CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Sarah J. Adams

Project Number
S1401

Project Title
The Utilization of a Photobioreactor to Optimize the Growth Rate of Lipids in Microalga for Use in Biofuels

Abstract

Objectives/Goals
To optimize the growing conditions of the alga strain Neochloris oleoabundans at the lab scale and then in a photobioreactor to maximize lipid production and extraction for the practical use in biodiesel fuel.

Methods/Materials
After purchasing the strain Neochloris oleoabundans from UTEX, I utilized nutrients in solution with a ratio of 1:1:1 (nitrate:phosphate:potassium) to stimulate algae growth in glass cups under a fluorescent grow light. I wanted to find the ideal ratio of algae to nutrients so that the reproduction of the algae (and lipids) could be maximized and measured through the use of a chlorophyll meter. The optimized parameters were then applied to a larger-scale photobioreactor which I built, and this encompassed all the necessary components critical to sustained reproduction, such as constant access to light, abundant surface area, and steady aeration. The alga produced was dried through evaporation and 5mg was mixed with 1mL of a hexane solvent. The hexane combined with ultra-sonification released the lipids, and then the hexane solvent was evaporated using a centrifuge, thus leaving behind the extracted lipids.

Results
After doing the testing at a lab scale using the glass cups, I was able to find that the concentration of nutrients, 2mL of a nitrate:phosphate:potassium solution in a 1:1:1 ratio added to 350mL of water caused the greatest alga bloom out of all my samples, each of which began with 25ug/L of chlorophyll. 36 hours later, this alga bloom had grown to 4,800ug/L of chlorophyll, determined using the chlorophyll meter. This ratio was then applied to my photobioreactor in which I produced sufficient quantities of alga with a growth cycle of 4 days. The harvested alga was dried and the oil extraction procedure revealed that the lipid makes up approximately 20% of the algae#s total mass, all of which can be extracted for transesterification into a biodiesel fuel.

Conclusions/Discussion
In conclusion, lipid production can be enhanced and sustained through the manipulation of variables, specifically the concentration of the nutrients nitrate, phosphate and potassium. By metering the nutrients into the photobioreactor as determined by the lab scale growth rates, the optimum ratios were maintained through a 4 day growth cycle. This allowed me to harvest the maximum amount of algae, and thus extract 20% of the algae#s mass in the form of a lipid.

Summary Statement
The manipulation of nutrients to maximize the growth rate of Neochloris oleoabundans so that it can produce the highest yield of lipids to be extracted for use in biodiesel fuel.

Help Received
Dr. Hossein Ahmadzadeh, Professor at Cal Poly Pomona, oversaw oil extraction, father helped build photobioreactor, mother helped glue the board

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Christina Apple

Project Number
S1402

Project Title
The Quantity of Microbacterial Colonies Found in Water Stored in Automatic Hog Waterers over a Four Day Period

Abstract

Objectives/Goals
The purpose of this study was to determine the quality (the absence of bacteria) of water stored in automatic hog waterers for a period of up to 4 days. The hypothesis is that there is a direct correlation between the number of bacterium colonies and the number of days water is left in the automatic waterers.

Methods/Materials
Washed cow nutrient agar prepared plates were used. The testing of water was organized into for different samples run every 24h for a six week period of time. Sterile inoculating loops were used to attain a sample of each of the waterers tested.
The plate was placed in an incubator for 24h and colonies of bacteria were counted. At the end of a 4-day testing period the containers of water were emptied and left to air dry for a 2d period. One hundred separate trials were conducted.

Results
There was no significant difference between water autoclaved and water standing in automatic hog waterers over a four day period.

Conclusions/Discussion
Mammals exist because of certain bacteria (Howard, 2004). Some medical practitioners say that we don't live in a sterile environment, that there are bacteria all around us, and that we shouldn't expect our water to be sterile either (Dooley, 2001). Although the data did not support the hypothesis, which was that the number of bacterial colonies in samples A, B, C and D would increase over time it is of little concern that water sits for four days or less in automatic hog waterers.

Summary Statement
The Quantity of Micro Bacterial Colonies Found in Water Stored in Automatic Hog Waterers Over a 4-Day Period.

Help Received
Agriculture instructor provided the agar and lab facilities.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

Roxanne Beltran; Beth Jacobs

Project Number

S1403

Project Title

Enhancement of Algae Lipid Composition through the Manipulation of Temperature, Light, and Nutrient Levels

Abstract

Objectives/Goals

Despite advances in technology, modern fossil fuel powered cars still contribute significantly to pollution and the greenhouse effect, emitting CO2 and other pollutants and leaving an immense ecological footprint on the environment. The use of fossil fuels, a non-renewable and diminishing resource, along with a reliance on foreign countries for this commodity have further led to international tension and pose a threat to national security. Many experts believe that phytoplankton lipids are by far the most promising source for a bio-fuel. In an effort to better comprehend how physical and chemical processes affect the biosynthesis of energy-rich lipid compounds in algae, the goal of this study was to experimentally vary temperature, light, and nutrient levels to find conditions optimal for lipid production.

