CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Jamison G. Celio

Project Number
J1701

Project Title
How Much Time of Exposure to Ultraviolet Rays Will Kill E. coli?

Abstract

Objectives/Goals
The objective of this project was to determine how long Escherichia Coli needed to be exposed to ultraviolet radiation to kill it.

Methods/Materials
I used nutrient agar petri dishes, incubator, and UV lights and a syringe to place 0.1 ml of E. coli onto the nutrient agar dishes. Then I placed a UV lamp 6 inches above each petri dish (at separate times). I used five time frames of exposure: 15 seconds, 30 seconds, 1 minute, 5 minutes, and 15 minutes. Then I did three procedures for each time frame, a total 15 experiments. After the exposure times, I put all 15 of the agar plates upside-down in an incubator for 24 hours. I took them out, took a few pictures, then put them in a cardboard box.

Results
The result of my experiments supported my hypothesis that the longer the E. coli was exposed to the ultraviolet radiation, the less E. coli would survive.

Conclusions/Discussion
In conclusion, the UV radiation killed most of the E. coli in 15 minutes of exposure time. The UV radiation has barely affected the E. coli within the 15, 30 and 60 seconds of time exposure though. I believe the UV radiation was not effective at these times because the ultraviolet germicidal lamp I used in my experiment was not very powerful and the wavelengths emitted were not able to quickly break down the DNA in the E. coli. The light breaks the bacteria down by initiating a reaction between 2 molecules of thymine. The cell tries to keep up with the damage, but if radiation is strong or if cell if exposed for to long, the cell dies. In this case, I believe that the radiation was not efficient at causing the reaction.

Summary Statement
I showed that the longer E. Coli was exposed to UV light the more bacteria it killed.

Help Received
I would like to thank Mr. Don Scott who has helped me organize this project and edit my papers. I thank my parents who have helped me with my experiment and help me buy supplies. I express gratitude to Mr. Brad Mason, the chemistry and biology teacher of Golden Sierra High School for letting me borrow his

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Emily A. Champion

Project Number
J1702

Project Title
Solutions for Canine Otitis

Abstract

Objectives/Goals
The objective of this experiment was to find easily accessible solutions to kill bacteria and yeast found in the infected ears of dogs. The hypothesis is, if bacteria grown from a dog's ear infection is treated with a homeopathic solution that kills bacteria and yeast with similar effectiveness to the medication, Mometamax, then it is feasible that the homeopathic solution could treat canine otitis.

Methods/Materials
This experiment used multiple homeopathic solutions: salt water, hydrogen peroxide, apple cider vinegar, coconut oil, and a combination of apple cider vinegar and coconut oil. The experiment collected swab samples from the infected ears of dogs which were used to inoculate petri dishes to grow pathogens. Two types of agar were used, nutrient agar and yeast agar. Each trial set grew 3 samples and used 4 dogs throughout the experiment. All the petri dishes had small discs of coffee filter soaked in the homeopathic solutions and placed into the petri dishes. Areas around discs where pathogens didn't grow were considered kill zones.

Results
The results proved apple cider to be the most effective homeopathic solution when treating bacteria and yeast. The data showed that apple cider had the most kill zones in the bacteria and yeast trails and was even more effective in numerous trials than Mometamax. Hydrogen peroxide also showed good results against yeast.

Conclusions/Discussion
In conclusion, the hypothesis was correct, because apple cider vinegar proved to be most effective when treating bacteria and yeast, which could make it a viable treatment for canine otitis.

Summary Statement
The research and experiment focused on finding a readily available homeopathic solution which could be used to treat ear infections in dogs by exposing pathogen samples cultured in petri dishes to various homeopathic solutions.

Help Received
My science teacher and parents guided me throughout the process of developing the idea of the experiment. I conducted the experiment myself under supervision of Tammy Levy and Shaun Champion. Pathogen samples provided by my mentor and Dr. Steven Leibl. Joseph McCorkle reviewed my board.

Name(s)
Harsh Deep; Shounak Ghosh

Project Number
J1703

Project Title
The Effect of T4 Bacteriophages on Antibiotic Resistant E. coli

Abstract

Objectives/Goals
Our experiment seeks to find a different way to solve the problem of antibiotic resistant bacteria, or superbugs, by using bacteriophages. We look at the effect of T4 coliphages, viruses that specifically attack strains of E.coli, including antibiotic resistant strains. We hypothesized that bacteriophages when used in combination with antibiotics will be a more effective treatment plan against antibiotic resistant bacterial infection.

