CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Barah Aljewad; Jennifer Mosch

Project Number

S2101

Project Title

The Effect of Cigarette Litter on the Urban Ecology of Armadillidium vulgare

Abstract

Objectives/Goals

The objective of this study is to determine and quantify the effect that leeched soil pollution has on pill bugs (Armadillidium vulgar)

Methods/Materials

Materials use include: small plastic containers as habitat for the isopods, hygrometer, stopwatch, fish food, heterogenous soil from natural habitat. By measuring the average curling and uncurling times of five pill bugs in each of seven levels of exposure to cigarette litter in soil, each day for five weeks.

Results

Results indicate that curling time increases in A. vulgare that have been exposed to greater quantities of cigarette butt litter. The death rates of the isopods exhibit evidence that exposure to cigarette litter is detrimental to these important decomposers.

Conclusions/Discussion

Cigarette butt litter leeches chemicals into the soil. Soil pollution is less addressed than air and water, however, directly affects the ecosystems of land-based decomposers.

Summary Statement

Soil pollution, in the form of substances leeched from cigarette butts, have an effect on populations of urban decomposers, as measured by behavioural response.

Help Received

My Science Research teacher helped us sample and collect populations of isopods.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Gissell Camarena; Jose De Anda Jr.; Jonnathan Sanchez

Project Number

S2102

Project Title

Galleria mellonella Immune System Response to an Insecticide

Abstract

Objectives/Goals

Evaluate which concentration of the insecticide, cypermethrin, would kill the larvae the most efficiently. Study the immune system response of the Galleria Mellonella Larvae to insecticide, strictly checking for the production of phenoloxidase in the larvae.

Methods/Materials

Injected the larvae with 10 mL of insecticide by using a syringe. Extracted the hemolymph by cutting the larvae open and spinning them through a centrifuge. The hemolymph was then tested to see the phenoloxidase level by using ELISA reader spectrophotometer.

Results

The survival rate data showed that the insecticide did not cause the death of the larvae and that the phenoloxidase response seemed to protect the larvae.

Conclusions/Discussion

We discovered that the insecticide used (Demon WP), did not kill the larvae. The immune system did have a response to the insecticide by producing phenloxidase in order to defend itself. The project was important because in the field of beekeeping, there has been many issues involving the Galleria Mellonella larvae. Beekeepers are attempting to produce a sufficient amount of honey; however, the moth Galleria Mellonella is preventing this to take place. The Galleria Mellonella enters the beehives and consumes the honey and wax.

Summary Statement

Galleria mellonella immune system response to an insecticide.

Help Received

Our chemistry teacher provided the necessary materials and explained the overall concepts of the experiment. Our mathematics teacher help us understand the basic concepts of standard deviation, graphing, and P value. Daniel Covarrubias helped us with the presentation of our data.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Emma Faciane; Hayley Minassian; Julia Wright

Project Number

S2103

Project Title

The Behavioral Effects of Sodium Lauryl Sulfate on Caenorhabditis elegans

Abstract

Objectives/Goals

The objective of this study is to determine if sodium lauryl sulfate is present in face washes and if it will cause behavior differences in c. elegans.

Methods/Materials

SLS, c. elegans, Clinique face wash, Olay face wash, HPLC. Face washes were run through HPLC to detect if SLS was present, then 3 different serial dilutions were exposed to the worms.

Results

SLS was detected in face washes. Four groups of C. elegans were treated and suffered from behavioral movements such as size, energy, and death.

Conclusions/Discussion

Face washes that don't list SLS as an active ingredient and still have a foaming effect, do Indeed have SLS which is activated by water. The C. elegans that were treated all suffered from behavior effects which can be parallel to the effects SLS may have when used on human skin.

Summary Statement

As measured in the bahavior differences in C. elegans, SLS can be toxic to organisms exposed to it.

Help Received

For HPLC, we were mentored by Dr. Greg Cauchion, and our teacher Dr. Malhotra

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Homin Key; Jaskirat Sandhu; Shotaro Yamaguchi

Project Number
S2104

Project Title
Testing Various Factors Affecting Varroa Mites

Abstract

Objectives/Goals
The objective for this project is to see the affects of different test subjects, against the Varroa mites.

