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What Is the Most Effective Way to Clean a Toothbrush?

Erin Bradley

Park View High School (PVH)

With thousands of bacteria living on a toothbrush, this experiment was designed to find the most effective method to clean a toothbrush. The independent variables of the experiment were the solutions used: white vinegar, distilled water, air-dry, hydrogen peroxide, and FreshBurst® Listerine® Antiseptic Mouthwash, while the dependent variable was the colony count of bacteria. The experiment’s control was air-drying the toothbrushes for ten minutes. The experimenter swabbed all toothbrushes with living, K-12 strain of Escheria coli, then soaked them in the different solutions. The toothbrushes were swabbed onto agar plates before and after all methods; the two were compared to measure which solution had the greatest impact on the colony count of bacteria. The results of the experiment support that FreshBurst® Listerine® Antiseptic Mouthwash had the greatest effect on the bacterial colony count. The t-values showed that compared to the control, for FreshBurst® Listerine® Antiseptic Mouthwash was 9.4596. The t-test results of the other methods are as followed, all are compared to the control, distilled water equaled 1.1198, hydrogen peroxide equaled 4.703, and white vinegar equaled 6.4186. The experimental hypothesis, if soaked in different solutions there will be no effect on the colony count, was not supported by the data collected. The independent variable had an effect on the amount of colonies, supporting that toothbrushes should be cleaned to kill bacteria. One source of error was that white vinegar killed the blood agar plates. Further research could explore which solution kills a wider range of bacteria.

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The Effect of Dandelion Root and Peppermint Leaf on E. coli

Lauren Brill
Loudoun Valley High School (LVH)

The purpose of this experiment was to figure out if dandelion and peppermint are effective at inhibiting the growth of E. coli. The independent variables in the experiment are dandelion root and peppermint leaf. The dependent variable was the rating of the amount of E. coli growth given to each Petri dish. The experiment was performed by spreading a dandelion root/water solution on five Petri dishes and a peppermint leaf/water solution on five dishes. The remaining five were left untreated (control group). Each Petri dish was inoculated with E. coli. They were left in an incubator at 37° for 48 hours. Finally, each dish was given a rating on the amount of bacteria growth (1-10). The Petri dishes with the peppermint received a rating of 1; the dandelion, a 10; and the control, a 3. This means that there was very little growth in the peppermint dishes, uncontrolled growth in the dandelion root, and relatively normal growth in the control. A Wilcoxon test was performed, which indicated there was significant difference between the ratings of the peppermint and control, but not in the dandelion and control. Therefore, the experimental hypothesis stating that the dandelion root would better control the growth of E. coli was rejected. If additional experiments were conducted, then a possible way to get better results would be to infuse liquid agar with the dandelion and peppermint powder, and use sectioned Petri dishes so that each would be exposed to the environment for an equal amount of time.

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The Effect of Genetic Variation in Escherichia coli on the Virulence of the Lambda Bacteriophage

Evan Cowling
Tuscarora High School (THS)

The current method of genetic tests is flawed; it costs a lot of money, and the actual test may take a long time to complete. Viruses select what to infect based off DNA, so if the DNA is slightly different, a virus might be able to detect the difference. If the virus goes through lysogenic conversion, the whole culture could change a physical property, such as color, quickly. This would make genetic testing much quicker and potentially much cheaper. An experiment was conducted to see how specific a virus is to its host. The lambda bacteriophage and its host, Escherichia coli, were selected due to their low hazardous potential coupled with the wide variation in E. Coli Genomes. E. coli strains B, C, C600, and K-12 were cultured in a tryptic soy broth. 50 µL of each strain, each at a .5 McFarland standard, was added to a cuvette holding 50 mL of the broth. Each strain was measured for % transmittance at different points, both before and after the Phage was added, and before and after each trial was subjected to UV light for 30 minutes. The purpose of the UV light is to lyse the bacteria which are infected by the bacteriophage. Strains C and B were shown to be statistically different from K-12 and C600, while C and B as well as K-12 and C600 were shown to be not statistically different. One may conclude that both strains B and C were infected, while K-12 and C600 were not. The results of this experiment are not conclusive as to whether or not a future of using viruses to detect genetic diseases is plausible or not. However, the future does look a bit brighter in this regard, as viruses can discriminate within a species.