Methods/Materials
Used 15 pre poured LB agar plates, E.coli, T4 coliphage, iodine, blank discs, tetracycline, bleach, 70% isopropyl alcohol, hockey stick spreaders, and an incubator. Prepared lawn culture of E.coli on the plates for 5 groups with 3 trials in every group following sterile techniques. In group 1, added tetracycline to each plate. In group 2, added the T4 coliphage to each plate. In group 3, added both tetracycline and coliphage. Groups 4,5 were positive and negative control groups respectively. Incubated the plates at 37 degree C for 6 days, and measured the diameters of the zones of inhibition where applicable. Disinfected all contaminated hockey stick spreaders and petri dishes with 10% bleach solution before disposal.

Results
The tetracycline yielded an average zone of inhibition of 21 mm in diameter. When tetracycline was combined with bacteriophage yielded an average zone of inhibition of 29 mm in diameter which is 40% more effective than tetracycline itself. The average zone of inhibition for positive control using iodine was 29 mm in diameter.

Conclusions/Discussion
The results supported our original hypothesis that when the bacteriophages and tetracycline are used in tandem they form a more effective treatment for antibiotic resistant bacteria as evident by the largest zone of inhibition. This is because the bacteriophages can efficiently wipe out antibiotic resistant bacteria which cannot be treated by antibiotics. The real world applications of our experiment are tremendous. Bacteriophages provide an individualized approach to treating dangerous, antibiotic resistant bacteria, with the possibility of saving millions of lives.

Summary Statement
Our project tests how effective T4 Coliphages are at wiping out antibiotic resistant strains of E.coli.

Help Received
We designed, built, and performed the experiments. Our teacher Mrs. Kathy Peng reviewed our work and was present during our work at school.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Mason S. Dougherty

Project Number
J1704

Project Title
Does the Expiration Date and Temperature of an Antibiotic Affect Its Effectiveness in Inhibiting Growth of B. subtilis?

Abstract

Objectives/Goals
The objective of this study is to determine if common antibiotics have the same effect in different temperatures and beyond their expiration date on Bacillus subtilis.

Methods/Materials
Non-expired and expired amoxicillin, cephalexin, and clarithromycin; Bacillus subtilis culture, petri dishes with agar, incubator, personal protective equipment. Measured and compared the zones of inhibition, after 72 hours incubation, at different temperatures of non-expired antibiotics, and repeated, but excluded the different temperatures for the expired antibiotics.

Results
Comparison of ten trials of expired antibiotics to ten trials of non-expired antibiotics at the following Fahrenheit temperatures:39 degrees, 71 degrees, 80 degrees, 95 degrees, showed expired cephalexin and clarithromycin were equal to non-expired susceptibility levels. Amoxicillin proved to be intermediate in susceptibility in both expired and non-expired antibiotics. Temperature trials showed increased susceptibilities with increased temperatures in clarithromycin and cephalexin, but amoxicillin showed a decline from intermediate to resistant in susceptibility.

Conclusions/Discussion
Increased temperatures showed equal susceptibility levels for clarithromycin and cephalexin, while Bacillus subtilis became resistant at higher temperatures while under the treatment of amoxicillin. This showed that the optimal storage temperatures for clarithromycin and cephalexin are warmer environments, while amoxicillin's effectiveness was reduced from intermediate to resistant at higher temperatures. Expiration dates of antibiotics showed that the posted expiration dates may not reflect the actual drug effectiveness on the treatment of Bacillus subtilis. This study may help us save money and resources in the manufacturing of antibiotics and in overall health care.

Summary Statement
I measured the effectiveness of certain antibiotics at different expiration dates and temperatures on Bacillus subtilis.

Help Received
I performed the procedural components of this experiment myself. My project supervisor helped me understand safety procedures and sterile technique as it related to my project, as well as looping techniques.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Lizzie D. Garcia

Project Number
J1705

Project Title
Foothill Pharmaceuticals: Assessing Antibacterial Potential of Sierra NV Flora & Microflora for Use in Clinical Medicine

Abstract

Objectives/Goals
The objective of this study is to determine if naturally occurring antibacterial agents can be derived from plants and soil-dwelling microorganisms in the Sierra Nevada Foothill Region and have the potential for application within the field of clinical medicine.

Methods/Materials
Agar plates, mortar and pestle, sterile pipettes, paper discs, antibacterial solution, buffer, 5 bacteria, native plants, and native soil-dwelling bacteria and fungi. The materials were purchased from Odin. Bacteria were put on plates. Plant samples were made into extract. Soil-dwelling bacteria and fungi were placed in medium. Paper discs were dipped in plant extract and bacteria and fungi soil sample solution and placed as 5 replications on plates with 3 controls (paper disc, antibacterial, and buffer). Every 12 hours pictures were taken along with measurements in mm of the area cleared by the antibacterial control, plant extracts, and/or the bacteria and fungi soil samples.