Methods/Materials

For the temperature and nutrient study, a standard curve was calculated to produce an optical density to cell count conversion. Twelve flasks under each of the three temperatures were setup with triplicates of each nutrient level. All cultures were kept under a 12-hour light/dark cycle. Each day, optical density readings were taken and converted to cell counts.

For the light study, cultures were inoculated in 6 polycarbonate bottles consisting of 200ml algae, 40ml nutrients and 1800ml of autoclaved seawater. Bottles were strategically place at various distances from a light source to create a gradient in light levels. An 8ml sample was taken daily from each bottle and tested for cell count, in vivo fluorescence, lipid content and optical density.

Results

Results from the temperature and nutrient study indicated that 2% nutrient content was the most efficient nutrient level. Additionally, optimal growth for the cultures was achieved at a temperature of 28C. While an increase in lipid content was observed across all light levels during the light experiment, an intensity of 250 uEin appeared optimal for lipid production.

Conclusions/Discussion

Through these experiments, ideal physical and chemical conditions for algae growth and lipid production were found for this unidentified algae isolated from the SD Bay. It was concluded that because of its nature, this species does not have a lipid yield high enough to be used as a source of oil for bio-fuel. In the future, it is proposed that different species of algae are tested using the same experimental procedures.

Summary Statement

An external condition alteration study on algae completed in an effort to better comprehend the effect of physical and chemical processes on the biosynthesis of energy-rich lipid compounds and the possible uses of algae as a biofuel.

Help Received

Used lab equipment in CALCOFI and Mitchell labs at the Scripps Institution of Oceanography under the supervision of Dr. Greg Mitchell, Ben Neal, Mattias Cape and Brian Seegers. Tests were run at General Atomics under the supervision of Ben Neal. Used equipment in the High Tech High Biotechnology lab.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Sudarshan Bhat

Project Number
S1404

Project Title
Effectiveness of Coliphage T4 on E. coli B at Variable Antibiotic Dilutions

Abstract

Objectives/Goals
This project explores the effects of antibiotics on the efficaciousness of bacteriophages on bacteria. I hypothesize that at certain dilutions, the phage will not have any effect on the bacteria due to the absence or alteration of some part of the bacterium which acts as a marker for the likely parasite.

Methods/Materials
The project consisted of two tasks which led me to my findings. The first task was to find dilutions where it would be easy to see that the bacteria had been affected by the antibiotic but were not completely destroyed. ANOVA and T-tests were used to prove significances in differences. The second phase consisted of two further sub-experiments: first were the actual tests with the bacteriophage and antibiotics accounting for all combinations and positive and negative controls. The second sub-experiment was to further understand what changes had occurred to the cell structure using a modified gram-staining procedure I developed.

Results
All acquired data and research was compiled into two categories defined by the mode of action of each antibiotic.

Exteriorly Resistant Strain:

Penicillin destroys bacteria by targeting the peptidoglycan layer of the bacterium's cell wall. Because the ompC receptors are located on the lipopolysaccharide layer, these too begin to denature reducing the chances of a phage latch-on. This would present a temporary inconvenience which could possibly confuse those administering the treatment. From this we can deduce that using penicillin in combination with phage therapy would not be a good decision in vivo.

Long-term Genetic Resistance:

Tetracycline works by halting the action of the 30S ribosome (one in charge of creating proteins used throughout the cell wall). Because this is a genetic alteration dealing with the blockage of the aminoacyl-tRNA, if the bacterium survives the treatment, a phage resistant strain will be produced. Being a genetic trait also means that the resistance can have a prolonged negative effect on the efficaciousness of phage therapy.

Conclusions/Discussion
In conclusion, caution is the word when combining antibiotic and bacteriophage therapies; "ultra bugs" may be produced when both treatments are used in unison. Therefore, we must make sure to have a well thought out transition in order for such a natural, self-bettering treatment to last for many future

Summary Statement
An exploration of bacteriophage to bacterium interactions at various antibiotic dilutions for future medical applications.

