CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Brenda Carerra; Ricardo Hernandez; Carla Lemus

Project Number
S2201

Project Title
The Effects of Over-the-Counter Pain Medication on Daphnia magna

Abstract

Objectives/Goals
There's a misconception is that throwing medication down the drain is the best way to dispose of medication. This experiment was conducted to show the effects of over-the-counter pain medication on Daphnia magna, an important aquatic organism. We hypothesized that if pain medication can cause physiological changes, then the Daphnia magna should display physiological changes that could lead to a change in their heart rate. The hypothesis was supported because based on the results, results showed that the over-the-counter pain medication changed their heart beat. The results showed that the medication changed the heart rate of the Daphnia magna, showing that medication does have a negative impact on the Daphnia magna population.

Methods/Materials
200 Daphnia magna, 9 plastic containers, 3 OTC medications: Ibuprofen, Acetaminophen, Naproxen Sodium, 30 pipettes, 1 Microscope, 4 disk plates, spring water, lab notebook, stopwatch.
Each concentrations(0.5mL, 1.5mL, 2.5mL) were made for each medication and mixed with 2.5mL of spring water. With a pipette, one drop of the concentration was placed on the Daphnia magna and with a microscope, the heartbeat of the daphnia magna was observed for one minute using 10 second intervals. This procedure was done 3 times for each different concentration of every medication tested.

Results
The pattern found in the experiment was that the heartbeat of the Daphnia magna decreased when exposed to each concentration of the medications. Among the three medications tested, the most significant was Ibuprofen at 2.5mL. Therefore, since the medication administered had a negative impact on Daphnia magna showing that throwing medication down the drain has a significant impact on Daphnia magna and their population.

Conclusions/Discussion
Results supported the hypothesis that the Daphnia magna presented with a change in heart rate when exposed to the over the counter medication used. The results showed that over-the-counter pain medication did have an effect on Daphnia magna heart rate. Based on the data, the higher the concentration the OTC medication became, the greater the decrease in their heart rate. Overall, ibuprofen provided the greatest decrease in heart rate. The experiment was conducted to demonstrate the effects of over-the-counter pain medication on Daphnia magna to show that throwing pain medication down drains has a negative impact on the Daphnia magna population.

Summary Statement
Exposing Daphnia magna to different concentrations of over-the-counter pain medication showed that as the concentration of medication administered increased, the heart rate of the Daphnia magna decreased.

Help Received
None. We designed and conducted this experiment on our own.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Cynthia Chen; Ji Hyun Lee

Project Number

S2202

Project Title

Combination Therapy Using Drug Repurposing and Drug Mapping: A Method to Find Synergistic Treatments for Leishmaniasis

Abstract

Objectives/Goals

Neglected tropical disease, Leishmaniasis, is a deadly disease that is most prevalent in poverty stricken countries. The purpose of this project is to create a drug therapy that will address the problems of the current treatments used for Leishmaniasis: inefficacy, adverse effects, and high cost of treatment. The hypothesis is that the combination of 2 FDA approved compounds with associated mechanisms of action will result in synergy, leading to lower dosage, decreased resistance, and shortened treatment time.

Methods/Materials

Compounds to repurpose were chosen based on the following criteria: target of the compound must exist in the parasite and the compounds selected to be used in a combination must have different mechanisms of action in the parasite. A computer generated drug map taking into account compound toxicity and compound mechanism of action was created. Human macrophages were infected with Leishmania donovani to replicate the host environment. 34 single compounds and 35 drug combinations were screened in a cell-based assay against Leishmania donovani parasites. Set ratios were used for the combination concentrations, and a software called Compusyn was used to measure synergy. Compusyn generated a combination index (CI value), and a CI value less than one indicates that the combination is synergistic.

Results

Compusyn generated 4 synergistic combinations from our set of 35 drug combinations: Afatinib and Rolipram, Afatinib and Mefloquine, Afatinib and Metformin, and Tacrolimus and Reserpine. All combinations were replicated in both plates and were only considered as hits when both of their CI values were under 1. The synergistic combinations that were found are extremely promising candidates for the treatment of leishmaniasis.