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In a society where music benefits from increased popularity there is a microscopic threat that silently targets musicians – namely instrumentalists. Commonly overlooked, hundreds of microbial colonies grow and prosper on the surfaces of saxophone and trumpet mouthpieces alike. In order to better appreciate this implication, an experiment was conducted comparing the number of bacterial colonies on those woodwind and brass mouthpieces respectively. Bacteria was vortexed from used mouthpieces (both types) and inoculated onto an agar plated for observation after being incubated. Due to the vast number of colonies present, a qualitative scale (0-10) was used to provide definitive measurements. After seven trials per test group, the average number of bacterial colonies on woodwind (saxophone) mouthpieces (6.79) proved to be greater than brass (trumpet) mouthpieces (only 1.92). Resultantly, the original hypothesis was supported; that woodwind mouthpieces would harbor more microorganisms. This outcome is most likely because woodwind reeds are significantly more porous than the comparatively hard, cold surface of brass. Because mouthpieces are exposed to the elements and therefore potentially less hospitable, further research of bacterial growth inside the instrument is recommended. Such follow-on examination would likely produce more thorough and statistically significant results. Regardless, this study helped further emphasize the point that instruments are ideal locations for microbial growth and necessary maintenance precautions should be taken to reduce the risk of potential bacterial-borne illness.
The Comparison of the Protective Effect of Antioxidants from Blueberries and Vitamin C on Saccharomyces cerevisiae Cells Exposed to the Oxidizing Agent, Hydrogen Peroxide

Carley Etzweiler
Stone Bridge High School (SBH)

Blueberries have antioxidants that can prevent oxidative stress and cell damage caused by free radicals, which otherwise are responsible for aging and other disorders. The experiment compared the efficiency of the antioxidizing potential of 0.7g/mL blueberry extract (IV) and 0.0006mg/mL Vitamin C (IV), in protecting Saccharomyces cerevisiae cells (yeast) from oxidative damage caused by oxidizing agent (50µL H2O2) to determine the protective effects of antioxidants supplements and surviving cells (CFU-DV) were counted.

Though not statistically different more, average CFUs were more in “Blueberries+H2O2” (28.6, variance 81.3) as compared to “Vitamin C+H2O2” (19.8, variance 27.7) and “No supplement+H2O2” (18.4, variance 44.8) indicating blueberries protected the cells better than Vitamin C against oxidative damage. Blueberries will most likely protect human cells from oxidative damage as well, due to similarity in Saccharomyces cerevisiae and human genes used to repair DNA.

The ANOVA and T-test showed no significant difference (P>0.05) in CFUs in “No supplement+H2O2” and “Blueberries+H2O2” indicating that blueberries protected against oxidative damage, but not significantly. There was no significant difference (P>0.05) in CFUs in “No supplement+H2O2” and “Vitamin C+H2O2” and in “Blueberries+H2O2” and “Vitamin C+H2O2” thus refuting the alternative hypothesis.

The anti-oxidizing potential of blueberries could have decreased due to denaturation of vitamin. Higher concentrations of blueberry extract can be used to provide sufficient protection to cells against oxidative damage.

Further research can compare different Vitamins to fruits and vegetables having respective vitamins. The effectiveness of blueberries in providing protection against other mutagens, such as UV rays, could be explored.

