MISSION COLLEGE
SUMMER RESEARCH
SCHOLARS’ ABSTRACTS & POSTERS

UC SANTA CRUZ
CAL STATE EAST BAY
SLAC NATIONAL ACCELERATOR LABORATORY
USDA United States Department of Agriculture

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Summer 2020 marks Mission College’s third year of STEM Summer Research experience. Our Summer Research program continues to provide our STEM students with the experiential learning they need to help them succeed in their educational journey.

Despite its challenges, Summer 2020 proved to be a productive one for both our faculty and students. Three of our faculty members, Dr. See Chan (Biology), Dr. Ashley Faris (Chemistry), and Dr. Bob Schaffer (Engineering) supported and mentored five of our students on summer projects and research. We were also fortunate to have been able to continue our partnership with SLAC and CSUEB and placed two of our students under the mentorship and guidance of their scientists/researches.

This year, three of our Summer Research Scholars submitted research abstracts and were invited to present at the Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS), the Annual Biomedical Research Conference for Minority Students (ABRCMS), and Sigma XI, The Scientific Research Honor Society. Last year, three Mission College students were accepted to present their research and work at SACNAS for work completed in summer 2019, and at the American Society for Engineering Education (ASEE) for work completed in summer 2018.

Mission College STEM students continue to excel and shine! We are proud of all of them and this booklet is one way to commemorate their achievement.
Over the recent years relevant scientific research has drastically changed. The isolation of careers has slowly diminished as more fields are becoming interdisciplinary. Current experiments within the general chemistry II course at Mission College are archaic and outdated, resulting in students being ill-equipped and unable to fully grasp the techniques used in the laboratories. Since this course is a requirement for several degrees, an important aspect of this internship was to engage the students in understanding why chemistry is important in their respective fields like health sciences, geology, engineering, etc. The goal of this research was to obtain 12 – 15 relevant and intriguing experiments that would emphasize on core lecture material while encompassing different career paths.

At the start of the internship we began in the conceptual phase, bringing ideas of what would be exciting and interesting for students. The primary tool used in this research was the American Chemical Society publication, the Journal of Chemical Education. In no particular order, the criteria for choosing potential experiments were as followed; is the experiment interesting? What educational level is the experiment suited for? If a higher understanding of chemistry is required, are there modifications to associate it for lower-level students? How harmful are the chemicals used? Did the experiment relate to course objectives or important topics? Is it a sustainable experiment? Can we reduce the amount of waste produced post-experiment?

Due to shelter in place mandates, the testing of the experiments was unable to be performed during the internship. However, this did allow us to fully explore with in-depth research of a greater volume of potential experiments than would have been possible if we were in the laboratory. By the end of the internship, we found 6 experiments that fit the criteria. We expect the remaining experiments to relate to topics or techniques not yet explored by the previous 6 experiments.
Out with the Old, In with the New: Revamping General Chemistry II Experiments

Student: Valentina Ruiz
Professor: Dr. Ashley Faris

Objective

The goal of this research was to find 12-15 experiments that dealt with relevant research, related chemistry to a variety of career fields, and made performing chemistry fun.

Background

Chemistry research has rapidly evolved over the last several years. While some laboratory techniques have become a staple for chemistry, the experiments have become archaic, leaving students unprepared to work on current research. In the effort to both engage and prepare students at Mission College for future endeavors in chemistry and elsewhere, it was decided to revamp the experiments in the general chemistry II course.

Questions to Consider

- Does the experiment relate to the course objectives or important topics?
- What educational level is the experiment suited for? If a higher understanding of chemistry is required, are there modifications for lower-level students?
- Is the experiment interesting?
- What is the toxicity of the chemicals used?
- Is the experiment relatively inexpensive?
- Is the experiment sustainable?

Future Work

Future works consist of obtaining data of the 6 established experiments that will form a guide to future Mission College general chemistry II professors of materials list, experimental results, and common errors. More work will also be done to gather 6–9 experiments that relate to the topics and techniques in the course objectives not demonstrated in the first 6 experiments obtained.

Results

The sole source of the experiments found was the American Chemical Society publication, the Journal of Chemical Education.

   - Students will learn to synthesize nanoparticles through diffusion and pipetting to help solve the important issue of water pollution.

2. Sizzle and Fizzle of Bath Bombs
   - In this fun and inexpensive experiment, students learn about kinetics by making and testing bath bombs in varying temperatures while getting an insight into the chemistry of cosmetics.

3. Urinalysis and Prenatal Health
   - In this urinalysis experiment, students learn about health equity while also improving their knowledge of organic functional groups by determining the effects of their presence in urine.

4. Detecting Microplastics in Soil and Sediment
   - This experiment gives students the opportunity to master solution concentration calculations as well as gain practice in solution preparation. It also improves students’ environmental awareness while teaching the importance of research.

5. Baby Wipes as a Buffer System
   - In this experiment, students dive into acid-base chemistry. They learn about buffers and use this knowledge to calculate and determine the pH of baby wipes.