Conclusions/Discussion

Our research confirmed the advantageous use of combination therapy in discovering synergistic combinations while repurposing FDA approved drugs. Combination therapy combined with drug repurposing allowed us to answer our question on how to find a more efficient method to to identify synergistic combinations, while drug repurposing addressed our concern with lowering the cost and time of the drug development process. In addition, synergistic combinations allows for a lower concentration of compounds to be used in treatment, which greatly lowers side effects and toxicity.

Summary Statement

We combined drug repurposing and combination therapy along with drug mapping in order to find synergistic combinations to treat the neglected tropical disease, leishmaniasis.

Help Received

We conducted our research at the University of California, San Diego and mainly received help from Dr. Jair Lage who was our mentor, and additional help from Dr. Julia Souza, Dr. Jean Bernatchez, and Dr. Ruben Abagyan.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Hunter C. Crawford-Shelmadine

Project Number
S2203

Project Title
How Byproducts Produced by Removal of Oxybenzone by Phytoremediation & Laccase/ABTS Beads Affect Morality of D. magna

Abstract

Objectives/Goals
1)if byproducts produced by the removal of oxybenzone using phytoremediation w/wetland plants & a biotech method using laccase/ABTS alginate beads are harmful to Daphnia magna 2)if laccase beads can remove oxy. at a higher & faster rate than wetland plants; 3)determine rate that sunscreen washes off skin to contaminate waterways

Methods/Materials
Phase 1-Using a UV Spectrophotometer, create a standard curve using 1:2 serial dilution of oxybenzone sunscreen. Use curve to determine amt. of sunscreen that washes off hand.
Phase 2-Perform 2 trials of ea: [control, leca, plant (5 species), plant & leca (5 species)] in 0.1 % oxy. solution. Test UV absorbance every 24 hrs. Make 4 combos of laccase/ABTS/buffer alginate beads and perform 2 trials of ea. in a 0.1% oxy. solution. Test UV absorbance thru time.
Phase 3-Select solutions with lowest % of oxy. from plants/beads & mix same % for controls. Place 6 Daphnia in ea. solution. Count survivors thru time.

Results
Phase 1: Standard curve is a near perfect line: r = .9969. This validates the use of UV Spec to measure the amt. of oxy. Hand w/sunscreen in water lost 62 % of sunscreen after 30 min.
Phase 2: 4 of 5 wetland plants were effective in removing oxy. from water. A one way ANOVA test = p-value of <0.0001 so I reject the null hypothesis & have high confidence that plants removed oxy. from water.Laccase beads had unreliable results. Two removed oxy. but the decrease was not significant -p-value = 0.0622. Two others had unreliable data.
Phase 3:Exposure to byproducts from plants resulted in a higher mortality rate/hr of D. magna compared to controls. The hrs. to reach 50% mortality were 22% to 76% faster than controls and to reach 100% mortality were 40% to 60% faster than controls (1 exception). Exposure to byproducts from laccase beads had mixed results. The hrs. to reach 50% mortality of D. magna w/LA & LABS beads were 15% & 72% faster than control & to reach 100% mortality, LABS were 72% faster than control but D. magna in LA survived longer than control.

Conclusions/Discussion
Byproducts produced by the removal of oxybenzone by both methods had an overall harmful effect on D. magna as evidence by the increase in the rate at which the D. magna reached the 50% and 100% mortality rate. Therefore, while we develop methods for removing toxicants from our waterways, it is critical to test that the byproducts produced are not as harmful as the toxicants.

Summary Statement
This experiment tests if the byproducts produced by two methods of removing oxybenzone from waterways (phytoremediation and alginate beads made with the enzyme laccase and a mediator ABTS) are toxic to Daphnia magna.

