

Spring 2020 Science 299 Abstracts (for students who completed a research project prior to the COVID-19 shutdown)

Tabarek Al Samaraee

BIO 299

Faculty Advisor: Dr. Marlena Yost

There is an increasing number of bacterial strains that have become resistant to the antibiotic drug's efficacy in inhibiting the growth of bacteria. Therefore some people are turning towards natural alternatives in which herbs and spices possess antimicrobial properties that could aid in reducing and inhibiting bacterial growth. One gram of clove and cumin was soaked in 10 milliliters of distilled water for 24 hours at 37 degrees Celsius. *Staphylococcus aureus* and *Escherichia coli* bacteria were used to lawn the plates, the lawned plates with solution were incubated for 24 hours at 37 degrees Celsius. For each bacteria and solution, 3 plates were used (cumin vs. *E.coli*, *S.aureus* and clove vs. *E.coli*, *S.aureus*). 2 plates of sterile saline against bacteria as negative control and for positive control 2 plates were used for each bacteria and the drug used is ciproflaxin.

The null hypothesis is that the solution will have little to no effect on the bacterial growth while, the alternative hypothesis suggest that the solution will significantly inhibit the growth of bacteria. The result turned out to be unexpected because cumin did not show any trace of antimicrobial properties. Instead it aided in the forming of bacterial colonies around the soaked disc with cumin solution. The clove solution showed inhibition of bacteria by producing a clear circle around the discs known as zone of inhibition. It showed a significant effect against *S.aureus* when compared to *E.coli* growth. Clove solution supported the alternative hypothesis while the cumin solution supported the null hypothesis.

Stephen Barker

GOL 299

Faculty Advisor: Dr. Larry Tiezzi

The results of this research contradict the conclusions made by Ann Witt (ref) where she said the landslides occurred in the Lovington biotite gneiss rather than Charnockite because the Lovington formation was more susceptible to landslides. She did leave open the possibility that it was the amount of rain in the various areas. My work would support the idea of more rain in the Lovington areas.

To test this, two types of soil were chosen and collected from areas of different geologic composition in Nelson county. These two soils were weathered Charnockite and Lovington, and each was tested to find which one had the lowest shear strength. This was done by constructing an incline plane set with an inclinometer and placing the soil samples on top of it and tilting the platform until the soil gave out. The weight of each sample was approximately 20 lbs. The moisture of the soil was also checked to ensure that it was consistent, and each sample had about 13% moisture. The samples were tested 20 times each, and at the end of the testing, the average critical angle of repose for the Lovington was 34.9°, while the average critical angle of repose for the Charnockite was 32.7°. After doing a t-test, the P-value was determined to be .00442, meaning that there was a statistically significant difference between the two means. As such, it seems that areas composed of Charnockite

could potentially be more susceptible to landslides, since soil composed of that base rock gives out at lower angles.

Taylor Barr

CHM 299

Faculty Advisor: Dr. Barbara Heyl

Utilizing various water testing methods to monitor the water chemistry of an established aquarium after a dense amount of plant life has been added. It was hypothesized that raised nitrates in the aquarium would encourage the reedfish bichir pair present to spawn, a species that is unknown to spawn in captivity. The parameters measured were nitrates, phosphates, pH, and dissolved solids. Water conductivity and temperature were also tested. The results could have been dampened by the evidence that one of the largest aquatic plants added was grown emersed. The large body of the plant melted back and left only the younger leaves and runner stems. The nitrates were shown to have decreased throughout the experiment with inconsistent collection. The nitrates collection was switched to an inaccurate liquid APi test it which gave minimal observed results in ppm. The collected results of the six weeks retrieved show no significant difference in water quality, however the ropefish pair in question displayed courtship within the fourth week. There was no clear indication of change in water chemistry except for a gradual increase in phosphates.

Kris Bland

Bio 299

Faculty Advisor: Dr. Donna Hoefner

Fertility through Workout Supplements

Today, many athletes workout taking pre-workout such as caffeinated supplements and nitric oxide supplements. Do these supplements affect the ability to have offspring? The purpose of this experiment is to determine if nitric oxide and caffeine affect fertility. The control of this experiment is water. Three petri dishes contain a solution of nitric oxide, caffeine, and water with 20 bean beetles

each (10 males and 10 females). The tests conducted were the number of eggs in each dish, motility of a beetle introduced to the solution, and the mortality after eight days. In a motility test consisting of 30 seconds, the nitric oxide specimen moved the farthest, then the caffeine specimen, and finally the control. The mortality ranks the control with the most living, followed by the nitric oxide, and caffeine with a sole survivor. Fertility ranked in the same order as mortality. With this experiment, it can be determined that pre-workout supplementation may actually affect fertility.