Methods/Materials
Powdered sugar, Oyster mushrooms, Shimeji Mushrooms, and provisional equipments that we used to get near the bee colonies and undertake our testing with safety.

Results
The test results of the factor's affect towards mite was recorded for three weeks and statistically showed that the oyster mushroom is the most effective in killing or fending varroa mites from honey bee colonies.

Conclusions/Discussion
We concluded that the mycelium of the Oyster mushroom helped with the eradication of the Varroa mites, because of the drastic difference of statistics from the mycelium producing Oyster Mushroom and the Shimeji Mushroom.

Summary Statement
In the course of three weeks, we tested various factors that might affect the elimination of the varroa mites and found that the most effective mite repellent was the oyster mushroom's mycelium and shown to reduce the number of varroa mites

Help Received
Though we designed our experiment our self, we received help from several beekeepers in California and received information to establish our experiment with a proper scientific method.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Isabella G. Liu

Project Number

S2105

Project Title

A Nano Particular Conundrum: Antibacterial Activity of Zinc Oxide Nanoparticles against Soil Microbes: Nitrobacteraceae

Abstract

Objectives/Goals

The objective of this experiment was to discover whether or not an increased concentration of zinc oxide nanoparticles leads to decreased levels of viable soil bacteria, specifically nitrosomonas and nitrobacter.

Methods/Materials

Tested the antibacterial activity of ZnO nanoparticles against nitrosomonas and nitrobacter by creating a growth media that catered to the growth and isolation of nitrosomonas and nitrobacter. Next, allowed bacteria collected from the soil to grow on the plates while isolation streaking and testing to make sure only Gram Negative bacteria growths occured. Once I isolated the nitrosomonas and nitrobacter, I subcultured them onto agar plates with ZnO aqueous solutions applied to the plates at 20%, 15%, 10% and 0% concentration. I measured the cell viability of the bacteria during their log phase with a Trypan blue solution.

Results

I discovered that in the presence of zinc oxide nanoparticles, the levels of viable nitrosomonas and nitrobacter decreased dramatically. Most notably, the data an inverse relationship between the percentage of viable bacteria and nano-zinc oxide concentrations as the r value was -.98 and the r^2 value stood at .96, or 96% correlation. This showed a a strong, negative relationship between an increased nanoparticle concentration and decreased bacterial viability.

Conclusions/Discussion

My research reasserted the antibacterial properties of the nanoparticle, zinc oxide. However, it shed new light on the subject. Before, it was assumed that nanoparticles could not penetrate the walls of Gram Negative nitrifying bacteria. I discovered the contrary. While nanoparticles have the capacity to make huge advancements in technology and medicine, they also have the capacity to derail our ecosystems by diminishing populations of nitrifying bacteria.

Summary Statement

As measured through cell viability, I demonstrated that ZnO nanoparticles have the capacity to harm our ecosystems by damaging populations of nitrifying bacteria, specifically, nitrosomonas and nitrobacter.

Help Received

I accessed my high school's lab facilities and equiptment to perform the lab. I adapted a recipe for an enrichment media from the paper "Isolation of Nitrosomonas in Pure Culture," by Lewis and Pramer, 1958. This text was available online.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Nykolas A. Maxey

Project Number

S2106

Project Title

Inhibiting Zophobas morio Larva Development with UV Light: A Phase III Expansion

Abstract

Objectives/Goals

In my Phase I research project my goal was to arrest the development within the larval stage of Zophobas morio (mealworms). Zophobas will not pupate if they are maintained in stocks allowing them to #touch# each other en masse. Development may also be arrested with Hydroprene, a chemical which mimics JV juvenile hormone not allowing them to develop into a pupa or adult. I wanted to explore if UV light might do the same thing. My Phase III project expands the data that examine the possible mechanism.

Methods/Materials

Research is suggesting possible DNA damage, and/or destruction of Prothoracicotropic Hormone (PTTH) producing cells and ecdysone triggering mechanisms required for molting and pupal development.I thought it improbable that UVB light would penetrate the exoskeleton of the larval stage of Zophobas morio and interfere with the PTTH producing cells. Since these cells are located very close to the brain and eyes of the larvae, my thought was that this was the entry source of the light causing damage to those cells. Basically, I painted over the eyes with a non-toxic correction fluid and tried exposure to UVB light over a 24/7 period. I used 500 control larvae and 500 UV exposed larvae.