Help Received
Ms. Burndon and Mr. Capp and Mr. Endberg from Carlmont High who helped brainstorm ways of measuring reduction of oxybenzone in solutions and helped me understand details of some published research as well as providing access to lab supplies.

Name(s)
Sumanth Gurram; David Wu

Project Number
S2204

Project Title
Low-Frequency Electromagnetic Fields Decrease Cancer Cell Viability for Potential Cancer Therapy

Abstract

Objectives/Goals
With drug delivery, expense, efficacy and side effects becoming problematic in cancer therapy, more directed, low-cost and effective therapy is needed. A potential candidate for such therapy is the use of low-frequency electromagnetic fields (EMFs), which are ubiquitous in the modern world and are a widely debated topic in public health. We aimed to develop a low-cost EMF-exposure system that would reduce cancer cell viability in vitro by aiming 60 Hz 2 mT EMFs at colorectal and neuroblastoma cancer cell lines, showing potential for therapeutic development.

Methods/Materials
We constructed an inexpensive 20-inch tall, 168-turn solenoid to generate 60 Hz EMFs up to 2 mT in strength. 96-well experimental and control plates containing cells lines HCT116, SH-SY5Y, and RAW macrophages in monoculture and coculture were created and exposed to EMFs 12 hours at a time for up to 5 days. Following exposures, Propidium iodide Assay and MTS Assay were conducted to quantify reduced cell viability in addition to qualitative observations under the microscope. Propidium iodide binds to fragments of DNA from dead cells and an absorbance reading is taken. The presence of NAD(P)H-dependent dehydrogenase enzymes in viable cells reduces the MTS reagent resulting in a colored compound with an absorbance maximum at 490 nm.

Results
After two days of 12-hour-daily exposures, the exposed well plate showed a 65-94 percent decrease in cell viability and proliferation as quantified by the MTS Assay when compared to the unexposed plates. After 4-5 days of exposure, the exposed plate cells numbered significantly less, were deformed and non-adherent. MTS assay revealed a dramatic difference between the exposed and unexposed with the exposed having little to no cell metabolic activity at 90-100 percent decreases in viability and proliferation.

Conclusions/Discussion
Our EMF device and exposure system has significantly reduced cancer cell viability and proliferation in vitro for both neuroblastoma and colorectal cancer. We plan to test exposures on non-cancerous cell lines and also optimize exposure intensity and duration for reduced cancer cell viability. Overall, our results point to potentially using EMFs in cancer therapy. EMF-based treatment represents a potentially low-cost, directed and effective way of treating cancer in the future.

Summary Statement
This project demonstrates the adverse effects that low-frequency EMFs have on cancer cell viability and proliferation, which presents EMFs as a potential candidate for cancer therapy.

Help Received
Dr. Salvesen at Sanford Burnham Prebys Research Institute provided us with the cell lines, culture materials, and training. The idea and plans for executing this project were developed independently. We carried out the experiments and analyzed the data ourselves under the appropriate supervision in the lab.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Joseph A. Huitt

Project Number
S2205

Project Title
Pollination! Its What's for Dinner! Investigating the Effects of Neonicotinoids on Bee Pollinators

Abstract

Objectives/Goals
The objective of this experiment is to determine if honey bee pollinators that have been exposed to neonicotinoids can pollinate crops and function efficiently compared to hives that have not had exposure to neonicotinoids. I tested for an increase or decrease in crop production.

Methods/Materials
I exposed 72 hives to neonicotinoids(control groups) and 72 hives were placed in pesticide free areas. 36 hives were exposed to Clothianidin(neonicotinoid) in alfalfa fields, 36 hives were exposed to Thiamethoxam(neonicotinoid) in a cornfield, 36 hives were in a pesticide free alfalfa field, 36 hives were in a pesticide free corn field. I exposed bee pollinators to different levels of Imidacloprid(neonicotinoid) through pollen cakes and liquid sugar. I tested bee samples, corn syrup, honey, and pollen patties for neonicotinoid residue. I checked crop production from pollination in each group.