Results
Some plants had antibiotic qualities. Bee's Bliss was effective against Escherichia coli, clearing an area of 11.79mm2-452.39mm2, but compared to the antibacterial control, clearing an area of 1218.16mm2-1551.95mm2, there was little effectiveness. Bee's Bliss was effective against Micrococcus luteus, clearing an area of 40.06mm2-157.48mm2, but compared to the antibacterial control, clearing an area of 1551.95mm2, there was little effectiveness. Bee's Bliss had some effect on both gram-positive and gram-negative bacteria. In last year's study, plant extracts only had an effect on gram-positive bacteria. This year, the plants affected gram-positive and gram-negative bacteria.

Conclusions/Discussion
The study found that naturally occurring antibacterial agents derived from plant or soil-dwelling microorganisms did not kill a broad spectrum of bacteria and were not fast-acting. Bee's Bliss had some effect on gram-positive and gram-negative bacteria. If more concentrated, Bee's Bliss might have more effect on bacteria. New antibiotics are needed due to antibiotic resistance and the possibility of catastrophic events with no antibiotic availability. New antibiotics could be found using plants and soil-dwelling microorganisms. In future studies, more plant and soil samples would be needed to find one that killed a broad spectrum of bacteria, would be fast-acting and a good candidate for application within the field of clinical medicine

Summary Statement
I showed that naturally occurring antibacterial agents found in the Sierra NV Foothill Region had some effect on gram+ and gram- bacteria, but currently would not be good candidates for use in clinical medicine.

Help Received
I conducted all the steps of my experiment on my own under adult supervision. My former teacher, Mrs. Garcia, helped me determine how to measure my findings so I could properly record my data. I also received help from a college student, Andy Garcia, to input the data into a statistical program.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Dimple Amitha Garuadapuri

Project Number
J1706

Project Title
Ocimum tenuiflorum: Phyto-medicine Extraordinaire

Abstract

Objectives/Goals
When you are sick, you look for medicines or soups and other remedies, but have you ever thought that a plant could cure you? The Ocimum tenuiflorum is a plant that is native to the Indian Subcontinent and has been used in ayurvedic practices for thousands of years. Since my experience supports that Ocimum tenuiflorum has anti-bacterial properties, I wanted to find out if science can also support this long-believed superstition.

Methods/Materials
I tested the anti-bacterial properties of the Ocimum tenuiflorum by observing the changes in the growth rates of bacteria exposed to the plant compared to the growth rates of bacteria that were not exposed to Ocimum tenuiflorum. I grew bacteria in petri dishes and exposed some to Ocimum tenuiflorum; and recorded the differences in their bacteria colony count. I also observed the decline of bacteria growth by exposing Ocimum tenuiflorum to grown bacteria.

Results
Exposure to Ocimum tenuiflorum resulted in slower growth rates of bacteria colonies than of those that were not exposed to the plant in all of the three trials. Despite the source of the bacteria, saliva or phlegm, the dishes exposed to the plant had almost no bacteria growth. The samples that were let to develop bacteria before exposure to Ocimum tenuiflorum had equivalent growth rates with the control samples, until exposure to the plant. The bacteria growth reduced significantly after exposure.

Conclusions/Discussion
Due to its natural derivation and competent outcomes, it has potential to be a part of modern medicine. The data that I gathered clearly proves that Ocimum tenuiflorum should be more widely used to treat bacterial illnesses. It may not replace drugs entirely, but the effects of exposure to Ocimum tenuiflorum incontrovertibly decrease the growth of bacteria.

Summary Statement
Based on the data that I gathered, in which exposure to Ocimum tenuiflorum nearly stopped all growth of bacteria, one can conclude that this plant has potential to be used as a natural alternate solution to treat common bacterial illnesses.

Help Received
I would like to thank my teacher, Mrs. Cole, and my district#s Science Fair Coordinator, Mark Newton, for assisting me with the Science Fair Process. I would also like to acknowledge my family for providing me with the supplies and space needed to perform my experiments and assisting me with photography.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Ahmad Ismail

Project Number
J1707

Project Title
Effect of Combination Antifungal Therapy on the Treatment of Candidiasis

Abstract

Objectives/Goals
The objective is to study the effect of combination antifungal agents on the treatment of candidiasis and the yeast cellular structure to develop a treatment.

