CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Ava Basile

Project Number

J1601

Project Title

"Lettuce" Discover a Solution to Inhibit E. coli Growth

Abstract

Objectives

This investigation tests common household product solutions, such as distilled water, chlorine bleach, white vinegar, baking soda, and salt, in order to determine which solution is most effective in eliminating E. coli bacteria from contaminated Romaine lettuce.

Methods

Blank paper discs were soaked in the various solutions listed above and placed on nutrient agar petri dishes streaked with E. coli, K-12. The effective bacterial growth inhibition of each solution was measured using calipers. The data collected established the relationship between household product solutions and their ability to inhibit growth of E. coli K-12.

Results

All bleach samples (negative control) consistently produced the largest average diameter of bacterial growth inhibition (1.86 centimeters: twice as much as the most effective solution, baking soda). The water (positive control) samples did not inhibit the growth of the E. coli. The baking soda solution was observed to be the most effective at inhibiting E. coli growth (0.87centimeter diameter). The results contradicted the hypothesis: it was predicted that either the salt or vinegar solutions would be most effective.

Conclusions

The baking soda solution was observed to be the most effective at inhibiting E. coli growth (0.87centimeter diameter). The results contradicted the hypothesis: it was predicted that either the salt or vinegar solutions would be most effective.

Summary Statement

This investigation tests the ability of common household product solutions to inhibit E. coli K-12 bacterial growth.

Help Received

None. I conceived and designed this experiment after learning about the recent E. coli contaminated Romaine lettuce illness outbreaks.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Courtnie Bui

Project Number

J1602

Project Title

Honey, I've Found a Solution! The Antibacterial Properties of Manuka Honey against S. epidermidis and S. salivarius

Abstract

Objectives

The goal of this experiment is to determine whether or not Manuka honey is comparable to common modern medicines as an antibacterial.

Methods

Tested whether or not Manuka honey could match up to Neosporin and ampicillin by inoculating agar dishes with either Staph. Epidermidis or Strep. Salivarius. Measured zone of clearance around antibacterial to determine comparability.

Results

Manuka honey is effective at killing Staph. Epidermidis bacteria, but not Strep. Salivarius. Neosporin and ampicillin both yielded no results, as proven by over 90 total trials. Manuka honey was more effective at killing bacteria than both modern medicines.

Conclusions

Manuka honey killed the external bacteria, indicating that Manuka honey can be an effective alternative to topical medications for bacteria found externally.

Summary Statement

By testing it against two types of bacteria, I found that Manuka honey is an effective alternative to Neosporin because it killed bacteria that is found externally.

Help Received

I was advised by my science teacher and a high school mentor on how to stay safe during the experiment as well as how to fine-tune my procedure to make it more realistic.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Kara Fan

Project Number

J1603

Project Title

Nano Particles Liquid Bandage

Abstract

Objectives

Each year in the U.S., at least 2 million people get an antibiotic-resistant infection, and at least 23,000 people die. A government study estimated that antibiotic-resistant bacteria could kill 10 million people every year by 2050 -- that s more than people died in cancer last year. The overuse of triple-antibiotics (polymyxin, bacitracin, and neomycin) first aid ointments may have created an antibiotic-resistance bacteria called USA300.

The objective of my project is to determine if nano-copper and nano-silver can be an alternative to triple-antibiotics used in wound care, thus reducing the overuse of antibiotics. I created two nanoparticles liquid bandages and tested their antimicrobial effectiveness on four bacteria.

Methods

Nano-copper was synthesized from lemon leave and copper sulfate. The nano-silver solution and triple-antibiotics Neosporin were purchased online. The existence of nanoparticles was characterized by a transmission electron microscope. The nanoparticles solution was mixed with a water-soluble polymer (PVP) to create the liquid bandage. The antibacterial effectiveness of the Nanoparticles liquid bandage and Neosporin were measured by zone inhibition method. Four types of bacteria were tested in the experiments - Bacillus Subtilis, E. coli, Micrococcus Luteus, and garden soil. Each testing was repeated five times.