Results
72 hives exposed to neonicotinoids had major losses 50%-70% in colony size and deformities in the bees noticeable in the baby larvae dying. Neonicotinoids leave trace amounts of residue in honey. I found mite populations to infest the hive, which causes CCD in worker bees and in capped brood cells. There was an insufficient work force to maintain the brood that was present and a noticeable decline in honey and pollination production from neonicotinoid fields. Neonicotinoids disrupt the bee's central nervous system, learning and GPS navigation, making them vulerable to parasites and virsuses. Testing for neonicotinoid residue in corn syrup showed that it survived the sugar processing. Pollination was reduced 16-20% due to navigation and learning disorders. Up to 17 different pesticides were found in a single pollen sample, levels of 11-22 ppb. Test colonies fed neonicotinoids had 1,000 times more Deformed Wing Virus and is 5,000 times more toxic than DDT to bees.

Conclusions/Discussion
I learned exposure to neonicotinoids are killing our bee populations and leading to CCD disorder, which causes a reduction in pollination. Pollinator bees have complex neurological systems, a biological GPS that provides them with a mental map of their hive, pollination areas and location which has been destroyed by neonicotinoids. It makes the bee more susceptible and vulnerable to parasites and viruses, including the intestinal parasite nosema. Pollination and production were up in pesticide free areas.

Summary Statement
My project shows how bees exposed to sublethal levels of neonicotinoids are killing my bees, leading to Colony Collapse Disorder, and less pollination.

Help Received
My mom worked with me, as she is a beekeeper, the Bee Diagnostic team helped with my testing along with the USDA.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Atticus J. Humphrey

Project Number

S2206

Project Title

Effects of Apollo SC Miticide on Galendromus occidentalis

Abstract

Objectives/Goals

The title of this project is Toxicity of Apollo SC Miticide on Galendromus occidentalis (G. occidentalis). The purpose of this study was to investigate if differing concentrations and intervals between the leaf-dip assay of Apollo SC (Apollo) and test subject exposure would affect its toxicity.

Methods/Materials

Concentrations consisted of a 100% label rate (LR) Apollo, a 50% LR, a 25% LR, and a 12.5% LR. The control was a 0% LR. Each concentration and the control test contained ten petri dishes with the leaf-dip assay and five test subjects of G. occidentalis. Three leaf-dip assays were conducted. Test 1 had a twenty-four-hour interval between Apollo application and test subject exposure, test 2 had an interval of three days before exposure, and test 3 had a 5-day interval before exposure. Toxicity was measured in mortality of the G. occidentalis and recorded every twelve hours for thirty-six hours.

Results

After performing this study, the results showed that differing concentrations and delayed leaf-dip exposure of the pesticide did affect the mortality of G. occidentalis. The 100% LR concentration did show the greatest mortality in all of the leaf-dip assays performed at an average of 4.2. The control had the lowest mortality at an average of 0.4. The remaining pesticide concentrations' results were 50% LR at 3.2, 25% LR at 2.7, and 12.5% LR at 2.1.

Conclusions/Discussion

These results indicate that that Apollo SC does have lethal impacts to G. occidentalis. Apollo SC is a selective pesticide and could be utilized in an integrated pest management (IPM) application in conjunction with G. occidentalis. The most effective concentration and exposure delay must be determined for maximum pest management.

Summary Statement

The focus of this project is to determine the selectivity of Apollo SC Miticide when applied to a beneficial mite.

Help Received

The help that was recieved was from Kearny Ag Center and Dr. Kent Daane for project setup, along with my project advisor, Mr. Aalto. I also recieved help from the miticide company and Ricom Vitova for the mite supply.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Rena N. Maduro

Project Number

S2207

Project Title

Evidence for Variable Resistance to Caffeine in Genetically Identical Nematodes

Abstract

Objectives/Goals

Humans respond differently to the stimulatory effects of caffeine, but it is not understood why. Here we test whether chronic low-level exposure to caffeine leads to behavioral or developmental differences in the genetically identical model system, Caenorhabditis elegans, as assayed by changes in growth and movement. Since caffeine interferes with the nervous system, we hypothesized caffeine exposure could interfere with development, leading to growth arrest or even death.