Methods/Materials
Water Volume Displacement: A gas collection apparatus was set up, which comprised of an inverted graduated cylinder and a tub filled with water. The cylinder and a plastic bottle were connected to tubing. Agents were tested by being applied to the yeast solution in the bottle. CO2 produced by the yeast travelled through the tubing, displacing water in the cylinder.
Broth Cultures: Test tubes were prepared with liquid broth. Yeast solution was pipetted into the tubes, and were incubated for 3 days on an Orbital Shaker. Weight of the colonies measured the yeast growth.
Agar Cultures: Petri dishes were prepared with agar. Yeast solution was spread onto the plates, and then incubated for 6 days. Area of the colonies were measured.

Results
The effectiveness of treatments were compared after conducting multiple trials in the above-mentioned experiments. From all three methods, the synthetic azoles and allylamines combination was most effective in treating yeast, and the natural allylamines and cell wall inhibitors combination was the least effective. Low data values indicate high effectiveness, as there is less amount of yeast cells. For the agar cultures, lines of best fit (derived using exponential regression) were drawn to model the growth. Standard deviation was calculated.

Conclusions/Discussion
The synthetic azoles and allylamines combination was the most effective therapy to treat candidiasis. Whenever both azoles and allylamines are present, the combination is effective; the yeast cells cannot become resistant to the treatment, though it would become resistant to allylamines in montherapy. Comparing combination to monotherapy shows that their effectiveness is between that of synthetic monotherapy and natural monotherapy. More tests are needed to identify the secondary positive benefits of natural agents and the negative effects of synthetic agents. If there are any, then combination therapy will be the most effective, taking into account all factors. We can notice that certain target organelles in the yeast cell increase the effectiveness of the therapy. The cell membrane is most effective, as clogging and making it dysfunctional prevents the cell from excreting wastes and getting the nutrients for necessary cellular processes.

Summary Statement
I tested combination antifungal agents to study the yeast cell's effect in the treatment of candidiasis; I found that the synthetic azoles and allylamines combination is most effective as it makes the membrane enzymes/proteins dysfunctional

Help Received
I designed the project and conducted the experiment independently. My Science teacher guided me through this project and reviewed my results.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Alexa D. Le

Project Number
J1708

Project Title
Superphages: A Revolutionary Weapon in the War against Superbugs

Abstract

Objectives/Goals
The objective of this study is to test if T4 bacteriophages can be used to fight E. coli better than our conventional antibiotics (Penicillin, Tetracycline, Erythromycin).

Methods/Materials
MATERIALS: E. coli culture, T4 type bacteriophages, antibiotic disks (Erythromycin, Penicillin, Tetracycline), blank disks, distilled water, agar Petri dishes and an incubator.
METHODS: Place five different disks (bateriophage, 3 antibiotics, blank) in the divided Petri dish that has already been spread with E. coli on agar. Incubate overnight and when finished, measure the zone of inhibition of all disks. Repeat 5 more times for a total of 6 trials. Take the zone of inhibition averages for each type of therapy.

Results
The zone of inhibition averages of all the types of therapies varied. Tetracycline had the largest zone of inhibition of 24mm. Erythromycin had the second largest zone of inhibition of 13.5mm. The Penicillin and bacteriophage therapies had the exact same zone of inhibition, 8.83mm. As expected, the distilled water had the smallest impact on the E. coli, an average of 0mm.

Conclusions/Discussion
Although my hypothesis was not fully supported by the results, the bacteriophages had the same zone of inhibition as the Penicillin. This appear to show that bacteriophages may have promising potential in the antimicrobial war against superbugs. Evidently, further research is required using higher concentration of bacteriophages or possibly phage therapy cocktails used alone or in combination with conventional antibiotics. The further development of different bacteriophages may be an alternative option to combat the growing antibiotic resistant bacteria.

Summary Statement
With the rising concern of superbugs resistant to conventional antibiotics, I am testing the effect of bacteriophages as opposed to current antibitiotics against the multi-drug resistant E. coli.

Help Received
My teacher Mrs. Conklin was extremely helpful in this project by facilitating me in my school's science laboratory, teaching me how to use the incubator and guiding me through the process of E. coli distribution.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Eric Markarian

Project Number

J1709

Project Title

Unnecessary and Excessive Antibiotic Use: An Uprising of Resistant Bacteria

Abstract

Objectives/Goals

The objective of my project was to determine which bacteria where susceptible or resistant to certain antibiotics and to find out why this occurred. My hypothesis was that bacteria that were susceptible to an antibiotic would have a larger zone of inhibition because the antibiotic prevented it from growing, while bacteria that were resistant would have a smaller zone because the antibiotic could not effectively prevent it from growing.