Results

My results indicated that there was a strong statistical correlation between successful development in the #painted# group, and, again, lack of development in the untreated group suggesting that this is the UVB light entry source that damages the PTTH producing cells preventing molting and pupal development.

Conclusions/Discussion

I found that an application of UVB light to untreated, normal Zophobas morio larvae arrested their development into pupal stages and adults. The control groups continued to develop normally. The UVB test groups that were #painted# with the non-toxic White Out over their eyes also continued to develop normally, though with a slightly lower rate of growth. I am speculating that these two pairs of PTTH cells have been permanently damaged or destroyed being in close proximity to a logical entry point for the UVB light through the eye structure and head nearest the brain, rather than the destruction of the entire ecdysone producing glands. By painting over the eyes with a non-toxic correction fluid, I prevented the UV light from following a course to these PTTH producing cells and allowed them to continue PTTH production without presumed destruction to the cells.

Summary Statement

This project examines if UV light is causing damage to PTTH producing cells.

Help Received

My teacher, Dr. Morse, provided his classroom and equipment to do this project. All work was mine.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Isha Mehrotra; Rohan Mehrotra

Project Number

S2107

Project Title

Novel Interactions between Parkinson's Risk Genes and a-synuclein Reveal Disease Mechanisms and Pathway-Based Therapies

Abstract

Objectives/Goals

Parkinson's Disease (PD) is characterized by the death of dopaminergic (DA) neurons. The hallmark of PD is toxic aggregates of a-synuclein (a-syn) that induce degeneration of DA neurons. It is unclear how a-syn becomes toxic, which has hindered development of therapies. To elucidate PD, we studied its genetic forms, which provide insight into mechanisms of a-syn toxicity. We identified interactions between PD gene mutations and a-syn in yeast. The goals of our study were to 1) identify mechanisms of a-syn toxicity, and 2) identify potential therapies that target these pathways for treatment.

Methods/Materials

Deletions: We transformed yeast so that each strain contained a-syn and a PD gene deletion.
Overexpressions: We transformed yeast so that each strain contained a PD gene overexpression and a-syn.
Both: All yeast strains were grown as spotting assays. After growth, each strain was assigned a toxicity score to identify genes that enhanced or suppressed a-syn toxicity.

Results

Enhancers: Genes Swa2 and INP53 enhanced a-syn toxicity when deleted.
Suppressors: Genes Sno4 and HSP31 suppressed toxicity when overexpressed.

Conclusions/Discussion

Enhancers: DA neurons fire after using vesicle recycling and ER->Golgi trafficking to transport dopamine. Swa2 and INP53 enable vesicle recycling, and a-syn inhibits ER->Golgi trafficking. Swa2 and INP53 may have enhanced toxicity because both mechanisms of vesicle trafficking were inhibited.
Suppressors: Misfolded proteins cause oxidative stress, which damages cells. Neurons use chaperones to ensure proper folding. Sno4 and HSP31 are chaperones, and a-syn induces oxidative stress. Sno4 and HSP31 may have suppressed toxicity because the increased chaperones prevented oxidative stress.
Validation of targets: We validated drugs that target these mechanisms. The compound curcumin promotes endocytosis, and nicotinamide prevents oxidative stress. Last year, we found that both compounds decreased toxic a-syn in C. elegans, confirming our results.
Conclusions:
1) Novel PD mechanisms: i) Impaired vesicle recycling and ER->Golgi transport cause defects in synaptic vesicle trafficking/transmission, and ii) shortage of stress resistance chaperones causes oxidative stress due to misfolded protein accumulation.
2) Potential PD therapies: Treatments that i) promote vesicle trafficking, or ii) protect cells from misfolded proteins or oxidative stress.

Summary Statement

This project showed that impaired vesicle trafficking and oxidative stress are two novel mechanisms of a-syn toxicity, and that therapies targeting these mechanisms may effectively treat Parkinson's disease.