Methods/Materials

Worms were grown on standard media. After 72 hours,the amount of worms and their stages were manually counted through a microscope. Worms that had reached adulthood in the experimental and control groups were separated from remaining population using a platinum wire worm pick. The movement of adult worms was measured as body bends per 20 seconds and recorded (assay) for each of two plates at 20 worms each plate. Worms that had not yet reached adulthood were allowed to develop a further 24 hours and were scored for movement and stage.

Results

After 72 hours, 100% of non-treated worms developed to young adults and remained synchronized (grew at the same rate). In contrast, the caffeine treated worms lost synchrony. After 72 hours, only about half of the population reached young adulthood, demonstrating a developmental delay.As soon as worms developed into adult worms, we tested their stimulatory response by performing a swimming assay, as a surrogate for alertness. 20 worms from each population were assayed for body bends over a 20 second interval for each of two trials. The normal- growing caffeine-treated worms had a 26% increase in their locomotion rate, thereby confirming the stimulatory effects of caffeine. In contrast, however, the slower -developing worms showed no changes in movement compared to the control- they were slower to develop but resistant to the drug.

Conclusions/Discussion

Since these are genetically identical worms, it is unlikely that in one generation they would have acquired a genetic resistance to caffeine; rather we surmise that they are showing differences due to uptake or turn-over of the drug. We conclude that it is possible for even genetically identical populations to respond differently to the chronic stimulatory effects of caffeine, as is seen in genetically diverse populations like humans.

Summary Statement

Genetically identical animal populations exhibit two distinct responses to chronic low-levels of caffeine exposure.

Help Received

All research animals,chemical, equipment and training was provided by the Maduro Lab, University of California Riverside

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Samiha Mahin

Project Number
S2208

Project Title
In Vitro Effects of Genistein and Di-(2-ethylhexyl) Phthalate on Testicular Macrophages and Spermatogonial Cells

Abstract

Objectives/Goals
(1)Determine whether Gen and MEHP, alone or mixed, directly target macrophages and affect their pro-inflammatory responses in-vitro. (2)Determine whether Gen and MEHP, alone or mixed, directly target spermatogonia stem cells, precursors of spermatozoa.(3)Determine whether Gen and MEHP change the interactions between macrophages and spermatogonia.

Methods/Materials
MHS Cell line cultured as a model for testicular macrophages and C18-4 Cell line cultured for spermatogonial cells.
(1)MHS was stimulated with Lipopolysaccharide (LPS) to induce the inflammatory response of macrophages. After treating and culturing the cells, MHS had gone through RNA extraction, cDNA synthesis and Quantitative Real-Time PCR (qPCR). (2)The spermatogonial cells were treated for 24 hr and 48 hr with Gen and MEHP and then analyzed with MTT assay. (3)For co-culture treatments, RAW 264.7 macrophage cell line was used as a model for testicular macrophages. RAW grew in transwell inserts, pre-treated with Gen and/or MEHP for 21 hrs. C18-4 viability was then analyzed with MTT assay.

Results
(1)Gen and MEHP alter the basal and LPS induced production of inflammatory cytokines by macrophages. The mRNA relative expression showed that macrophage activity can be altered by Gen and MEHP, which could have consequences for testis functions in vivo. (2)Gen and MEHP combination at the highest concentration increased viability/proliferation of spermatogonial cells at both 24 hr and 48 hr treatments. So, this confirmed my hypothesis that these EDCs can directly target spermatogonia, which may affect spermatogenesis. (3)The presence of macrophages pre-treated with Gen and MEHP, alone or in combination, and activated or not by LPS did not have an effect on the viability/proliferation of spermatogonial cells after 48-hour co-culture.