Results

At 500ppm concentration, nano-silver liquid bandage was 48% as effective as Neosporin.
At 250ppm concentration, nano-silver liquid bandage was 34% as effective as Neosporin.
At 125ppm concentration, nano-silver liquid bandage was 15% as effective as Neosporin.
At 100 and 30ppm, nano-copper liquid bandage showed no antibacterial effect.

Conclusions

In this study, I wanted to see if nano-silver and nano-copper liquid bandage be an alternative to triple-antibiotics first aid ointment. My results showed that nano-silver liquid bandage inhibited growth on all four bacteria. At 500ppm, nano-sliver liquid bandage was 48% as effective as triple-antibiotics Neosporin. The results are very promising as they show that nano-silver liquid bandage could be an alternative to triple-antibiotics ointment in wound care.

Summary Statement

I created a nano-silver liquid bandage that effectively inhibits growth of Bacillus Subtilis, E. coli, Micrococcus Luteus, and garden soil bacteria.

Help Received

Mr. Timo Meerloo at University of California San Diego School of Medicine provided the training and usage of Transmission electron microscope. My science teacher, Mr. Russ Bird, at Mesa Verde Middle School for his guidance and information of the science fair. My father helped me to setup a mini-lab and

Name(s)

Kelly Gan

Project Number

J1604

Project Title

Natural Antibiotic Effects of Honey, Garlic, Lemon, and Ginger against Escherichia coli

Abstract

Objectives

Antibiotic resistance is a serious issue with the overuse of synthetic antibiotics, which kill good bacteria and kill with one method, allowing bacteria to evolve and mutate, unlike natural antibiotics. The purpose of my project was to find out which natural antibiotics- Manuka Honey, Garlic, Lemon, and Ginger, is the most effective against inhibiting Escherichia Coli (E.Coli) growth. My hypothesis was that Garlic is best with biggest zone of inhibition, due to its multiple active compounds.

Methods

20 Luria Broth Agar plates were swabbed with K-12 strain E.Coli bacteria and split into six parts each, consisting of: Negative control with nothing, Positive control with Ampicillin, and 4 different concentrations of natural antibiotic on a disk (4000mg/ml, 2000mg/ml, 1000mg/ml, 500mg/ml), using a serial dilution with water. 5 samples per antibiotic (Honey, Garlic, Lemon and Ginger) were prepared, and the 20 plates were incubated for 24 hours at 37 degC. The zone of inhibition's diameter in millimeters for each disk was measured. 3 trials were performed.

Results

Based on the average zone of inhibition for 15 samples in 3 trials, Garlic exhibited the largest zone at all concentrations (23.9mm at 4000mg/ml) and was better than Ampicillin. Manuka Honey (12.8mm at 4000mg/ml) and Lemon (11.4mm at 4000mg/ml) inhibited E.Coli but were not very effective. Ginger results are poor (8.6mm at 4000mg/ml), and dropped rapidly at lower concentrations.

Conclusions

My hypothesis was correct, Garlic inhibits E.Coli best even at lowest concentrations of 500mg/ml (10.7mm). Garlic is effective due to its 100+ active compounds from Allicin, and targets enzymes that are needed for the production of energy for the bacteria. These results encourage people to take natural antibiotics instead of synthetic antibiotics, so that antibiotics resistance doesn't proliferate. Moving forward, I want to try different types of bacteria for these 4 and other natural antibiotics, since they may be effective for different bacteria.

Summary Statement

I investigated the effectiveness of 4 natural antibiotics (Honey, Garlic, Lemon, Ginger) against inhibiting Escherichia Coli growth by measuring zone of inhibition, and found that Garlic far exceeded others due to its many active compounds.

Help Received

Dr. Eisen helped with E.coli purchase and experiment advice. My mom helped with purchasing of materials.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Marie Huitt

Project Number

J1605

Project Title

Honey, There's No More Infection! The Effects of Manuka Honey, Nature's Defense!

Abstract

Objectives

The objective of this study is to see if the antimicrobial properties of Manuka Honey can combat bacteria to the same extent as your common Turmeric, Tea Tree Oil or Garlic oil naturally. I studied the efficacy of all four with an emphasis on Manuka Honey, and determined their effectiveness against a nonpathogenic strain of E. Coli by measuring their zones of inhibition.