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Food that Kills: The Effect of Natural Substances with Antibiotic Properties on Bacteria

Rebecca Giles
Tuscarora High School (THS)
Curtis Hart
Tuscarora High School (THS)

Antibiotic resistance is a problem in the medical community as bacteria evolve and become immune to known antibiotics more rapidly than they are discovered. The purpose of this experiment is to explore alternate remedies to which bacteria are not yet resistant. Substances including garlic, vinegar, onion, Bhut jolokia, Urena lobata, water, and penicillin were tested to conclude which has the greatest effect on three different strains of bacteria: Escherichia coli, Streptococcus salivarius, and Staphylococcus epidermidis. Water serves as a control and is used for comparison purposes along with penicillin. Success of each remedy is measured and compared using their zone of inhibition. Garlic was most successful with a mean zone of inhibition of 2.488 cm, followed by penicillin with 2.058 cm, while onion and water had the least effect, with 0.075 cm and 0.100 cm, respectively. Using t-tests it was found that garlic, vinegar, and penicillin were consistently able to reject the null hypothesis with p-values below 0.05. However, Urena lobata, Bhut jolokia and onion were the only substances that failed to reject the null hypothesis with any type of bacteria. The hypothesis that certain natural substances can kill bacteria was conditionally accepted. Based on the data, some substances including garlic, vinegar, and penicillin accept the alternate hypothesis, and therefore can be helpful against resistant bacteria. Further research could explore if the substances remain successful against stronger bacteria pathogens. A question arose when some Urena lobata trials produced a type of mold that seemed to be more successful than the Urena lobata plant itself.

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The Effect of All-Natural Soap on The Amount of Escherichia Coli it Kills

Aakansha Jain
Freedom High School (FHS)

Imagine doctors washing their hands; the purpose is to kill as much bacteria as they can with the pressure to keep the earth "green". This experiment tests two types of soap in order to observe the amount of bacteria killed. Isopropyl alcohol was used as the control while Dr. Bronner's all-natural "baby mild" liquid soap and Ivory Liquid Clear Soap were the independent variable. The dependent variable was the diameter of the zone of inhibition in Escherichia coli (E. coli). These solutions were blotted on blank disks then incubated at 32 degrees Celsius for 48 hours. Next, measurements were taken; Dr. Bronner's soap conveyed three unusual rings of growth around the bacteria. Scientists from Dr. Bronner's company claim that "brown stuff may have been left on the equipment". The mean diameters for the zone of inhibition for Isopropyl alcohol, Ivory Liquid Clear Soap and for the all-natural soap's 3rd ring were 9.5 mm, 31.4 mm, 32.6 mm, and 16.8 mm respectively. After taking the measurements, statistical analysis (F-stat, T-stat) were completed to determine equal variances and significant differences. All the solutions had equal variances with significant differences in all the solutions. The alternative hypothesis "If Dr. Bronner's "Baby Mild" all-natural liquid soap is used, then the zone of inhibition will be larger than if Ivory Liquid Clear Soap is used" wasn't supported by Table 2: ivory liquid soap had a greater T-critical than all-natural soap. Further research could explore densities of the three solutions and its impact on the effects.

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The Impact of Photoreactivation on the growth of Saccharomyces cerevisiae

Benjamin Kellogg
Loudoun Valley High School (LVH)

Ultraviolet radiation can cause severe damage to the DNA of a cell. The focus of this experiment was to discover how effective photoreaction was in repairing this damage in yeast cells compared to dark repair methods. Photoreaction is caused by an enzyme called photolyase which is activated by visible wavelengths of light. This enzyme repairs pyrimidine dimers or bulges in the DNA caused by UV light. All dark repair does is cut the DNA sequence out and replace it. In this experiment yeast was grown on agar plates and then irradiated with UV light measuring 254 nm (nanometers) for two and a half minutes in order to damage the DNA. The photoreactivation group was then irradiated with visible light measuring between 320 to 600nm for half an hour in order activated the photolyase. Once the yeast was grown, the colonies on each plate were counted. The Photoreactivated yeast had an average of 59 colonies and while Dark repair had 40. Using a t-test it was shown that the results were significantly different and there was a less than ninety-five percent chance that the results happened by chance. Therefore the hypothesis that Photoreactivation would be much more effective in repairing the yeast than dark repair was supported. Further research can be done to expand the experimental group to include other organisms that can do photoreactivation. Also it could test to see if one of the groups contained more mutations than the other.