Conclusions/Discussion
Changes in the mRNA relative expression of cytokines confirmed the hypothesis that Gen and MEHP can alter directly macrophages and change their biological responses. MTT assays suggest that Gen-MEHP mixture affect spermatogonial viability or proliferation, while Gen and MEHP had no effect alone. For both cell lines, MEHP and Geni did not behave the same way when together or alone. These studies will help understand how the effects of the two EDCs early in life on macrophage and spermatogonia may play a role in their long-term negative effects on male reproduction.

Summary Statement
I demonstrated that the endocrine disruptors, Genistein and DEHP, can directly alter testicular function and maintenance such as a pro-inflammatory in macrophages and proliferation in spermatogonia.

Help Received
I have conducted this research at the USC School of Pharmacy under the supervision and mentorship of my Principal Investigator, Dr. Martine Culty and the assistance of the postdoctoral student, Dr. Vanessa Brouard.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Ishika Masson; Shania Relucio

Project Number

S2209

Project Title

Effects of Caffeinated and Non-Caffeinated Beverages on the Physical Mechanisms in Animal Movement Processes: Lumbricus

Abstract

Objectives/Goals

As Hunger remains the leading source of death in today's world, it is important for all of us to do something for our brothers and sisters. While doing our weekly AP World History homework, in the textbook we stumbled upon a picture of some malnourished children. From this we were inspired to help our peers out by creating a project that moves towards hunger being diminished. Thus quantifying the effects of energy drinks on the movement activity of Lumbricus Terrestris and How will giving Red Bull, Sugar-Free Redbull, Gatorade, Sucrose Solution, Soda, 5-hour energy drink, and caffeine affect the distance moved on a grid by the clitellum and frequency of clitellum contractions for 2 minutes after exposure to various fluids?

Methods/Materials

We used 84 worms purchased from a local department store and tested them over the course of two trails. We tested eight different beverages including Red Bull, Red Bull Sugar-Free, Gatorade, Sucrose Solution, Soda, 5 hour Energy, Coffee, and Water. We first placed the lumbricus Terrestris on a grid and meaured its distance by looking at how many boxes the clitellum covers without any exposure to fluids. Then, we gave them various fluids a week before we started measuring them. Then after a week of them consuming different fluids, we meaured out how far the lumbricus Terrestris traveled by looking at how far the clitellum moved for 2 minutes on a grid.

Results

In our first trial, there was no possible data because all our Lumbricus Terrestris had passed away. However in our second trial the Lumbricus Terrestris seemed to move slower when given caffeine and they increased in size. The average movement of the Lumbricus Terrestris for caffeinated drinks over the course of one minute was 6 boxes covered and the average for non-caffeinated drinks was 8 boxes moved over the period of one minute.

Conclusions/Discussion

Our hypothesis did not match up to the results we got because we predicted that the worms would move faster when given caffeine, while in reality their speed slowed down. While we did not see an increase in their movement, we did notice that the worms seemed to be bigger than when we first got them. The next steps could include using different organisms such as those with vertebrates and testing more beverages with different concentrations to see how it affects the movements.

Summary Statement

We measured the distance moved on a grid by the clitellum and frequency of clitellum contractions for 2 minutes after exposure to eight different beverages.

Help Received

Our Science Fair advisor helped us with creating a plan on how to test the Lumbricus Terrestris.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Anshul Narain

Project Number
S2210

Project Title
Investigating Pesticides' Effects on Plant Defenses and Development

Abstract

Objectives/Goals
To determine whether pesticides have an impact on a plant's ability to express physical and chemical defenses.

Methods/Materials
Chemical and physical defenses were induced in the Brassica rapa plant through application of; 3 different pesticides (Actinovate, CITation, M-Pede), Jasmonic Acid, and Ethanol. Height measured with ruler. Leaf surface area measured with pictures that were analyzed using Fiji software application (Also used for counting number of trichomes). Toughness measured with 3D printed penetrometer. Wet and dry mass measured with analytical balance. Carbon: Nitrogen (C:N) analysis done with elemental analyzer.