Methods

I mixed Agar and put it into Fifteen petri dishes, then labeled them and allowed them to cool. I used an inoculating loop to streak liquid E. Coli to all of my petri dishes and waited a week till the bacteria had grown to a healthy amount. Used Manuka Honey, tea tree oil, turmeric, and garlic oil to stop the growth of the bacteria. I left 3 of the petri dishes as a control group to compare the growth of the normal growth.

Results

The testing of the E. Coli was compared to the control group after the different treatments have been introduced to the petri dishes. The Manuka Honey treatment killed most of the bacteria and it neutralized the bacteria from letting any more grow. The other treatments would slowed the growth of bacteria or neutralize the bacteria. They didn t have as good of a success rate as the Manuka Honey which had a 95% success rate.

Conclusions

The Manuka Honey neutralized and killed the most bacteria which is very beneficial to the medical world. Manuka Honey will help to heal cuts and scrapes because of the two antimicrobial compounds of hydrogen peroxide and Methylglyoxal (MGO) for healing. The Methylgloxal releases more glucose into the cells to help them heal faster and keeps a moist wound environment and gives a protective barrier which prevents microbial infections in wounds. Manuka Honey helps with inflammation and healing wounds. Manuka Honey promotes healing because of the 3.2 to 4.5 pH that it contains. The UMF of Manuka Honey has to be plus 15 to kill bacteria faster. This significant discovery may lead the medical community to use Manuka Honey more commonly to heal wounds naturally.

Summary Statement

My project showed how using different treatments affect the way that the bacteria was killed and that Manuka Honey was the best to neutralize and heal wounds.

Help Received

My mom helped me to buy the materials and to make the agar and my brother helped me to use the inoculating loop to streak the E. Coli onto the agar.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Maryam Ismail

Project Number

J1606

Project Title

Eliminating the Zit: Finding an Effective Treatment in Exterminating Bacteria

Abstract

Objectives

The objective of this project is to study the effect of different acne agents on E. coli bacteria and to find an effective agent in eliminating E. coli bacteria.

Methods

For this project, the Kirby Bauer Disk Diffusion Method was utilized. E. coli was spread on nutrient agar plates. The agents were diluted to 3 different strengths: 0.5%, 1%, and 2% of the active ingredient. Paper disks were dipped in the different strengths of the medicines and placed on the agar. Water was used as the negative control and drugstore iodine as the positive control. The plates were incubated for 48 hours at 37 degrees Celsius. Zones of inhibition were measured after incubation. Proper sterile techniques were used throughout experimentation.

Results

I compared the effectiveness of the agents at different strengths after conducting multiple trials of the disk diffusion method. I found out that Benzoyl Peroxide worked most efficiently in killing the bacteria, followed by Salicylic Acid, Glycolic Acid, and Sulfur. Additionally, I calculated the average ratio of diameters of zones of inhibition between the three concentrations of agents. I found out that as the strength of the agent increases, the effectiveness increases as well.

Conclusions

Based on the data gathered, it was shown that Benzoyl Peroxide was the most effective in treating acne, as it killed the largest amount of E. coli bacteria.

Summary Statement

My experiment tested different acne agents on E. coli using the Kirby Bauer Disk Diffusion Method and found that Benzoyl Peroxide was the most effective treatment.

Help Received

I conducted my project and experimentation independently under the supervision of my science teachers, Zeba Haq and Haadiyah Razzack, at my school. They helped me during my project and reviewed my results.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Brianna Julio

Project Number

J1607

Project Title

Where Are the Most Antibiotic Resistant Bacteria?

Abstract

Objectives

My goal was to find out if there were more antibiotic-resistant bacteria inside the home or outside the home. I hypothesized that I would find more resistant bacteria inside the home versus outside.

Methods

I collected bacteria from three different surfaces inside and outside the home. One type of bacteria from each surface was tested with three antibiotics (kanamycin, streptomycin, and ampicillin) to determine the extent of resistance. This was done by soaking sterile disks with each antibiotic and then placing the disc on a plate that had been spread with the bacteria. After three to four days, any growth inside the zone of clearance would be scored as antibiotic resistant.