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The Effect of Whether or Not a Bacterium is Encapsulated on the Bacterium's Resistance to Antibiotics

Arianna Laghaeian
Heritage High School (HTH)

Bacteria are considered to have been conquered in microbiology; however, bacteria have provided another obstacle: capsules, or barriers outside the cell wall of certain bacterium. The purpose of this experiment was to test the effects of capsules and determine if they provided increased resistance against antibiotics. It included an IV of bacterial capsules, a DV of antibiotic resistance, and a control of a non-encapsulated bacterium: Staphylococcus aureus. Petri dishes were inoculated with three encapsulated bacteria, Streptococcus pneumoniae, Haemophilus influenzae type b, and Streptococcus agalactiae; and one non-encapsulated bacterium, S. aureus. Three disks of antibiotics—Ampicillin, Vancomycin, and Gentamycin—were placed in each petri dish, and after five days in incubation, the inhibition zones of each were measured. The results were as follows: S. agalactiae had a mean zone of 19.933 mm with ampicillin, 14.467 mm with vancomycin, and 0 mm with gentamycin; S. pneumoniae had 38.6 mm, 17 mm, and 9.533 mm; and H. influenzae type b had 33.533 mm, 6.667 mm, and 18.2 mm; the means for the control, S. aureus, were 48.2 mm, 17 mm, and 24 mm, respectively. The ANOVA statistical test determined a P value of 0.00, meaning the alternative hypothesis of “If a bacterium is encapsulated, it will have a larger resistance to antibiotics,” is accepted. This concludes that the capsules influenced the antibiotic resistance by having a higher resistance compared to the control. Regarding further research, questions include if capsules require a higher concentration of antibiotics to be killed, and whether or not capsules affect bacterial mutation.

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Natural Extract’s Effect on Extracellular Polymeric Substances (EPS) in Biofilm Dispersal

Kavya Mathur
Dominion High School (DMH)

Natural disasters such as tsunamis, hurricanes and floods initiate the spread of disease through the destruction of pipelines and infrastructure. Communities of microorganisms called biofilms form due to the attachment of microbes to extrapolymeric substances (EPS). The microorganisms that make up biofilms are less harmful in their free-floating state than when attached to one another.

The purpose of this research was to determine whether herbal (ginger) and fungal (polypore mushrooms) extracts could cause the breakdown of extrapolymeric substances (EPS) produced by Vibrio fischeri and Bacillus subtilis in order to cause biofilm dispersal. Vibrio fischeri and Bacillus subtilis were allowed to form biofilms and were subjected to ginger and polypore fungal extracts. Methylene blue dye was added to cultures in order to determine biofilm breakdown by measuring dye color intensity over a period of 6 days. Statistical analysis via t-test determined that there was a significant breakdown in the biofilm’s extracellular matrix (EPS) when subjected to both extracts. Ginger had a greater effect on the breakdown of the EPS subsequently causing greater biofilm dispersal than polypore mushrooms. Hence, substances such as ginger and polypore tree fungi which may prevent biofilm formation and disease outbreak.

Further research would entail testing additional substances which are commonly available in countries which often experience natural disasters such as tsunamis and hurricanes to determine the further viability of biofilm remediation. This may provide low cost methods of limiting the spread of waterborne diseases.

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The Effect of Antioxidants on Percent DNA present in the “Tail” of S. cerevisiae strain BY4741 Using Comet Assay when Exposed to 0.3% Hydrogen Peroxide

Grace Morales
Freedom High School (FHS)

Antioxidants are an everyday substance marketed in stores claiming health benefits like cancer prevention and mending of oxidized DNA. The experiment tested antioxidants down at the cellular level and their ability to protect S. cerevisiae, strain BY4741, from oxidizing agents in order to find if the said claims made by products are true. It used single cell gel electrophoresis (SCGE or Comet Assay) to find if different antioxidants produced similar percentages of damaged DNA. Slides of treated BY4741 were submitted to electrophoresis and analyzed under a fluorescent microscope with the help of comet scoring software. While pomegranate and blueberry protected the DNA of BY4741 well, pomegranate worked best by 1.6% mean. The acai on the other hand was statistically similar to the H2O2 and only acai samples. Further research can be done with this technique using other organisms and their reaction with other antioxidants, including Vitamin C, green tea, and Vitamin E when exposed to an oxidizing agent, such as UV radiation or chemicals like Chlorine (Cl2).