6. Electrochemistry with Common Objects
   - In this green alternative experiment, students learn about the electrochemistry of common objects while practicing a set of skills not limited to pipetting, solution preparation, mixing, and data analysis. They compare the reactivity of different U.S.-based coins by testing the efficiency of the current produced in varying standard solutions.
This summer in the STEM core program I migrated three different websites for the Operational Power Systems Department to a new framework, conducted a research study on the effects of web design on users across demographics, and adapted a guidebook on using Drupal 7. These websites needed to be migrated to a different platform because they were hosted on decaying infrastructure. Using Drupal 7 as the web content management system I rebuilt the websites as well as documenting and replacing all files and links from an old server to an updated one. Drupal was used because it is a widely used software that allows for multiple creators to build a website and has many built-in tools that help establish workflows along with many other functions that help with constructing a website. Drupal is also an open-source platform which means that it is free to use and developers can change the software to improve it which allows it to be more customizable. I moved the content from the decaying website to the new website which consisted of transferring links to other websites, written content, files, and photos over to the new site. Along the way, I troubleshooting any errors and designed the layout of the websites once the content was successfully transferred over. I also adapted a guidebook on Drupal 7 that was created by past summer interns and updated it with more information that future editors of the websites can utilize. My work on building these websites made me curious about the effects of web design on user’s impressions and if they varied across different demographics such as age and how many hours spent using technology each day. Prior research has shown that website design affects the user’s overall impressions, time spent, and prolonged use of a website. But there is limited research on how a user’s demographics affect their impressions of a website. Using a survey to collect participant’s age, gender, educational level, time spent using technology (computer, laptop, and smartphone), and overall technological literacy I did not find any significant results based on demographics both due to a small and fairly homogeneous sample size. However, the data did show that users were affected by website design which did affect their use of a website. A majority of participants favored the newer designs over older styles as well as more familiar text design rather than unusual ones. In the future, if this survey were sent to a larger diverse sample size the results could be used to look further into whether demographics play a role in user’s impressions of websites.
Managing Websites with Drupal 7 and User’s Impressions

Sophia Chadsey
September 17, 2020

BOLD PEOPLE. VISIONARY SCIENCE. REAL IMPACT.

Editing view - Homepage

Accelerator Power Systems

missioncollege.edu
The European honey bee (Apis mellifera) is a generalist pollinator that was introduced to California for agriculture. California is a global biodiversity hotspot and one of only 5 Mediterranean-type ecosystems in the world, with hundreds of unique flowering plant species found nowhere else. Given the abundance of honey bees in California ecosystems, it is important for plant conservation to understand if they are actually pollinating plants or nectar robbing. Nectar robbing would indicate that the bees are accessing the plants’ rewards without returning the favor of pollinating them.

In this study, we use citizen science data submitted through the app iNaturalist to analyze the frequency of legitimate pollination versus nectar robbing in Lamiaceae plants within California. We predicted that honey bees would rob native plants more than non-native plants rather than visiting them legitimately.

120 photos were gathered from iNaturalist observations that were identified as honey bees, gathered over the course of 2 weeks. We selected only research-grade observations (those that have at least 3 community identifications on the iNaturalist platform) that had been identified as a honey bee, and that occurred within the state of California. A binomial test was conducted to determine whether the presence or absence of nectar robbing was true or simply due to random chance if both outcomes were equally likely. Finally, to answer the question of whether plant status (native or non-native) had any bearing on the robbing status, a chi-square test of independence was performed only using data in which the plant status from the observation was known. From this study it can be concluded that although honey bees are an invasive species in California, it has been demonstrated to pollinate more than nectar rob, possibly contributing to Lamiaceae reproduction.
Are Honey Bees Nectar Robbers?
Gary Kong
HSI-STEM, Mission College
Department of Biological Sciences, California State University East Bay

MissionCollege.edu

Background
- The importance of honey bees as a pollinator peripheral tax is in California for their ability to produce food and support ecosystems.
- The behavior of bees when they land on flowers is not ideal, which can potentially harm plants.
- Studies have shown that bees can be found in various locations, including flowers and plants.

Methods
- Over a period of 3 weeks, photos were taken of bees that were seen nectar robbing on hundreds of native and non-native plants.
- Bees were observed for 10 minutes at each location to determine the frequency of visits. Bees were categorized as being native or non-native to the study area.
- The behavior of bees on native and non-native plants was recorded.

Results
- Bees were observed nectar robbing on hundreds of native and non-native plants.
- The behavior of bees on native plants was found to be more frequent than on non-native plants.

Discussion
- The results suggest that honey bees are more likely to rob native plants than non-native plants.
- This behavior may have negative implications for the health of native plants and the ecosystem.
- Further research is needed to understand the impact of this behavior on the ecosystem.

Table of Figure 1

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Table of Figure 2

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</tr>
<tr>
<td>Non-native (NN)</td>
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<td>14</td>
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Figure 1. Frequency of visitation behaviors (hitting hole in flower to rob, illegitimate visitation through front of flower, possible contact with flower reproductive parts, unknown).

Figure 2. Frequency of robbing in native and non-native Lamiaceae plants.