Results

I found that the most antibiotic resistant bacteria were present outside. The number of times the outside bacteria was resistant to antibiotics was eight, and the number of times the inside bacteria was resistant to antibiotics was four. From these results, I was able to answer the question whether there were more resistant bacteria inside or outside.

Conclusions

My results did not support my hypothesis, but instead suggest that there is more resistant bacteria outside than inside the home. It is possible that the bacteria outside are more diverse due to the large pool of bacteria outside. The chances of finding one resistant are therefore increased. These results show that where people are more exposed to outside environments, they need to be aware of how much resistant bacteria are present.

Summary Statement

By using three different antibiotics, I found there were more resistant bacteria outside the home than inside.

Help Received

Dr. Steve Julio, Professor of Biology at Westmont College, helped me obtain the resources and materials I needed, and helped me organize the data.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Charlotte Myers

Project Number

J1608

Project Title

Identification and Characterization of Novel Potential Antibiotics Targeting Bacterial Motility

Abstract

Objectives

The objective of this study is to identify which phytochemical or synergistic combination of phytochemicals of P. granatum is responsible for its motility-inhibiting effects on bacteria in order to facilitate the development of novel antibiotics.

Methods

I used nutrient agar plates, a culture of E. coli, a microbial incubator, sterile discs, and samples of chemicals found in P. granatum. Used serial dilution to dilute each chemical to the same concentration and prepared mixtures of these solutions to test for synergy. Dipped sterile discs into these solutions, absorbing the same quantity of antibiotic, and placed them into agar plates inoculated with E. coli. Incubated the plates and measured the diameters of the zones of inhibition to determine the effectiveness of the chemicals.

Results

The results indicated that quercetin, representative of the flavonoid group, best inhibits bacterial growth of the key phytoconstituents of P. granatum. The differences between the zones of inhibition were rather narrow, however, and ferulic acid and the synergy between quercetin, ferulic acid, and ellagic acid were also effective antibacterial agents.

Conclusions

I determined that flavonoids are likely responsible for the motility-inhibiting impacts of P. granatum. In examining previous studies, this is likely due to an increase in membrane permeability, which affects ATP synthesis and flagellate movement. My experiment will allow the development of novel and efficient antibiotics targeted towards bacterial motility, an often unexplored trait, to help combat increasing antibiotic resistance.

Summary Statement

I identified which phytochemical is the cause of the motility-inhibiting effects of P. granatum on bacteria, facilitating the development of novel antibiotics.

Help Received

I received help from my school's high school chemistry teacher, Dr. Rasmussen, in understanding the chemical aspects of my experiment, including serial dilution and the final antibiotic concentration. He also supervised my experiment to ensure proper procedure and use of the school's incubator.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Namrata Nair

Project Number

J1609

Project Title

The Effect of Different Metal Nanoparticles on the Growth of E. coli

Abstract

Objectives

The objective of this project was to find out which metal nanoparticle--silver, copper, or gold--could kill the most E. coli bacteria.

Methods

To conduct the experiment, a paper disc coated with either the silver, copper, or gold nanoparticle liquid was placed in the center of each Petri dish inoculated with E. coli. After 24 hours, the diameters of the zones of inhibition were measured; the zone of inhibition is the clear circle around the disc where bacteria does not grow due to the diffusion of the nanoparticles.

Results

The results showed that, as hypothesized, silver nanoparticles killed the most bacteria as the zone of inhibition was the largest. Gold nanoparticles killed the second-most, and copper killed the least. This is because silver cuts of the vital processes a bacterium needs to live, such as cellular respiration. However, gold's elemental properties make it naturally less reactive than other metals, and copper forms a layer of oxide material on its surface quickly, which hinders its antibacterial properties.

Conclusions

The results of this experiment suggest that silver nanoparticles are among the best choices as an antibacterial product. The results show that gold and copper are also effective against E. coli, even though they are not as effective as silver. Therefore, these nanoparticles, specifically silver, can potentially be used as antibacterial agents in oral products, textiles, wound dressings, biomedical devices, water purification, and as an alternative to antibiotics.

Summary Statement

I tested the effects of silver, gold, and copper nanoparticles on E. coli bacteria, discovering that silver nanoparticles had the most effective antibacterial properties.

