLYMER BRUSH BIOCOATINGS AS ANTI-INFECTION SURFACES

Jonathan Nunez, Kyle Richards, Katrina Cabinian, *Dr. Christian Traba*
Department of Chemistry, Biochemistry & Physics, Fairleigh Dickinson University, Metropolitan Campus

In this study, plasma chemistry and a "Grafting-From" technique were used to modify the physicochemical composition of different biomaterials. More specifically, covalent bonds were formed from the surface of the biomaterial to the allyl group of an innovative cationic monomer. In doing so, we were able to engineer polymer brushes from the surface of a biomaterial, creating biocoatings that were stable, biocompatible, and active against adherent bacteria. We report that variation in the positively charged polymer brush density and polymer chain length offer different antibacterial and anti-biofilm activities. Further studies revealed that the antibacterial activity of

grafted surfaces had two distinct mechanisms of action (1) reducing bacterial attachment and (2) eradicating adherent bacteria upon adhesion. The excellent anti-infection activity of these polymer brush biocoatings, were initially investigated through stationary cultures and later confirmed in a micro-fluidic cultivation system that modeled the in vivo conditions of an implanted catheter. The information gathered from these investigations suggest that the positively charged brushes achieved under appropriate grafting conditions may be employed to prevent infections on both implants and medical devices.

QUATERNARY AMMONIUM MONOMERS AS BACTERIOSTATIC NANOCOATINGS

Janeen Darwish, Camila Mafla-Gonzalez, *Dr. Christian Traba*
Department of Chemistry, Biochemistry & Physics, Fairleigh Dickinson University, Metropolitan Campus

Our group has studied the toxicity and mechanism of action of quaternary ammonium compounds (QACs). From this work, we have designed and synthesized an innovative quaternary ammonium monomer (QAM) to possess three short alkyl chains and an allyl group. As a result, the long carbon chain

required for alkyl insertion, which is commonly accepted as the killing mechanism for QACs is removed, and drastically reduces their toxicity towards tissue cells. In addition, the terminal carbon – carbon double bond of the QAM, is used to facilitate a free-radical polymerization reaction, and is initiated by an argon plasma-assisted "Grafting-From" technique. With plasma grafting technology and the "Grafting-From" approach, the innovative QAM can be covalently bound to the surface of a biomaterial, therefore creating a polymer brush layer (nanocoating). When constructed properly, these stable nanocoatings offer a wealth of opportunities including biocompatibility, antibacterial activity, bioengineering, and drug delivery abilities. In this study, we report that quaternary ammonium polymer nanocoatings (QAPNs) with appropriate polymer brush density and brush length behave as anti-adhesive materials, that are both biostatic and non-toxic towards tissue cells.

THE EFFECTS OF HALOPERIDOL ON CRAYFISH MOVEMENT IN RESPONSE TO FOOD STIMULI

Jade Castro, Gulianna Eggart, Niurka Castro, *Dr. Josh Stout*
Department of Biological Sciences, Fairleigh Dickinson University, Metropolitan Campus

The goal was to observe if haloperidol's dopamine-antagonistic effects will decrease crayfish movement. In the control trial, in a 6x15 tank, a crayfish was acclimated with 2L of DI at 20°C, and movement was recorded for 20 minutes after adding 1ml of food concentrate to the opposite end of the tank. In the experimental trial, 2ml of 3.26µM/mL haloperidol was added to the opposite end of the tank along with 1 ml of the same food concentrate. The number of times the head of the crayfish crossed any of the gridlines was observed and used to track the movement of the crayfish. After combing the results from the two labs with each having a control and experimental trial, the control group (N=14) exhibited a total of 1,203 movements with 30.58 movements per minute (SD= 18.38). The haloperidol group (N=13) showed a reduction in movement with the total being 643 movements with an average of 16.08 movements per minute (SD= 9.04). Conclusion: The results support the hypothesis that haloperidol reduces crayfish

movement due to its role in DA inhibition by blocking D2 receptors in their basal ganglia. This decrease in movement in the experimental group suggests that DA plays a major role in crayfish motor activity.