Figure 3. Honey bee nectar robbing Mimosa hostilis

Figure 4. Jerusalem sage nectar robbed by honey bee

Figure 5. Nectar robbing of a Lamiaceae family flower

Figure 6. Lamiaceae being nectar robbed

Figure 7. Honey bee legitimately visiting a desert lavender

Figure 8. Cleveland sage legitimately robbed by honey bee

Figure 9. Honey bee legitimately visiting thyme
Osteoarthritis (OA) is a degenerative disorder characterized by cartilage degradation and inflammation of synovial joints. Nitric oxide (NO) and prostaglandin E2 (PGE2) mediate inflammation and pain in OA besides up-regulating levels of proteases leading to cartilage degradation. Deer antler is a traditional nutritional supplement used in many Asian countries but is not well studied. It has been reported to attenuate pro-inflammatory cytokines and may potentially be a therapeutic agent for OA. This study investigates the effects of different concentrations of deer antler on interleukin-1 beta (IL-1β)-induced release of NO and PGE2 using bovine cartilage explants. Two 6mm diameter cartilage discs were cultured per well in a 48-well plate with DMEM:F12 media for 2 days before receiving five different treatments. Treatments included 10% fetal bovine serum (FBS) control, 20ng/mL IL-1β, and 20ng/mL IL-1β with three different concentrations of deer antler; 2, 5, and 10mg/mL. Conditioned media were collected at 0, 1, 2, and 3 days and stored at 4°C for NO and PGE2 assays. All concentrations of deer antler did not significantly suppress IL-1β-induced levels of NO for all three different days although 2mg/mL deer antler showed a numerical attenuation of NO release (% relative to 0 hour) by about 101% compared to IL-1β on day 3. There was no significant difference in PGE2 levels for all treatments on days 1 and 2. On day 2, numerical decreases in PGE2 relative to IL-1β from 1582 to 1553, 1335, and 966pg/mL were observed for 2, 5, and 10mg/mL deer antler, respectively. All treatments of deer antler showed a significant reduction in PGE2 levels relative to IL-1β on day 3. These results suggest that one of the mechanisms for possible anti-inflammatory property of deer antler is in suppression of PGE2. The significance of NO elevation with deer antler needs to be further explored.
Effects of Deer Antler Nutraceutical on Inflammatory Mediators Implicated in Osteoarthritis

Student: Jennifer Voong; Professor: Dr. See Chan
Biological Sciences Department

Objective
The objective of this study is to investigate the effects of different concentrations of deer antler (DA) on interleukin-1 beta (IL-1β) induced release of nitric oxide (NO) and prostaglandin E2 (PGE2) using bovine cartilage explants.

Background
- Deer antler has been demonstrated to possess anti-inflammatory properties1.
- IL-1β is a key inflammatory cytokine able to induce inflammation and catabolic effects2.
- NO and PGE2 are mediators of inflammation and pain in osteoarthritis3,4.

Methods

48-well plate with two 6 mm bovine cartilage explants per well bathed in DMEM:F12 for 2 days before treatments were administered.

Treatments administered to wells. Plate was incubated at 37°C.

200ng/mL IL-1β used to induce NO & PGE2 release.

Conditioned media collected each day, stored at 4°C for NO and PGE2 assays.

Results

% NO Concentration relative to day 0, with DA treatments for 3 days

- All concentrations of DA did not show significant suppression of NO release induced by IL-1β on all 3 days of culture (Fig. 1-3).
- On day 3, 2mg/mL of DA showed a numerical decrease by 101% compared to IL-1β (Fig. 3).

Conclusion
To our knowledge, this study is the first to examine the effects of deer antler on inflammatory mediators using bovine cartilage explant culture. The results demonstrated that deer antler did not suppress NO production induced by IL-1β. However, PGE2 levels decreased significantly on day 3 with all concentrations of deer antler suggesting a mechanism for its possible anti-inflammatory effect.

References

Acknowledgements
I would like to thank Dr. Chan, for guidance and for giving me this opportunity. To Uma Nagarajan for helping us get setup in the laboratory. Also, to Raiida Thompson and HSI-STEM for organizing this summer research program as well as the Biological Sciences department for supporting this program.
Introduction: There is an increasing number of patients affected by osteoarthritis (OA) both in the US and worldwide. OA is one of the leading causes of disability in the US. Inflammation and pain are two major symptoms of OA. Astaxanthin is a relatively new nutraceutical that has not been well studied mechanistically. Few studies that exist implicated astaxanthin as possessing anti-inflammatory property, and it is touted as a natural therapeutic agent for OA.

Objective: To determine the effects of different physiologically relevant concentrations of astaxanthin on nitric oxide (NO) and prostaglandin E2 (PGE2), known pain and inflammatory mediators of OA, using an interleukin-1 beta (IL-1β) induced cartilage explant model.

Methods: Two 6mm bovine cartilage explants were cultured per well in a 48-well culture plate and maintained in DMEM/F-12 media for 48 hours before treatment started. There were five treatments; FBS control; FBS + 20ng/ml IL-1β; FBS + IL-1β + 5ug/ml astaxanthin; FBS + IL-1β + 15ug/ml astaxanthin and FBS + IL-1β + 30ug/ml astaxanthin. 10% FBS was used in all treatments. Conditioned media were collected at 0, 24, 48 and 72 hours, stored at 4°C, and then used for NO and PGE2 analyses.

Results: IL-1β induced release of NO (expressed as % relative to 0 hour) in the media was significantly decreased by 5 and 30ug/ml astaxanthin at all timepoints. The suppression of % NO release with 5 and 30ug/ml astaxanthin at 48 and 72 hours were to the levels of FBS control. All concentrations of astaxanthin numerically abrogated IL-1β stimulated PGE2 release at 48 hours. Significant reduction of PGE2 to levels comparable to FBS control was observed at 72 hours with 5, 15 and 30ug/ml astaxanthin.