Help Received

We would like to thank Noori Chai and Dr. Aaron Gitler for their help and providing yeast strains.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Matthew S. Moser

Project Number

S2108

Project Title

Metalloprotease Inhibitors as Lead Candidate Drugs to Treat Lymphatic Filariasis and Other Roundworm Infections

Abstract

Objectives/Goals

Lymphatic filariasis (elephantiasis) is a Neglected Tropical Disease caused by the parasitic nematodes Wuchereria and Brugia. Over 120 million people worldwide are infected and more than 1.4 billion people are at risk of infection. Adult worms live inside lymphatic tissue for several years and chronic infections lead to tissue swelling, pain, and enlarged limbs. Only the adult stage causes the disease and currently, there are no optimal drugs (Ivermectin) that eliminate the adult worms. The focus of this study was to identify a compound or drug that could inhibit the adult worm#s proteolytic enzymes which are important to the worms# survival. Previous results showed that the metalloprotease inhibitor, 1,10-Phenanthroline (1,10P) was highly effective in killing adult Brugia pahangi within 48 hours. In this study, FDA-approved drugs and a preclinical drug that are all metalloprotease inhibitors were assayed with adult B. pahangi in vitro.

Methods/Materials

Worm mortality was quantified using a "Worminator", an instrument that records how many pixels per second are being displaced under a set camera, allowing for an accurate measurement of the protease inhibitor's impact on worm survival. To determine if metalloproteases are also critical to the survival of other parasitic nematodes, the sushi parasite, Anisakis, was assayed with the metalloprotease inhibitors. A spectrofluorometer was used to analyze enzymatic activity

Results

Results showed that Luteolin, 1,10P, and 4,7-D were the most effective drugs in killing the adult stages of Bruiga pahangi with IC50s of 32µm, 15µm, and 7µm, respectively. Luteolin and 1,10P inhibited the motility of the infectious stage of Anisakis in vitro by 85% and 90%, respectively. Biochemical assays showed that Luteolin and 4,7-D inhibited the metalloproteases in Anisakis worm lysates by 100% compared to the control.

Conclusions/Discussion

This study showed that metalloproteases are critical for the survival of Brugia, the parasitic nematode that causes Lymphatic Filariasis as well as, Anisakis, which is also known as the sushi parasite. WHO estimates that over 2 billion people are infected by helminths worldwide and this study suggests that metalloprotease inhibitors may be useful as lead candidates to treat lymphatic filariasis and other roundworm infections.

Summary Statement

This study was able to identify three metalloprotease inhibitors that can be used as an effective treatment to lymphatic filariasis and other roundworm infections

Help Received

My mentor, Dr. Judy Sakanari, supplied with me the compounds, worms, and lab space to conduct my research.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Emily T. Nguyen

Project Number

S2109

Project Title

Effects of Glyphosate Toxicity on Caenorhabditis elegans with the Application of the Matrix Projection Model

Abstract

Objectives/Goals

In 2015, WHO (World Health Organization) classified glyphosate as a "probable human carcinogen." The possible increased risk and common use of glyphosate are a global concern. In this study, an experiment was designed to measure the toxicity of glyphosate and its surfactant, polyethoxylated tallow amine (POEA), in a commercial product called Roundup on Caenorhabditis elegans by calculating the survival rate and frequency of basic body movements per minute. The Matrix Projection Model was used to predict whether a population will increase or decline.

Methods/Materials

Continuous Exposure: C. elegans share 60% of their DNA with humans. A control was created along with four groups: 6 ppm, 40 ppm, 100 ppm, and 200 ppm. A C. elegans' life cycle consists of six stages (Larvae 1-4, young adult, mature adult). To measure the survival rate, the number of dead or unresponsive C. elegans was recorded after each stage. Acute Shock: C. elegans were exposed to 0, 0.01, and 0.001% glyphosate concentrations for 30 mins, washed with M9, and then placed in a microfluidic to be observed and videotaped. Endpoints of head thrashing, body bend, and Omega/U-turn were chosen to evaluate the locomotive behavioral deficiencies.