THE EFFECTS OF DOPAMINE AND HALOPERIDOL ON DAPHNIA HEART RATE

Mahasin Izquierdo, Janeen Darwish, Kyle Richards, *Dr. Josh Stout*
Department of Biological Sciences, Fairleigh Dickinson University, Metropolitan Campus

The goal of the experiment was to determine how dopamine and haloperidol affect the heart rate of Daphnia. We hypothesized that exposure to dopamine would increase heart rate, while haloperidol, a dopamine antagonist, would reduce this effect. To test this, Daphnia were first placed in DI water as a control, and heartbeats per minute were recorded under a microscope for one minute. Next, Daphnia were exposed to a 3.26 μM dopamine solution for ten minutes, and their heart rate was measured again. Lastly, a 3.26 μM haloperidol solution was introduced for ten minutes, and the heart rate was recorded. The mean heart rate, and standard deviation were calculated across

all conditions. The mean for the control was 267 BPM (beats per minute) (SD 85.47). The mean for the dopamine treatment was 330 BPM (SD 32.87). The mean for the haloperidol experiment was 173 BPM (SD 94.17). Results showed that dopamine increased heart rates, but the results were not significant (P = 0.14), while haloperidol decreased heart rate, yet was borderline statistically significant (P= 0.052). These findings suggest that dopamine has a stimulating effect on Daphnia cardiac activity, and haloperidol may have inhibitory effects.

DOPAMINE ACTING TO INHIBIT MOVEMENT IN MARBLED CRAYFISH *PROCAMBARUS VIRGINALIS*

Christopher Jean, Tommy Villegas, Jelani Richards, Mira Sarabamon, and Purnima Sengupta,
Dr. Josh Stout
Department of Biological Sciences, Fairleigh Dickinson University, Metropolitan Campus

The standard dopamine model only considers its stimulatory effects in driving desire. It does not account for its inhibitory role when the reward is received. This study aims to address the gap by introducing the Donkey and Carrot Model, which offers a thorough understanding of dopamine's dual role. It not only measures the reward potential but

also inhibits motivation when the reward is acquired. To test the aim, crayfish (*Procambarus virginalis*) were employed to provide data on dopamine's effect on motivation and activity over time. An experimental method was used to observe their movement in controlled and dopamine-exposed conditions once a week for six weeks. In the control portion, crayfish were exposed to food solution, while in the experimental portion, they were exposed to food and dopamine solutions. Movement was quantified by counting how many times the crayfish crossed a gridded tank within a 20-minute period. Results in the control portion (Line A) had a high mean movement rate (7.88 min^{-1}, SD = 1.79, N = 27) compared to the experimental portion (Line B), which had a mean movement rate of 6.85 min^{-1} (SD = 1.73, N = 20). The findings suggest that dopamine inhibits motivation, supporting the Donkey and Carrot Model in explaining its dual role in reward processing and potentially contributing to broader neurological research.

THE P38 MAP KINASE FAMILY GENE, PMK-1, REGULATES ACTIN NUCLEATION DURING DEVELOPMENT

Avery LaRusso, *Dr. Andre Wallace*
Department of Biological Sciences, Fairleigh Dickinson University, Metropolitan Campus

An organism's development requires the meticulous process of cell migration. Although there is a wealth of knowledge about the process of cell migration, all the details on how it occurs have not been fully described. There are numerous disorders that have been linked to abnormalities in cell migration. For example, individual and collective cell migration mechanisms are altered in cancer cells. Defective cell migration has also been linked to improper neuronal development contributing to the occurrence of numerous neurodegenerative diseases. In *Caenorhabditis elegans*, the WAVE/SCAR pathway has been shown to regulate epidermal cell migration during embryonic morphogenesis. WAVE receives signals from three axonal guidance receptors (SAX-3, UNC-40, and VAB-1) to nucleate branched actin and initiate cell movement. Actin, specifically filamentous actin (F-actin) plays a crucial role in the closing and formation of embryos in *C. elegans*. During the ventral enclosure step of morphogenesis, actin becomes enriched at the leading edge of the

migrating cells and promotes enclosure. We examined actin levels in *pmk-1* mutants by crossing in an actin reporter. Actin imaging was also performed on *pmk-1* RNAi mutants. Loss of PMK-1 resulted in an overall increase of actin in the ventral epidermal cells. We also examined actin levels in double mutants of *pmk-1* and the three axonal guidance receptors. Our preliminary analysis suggests that there is a slight increase in actin levels when both vab-1 and pmk-1 are mutated together. These results are in line with the increased embryonic lethality we see in vab-1 mutants when *pmk-1* is mutated. We intend to further investigate the role PMK-1 plays during the actin nucleation step of embryogenesis. However, our data strongly suggests that PMK-1 does have a role and likely in response to stimuli from one or more of the axonal guidance receptors.