Help Received

My science teacher provided me with a bacteria incubator and instructed me on how to use it.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Rhea Sharma

Project Number

J1610

Project Title

Germ Warfare

Abstract

Objectives

The goal of my project was to see if exposing consecutive generations of Eschericia Coli (E. Coli) bacteria to antibiotics would affect their level of resistance.

Methods

Materials: E. Coli strain from a hospital lab, Vitek2 Machine (to check for antibiotic resistance), and various antibiotic discs (Cefazolin, Levofloxacin, Gentamicin, Ciprofloxacin).

Methods: In a microbiology laboratory, I used the Vitek2 to test which antibiotics the bacteria were susceptible to. Then I grew them on a plate and measured how close to the antibiotic disc they were able to grow. I repeated this once per day for 7 days. At the end, I repeated antibiotic susceptibility testing.

Results

From Day 1 to Day 7, the bacteria were able to grow closer to the antibiotic disc in 4 out of 4 of the antibiotics tested. Antibiotic susceptibility testing in the Vitek2 showed on Day 1 the bacteria was susceptible to all antibiotics, and on Day 7 it was resistant to the antibiotics I was using as well as to antibiotics I was not testing for in my experiment.

Conclusions

The bacteria were able to grow closer to the antibiotic disc meaning they were able to tolerate a higher concentration of antibiotic and survive. The Vitek2 test showed the bacteria were resistant to certain antibiotics. Thus, it is important to use antibiotics in a responsible manner to help avoid resistance.

Summary Statement

I measured how close to an antibiotic disc bacterial colonies were able to grow over consecutive generations.

Help Received

I had help from the Bakersfield Heart Hospital Lab, and Awa Chalabi, a lab technician.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Nathaniel Shin

Project Number

J1611

Project Title

Using Cu, Fe, ZnO, and AgNO3 Microparticles as Antibacterial Agents to Create Inhibition Zones on DH5a E. coli Cultures

Abstract

Objectives

Antibiotic resistance is thought to be one of the greatest public health crises of the future. Microparticles possess unique properties that may lend themselves to inhibiting the growth of microorganisms. The utility of these compounds in this capacity has not been extensively explored. In this experiment, I attempted to create growth inhibition zones on colonies of DH5a E. coli as well as prove that these microparticles were able to create sterile fields by homogenizing Cu, Fe, ZnO, and AgNO(3) microparticles with the agar growth medium.

Methods

Antibacterial activity was measured by counting the number of visible colony forming units (CFUs). Each compound was pulverized into microparticles before being mixed with agar. All tests were conducted in a sterile area, and all contaminated materials were properly disposed of.

Results

The untreated control plates grew on average 43.25 ± 29.1 CFUs, the zinc oxide plates grew on average 3 ± 6 CFUs, and both the copper and silver nitrate groups had 0 CFUs.

Conclusions

My hypothesis was proven to be partially supported, as the Cu, ZnO, and AgNO(3) groups proved to be effective ($p < 0.05$) relative to the untreated control plates. Fe was not effective, while the Cu and AgNO(3) groups were completely devoid of visible CFUs. Because the microparticles were completely mixed into the agar, the exhibited antimicrobial effects were due to the creation of a sterile field, not contact killing.The present study demonstrates the antimicrobial properties of Cu, ZnO, and AgNO(3) and further highlights the potential of microparticles for advancing human health.

Summary Statement

I used the unique properties of copper, iron, zinc oxide, and silver nitrate microparticles to create statistically significant inhibition zones on DH5a E. coli.

Help Received

I received help in gaining an understanding of the scientific method and editing my lab report from my teacher and Project Adviser, Ms. Gramajo. Contaminated materials were disposed of by Mr. Don Shin.

Name(s)

Sahil Vaidya

Project Number

J1612

Project Title

Comparison of the Effects of Natural and Artificial Food Coloring on Microbes

Abstract

Objectives

The goal of this experiment was to compare the effects of a natural food coloring agent curcumin versus an artificial food coloring agents Sudan dye on the growth of two strains of bacteria that reside in our microbiome.