Results
Toughness tests indicate that pesticides reduce a plant's ability to express physical defenses as seen through the reduced ability to withstand impact. The C:N analysis also indicates that pesticides hinder a plant's ability to express chemical defenses as seen through the reduced ability to sequester nitrogen away from the leaves.

Conclusions/Discussion
Pesticides potentially have an impact on some of the plant's physical and chemical defenses. This means that even as pesticides are trying to reduce the threat of some herbivores, they potentially increase the threat from those herbivores they are not designed to protect against.

Summary Statement
I measured the impacts of pesticides on a plant's ability to express its physical and chemical defenses (through phenotypical and chemical analyses) to see if they hindered plant development.

Help Received
I designed the setup of the project and the methods used with some assistance from two lab partners while working in a lab at UC Santa Cruz. I was mentored by Ms. Julie Herman (a PhD Candidate) and worked under Professor Kathleen Kay in the department of Ecology and Evolutionary Biology at UCSC.

Name(s)
Shreya Ramachandran

Project Number
S2211

Project Title
The Effect of Soap Nut Grey Water on the Environment: Vegetables (Year 3)

Abstract

Objectives/Goals
As many parts of the world are facing water scarcity there is a growing interest in reusing greywater. However, many commercial laundry detergents contain chemicals harmful to soil, plants and aquatic life. I tested if the greywater from soap nuts, a natural berry shell, could be used as irrigation water for vegetables without leading to contamination with bacterial pathogens or excessive nutrients.

Methods/Materials
To conduct my experiment I grew three types of plants (tomato, chard, spinach) in two types of soil (sandy & sandy loam) for a total of 6 weeks. I had 3 replicates for each greywater treatment(soapnut(SN), organic detergent(OD), non-organic detergent(ND) and a soapnut-tea -tree-oil(SNO) combination). I measured the abundance of Escherichia coli and Fecal coliforms (FDA produce safety marker) on the outside and inside of the plant as well as in the soil using 3M Petrifilms or Chromagar ECC (1400+ samples). This experiment was repeated twice. Overtime analysis was performed on spinach in sandy soil by inoculating with 10 power 6 E.coli K12 at the beginning of the experiment. Bacterial counts were taken everyday for a week followed by weekly measurements for 4 weeks. In all the above cases, the level of soil and plant nutrients were measured and the data was analyzed with ANOVAs ($p < 0.05$) followed by post-hoc tests.

Results
I found that soapnut greywater was not detrimental with a trend for higher plant growth and biomass than other greywaters. Even with the addition of E.Coli, bacterial counts declined and became undetected after 2-3 weeks, both in the soil and the plant resulting in no E.coli and very low levels of fecal coliforms at the end of the experiment across all grey waters. This indicates that grey water type does not have an effect on the bacterial content of plants tested except soapnut-tea-tree-oil where the levels declined quickly but caused plant death. I also found that plants watered with non-organic detergent died due to high levels of Boron and soluble salts leading to toxicity issues.

Conclusions/Discussion
After the three year study, I now conclude that soapnut greywater does not significantly affect the environment, and can be used for irrigating landscapes and vegetables. In addition, Soap nuts are affordable and cheaper than organic laundry detergents which makes them an ideal solution in drought stricken areas of the world including California and Cape Town.

Summary Statement
Grey water from soapnuts, a berry shell that produces soap, can be used for irrigating lawns and vegetables without leading to bacterial contamination and toxicity issues.

Help Received
I designed and conducted the experiments by myself using equipment from U.C. Berkeley, U.C. Davis and a community lab. Dr. Celine Pallud and Dr. Eric Espinosa helped answer my questions.

Name(s)
Angelina E. Stone

Project Number
S2212

Project Title
Alzheimer's and Aluminum: The Effect of Low-Level Aluminum on Drosophila melanogaster

Abstract

Objectives/Goals
The objective of this study is to see if Aluminum is linked to Alzheimer's disease by causing brain degeneration in fruit flies. Tested with both a behavioral assay and a protein analysis procedure.