Mike Conrad

BIO 299

Faculty Advisor: Dr. Anne Allison

Multicellular Colony Organization in Single-Celled Algae due to the Presence of Predators

Multicellularity in organisms has baffled scientists for years. Though we understand the concept and the origin, it is still difficult to pinpoint the main underlying factor that caused single-celled organisms to evolve. Researchers such as Nichole King are developing new procedures and methods to further understand the concept. Colony organization is a key contributing factor in survival of single-celled organisms as it can lead into multicellular evolution. In my research, I aimed to discover the factor that induced the beforementioned survival of a type of algae, *Eudorina elegans*, when exposed to predatory water fleas. In my experiment, I made samples of 5mL spring water and 5mL of the algae culture. I then added three *Daphnia magna*, the predatory water flea, to the new samples and incubated them under UV light at room temperature for 24 hours. I then made slides to observe under a microscope. In my findings, I discovered that there were several algae colonies that formed, indicating a form of cellular communication that allowed for colony formation for better survival.

Sebastian Selena

CHEM 299

Faculty Advisor: Dr. Barbara Heyl

Testing for Bisphenol A (BPA) in plastic water bottles

Bisphenol A (BPA) is a compound used to make plastics and resins. It can be found in food storage containers, bottled water, medical devices and breast milk. The Food and Drug Administration (FDA) reviewed hundreds of experiments claiming that BPA is carcinogenic, disrupts progesterone receptors and more. After review, the FDA claimed that such dangers would not affect us and that the current levels of ingestion of BPA were safe. However, due to public pressure and the suggestion from the American Chemistry Council, the FDA banned the use of BPA in baby bottles, sippy cups, and infant formula packaging. To test for BPA in water bottles claiming to be BPA-Free and bottles with no labels, a standard of BPA with Methanol was made to make sure the column in the High-performance liquid chromatograph (HPLC) could identify BPA. This was followed by a standard of BPA with water. A total of 8 different water bottles were put in pairs in an oven at 71 degrees Celsius for 2 hours and then cooled to room temperature. Then a sample of each water bottle was put in the HPLC. The retention times found in the BPA standards of water are very similar to the retention times found from every sample of water from every water bottle tested. The retention times of standards for BPA in water ranged 2.396min-2.420min. The retention times from the samples of water bottles ranged 2.295min-2.435min. From the results, it is the assumption that these retention times represent BPA, but it could be the leaching of other plastics that these water bottles were made of. It can be concluded that there is no guarantee that your plastic water bottle is BPA-Free, and if it is, there's no guarantee that these other plastics are safe either. However, there are alternatives, such as stainless-steel and glass bottles.

William Tornel

BIO 299

Faculty Advisor: Dr. Joanna Vondrasek

Honey is an organic substance, rich with antioxidants, that has been used as a homeopathic remedy to treat conditions such as diabetic ulcers, eczema, and throat infections. Manuka honey, derived from the nectar of *Leptospermum scoparium* flowers, is especially regarded for its healing properties when compared to other kinds of honey. This study focuses on the effects that Manuka honey has on the growth of the bacterium *Escherichia coli*. A combination of honey and lime was tested to see if this traditional home remedy has any impact on the inhibition of growth for the bacterial culture. It was predicted that Manuka honey would inhibit microbial growth more than the corn syrup control, and the honey and lime mixture would inhibit more than the honey alone. Bacterial cultures of *E. coli* were grown in nutrient agar plates and exposed to different experimental groups via paper disk diffusion. The results showed that the average zone of inhibition for the Manuka honey was larger than that of the control group ($t=4.848$, $df=12$, $p=.0004$). Additionally, the zones of inhibition for the lime mixtures were found to be smaller in size (3.5cm and 2.9cm) compared to the average zone of the controls (4.2cm and 3.55cm, respectively). In conclusion, Manuka honey does contain some intrinsic antimicrobial properties but adding lime did not amplify these qualities.

Mariana Villate

CHM 299

Faculty Advisor: Dr. Frances Rees

The objective of this experiment was to measure the caffeine content in different types of coffee beans. Caffeine was measured from light, medium, and dark roast coffee beans obtained from a regular supermarket. The brands used were India for light roast coffee, Peru for medium roast coffee, and MN Mud for dark roast coffee. This process was performed by adding MgO to ground and sieved coffee bean powder and heating the mixture for 20 min at 90 °C. These solutions were analyzed using reverse-phase HPLC. The results from HPLC analysis found no significant difference between the caffeine content of dark, medium, or light roast beans. Report of compared mass % caffeine between HPLC and UV analysis found no significant difference in caffeine concentrations, and therefore the null hypothesis could not be rejected. The obtained results may be due to different types of errors that could be made during the experiment.