Methods

Bacteria, culture media, curcumin, Sudan dye, ciprofloxacin, incubator, spectrophotometer.
I evaluated the effects of curcumin, Sudan dye and cirpofloxacin on the growth of two strains of bacteria- E. coli and L.acidophilus measured at OD 600 in a spectrophotometer over a period of 24 hours.

Results

Two different concentrations of curcumin and Sudan dye were tested against the two strains of bacteria in triplicates. The artificial coloring agent Sudan dye inhibited both strains of bacteria, while curcumin did not show any negative effects on L.acidophilus.

Conclusions

This experiment revealed contrasting effects of natural and artificial coloring agents on the growth of the the two bacterial strains tested. The inhibitory effects of Sudan dye on the two bacterial strains suggests that consuming processed foods with artificial coloring agents can have significant effects on the bacteria in our microbiome.

Summary Statement

I showed that artificial food coloring agents have potentially negative effects on the growth of probiotic strains of bacteria.

Help Received

I performed initial research on my project using online resources. I then consulted two microbiologists Dr. Gulmezian-Sefer and Dr. Srikumar (Allergan) regarding the procedure I developed. I also received space to conduct my procedure and training to use the equipment by graduate student Amruta Karbelkar in the

Name(s)

Miguel Velasquez

Project Number

J1613

Project Title

The Antibacterial Effects of Natural Remedies Compared to Antibiotics, Part 2

Abstract

Objectives

The objective of this experiment is to study if natural remedies such as ginger, silver, thyme oil and zinc commonly used for illness possessed antibacterial properties compared to antibiotics when tested against two common bacteria: Staphylococcus epidermidis (Staph epi.) and Escherichia coli (E. coli).

Methods

Agar fill petri dishes were inoculated with either E. coli or Staph epi. Control groups consisted of petri dishes with no antibiotic discs, blank discs, penicillin discs, and neomycin discs for each bacterial group. Test groups consisted of blank antibiotic discs saturated with either ginger juice, colloidal silver, ionized zinc, or thyme oil and placed in their perspective pre-labeled petri dishes (two petri dishes per group with 4 discs per dish). Petri dishes were incubated for 48 hours at 26.7 degrees Celsius (80 degrees Fahrenheit). The zone of inhibition was then measured in millimeters for each control and test groups.

Results

The petri dishes with no antibiotic discs and blank antibiotic discs not saturated with any test subject demonstrated no zone of inhibition. The penicillin group had an average of zero millimeters for the E.coli group in both Trial 1 and 2, while the penicillin had an average inhibition zone of 8.75 and 6.13 for the Staph epi bacterial group in each trial respectively. Ginger had a zone of inhibition of 0 mm for both Staph epi and E. coli groups in both trials. Colloidal silver showed an average inhibition zone of 2.13 (Trial 1) and 7.25 (Trial 2) for Staph epi group compared to the E. coli group demonstrating an inhibition zone of 1.38 (Trial 1) and 2.0 (Trial 2). Thyme oil group had zones of inhibition greater the 20mm in both E.coli and Staph epi. group for both trials. Zinc demonstrated an average zone of inhibition of 7.38 for trial 1 and 7.75 in trial 2 for the E. coli group. In the Staph. epi group, the inhibition zone in Trial 1 and Trial 2 was 13.88 and 13.63 respectively.

Conclusions

The hypothesis that zinc would demonstrate the most antibacterial effects was incorrect. Zinc did not have the largest zone of Inhibition but did demonstrate moderate antibacterial effects. The subject that demonstrated the most antibacterial effects was thyme oil (thymol). The thyme oil group demonstrated no bacterial growth in both the first and second trial for both bacterial groups, proving more effective than Penicillin and Neomycin control groups. This is important in that we can look at alternative sources to develop new antibiotics to fight increasing bacterial resistance. We can possibly use natural remedies to fight simple infections as opposed to inappropriately using antibiotics.

Summary Statement

In measuring the average zones of inhibition of the studied natural remedies, I was able to determine that thyme oil had significant antibacterial effects against both E. coli and Staph. epi bacteria.

Help Received

I designed the study myself. My mother taught me how to inoculate petri dishes with the bacteria.