Methods/Materials
I tested the behavioral differences between the experimental group (given 5 mM of AlCl3 through their food) and the control group (not given any AlCl3) using a choice chamber assay. In the chamber, the flies could either travel to the dark arm with a cotton ball saturated with tomato juice, the light arm that has a cotton ball saturated with lavender oil, or they could stay in place at the opening on top. One day they'd be tested with the cotton balls in the arms and the next day without the cotton balls. For the protein analysis procedure, I homogenized the fruit fly heads by placing the heads in the Bullet Blender, centrifuged them, and boiled the the tubes for 10 minutes. Lastly, I will perform the western blots to see if there was over-expression of a-beta and tau proteins in the flies given AlCl3.

Results
Significant P values were obtained based the actions taken in the choice chamber by the 5 mM and 0 mM for each testing period (2-3, 7-8, and 13-14).When comparing activity levels between the same groups, there seemed to be no difference between testing days 2-3 and 7-8. In both analyses, the 13-14 test day groups weren't able to obtain a P value due to all of the dead 5 mM flies. As for the death rate, the fruit flies administered AlCl3 died about twice as fast as those not given the toxic metal. Although the protein analysis (western blot) procedure is still in progress, my intended results would be seeing an over-expression of the a-beta and tau proteins in the experimental group.

Conclusions/Discussion
In the behavioral assay, the AlCl3 toxicity seemed to have an immediate effect on the flies' preferential (and learning) behavior based on the obtained P values. This proposes that Aluminum could be responsible for the behavioral and preferential differences often seen in humans with Alzheimer's disease. Also, since there was an immense lifespan difference between the 0mM and 5mM groups, it suggests the AlCl3 leads to a shorter life expectancy. No significant P values were found for the activity analysis. Therefore, either this type of learning is not affected by AlCl3, and/or the effects on learning are not observed in the first week (2-8 days), but may be in the second week.

Summary Statement
I tested to see if Aluminum toxicity caused neurodegeneration in Drosophila melanogaster through a behavioral assay and protein analysis procedure.

Help Received
My project was done in a Neurobiology lab at CSU Fresno State under the professional guidance of a Neurobiology professor. Although I formulated what my procedures would consist of, my professor would give me feedback on how to improve my project to get the most accurate results. I performed the

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Haidyn N. Washburn

Project Number
S2213

Project Title
Analysis of Chronic Toxicity of Glyphosate on Fecundity and Mortality of Daphnia magna

Abstract

Objectives/Goals
The present study aims to assess the impact of Glyphosate on the fecundity and mortality of Daphnia magna in an aquatic environment.

Methods/Materials
Daphnia magna were exposed to varying concentrations of glyphosate to assess fecundity and mortality. The tests were monitored closely and mortality of Daphnia magna was documented every 24 hours over the course of 15 days. After the 15 day testing period, the Daphnia were observed under a microscope to assess fecundity.

Results
The control group, consisting of 600mls water repeatedly had the highest rate of fecundity averaging 2.98 eggs per clutch and only an 8% mortality. While test group 3 (5µg/L) had an average fecundity of 1.12 eggs per clutch with 17% mortality. This indicates that glyphosate adversely affects fecundity while increasing mortality.

Conclusions/Discussion
Although mortality was proven to be dose dependent, changes in terms of fecundity and death rate were significant at 5µg/L glyphosate exposure. These findings are compelling in the argument that glyphosate causes increased toxicity to a vital part of the aquatic food web. The results of this study contribute to a growing number of studies that prove the need for considerably more testing of Glyphosate and glyphosate formulas on their effects in aquatic ecosystems.

Summary Statement
I demonstrated that glyphosate negatively affects fecundity while increasing mortality of Daphnia magna.

Help Received
Former student Titus Patton helped design my testing tanks. I built the testing system and performed all experiments myself.