Conclusion: Astaxanthin suppressed NO and PGE2 releases into the media in our in vitro culture. This study supports the purported anti-inflammatory ability of astaxanthin and its potential as OA treatment.
Physiological Concentrations of Astaxanthin Demonstrated Suppression of Inflammatory Mediators in In Vitro Cartilage Explant Culture

Jane Yen Nguyen
Dr. See Chan, Biological Sciences Department.

Introduction:
* Osteoarthritis (OA) is one of the leading causes of disability in the US. Inflammation and pain are two major symptoms of OA.
* Astaxanthin is a relatively new nutraceutical. Few studies that exist implicated astaxanthin as possessing anti-inflammatory property, and it is touted as a natural therapeutic agent for OA.

Objective:
* To determine the effects of different physiologically relevant concentrations of astaxanthin on nitric oxide (NO) and prostaglandin E$_2$ (PGE$_2$), known pain and inflammatory mediators of OA, using an interleukin-1 beta (II-1B) induced cartilage explant model.

Methods:
* Two 6mm bovine cartilage explants were cultured per well in a 48-well culture plate and maintained in DMEM/F-12 media for 48 hours before treatment started. This in vitro culture followed protocol established by Chan et al. (2006)\(^2\).

Results:
* IL-1B induced release of NO (expressed as % relative to 0 hour) in the media was significantly decreased by 5 and 30ug/ml astaxanthin at all timepoints (A, B & C).
* The suppression of % NO release with 5 and 30ug/ml astaxanthin at 48 and 72 hours were to the levels of FBS control (B & C).

Results (cont.):
* All concentrations of astaxanthin numerically abrogated IL-1B stimulated PGE$_2$ release at 48 hours (E).
* Significant reduction of PGE$_2$ to levels comparable to FBS control was observed at 72 hours with 5, 15 and 30ug/ml astaxanthin (F).

**Different letters for values at each marker indicate significant (p < 0.05) differences between treatments.

Conclusion:
* Astaxanthin suppressed NO and PGE$_2$ release in our in vitro culture.
* This study supports the purported anti-inflammatory ability of astaxanthin and its potential as OA treatment.

References:

**Different letters for values at each marker indicate significant (p < 0.05) differences between treatments.

* AANAPISI
* HSI
* MISSION COLLEGE SANTA CLARA
Our Summer internship consisted of working with Professors Castronovo and Schaffer, as well as Luis Morfin. The main objective of the project was to design a 3D game that would assist in the Engineering 10 class to help students grasp the concept of Wind energy. The ENG 10 course is an introductory to engineering course that students take to get an introduction to electrical engineering, physics engineering, etc. Research included resources from the lab the game would assist with, descriptions and break-down of the in-class materials the students would use to create their labs, and common issues that the students would face were addressed in the outlining blueprint of the game design.

Getting started we had to learn two programs to create our 3D game. The first program we learned was SketchUp, in which we learned how to take basic shapes and manipulate them to create real life-like objects, for example the multi-meter to measure electric current being generated. The next step was to create a game design based off our demographic, and the use of the game. We created an analysis paper which addressed questions like, “Who is the game audience?” and “What objective does the audience need to learn by playing this game?” We then learned the program Unity, that took the objects we built in SketchUp, and created a 3D interactive environment. From there Luis took over majority of the coding, and made the environment interactive, for example you can alter the lighting of the house in the game.

The result of our summer internship was a 3D interactive game that teaches a student the basics and results of wind energy. This game can be used in future classrooms to help assist with the education of a working turbine, and the energy levels alternative electricity sources stem from.
The purpose of the experiment was to find a method of DNA isolation that ensured a pure DNA sample was obtained and measure the difference in ultra-violet radiation absorbency between double-stranded DNA and single-stranded DNA. In order to extract the DNA from the strawberries, the strawberries were pulverized and mixed with a lysis buffer. The strawberry mixture was then filtered out to isolate the thin components and the solid strawberry debri. To separate the DNA out from, ethanol was used to extract the DNA from the homogenous mixture and purified the DNA even more. The DNA was then spooled together and transferred to another cuvette and mixed with ethanol to further purify the DNA. Because the absorbance of the solution was higher than two, a serial dilution was completed in order to have a more feasible solution.

The results showing the relevant absorbance was what we expected in the wavelengths expected from proteins and DNA absorbing light. There was a small peak at each wavelength-260 for DNA and 280 for proteins-relative to the rest of the wavelengths. There were some issues when measuring the DNA after the solution was heated in a water bath. The absorbance at 280 had either remained stagnant or it decreased a small increment. After repeating the experiment, the results were the same. This may have been because of issues with purifying the substance or the DNA not being able to fully denature due to the histones bound to it.
WHAT EXACTLY IS DNA?
DNA or Deoxyribonucleic Acid is an essential molecule comprised of two strands that form a double helix and carry the information necessary for an organism or virus to grow and thrive.

THE EXTRACTION PROCESS:
1. LYSING THE CELLS
   - Since DNA is in the nucleus, we have to disrupt the bonds holding together the Plasma & Nuclear membrane with a detergent.

2. FILTERING OUT LARGE DEBRI
   - A vacuum was used to facilitate the filtration of smaller cellular components.

3. PRECIPITATING OUT DNA
   - Ethanol was used to help precipitate the DNA because of its density & its low dielectric constant

4. RESUSPENDING DNA
   - The DNA was spooled out and resuspended in Ethanol.

THE ABSORBANCE OF UV LIGHT:
What determines whether a molecule will absorb UV light or not?
- Molecules that contain pi electrons or non-bonding electrons are able to absorb the energy in the form of UV light to excite these electrons to higher anti-bonding molecular orbitals.