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The Effects of Natural Repellents on the Growth and Development of Agrobacterium tumefaciens in Phaselous lunatus

Neha Onteeru
Potomac Falls High School (PFH)

Each year thousands of plants die from a Crown gall, strain of plant cancer caused by the pathogen Agrobacterium tumefaciens. The purpose of this experiment was to find out what type of natural repellent, if any, restrained the growth of A. tumefaciens the most efficiently. The independent variable was the type of natural solution given to infected lima bean plants, either cayenne pepper solution, mint solution, or garlic solution; and the control group was the set of plants only given water. The dependent variable was the size of the cancerous tumors that developed on the roots and bases of the plants. Lima bean plants were sprouted and grown, then infected with the bacteria, and then watered with their respective solutions every other day. The average size of tumors in each of the groups after a two week trial period were 0.19cm for the control group, 0.15cm for the cayenne pepper solution group, 0.22cm for the garlic solution, and 0.18cm for the garlic solutions. Through an ANOVA test, the p-value was 0.71 and so the hypothesis of cayenne pepper being the best repellent was not supported. For further research scientists could explore the effects of the repellents for a prolonged period of time rather than a shorter period. The discovery of an effective natural repellent for Crown gall could save millions of dollars for all agricultural institutions.

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The Effect of Pool Depth on Bacteria Level

Shannon Song
Woodgrove High School (WHS)

The purpose of this experiment was to determine whether the shallow end of a swimming pool or the deep end of the pool contained more bacteria. The independent variable was the area of the pool tested and the dependent variable was the amount of bacteria found. There was no control group assigned to the experiment because it was a comparative study. To test the pool, a test strip would be dipped into the surface of the indicated testing spot and then transported to an incubator, where it sat for 48 hours at the specified temperature. It was then read and the results were recorded. The shallow end did have more bacteria present, however the amount of bacteria found in the pool was shocking. Both pools exhibited the highest amount of bacteria possible according to the test strip. The mean for the shallow end of the pool was 4.669E+08 bacteria/mL, while the deeper end of the pool had a mean of 1.004E+08 bacteria/mL. The hypothesis that the shallow end of a pool would have increased levels of bacteria, was supported. According to the statistical results the shallow end had a variance of 1,014,450,289.83, 4.04486E+08 higher than the deeper end, and a standard deviation of 5.072E+08, which is 2.022E+08 higher than the deep end of the pool. This demonstrates that the independent variable influenced the dependent variable. Further research could test the effect of numbers of swimmers and bacteria levels, at each end of the pool.

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The Effect of Multiple Antibiotics on the Zone of Inhibition of E. coli k-12.

Evelyn Soon
Freedom High School (FHS)

There are presently many different antibiotics on the market for doctors to prescribe. This experiment was designed to determine if antibiotic combinations can be more effective at killing bacteria than a single antibiotic type. It tested the effect of 3 Ciprofloxacin disk, 1.5 Ciprofloxacin and 1.5 Tetracycline, and 1 Ciprofloxacin, 1 Tetracyclin, and 1 Penicillin on the zone of inhibition (mm) of E. coli growth. Each condition was tested fifteen times. In pre-tests it was determined that Ciprofloxacin produced a larger zone of inhibition than Tetracyclin and Penicillin. Therefore it was made the control. The dependent variable was the diameter of the zone of inhibition which was measured after two days of bacterial growth. Using the t-test, results showed that there was a significant difference in the zone of inhibition for each group; however, the difference was the decrease in effectiveness with less ciprofloxacin. The average zone of inhibition for the Ciprofloxacin was 45.13 mm, the Ciprofloxacin and Tetracycline was 40.6 mm, and all three combined was 39.93 mm. The experimental hypothesis was therefore not accepted. Antibiotics should be taken in recommended dosages and increasing the amount or the variation does not help inhibit or kill the growth of bacteria more rapidly. With the experiment being conducted in a school environment, there were a few restrictions. If given the opportunity, a question could be explored is if multiple antibiotics increase antibiotic resistant strains of bacteria.