Help Received
I acknowledge my family for their moral support and encouragement. I would especially like to thank Mrs. Alonzo, my advisor and head of the Lynbrook science department, for the many hours she gave up to supervise and advise.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Hailey A. Camillone

Project Number
S1405

Project Title
Stop Contagious Conidia on Cucurbits

Abstract

Objectives/Goals
My experiment was performed to find the best topical application, among Sulfur, Sodium Bicarbonate, and Trichoderma, in prevented the onset of powdery mildew on cucurbits.

Methods/Materials
I grew 40 squash plants and moved them into a greenhouse. I separated the pots into test groups, A, B, C, and D. Within each test group I labeled the plants either 1, 2, 3, or 4. The 1 pots were given no application, the 2 pots were sprayed with a sulfur/water solution, the 3 pots were sprayed with a Sodium Bicarbonate/water solution, and the 4 pots were sprayed with a Trichoderma/water solution. Then I infected all the plants by sprinkling them with powdery mildew from an infected leaf. I let it grow and measured the results.

Results
Sulfur was 82% more effective in preventing the onset of powdery mildew than the control. It was 78% more effective than the Sodium Bicarbonate and 85% more effective than the Trichoderma, which is highly significant. Sodium Bicarbonate was only 4% more effective than the control and 5% more effective than Trichoderma, which is insignificant.

Conclusions/Discussion
Sulfur is the best topical application in preventing the onset of the powdery mildew, Sphaerotheca fuliginea, among Sulfur, Sodium Bicarbonate, and Trichoderma.

Summary Statement
My project was performed to find the best topical application in preventing the onset of powdery mildew.

Help Received
Neighbor provided information and infected leaves; S. Koike provied greenhouse space and lab equipment

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

Joyce S. Chai

Project Number

S1406

Project Title

Modeling the Toxic Effects of Silver Nanoparticles under Varying Environmental Conditions

Abstract

Objectives/Goals

With an increased surface area to volume ratio, silver nanoparticles exhibit a more efficient antimicrobial potential than its metallic counterpart, silver ions. The abundance of silver nanoparticles in the consumer market, however, increases the risk of environmental exposure. This investigation attempts to model and quantify the toxicity of silver nanoparticles under varying environmental conditions and to measure the toxicity of nanosilver in a model consumer product.

Methods/Materials

Preliminary experiments conducted under varying interaction times and particle concentrations determined the optimum time and condition for the assay. From this, a novel, high-throughput bacterial toxicity assay was developed. Toxicity, redefined as the percentage of dead cells that died in excess to that of the natural death of cells, was subsequently quantified using the live to dead cell fluorescence intensity ratio. A water filtration system was developed to provide a practical application of the bacterial toxicity assay to a model consumer product containing silver nanoparticles.

Results

From the preliminary experiments, the optimum interaction time between the surrogate bacteria and the silver nanoparticles/silver ions was determined to be approximately 3 hours. The bacterial toxicity assay showed that silver nanoparticles and silver ions induce equal toxic effects on the environmental bacteria; yet, they induce a greater toxicity in gram-negative bacteria than in gram-positive. Finally, the practical application of the water filtration system revealed the potential risks of using nanosilver consumer products.

Conclusions/Discussion

The conclusions of this investigation demonstrated three essential concepts. First, this novel bacterial toxicity assay technique is a reliable, reproducible approximation of the potential toxicities of silver nanoparticles. Secondly, the toxicity assay revealed that the silver nanoparticles induce high toxic effects, including overwhelming cell death and cell inactivity, in a relatively short period of time. Finally, the practical application of the toxicity assay substantiates the known efficacy of silver nanoparticles, but questions the reliability of using nanosilver consumer products. This investigation took fundamental steps toward understanding and quantifying the potential environmental consequences and risks of using nanoparticles.

Summary Statement

This investigation attempts to model and quantify the toxicity of silver nanoparticles on various surrogate environmental bacteria and to measure the potential toxicity of nanosilver in a model consumer product.

Help Received

Mentored by Dr. Eric Hoek; Used lab at UCLA under supervision of Jin Xue and Xiaofei Huang; Advised by Peter Starodub

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Leland I. Coontz

Project Number
S1407

Project Title
Maximizing the Production of Ethanol from Corn Starch

Abstract

Objectives/Goals
The objective of this experiment was to increase the amount of starch broken down in fermentation to produce more ethanol through the use of enzymes

Methods/Materials
Glucoamylase
Alpha-amylase
Yeast
Insulated Cooler
Flasks
Pressure sensors
Hyrdometer

Flasks where filled with starch solution and variable enzyme and allowed to undergo fermentation for 23 hours. Change in specific gravity was measured with a hyrdometer and change in pressure with pressure sensors.