Methods/Materials

First petri dishes were divided into 4quadrants and the bacteria was loaded on the dish. Next, diffusion disks were soaked in different antibiotics and loaded on the plates. Once finished, the plates were inverted and left to incubate for 16-20 hours.The zone of inhibitions were calculated by measuring the diameter of each zone, using a metric ruler. This was repeated 2 times. The E. Coli and Enterobacter were obtained from carolina.com, a biological supply website.

Results

It was found that E. Coli was susceptible to Amoxicillin, Augmentin, Sulfamethoxazole-trimethoprim, Azithromycin, Cefdinir, and Cephalexin. However, E. Coli was resistant to Clindamycin and Penicillin. It was found that Enterobacter was susceptible to Sulfamethoxazole-trimethoprim, Augmentin, Azithromycin, Cefdinir, and Cephalexin. However, Enterobacter was resistant to Amoxicillin and Penicillin.

Conclusions/Discussion

For both E. Coli and Enterobacter, Sulfamethoxazole-trimethoprim was effective in fighting them because Sulfamethoxazole interferes with the synthesis of folate by competing with p-aminobenzoic acid in the biosynthesis of dihydrofolate. Trimethoprim serves as an inhibitor of dihydrofolate reductase, inhibiting the synthesis of tetrahydrofolate. Finally, when exposed to Cephalexin both E. Coli and Enterobacter were susceptible because Cephalexin acts by inhibiting synthesis of the peptidoglycan layer of the bacterial cell wall; cephalexin closely resembles d-alanyl-d-alanine, an amino acid ending on the peptidoglycan, so it is able to irreversibly bind to the active site of PBP. With this information, it can be proven that undestanding the way antibiotics work could provide us with an insight into the future and how to fight antibiotic-resistant bacteria. This knowledge can help scientists modify antibiotics in order to combat the newly growing population of resistant bacteria.

Summary Statement

Bacteria that were susceptible had a larger zone of inhibition and were prevented from growing; however, bacteria that were resistant had a smaller zone and had mutated over many yers to resist that antibiotic.

Help Received

I was assisted by Lida Gevorkian, school site coordinator, and Dr. Albarez, Glendale Adventist Medical Center immunologist, who verified my results and answered my questions about the function of the antibiotics.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Kaia J. Moehlis

Project Number
J1710

Project Title
The Vinegar Effect: Cancer Cure?

Abstract

Objectives/Goals
It has been suggested that yeast growth has important similarities to cancer growth. In this project I considered the effect of apple cider vinegar on yeast growth, with the goal of determining if it would be an effective cancer treatment.

Methods/Materials
I performed experiments in which increasing amounts of apple cider vinegar were added to a solution consisting of sugar and body-temperature water. Yeast was then added, and the height of the yeast growth was measured 15 minutes later.

Results
I found that using more apple cider vinegar slowed the growth of yeast, and that using enough apple cider vinegar stopped all yeast growth.

Conclusions/Discussion
Apple cider vinegar can be used to slow or stop yeast growth. Given the similarities between yeast and cancer, my research suggests that apple cider vinegar should be studied further as a possible cancer treatment.

Summary Statement
Apple cider vinegar can be used to slow or stop yeast growth, and given the similarities between yeast and cancer, this suggests that apple cider vinegar might also be an effective cancer treatment.

Help Received
My science teacher and my father helped me to formulate the experimental methods, and assisted with editing the text.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
William Ian Lyle B. Sahagun

Project Number
J1711

Project Title
The Fungus among Us: Can Guava Leaves Kill It?

Abstract

Objectives/Goals
This project is about finding out if the extract of guava leaves can kill yeast, the fungus, which at times, becomes pathogenic. The extract of guava leaves is supposed to contain bioactive compounds that are antifungal. Since yeast is a fungus, the guava leaf extract should be able to kill it.

Methods/Materials
Guava leaves, active dry yeast, sugar, water. Guava leaves were boiled in water to make a decoction. The yeast was proofed by using sugar and water for the control, then sugar and the guava leaf decoction. The foam volume produced by each setup was then measured.

Results
The number of times the yeast in the guava leaf decoction produced less foam than the control was 11 out of 20 times in total, which is not a significant difference.

Conclusions/Discussion
A definite conclusion cannot be drawn based on the results of this experiment. Upon further research, I found out that other variables affecting the experiment were not controlled, like room temperature and humidity. However, if guava leaves are proven to be an effective antifungal, then there can be an alternative medicine for treating yeast-related diseases, especially now since pathogenic organisms are getting resistant to traditional medicines.

Summary Statement
I tried to find out if the extract of guava leaves can kill yeast, but the results were inconsistent because of variables affecting the experiment that I did not control.

Help Received
None. I performed the entire experiment myself.