AN RNAi SCREEN TO IDENTIFY CELL MIGRATION REGULATORS IN *C. elegans*

Johnna Mainhart, *Dr. Andre Wallace*
Department of Biological Sciences, Fairleigh Dickinson University, Metropolitan Campus

The *Caenorhabditis elegans* genome is 60-80% homologous to humans making it invaluable to genetics research that improves our understanding

of humans. Cell migration is a critical process in the functioning of mammalian organisms. In fact, it helps to regulate development, wound healing, immune response and other important biological processes. Numerous disorders have been linked to abnormal cell migration, one of which is cancer metastasis. Actin polarization is a key step during cell migration. In *C. elegans*, actin is a thin filamentous protein that forms a cytoskeleton, and this is highly similar to the human cytoskeleton. One of the pathways that promote proper actin nucleation is the WAVE/SCAR pathway. The WAVE/SCAR complex is activated in response to signals from three axonal guidance receptors (SAX-3/robo, VAB-1/ephrin and UNC-40/netrin). Activation of WAVE turns on ARP2/3, a known actin nucleator, triggering the formation of branched actin and forcing the cell to move. In *C. elegans*, ventral epidermal enclosure has provided a model for us to study WAVE pathway function. There are six rows of epidermal cells that form, actin gets enriched at the leading edge of these cells, forcing them to migrate until they meet. Mutation of any gene in the WAVE pathway prevents proper actin nucleation and leads to a failure in epidermal closure, ultimately causing death. To identify genes that function in the WAVE pathway, we designed an RNAi screen for enhancers and suppressors of *sax-3* embryonic lethality. Mutation of SAX-3

results in approximately 40% of dead embryos. So, we screened for genes that enhanced the embryonic lethality by more than 15% or suppress the lethality by more than 15%. From a list of 500 genes screened, 25 enhanced the lethality and 2 suppressed the lethality. The genes identified have mammalian orthologs and have known functions ranging from early embryonic development to neuronal migration in adults. A subset of these genes will be further investigated to define their exact role in the WAVE pathway during cell migration.

THE EFFECTS OF LONG TERM VERSUS SHORT TERM HALOPERIDOL EXPOSURE ON CRAYFISH MOVEMENT

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Dopamine is understood to be a stimulant, but its effects on invertebrates are not well studied. To determine if dopamine (DA) is a stimulant or a movement inhibitor in crayfish, the effects of dopamine and the dopamine blocker haloperidol on crayfish movement were measured. Treatments

were compared to the control, 1ml of food filtrate in 4L of de-ionized water. All crayfish were observed for 20 minutes, and movements were recorded each minute. Haloperidol (HA) was used as a non-selective dopamine receptor antagonist known to inhibit movement in vertebrates. Crayfish were exposed to 3.26 µM HA and observed. Exposure to haloperidol for twenty minutes was found to significantly increase the average movements per minute, indicating that short term dopamine inhibition is stimulatory. Conversely, haloperidol exposure over a four hour period demonstrated the lowest mean movements per minute. Dopamine exposure (3.26 µM) showed no significant difference from the control of food filtrate only.

CONVENTIONAL SCREENING OF ANTIMICROBIAL ACTIVITIES OF NCI NATURAL PRODUCT V LIBRARY

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The high level of antibiotic-resistant microbes which is currently impacting human health highlights the urgent need for the identification of new chemotherapeutic compounds with

antimicrobial activity. It is estimated that ~42,000 deaths were recorded in the United States in 2022 alone. One of the most prolific sources of antimicrobial screening has been the National Cancer Institute (NCI)'s molecular libraries. This study is evaluating the antimicrobial potential of the NCI Natural Products Set V consisting of 390 structurally diverse compounds. Each compound was tested against a panel of three common microbial pathogens *Candida albicans* (yeast), *Escherichia coli* (Gram-negative bacteria) and *Staphylococcus aureus* (Gram-positive bacteria) resulting in the identification of 102 hit molecules with antifungal and/or antibacterial activity. The results show that many potent antibiotic compounds from nature remain unidentified.