What do pi electrons have to do with DNA?
- DNA is composed of nitrogenous bases, which consist of aromatic rings; the aromatic rings have plenty of pi bonds that absorb UV light.

Why does denaturing DNA increase the absorbance in the UV range?
- By breaking the Hydrogen bonds between the two strands, the nitrogenous bases are then no longer shielded by the sugar-phosphate backbone and can interact more with light.

Why does DNA absorb light of a specific wavelength?
- Electrons jump energy levels with a discreet amount of energy; if the energy of the light is too high or too low, the transition won’t happen and the light won’t be absorbed.
Stanford Linear Accelerator Center (SLAC) needed a robot that could help remotely monitor the tunnels when the accelerator is operating. Therefore, during our work at SLAC, we helped our team create a monitoring system that significantly improved the robot’s vision. When the accelerator starts working, the tunnels will be locked down due to high radiation and temperature. Therefore, no one can be in the tunnels and that is why a robot was needed to execute the monitoring task. A team from UC Merced built the robot, and we were tasked with the Thermal Radiometric Object Detection. The robot would move through the tunnels and check on important units to see if they were in an acceptable operating temperature range. With the Object Detection and Classification feature, the robot could classify an object and understand which unit it is looking at. It was also able to stop whenever it sensed an obstacle in front of it, which helped us avoid hardware disruption.

The robot would have a radiation sensor and other features. According to our plan, as soon as the robot detected any problems, it would send an alert to the operators in order to have the issues solved. Overall, with the robot having its own mobility system and thermal radiometric object detection functionality, the researchers at SLAC have more access to the acceleration laser while it is running and avoid time-consuming processes due to the robot being more efficient than a human technique.
Remotely Operated Accelerator Monitor

Colin Scholler¹, Madison Avila², Nguyen Dinh²

¹Department of Robotics Engineering, Worcester Polytechnic Institute, Worcester, MA
²Department of Computer Science, Mission College, Santa Clara, CA

Background and Development

This is a robot we helped create, which will be operating in one of the SLAC’s tunnels. Our team worked on the cameras that were in charge of thermal radiometric object detection and a GUI application to control the cameras. We used PyQt5 – a set of python bindings for the Qt application framework - along with OpenCV, and TensorFlow.

Thermal Radiometric Object Detection Development

USB camera + Thermal camera = Overlay Image

missioncollege.edu
Over the last 20 years, the acceleration of the development of polysaccharide materials has flourished making way to biodegradable renewable sources inexpensive. (Polysaccharide- are polymeric carbohydrate molecules composed of long chains of monosaccharide units bound together by glycosidic linkages, and on hydrolysis give the constituent monosaccharides or oligosaccharides. They range in structure from linear to highly branched.) Cellulose is an organic compound, with is consisted of a linear chain of several hundred to many thousands of linked D-glucose units. Cellulose has been researched for the field of thin films, electronic, and sensor systems. Working at the USDA ARS in Albany, provided me with the unique opportunity to work with one of their scientist by the name Luiz Silvia.

Brazil’s most industrial exploited source of cellulose comes from the eucalyptus. It contains a median of 53wt%, which makes it the appropriate means of retrieving cellulose. Getting cellulose can be quite easy but the difficult property is maintaining good control of the nano fibers structures since itsis crucial to achieve the desired properties. Cellulose Nanocrystals (CNCs) and cellulose nanofibrils (CNFs) are often produced by involving acid hydrolysis and shearing. According to Silvia’s research team, the Amazonian plant of the bromeliad family (ananas erectifolious) or Curaua Leaf Fibers (CLF) is an eligible bachelor to become the new economic source of obtaining cellulose nanocrystal and nano fibers.
Curaua and Eucalyptus Nano-fibers Films

Introduction

Over the last 20 years, the development of polymeric-based materials has not only created new ways to biomimetic marine sciences transformative. (Polymer-based materials with polymeric refers to introductory component of biodegradable polymers. They provide new ways to biomimetic marine sciences transformative. These mechanisms are in the near future, in a wide variety of field, such as biomedical, biodegradable and biocompatible in the field, such as biomedical, biodegradable and biocompatible materials as cellulose, starch, proteins and other natural materials. These mechanisms are in the near future, in a wide variety of field, such as biomedical, biodegradable and biocompatible materials as cellulose, starch, proteins and other natural materials.

Methodology

CLFs were pre-treated with 5% NaOH solution and bleached with a mixture (1:1 v/v) of NaOH (4 wt%) and hydrogen peroxide (24% v/v) solution. The CNCs were obtained by acid hydrolysis of bleached CLFs (Fig. 1a). The CNCs were neutralized in dialysis tubing cellulose membrane (D9402 Sigma-Aldrich) for 72 h with constant stirring, and the CNCs were obtained from extrusions and film formation was presented in Fig. 1b. The CNCs were then freeze-dried and the CNCs films were prepared by casting onto a glass plate by evaporation of the water. The CNCs films were then dried in a drying oven at 105 °C for 24 h. The CNCs films were then dried in a drying oven at 105 °C for 24 h. The CNCs films were then dried in a drying oven at 105 °C for 24 h.