Results

The survival rate decreased as the concentration of glyphosate increased. According to the matrix projection model, the lambda is greater than one for the control, 6 ppm, 40 ppm, and the 100 ppm groups, and less than one for the 200 ppm group. The 200 ppm group becomes extinct by 55 hours. The populations that are 100 ppm and less will increase over 200 hours. Behavioral Analysis: at 0.01% glyphosate concentration, the frequency of basic movements per minute was about 50% less than the control and the 0.001% concentration.

Conclusions/Discussion

This study increases our understanding of glyphosate's toxicity on C. elegans. Glyphosate may have a neurodegenerative effect on C. elegans. The matrix model shows that the greater the glyphosate concentration, the slower the population will increase. Since increasing the concentration of glyphosate decreases the survival rate and number of basic movements of C. elegans, the findings supports the statement from WHO that glyphosate may be toxic to humans.

*To understand more about glyphosate#s effect, experiments studying lifespan and chemotaxis behavior will be incorporated into this project by May 19, 2016.

Summary Statement

Studied the effects of glyphosate and POEA on the survival rate and behavior of C. elegans using the Matrix Projection Model.

Help Received

This work was financially supported by my parents and was done in their hobby plant tissue culture lab.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Leigh F. Polson

Project Number

S2110

Project Title

The Effects of Antioxidants on Daphnia magna under Oxidative Stress Conditions

Abstract

Objectives/Goals

The objective of this test is to measure the efficacy of antioxidants to reduce oxidative stress induced on D. magna.

Methods/Materials

2000 Daphnia and aquarium, microscope and slides, Liquid Vitamin C, Liquid Vitamin E, Stopwatch

Set up aquarium with Daphnia, food supply, filtration, and proper pH level water. Record Daphnia heartbeats under microscope for each of six solutions of Hydrogen Peroxide and various concentrations of Vitamins A and C antioxidants.

Results

Measuring the Daphnia heartbeats under the influence of a mock oxidative stressor, Hydrogen Peroxide (H2O2), combined with the six vitamin solutions of differing ratios of Vitamins A & C, it was proven that the solution that most effectively reduced the oxidative stress was the 1:1 ratio of the vitamins.

Conclusions/Discussion

Repeated trials under the influence of the six H2O2/antioxidants solutions concluded that the most effective was the solution with a 1:1 ratio of antioxidants. Vitamins A and C worked best in this combination due to one being hydrophobic (Vitamin E) and hydrophilic (Vitamin C). At this ratio, the antioxidants work together by breaking into the outer and inner layers of the free radicals and supplying the needed electrons to reduce oxidative stress. My goal is to continue this research to further understand the impact of these vitamins on athletes, to improve performance and overall health.

Summary Statement

My project uses hydrogen peroxide to mock oxidative stress on D. magna, which is combated by added antioxidants to measure how a body can recover from a rigorous workout.

Help Received

Ms. Jennifer Polson, Dr. Cheuvront (Villa Park HS), Mr. Paul Hunt (VPHS), Ms. Corbett (VPHS)

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Robbi A. Razal

Project Number

S2111

Project Title

Analyzing the Ecotoxicity of the Surfactant, Cocamidopropyl Betaine, on the Hatching of the Aquatic Crustacean A. salina

Abstract

Objectives/Goals

Research was conducted in order to assess the toxicity of the surfactant, cocamidopropyl betaine (CAPB), to the arthropod species, Artemia salina, by observing the hatching amount of the organisms. Tests included the exposure of varying concentrations of CAPB, (5, 10, 15, and 20 mg/ 500 mL) to A. salina, while the separate control group consisted of an untreated species of A. salina. The control and treated groups of the crustaceans were maintained under the same conditions in regards to light exposure, temperature, etc. Outcomes of the experiment indicated a lower hatch rate and premature nauplii death with increasing concentrations of CAPB. Results demonstrated that CAPB is toxic to A. salina, endangering the overall conditions of the aquatic environment.

Methods/Materials

API Aquarium Salt (18 ± .1 g mix/ 500 mL) was placed in a 500 mL beaker. Deionized water was added to the 500 mL mark of each beaker, achieving the saltwater environment of the brine shrimp. The pH of the solutions were kept at a range of 7-8. pH was periodically monitored using pH paper and was adjusted accordingly with the addition of sodium bicarbonate. This procedure allows for a consistent saltwater environment.