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Analyzing the Effects of an Attractant (Aspartate) for Escherichia coli on the Chemotactic Response of Other Enterobacteriaceae

Edward Tiernan
Stone Bridge High School (SBH)
Academy of Science (AOS)

The Enterobacteriaceae bacterial family, with species like E. coli and Salmonella, causes infections in the intestines of hundreds of thousands of people each year. My research focuses on taking aspartate, an amino acid that is known to have a chemotactic relationship with E. coli, and seeing if that relationship is replicated in other members of the family. Several species of Enterobacteriaceae were cultured in minimal media, and then their chemotaxis was assayed in the presence of aspartate and compared to a negative control of bacteria without any amino acid, and an additional control of bacteria supplemented with a different amino acid, glycine. E. coli was used as a positive control. The results of this experiment show that H. alvei exhibits chemotaxis in aspartate as opposed to glycine with a 96% confidence (p = .036) in a 1 tailed t-test. The control group E. coli also showed chemotaxis but with a lower confidence of 92% (p = .082). Experiments are underway to test for aspartate chemotaxis in E. ictaluri and K. cryocrescens. If the aspartate chemotaxis continues to be conserved in the Enterobacteriaceae family, then it is reasonable to conclude that other members of the Enterobacteriaceae family will exhibit the same behavior, including killers like Salmonella. Aspartate may be useful as a future medicine against intestinal infections, especially because aspartate, as an amino acid, has virtually no adverse affect on the human body.

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The Effects of Water on Bacteria

Justin Touve
Potomac Falls High School (PFH)

Every year thousands of people get sick due to cross contamination of food with dangerous bacteria from raw chicken during the food preparation stage. The majority of these cases could be reduced by simply rinsing cutting boards and knives with water that is 70°C or hotter. This experiment tested the effectiveness of water alone at certain temperatures on reducing bacteria on food preparation utensils. Water at room temperature, 50, 70, and 100°C was used. The remaining bacteria were cultured to determine how effective the water was at reducing the amount present. All results were compared to the amount of bacteria that was cultured after being exposed to room temperature water. The results showed that the hotter the temperature of the water, more bacteria was destroyed. An ANOVA test was used to identify the quantitative data and 4 divisions per inch graph paper were used to measure the data. When room temperature water was used, an average of 45.25 squares were filled, an average of 44.25 squares were filled when 50°C water was used, an average of 33.25 squares were filled when 70°C water was tested and an average of 23.5 squares were filled when 100°C water was tested. The hypothesis of the experiment was that if you use 70°C water on bacteria, then more bacteria would be killed. The results support the hypothesis because 70°C water killed more bacteria than the other water temperatures except for the 100°C water.
The Effect Of Triclosan Exposure On The Antibacterial Sensitivity of Escherichia coli

Viruthika Vallanadu
Stone Bridge High School (SBH)

Triclosan is an antibacterial common in household, personal care products that may hold risks to health and the environment. Wastewater treatment cannot remove Triclosan and it may get converted into dioxin. Its byproduct is lipophilic, bioaccumulative and toxic to algae, invertebrates and fish. Triclosan's mode of action and target site in bacteria is similar to antibiotics. Triclosan exposure may trigger a cross resistance to antibiotics/antimicrobials. The experiment investigated the effect of Triclosan exposure on the reduction of antibacterial sensitivity of Escherichia coli.