Acknowledgements

A special thank you to Luiz Eduardo Silva, M.Sc. for letting me engage in his research. To our Transfer Alliance Coordinator, Mrs. Raina Thompson. Our Student Support Specialist for STEM Core, Rebecca Davidson. The USDA for allowing me to be a pilot intern at their facility. Lastly I want to acknowledge the National Council for Scientific and Technological Development (CNPq), Federal University of Lavras (UFLA) Graduate Program in Materials Science and Engineering (PPGCEM), Federal University of Sao Carlos (UFSCar), and Brazilian Agricultural Research Corp. (Embrapa). For providing the opportunity and the economic research on which I was able to base my internship.
Developmental manganese (Mn) exposure is associated with cognitive impairment and fine-motor dysfunction in children. While the mechanism(s) of how Mn causes these impairments in humans are not well-known, studies in rats have shown that developmental Mn exposure causes lasting impairments in attention and fine-motor function associated with changes in levels of several catecholaminergic system proteins in the prefrontal cortex (PFC). The PFC catecholaminergic systems are important mediators of executive functions, including attention and impulse control. Catecholamine neurotransmitters, such as dopamine and norepinephrine, are biomolecules that contain catechol and amine functional groups. The catecholaminergic systems also involve several enzymes, transporter, and receptor proteins responsible for the synthesis, transport, and signal transduction of these neurotransmitters. My research will use a human immortalized neuronal cell culture line and an in vivo rat model of developmental Mn exposure to analyze changes in expression levels of the catecholaminergic system proteins tyrosine hydroxylase, dopamine transporter, and the dopamine 2 receptor using immunohistochemistry and fluorescence microscopy. In addition, the research will use RT-qPCR to quantify gene expression in the cell model for these catecholaminergic system proteins, as well as gene expression levels of DNA methyltransferase (DNMT) and histone deacetylase (HDAC), which are enzymes responsible for epigenetic modifications of DNA. Through looking at changes in gene transcript and protein levels, together with further experiments, I expect to find out whether the changes in catecholaminergic system protein levels caused by developmental Mn exposure are due to epigenetic modifications of their genes.
Objective:
- Determine whether the changes in catecholaminergic system protein levels caused by developmental manganese (Mn) exposure are due to epigenetic mechanisms.

Background and Rationale:
- Mn is a trace element essential for proper biological function, but is toxic at high levels (1).
- Developmental exposure to Mn has been associated with attention and impulse control deficits in children and animal models (2-5).
- Studies in our lab have shown that Mn alters protein levels of tyrosine hydroxylase (TH), dopamine transporter (DAT) and dopamine D2 receptor (D2), all of which play a role in learning and attention (6-7).
- We hypothesize that Mn will cause a change in gene transcript and protein levels in SH-SY5Y cells, with decreased TH and DAT levels and increased D2 levels.
- These changes may be due to epigenetic modifications, caused by altered DNA methyltransferase (DNMT) transcript and protein levels in SH-SY5Y cells, with changes from respective control ($p < 0.001$).

Methods:
- Objective: Determine whether the changes in catecholaminergic system to test for Mn effects
- Experimental Design
  - Culturing SH-SY5Y cells: Neuroblastoma cell line seeded and maintained in growth media.
  - Morphology Confirms Differentiation
  - Immunohistochemistry
    - TH, D2, and DAT 1 and 2 ABs
    - Image w/fluorescence microscope
    - Semi-quantitative
  - RT-qPCR and Results
    - QUANTITATIVE REVERSE TRANSCRIPTION PCR (RT-qPCR)
      - RNA → cDNA
      - Amplifying + Quantifying
    - Developmental Mn exposure alters SH-SY5Y catecholaminergic proteins
      - TH, DAT = Red
  - Results (cont.)
    - Method development - RNA Extraction 3
      - Standoff scaling spots
      - No band on gel.

Conclusions
- TH, DAT, and D2 protein level changes are consistent with changes in Mn exposed animals.
- We were unable to extract good quality RNA from our cells to proceed with the RT-qPCR process.
- We will improve our protocol and skills by reviewing literature and getting help from predecessors.
- We expect that a successful RT-qPCR result will show that Mn exposure causes a decreased TH and DAT gene expression, and increased D2 gene expression in SH-SY5Y cells, possibly due to DNMT and HDAC activities. Future analysis will confirm these findings.

Future Work
- Complete RT-qPCR on TH, DAT and D2 transcripts.
- Proceed to do RT-qPCR and Western Blot on epigenetically regulated genes such as DNMT and HDAC.
- Inhibit DNMT and HDAC to confirm their direct effects on TH, DAT and D2 transcript levels.
- The overall goal of the project is to understand how Mn alters the catecholaminergic system and elucidate how Mn causes the attention and impulse control deficits seen in animal models and humans. Potentially, it will provide molecular targets to develop therapies to prevent the Mn effects.