Microscope slides were obtained and cleaned. Graph paper was cut into a small square and adhered onto a slide using double sided tape. Twenty five brine shrimp eggs were placed on the tape using a toothpick and counted using a microscope. The slide was placed in a 100x15 mm petri dish. Thirty five mL of the 0 mg CAPB saltwater solution was poured into the petri dish and placed under a lamp at 25°C. The process was repeated for 5 mg, 10 mg, 15 mg, and 20 mg CAPB per 500 mL concentrations which were prepared in separate beakers. Each petri dish was labeled respectively. The number of live hatched nauplii was recorded at each concentration at 24, 48, and 96 hours.

Results

Results show a significant decline in hatched cysts with the introduction of CAPB into the environment.

Conclusions/Discussion

CAPB ultimately poses an ecotoxicological danger to A. salina as seen through the decrease in live nauplii over time at different concentrations. Although the concentrations of CAPB in nature are likely very small, it is nonetheless a toxic surfactant that can build up in surface waters and negatively impact wildlife such as A. salina.

Summary Statement

Surfactants, specifically CAPB, is ultimately toxic to A. salina, and this will be shown through the decreased number of hatched cysts that occurred as time and concentration increased.

Help Received

I used laboratory equipment at Thousand Oaks High School under supervision of Dr. Nikki Malhotra

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Davyd Slesarenko

Project Number
S2112

Project Title
The Effects of Colas on Turbatrix aceti

Abstract

Objectives/Goals
The objective of the project was to determine which variety of Coca Cola was healthier and why.

Methods/Materials
The pH was tested first and it was determined through NaOH titration. The effects of the certain pH were determined by tests on trials of Turbatrix Aceti that was made through a half-half combination of Turbatrix Aceti culture and the liquids being tested. Control was made in a similar fashion. After, the effects of Aspartame and Sugar were tested on Turbatrix Aceti through trials filled with culture and the proper ratios of sugars. This organism was chosen in particular due to its pH similarities to a human esophagus.

Materials sued include: Turbatrix Aceti culture; H3PO4 15 M ; NaOH 6M; micro pipets; burettes ; Aspartame, sugar, dH2O; Coca Cola Regular; Coca Cola Diet; Apple Cider Vinegar; safety equipment.

Results
The survivabilty of the Turbatrix Aceti was observed under a microscope. The survivabilty results of the Turbatrix Aceti were compared. The Diet Coca Cola was determined to be worse for an organism due to the presence of Aspartame.

Conclusions/Discussion
The Aspartame being worse for consumption means that the Coca Cola Diet is worse for consumption than Regular Coca Cola and therefor the popular belief about the Coca Colas is false as is the Coca Cola Diet Advertisement campaign.

Summary Statement
The lower calorie beverages were determined to be dramatically worse for consumption than the regular kind due to the presence of Aspartame in the lower calorie variety.

Help Received
My AP Chemistry teacher M. Morgan thought me titration; my AP Biology teacher L. Hua provided 6 M NaOH; my STAR 1 teacher Ms. Ramirez-De La Cruz provided glassware.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Lauren P. Takiguchi

Project Number

S2113

Project Title

The Effects of Various Concentrations of Sotalol and Caffeine on the Heart Rate of Daphnia magna

Abstract

Objectives/Goals

The purpose of discovering the effects of sotalol and caffeine on the heart rate of Daphnia magna is to observe if these substances actually have an effect on heart rate.

Methods/Materials

This research project was conducted by testing ten specimens of Daphnia magna in three concentrations of sotalol, three concentrations of caffeine, and a control group with Arrowhead spring water for both studies. Each specimen was individually inundated in an aqueous solution of the concentrations of sotalol and caffeine. Then, each Daphnia magna was pipetted onto a microscope slide, to be viewed under the lowest power setting of a Flinn Scientific microscope. The number of heartbeats was counted for fifteen seconds, and then multiplied by four to retrieve the recorded number of beats per minute for each specimen.