E. coli “Exposed” (IV) to Triclosan and “Unexposed” (diluted 10E5cells/mL) was used in drug-susceptibility tests (MIC broth method and MBC sub-culturing) and CFUs (DV) were compared with un-inoculated control (no Ampicillin no culture) and control (Ampicillin no culture).

T-tests show statistically significant difference (p<0.05) in CFU “Unexposed” and “Exposed” prior to treatment of 0.5mg/L, 1mg/L, 2mg/L, 16mg/L with higher CFUs in “Exposed” than “Unexposed” on N. agar thus supporting alternative hypothesis. T-tests did not show significant difference (p>0.05) in 4mg/L, 8mg/L Ampicillin. ANOVA shows statistically significant difference (p<0.05) in CFU “Exposed” and “Unexposed” for all concentrations with least CFUs in 32mg/L Ampicillin. MBC for “Exposed” and “Unexposed” were equal thus refuting the alternative hypothesis.

Ampicillin susceptibility for E. coli had not altered significantly but Triclosan exposure resulted in increase in survival rate at lower concentrations of Ampicillin. Triclosan blocks the active site of the enzyme ENR and prevents bacteria from synthesizing fatty acid necessary for cell membranes and reproduction.

Future research can investigate whether antibiotic susceptibility of E. coli towards chloramphenicol and other antibiotics is reduced with repeated Triclosan passages. The different strains of E. coli could be tested to determine whether resistance is strain specific.

I/We hereby certify that the above statements are correct and the information provided in the Abstract is the result of one year's research. I/We also attest that the above properly reflects my/our own work (digitally signed).
The Effect of Magnetism on the Growth of Escherichia coli in Organic Produce

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The purpose of the experiment was to observe whether magnetism could reduce the growth of bacteria, so it could be used on organic produce to extend shelf life. This could then serve as a substitution for preservatives, without the negative health effects. The independent variable was the amount of magnetism, in gauss, a petri dish of Escherichia coli was exposed to, with the control group 0 gauss. The dependent variable was the percent of the petri dish covered with Escherichia coli in a 2.5 cm radius around the center. This was measured after 24 hours, and later again after 48 hours. The percent of coverage at 48 hours was subtracted by the percentage at 24 hours to get the change in growth.

The results of the experiment showed that magnetism did have an effect on the growth of bacteria. When exposed to magnetism, the bacteria grew more constantly, with a standard deviation of 5.47 for the control, 4.8 for the 14800 gauss group, and 3.34 for the 13200 gauss group. The Mean for the control was 9.5 percent, but when exposed to 13200 gauss of magnetism, it was reduced to 6.83 percent, and 5.67 percent for 14800 gauss. The changes in the mean supported the hypothesis, that if organic produce was exposed to magnetism, then the growth of Escherichia coli would be inhibited. This knowledge could be used for food preservation techniques, and further research could be done to see how magnetism affects bacteria growing on organic produce.

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Investigating the Effect of Antioxidants Found in Dark Chocolate on the Growth of Propionibacterium acnes

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The bacterium Propionibacterium acnes plays a role in the inflammation of acne blemishes. Polyphenols are a subgroup of antioxidants, and in previous studies, the polyphenol resveratrol has inhibited the growth of P. acnes. Therefore, the goal of this study is to determine if polyphenol antioxidants in dark chocolate are able to inhibit the growth of P. acnes. A dark chocolate antioxidant solution was created and split into two solutions: one that was sterilized through the use of 0.22 micron filters and one that was autoclaved. Four concentrations of dark chocolate extract were created from each of these solutions, and their antioxidant activities were determined through the DPPH assay. The effect of these concentrations on the growth of P. acnes was determined through the disk diffusion method. Distilled water and the antibiotics doxycycline, erythromycin, and tetracycline were used as controls. Zones of inhibition were measured to determine the antimicrobial effects of the concentrations and controls. The DPPH assay indicated that the concentrations contained antioxidants; however, no zones of inhibition were found for any of the antioxidant disks with concentrations varying from 1x to 1/64x. Further testing was carried out for concentrations as high as 10x, but no zones were observed.

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