Acknowledgements
- ACES Student Program: Phil Cox, Director; Pam D’Arcey, Associate Director, David Cepanek, Program Assistant. Christine Fink, Community College Liaison. Rachel H. Thompson, IDE-STEM Transfer Alliance Coordinator.
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Sunscreens contain several compounds designed to absorb or reflect ultraviolet (UV) radiation and prevent sunburns. The most common way to indicate the effectiveness of a sunscreen’s ability to protect the skin from UV rays is called the Sun Protection Factor (SPF). The higher the SPF number, the more protection from UV light. The objectives of this project were to establish the relationship between SPF and UV absorbency and find a dilution series that falls within a linear Beer-Lambert Law range. According to the Beer-Lambert Law, a substance’s concentration and its absorbency are directly proportional. Under ideal situations, a high concentration solution absorbs more light, and a solution of lower concentration absorbs less light. We explored different sunscreen brands, SPF ratings, concentrations, and solvents to optimize the conditions suitable for our teaching labs. Within a given sunscreen brand (Walgreens Sport), two SPF 30 lotions had a different absorbency at the same wavelength. We found that aerosol spray sunscreens had absorbency in the UV range and no absorbency in the visible light range. The spray sunscreens were only soluble in ethanol and subsequent dilutions were done in ethanol. In future tests, we will optimize conditions around this to demonstrate the Beer-Lambert principles.
Abstract
Sunscreens contain several compounds designed to absorb or reflect ultraviolet (UV) radiation and prevent sunburns. The most common way to indicate the effectiveness of a sunscreen’s ability to protect the skin from UV rays is called the Sun Protection Factor (SPF). The higher the SPF number, the more protection from UV light.

Objectives
The objectives of this project were to establish the relationship between SPF and UV absorbance and find a dilution series that falls within a linear Beer-Lambert Law range. According to the Beer-Lambert Law, a substance’s concentration and its absorbance are directly proportional. Under ideal situations, a high concentration solution absorbs more light, and a solution of lower concentration absorbs less light.

Results
Within a given sunscreen brand, two SPF 30 lotions had different absorptivity at the same wavelength.

Different brands of SPF 50 lotions had different absorbances in the UV range.

Conclusion
We found that aerosol spray sunscreens had absorbances in the UV range and no absorbance in the visible range.

We found that aerosol spray sunscreens had absorbances in the UV range and no absorbance in the visible light range. The spray sunscreens were only soluble in ethanol and subsequent dilutions were done in ethanol. In future tests, we will optimize conditions around this to demonstrate the Beer-Lambert principles.
The objective of this research was to optimize an experiment - which revolves around acid-base titrations and the carbon cycle - for future chemistry students. In order to do this, we had to imitate the experiment and change different variables to figure out what should be altered in the procedure. We decided on using strontium chloride as our precipitating agent and tested that a precipitate was produced solely with sodium carbonate and not with sodium hydroxide. Afterwards, we used potassium hydrogen phthalate to standardize the sodium hydroxide solution and create concentrated solutions for future dilutions. This enabled us to find the true molarity of the sodium hydroxide solution. We then attempted to isolate the precipitate, strontium carbonate, completely from the remaining solution instead of just pouring off the solution to use later. The precipitate would be measured to find out the concentration of the excess hydroxide left in the solution. This wasn’t successful because we discovered that there was error that resulted from an unknown substance in the expected precipitate. We found this out by comparing the color of the flames of different burning samples. Afterwards, different conditions of leaves were left alone for a two-day duration. We implied that there was enough carbon dioxide in the atmosphere to not completely eradicate all of the hydroxide and that adding spinach, no matter in what condition, would be overabundant.
ACID-BASE TITRATION & THE CARBON CYCLE

General Idea of The Experiment:
A sodium hydroxide solution is left in a closed jar aside decomposing leaves. Microbes present in the jar begin to break down the leaves, which are primarily composed of carbohydrates. The carbon dioxide reacts with the water in the sodium hydroxide solution to form carbonic acid. The carbonic acid dissociates into bicarbonate and hydrogen ions. The hydrogen ions react with hydroxide ions to form water while the sodium ion reacts with carbonate to form sodium carbonate. We can then use a precipitating agent to obtain the carbonate. The Sodium hydroxide solution can then be titrated to find the amount of sodium hydroxide remaining. This will allow us to indirectly find the number of moles of carbon dioxide that reacted.

Standardizing NaOH:
The goal of standardizing sodium hydroxide was to find the actual concentration of the NaOH solution using potassium hydrogen phthalate and thymol Blue (0.1%). We have to do this because sodium hydroxide is hygroscopic, easily able to absorb water. This then affects the mass of the sodium hydroxide because what is weighed is the water it absorbs and its own mass. Therefore, the desired concentration isn't achieved because the concentration will actually be less than expected.

How is this accounted for?
To find the true concentration of the sodium hydroxide, we created a 0.1 M solution of KHP. A few drops of thymol blue was added to the solution and turned the solution to a faint yellow. As the KHP is titrated with NaOH, the Erlenmeyer flask is swirled. Once the solution transitions to a faint blue color and the color is stable, the KHP is neutralized by the NaOH. Because KHP and NaOH react in a one-to-one mole ratio, we can use stoichiometry to find out the actual molarity of the NaOH.

Is There A More Efficient Way to Find the Amount of Carbon Dioxide that reacted?
We attempted to try an alternative approach to discover the amount of carbon dioxide that had reacted. We attempted to decant the supernatant. In order to obtain majority of the precipitate, we used a centrifuge to cause the solution and precipitate to become more distinct.

There was A Flaw that Came Along with Finding the Quantity of Carbon Dioxide...
By qualitative analysis of atomic emission in a flame test, we determined that the precipitate was contaminated. The flame produced by strontium carbonate should have been red, but the flame turned out to be orange. This caused us to suspect that there was sodium chloride in the supposed strontium carbonate that was causing this to occur. Therefore, directly measuring the strontium carbonate wasn’t as efficient as titrating the leftover sodium hydroxide solution.