Results

All three means for the solutions with concentrated caffeine had higher average heartbeats than the mean of the control group of Daphnia magna. The control group averaged 140 heartbeats per minute, the 2.80% caffeine concentration averaged 170 BPM, the 5.93% caffeine concentration averaged 188 BPM, and the 11.20% caffeine concentration averaged 205 BPM. The average deviation for all of the test groups was less than 6%, which indicated a relatively high level of precision. For the most part, the means for the solutions with sotalol resulted in a lower amount of heartbeats per minute than the control group. The control group averaged 141 BPM, the 2.36% sotalol concentration group averaged 146 BPM, the 4.72% group averaged 137 BPM, and the 7.29% sotalol concentration group averaged 116 BPM. Although the average deviation for each group was less than 5%, the groups did not indicate a significant difference in number of heartbeats per minute until the 7.29% sotalol concentration group.

Conclusions/Discussion

Overall, the data collected in this experiment supported the hypothesis that increased concentrations of caffeine would cause the heart rate of Daphnia magna to increase, while increased concentrations of sotalol would cause the heart rate to decrease. An inference based off this outcome would be that caffeine is potentially harmful since it causes the heart rate to increase rapidly, which puts immense strain on the heart muscle. An inference based off the sotalol data would be that sotalol functions as a prescription drug should because it decreases heart rate gradually as the concentration increases.

Summary Statement

My experiment showed that caffeine increased the heart rate of Daphnia magna significantly, but sotalol only decreased the heart rate in the highest concentration used.

Help Received

My chemistry teacher, Mr. Mike Antrim, suggested using Daphnia magna as test subjects. Other than that, I conducted the experiment in my house.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Perrin J.G. Turney

Project Number

S2114

Project Title

Effects of Inhibiting and Enhancing Water Pollutants on Microorganism Mortality at the Arcata Marsh

Abstract

Objectives/Goals

The objective of this project is to determine the effects of an enhancing water pollutant, fertilizer, and an inhibiting water pollutant, chlorine, on the mortality of freshwater microorganisms at one of the nation's most ecologically responsible water treatment facilities located in Arcata, California.

Methods/Materials

Materials: Water samples from the Arcata Marsh Log Pond, chlorinated tap water tested for residual free chlorine utilizing DPD free chlorine reagent, measurable fertilizer components: phosphorus, nitrogen and phosphate. Method: Utilizing a series of concentrations of chlorinated tap water and each of the three fertilizer components to pollute measured samples of Log Pond freshwater, mortality and health of populations of Euglena, Daphnia, Coleps, Rotifers, green algae, diatoms, and Cyclops were observed and recorded.

Results

After 72 hours, all of the freshwater microorganisms in all concentrations of chlorinated water died. Using similar concentrations of fertilizer to the concentrations of chlorine, the microorganism populations increased significantly, beginning with the green algae. Increasing fertilizer concentrations to that similar to the salinity concentrations used in the prior year's experiment led to the death of microorganism populations within 120 hours.

Conclusions/Discussion

Inhibiting pollutants such as chlorine will lead to the eradication of Euglena, Daphnia, Coleps, Rotifers, green algae, diatoms, and Cyclops in freshwater ponds at the Arcata Marsh. Enhancing pollutants such as fertilizer kept at low concentrations increases populations of green algae. This then leads to increased numbers of microorganisms that feed on green algae. Increasing the concentration of fertilizer to that which may be leaching into the soil from numerous illegal and unregulated cannabis grow sites in Humboldt County proved to be detrimental to the freshwater microorganisms at the Arcata Marsh.

Summary Statement

Chlorine water pollution, even at low concentrations, increases mortality of freshwater microorganisms while fertilizer enhances populations of microorganisms at low concentrations and becomes a detriment as concentrations increase.

Help Received

After researching the processes for cleaning waste water in an ecologically safe manner at the Arcata Marsh, I designed and performed this experiment myself.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Gina Y. Yang

Project Number

S2115

Project Title

Investigating Colony Collapse Disorder: Effects of tau-Fluvalinate on the Health of Honeybees Apis mellifera l.