Leaves in Different Conditions
We decided to test if the effect of different environments that the leaves were in would affect the amount of carbon dioxide that reacted. We had two controls, two jars with half a gram of leaves in room temperature, two jars with half a gram of frozen spinach leaves, and two jars with half of a gram of leaves that were left overnight in the fridge.

Results from Experimenting with Multiple Jars with Leaves Under Different Conditions
Overall, it seemed that majority of the NaOH was reacting with the carbon dioxide - a lot more than expected no matter in what condition. This may have been because of the carbon dioxide from the atmosphere reacted with the sodium hydroxide prior to being left over night in a jar. A corollary for this explanation is that the stock sodium hydroxide produced a precipitate when exposed to strontium chloride. Therefore, the concentration of the sodium hydroxide has to be increased for this Experiment to be cohesive or a major decrease of leaf mass has to be Imbedded.
Student researchers created an educational Virtual Reality game for construction engineering and architecture students, called Design Review Simulator. Dr. Fadi was the one who directly instructed Anh and Nguyen on analyzing and planning throughout the whole process. Besides, Cal State East Bay provided Anh and Nguyen with necessary equipment, including two sets of Alienware laptop and Oculus Rift headsets for developing and testing the game. The laboratory environment was helpful due to having modern and interactive facilities, making the entire performance more productive and efficient than expected. In this experience, not only the student researchers get a chance to apply knowledge from courses such as Software Development with Java and basic knowledge in User Interface designing, but also knowledge from essential scientific courses like Trigonometry, Geometry and Physics.
The growing adoption of building information modeling software in the construction industry requires instructors to design and leverage innovative pedagogical interventions. In this study, the research team aimed at designing and developing an educational virtual reality game to support students in evaluating and reviewing design models of residential buildings. The team has tackled the issue of evaluating and reviewing drawings as research has illustrated that performing such tasks with traditional methods, such as drawings, can tax a student's cognitive process. To tackle this issue, the team has developed the Design Review Simulator, a virtual reality educational simulation game. The learning objectives of the game are to support students when playing a construction virtual reality game or traditional methods, such as drawings. To measure the effectiveness of the game, the research team conducted an experiment comparing the performance of students using the game versus drawings.

A virtual reality educational simulation game can be a powerful aid in enhancing the evaluation of architectural design by providing a close to realistic environment. Some previous studies illustrated that serious games are being analyzed for their ability to support learning by providing a close to realistic environment. A virtual representation can enhance the evaluation of architectural design. When college students play a construction virtual reality game, their higher-order thinking skills will increase. In this study, the research team aimed at designing and developing an educational virtual reality game to support students in evaluating and reviewing design models of residential buildings. The team has tackled the issue of evaluating and reviewing drawings as research has illustrated that performing such tasks with traditional methods, such as drawings, can tax a student's cognitive process. To tackle this issue, the team has developed the Design Review Simulator, a virtual reality educational simulation game. The learning objectives of the game are to support students when playing a construction virtual reality game or traditional methods, such as drawings.

The research team conducted an experiment comparing the performance of students using the game versus drawings. The research team concluded that the virtual reality educational simulation game can support students in evaluating and reviewing design models of residential buildings.

The research team also implemented the game in several engineering courses. The research team will be completing the development of the game. The research team will be implementing the game in several engineering courses. The research team will be completing the development of the game.

The research team will be implementing the game in several engineering courses.
My summer math project was to use Python programming language to implement RSA algorithm. RSA cryptosystem is based on mathematics and is the most widely-used cryptography in the world. Its security relies on the difficulty of factoring large integers that are the product of two large prime numbers. In practice, RSA 2048-bit key strength is hard to be cracked by computer now and will be secure for the next ten years. The RSA algorithm can be used for public key encryption to secure sensitive data over the Internet; it can also be used for verifying digital signatures so that signatures can’t be forged or no signer can later deny having signed the message.

I implemented the RSA algorithm using Python language. I used ASCII code to encode each letter in a sentence and apply the formula $C = \text{mod } n$ and $M = \text{mod } n$ to encrypt and decrypt the message. In the first version, program runs fine if the prime number has 3 digits. The program’s running time will significantly increase if the prime number has more than 3 digits. In order to speed up the decryption process, I used the modular arithmetic property to reduce the decryption computation. In the revised version, the number of digits in the prime number can be increased to 14 digits while program generates the correct output within 5 seconds.

The RSA cryptosystem is based on number theory in mathematics. When I was implementing it in Python, I met with problems such as integer overflow and algorithm efficiency. I used math theories to solve them and improve the program’s performance. Future optimization could be: Apply advanced primality test such as Miller-Rabin test, use Chinese Remainder Theorem to speed up the decryption, and break long sentence into blocks and encrypt each block to enhance its security.
RSA Cryptosystem is based on mathematics and is the most widely-used cryptography in the world.

**Key Generation by Recipient**

Choose two prime numbers: p, q
Compute: \( n = p \times q \); \( \phi = (p-1)(q-1) \)
Compute: \( \gcd(e,\phi) = 1 \); \( d \times e \equiv 1 \mod \phi \)
Public key = (e, n); Private key = (d, n)

**RSA Implementation in Python Programming Language**

Please enter a message: The password is "MathIsCool"
The encrypted message using public key is:
312303825931962173822956366363042251374181519626076361962295013592295545303821796361930225122518132950
The decrypted message using private key is: The password is "MathIsCool"
If you are interested in summer research please contact Raiida K. Thompson at: Raiida.Thompson@missioncollege.edu