Abstract

Objectives/Goals

Bee pollination accounts for 15 billion dollars in added crop value and more than one-third of the food consumed in the U.S. For almost ten years, Colony Collapse Disorder (CCD) has been responsible for unexplained large-scale bee losses. Such large bee die-offs resembling CCD have implicated not only the deadly parasitic mite Varroa destructor, but also the miticides used to control it. This project investigated the effects of tau-fluvalinate, a common active ingredient found in miticides, on the health of honeybees. It was hypothesized that bees orally exposed to tau-fluvalinate would exhibit learning and memory impairment and higher mortality.

Methods/Materials

64 honeybees were divided into 4 groups of 16. A control group was fed with sucrose solution, while the three remaining groups were fed with different concentrations of tau-fluvalinate (1%, 5%, and 10%). All groups were triplicated. Bees were kept in hoarding cages and allowed to feed ad libitum from feeders. Mortality was recorded daily, and after 3 days of feeding, proboscis extension reflex (PER) assays were conducted to assess associative learning and memory.

Results

According to Pearson chi-square test for independence, mortality in tau-fluvalinate-fed groups (1% tau-fluvalinate solution: 14.6%; 5% tau-fluvalinate: 14.6%) was not statistically different than mortality in control groups (10.4%). However, there was a statistically significant difference between mortality in groups fed with 10% tau-fluvalinate solution (27.08%) and control groups. Another Pearson chi-square test was conducted to examine the relationship between the learning performances of tau-fluvalinate-fed bees and controls; the number of PER responses elicited in all tau-fluvalinate-fed groups was determined to be significantly lower than the number of responses in control groups.

Conclusions/Discussion

As confirmed by the absence of PER responses in most miticide-fed bees, tau-fluvalinate had a detrimental impact on bee learning and memory. Such learning and memory association is vital to the foraging and homing behavior of worker bees, whose jobs are crucial to colony food supply. Learning impairment in workers would therefore have serious implications for the health of colonies. Thus, the negative effects of tau-fluvalinate on bees suggest that the widespread use of in-hive miticides could be linked to CCD.

Summary Statement

The miticide active ingredient tau-fluvalinate was determined to have negative effects on honeybee learning and memory and thus may be linked to the unexplained phenomenon of Colony Collapse Disorder.

Help Received

Beekeeper Ken McKenzie donated live bees used in the experiments; my mentor Ms. Fallon provided advice and guidance.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Justin J. Wang

Project Number

S2199

Project Title

Phasor-FLIM Analysis of Metabolic Effects of Caffeine and Cisplatin on a Triple-Negative Breast Cancer Cell Line

Abstract

Objectives/Goals

Caffeine and cisplatin's effects on NADH related energy production pathways within a breast cancer cell line.

Methods/Materials

Treated cells with different concentrations of caffeine, cisplatin, and a combined treatment of caffeine and cisplatin. Examined metabolism by measuring free and bound NADH in treated cells by using Fluorescence Lifetime Imaging Microscopy (FLIM). Acquired images with the ZEISS LSM 710 microscope. Analyzed images using the Phasor-FLIM technique with the Globals for Images program written by Dr. Enrico Gratton.

Results

Treatment with caffeine caused breast cancer cell energy production pathways to shift from primarily glycolysis towards more wild-type oxidative phosphorylation. Treatment with cisplatin also shifted cancer cell energy production pathway towards oxidative phosphorylation energy production. A combined treatment of caffeine and cisplatin induced cancer cells to shift towards wild-type metabolism as well, but the magnitude of the shift was similar to that of the cisplatin only treatment.

Conclusions/Discussion

Treating triple-negative breast cancer cells with caffeine induces anticancerous effects by inducing more oxidative phosphorylation. Although, according to literature, caffeine and cisplatin potentiate each other in lung and bone cancer cell treatment, the two do not when used on the triple negative breast cancer cell line studied. This experiment also shows that FLIM can be potentially used for targeted drug therapy screening in biopsied patient specimens to evaluate the efficacy of different drugs on individual tumor cells.

Summary Statement

I showed that caffeine is an effective drug in the treatment of invasive triple-negative breast cancer cells and that FLIM can be used for targeted drug therapy.

Help Received

Dr. Michelle Digman from the Laboratory for Fluorescence Dynamics at the University of California, Irvine mentored me while I completed my project. Ning Ma is a graduate student under Dr. Digman who also mentored me and helped with acclimating me to lab equipment and techniques.