Results
After experimentation the combination of glucoamylase and alpha-amylase allowed yeast to utilize 47% of the starch. Glucoamylase itself converted 17% of the starch to sugar and Alpha-amylase converted 6% and the control group converted 2-3% average of the starch. Alpha-amylase increased pressure by average 32.34 kPa, 4ml glucoamylase by 79.57 kPa, 4ml of both by 93.42 kPa. control average change in pressure of 8.46 kPa.

Conclusions/Discussion
Enzymes greatly increase the productivity of fermentation. Alpha-amylase breaks apart complex starch bonds, Glucoamylase breaks apart only the end polymers of starch quickly into maltose. The combination of these two produce the greatest results. Other sugar sources can be used instead of starch, including sugar cane, beets, and wheat.Changes to my experimentation method would include using a larger flask and increasing the density of the sugar mass to produce greater amounts of alcohol. Future research into the conversion of biomass into ethanol also seems possible.

Summary Statement
Increasing ethanol production in the fermentation of corn

Help Received
No significant help recieved

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Adella A. Fejeran

Project Number
S1408

Project Title
Antioxidant Protection of Escherichia coli against UV Radiation

Abstract

Objectives/Goals
Antioxidants are said to prevent the damage of cells caused by ultraviolet radiation. To observe the effect of antioxidants on the survival rate of nonpathogenic MM28 and QC781 strains of Escherichia coli (Yale University), concentrations in correlation with the recommended daily allowances/recommended doses for supplementation of vitamin C, vitamin E, and the combination of vitamins C & E were made.

Methods/Materials
The solutions were incorporated into nutrient broth media containing E. coli that grew for 24 hours, were serially diluted, plated, and exposed to ultraviolet light for 0, 5, and 10 minutes. After exposure, the plates were placed in an incubator at 37º C and allowed to grow for 48 hours at which time the colonies present on the plates were counted and recorded.

Results
From the results, the presence of vitamins had an adverse effect to the E. coli. Plates that did not contain vitamins and were not exposed to UV light exhibited a significantly greater average amount of colonies than plates that contained vitamins and were not exposed to UV light. Vitamin C (37.5mg/500mL and 45mg/500mL) vitamin E, and the combination of vitamins C & E (37.5 & 100mg/500mL at 10 minutes, 45 & 100mg/500mL, 75 & 200mg/500mL, and 90 & 200mg/500mL) did not significantly increase the amount of colonies on plates that were exposed to UV light.

Conclusions/Discussion
The research hypothesis that higher concentrations of antioxidants will result in the survival of more E. coli colonies was not supported for vitamin C (37.5mg/500mL and 45mg/500mL), vitamin E, and the combination vitamins C & E (37.5 & 100mg/500mL at 10 minutes, 45 & 100mg/500mL, 75 & 200mg/500mL, and 90 & 200mg/500mL). However, the research hypothesis was supported for vitamin C concentrations 75mg/500mL and 90mg/500mL (strain MM28) and for the combination of vitamins C & E concentration 37.5 & 100mg/500mL at 5 minutes (strain MM28).

The research hypothesis that longer exposure time of UV irradiation will cause fewer colonies of E. coli to survive was supported. Conversely, the research hypothesis that the combination of vitamins C & E will increase UV resistance in E. coli was not supported.

Summary Statement
The effect of vitamins C, E, and the combination of C and E on the protection of E. coli against UV radiation, was tested by comparing the number of colonies on plates that contained viatmins and were exposed to UV light with the control.

Help Received
Teacher Todd Linke helped guide my completion of this project; the Mount Miguel Science Department provided that lab equipment and work space; Dr.Wertz of Yale University provided the E. coli and helpful advice.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

Srishti Kedia; Kristy Nguyen

Project Number

S1409

Project Title

The Effect of Gradient-Coated Sunglass Lenses on Yeast Growth after Exposure to UVA Rays

Abstract

Objectives/Goals

The purpose of this experiment is to find the effect of different colored gradient-coated sunglass lenses on yeast growth after exposure to UVA rays for ten minutes. The objective is to eventually identify the gradient-coating color that most effectively blocks out UVA rays.

Methods/Materials

Ten Petri dishes containing yeast extract dextrose (YED) medium were streaked with a special UV sensitive yeast strain (G948-1C/U). The Petri dishes were divided into quadrants, three of which contained a different colored lenses while the fourth quadrant had no lens(control group). The Petri dishes were then exposed to UVA rays via a black light for ten minutes and incubated at 30 degrees Celsius for 72 hours. After this period, the dishes were removed from the incubator and the area of the regions lacking yeast growth were found and analyzed.

Results

The quadrants containing the pink gradient-coated sunglass lenses, on average, had the largest ratio of the area of the regions lacking yeast growth to the area of the sunglass lenses. On the other hand, the black gradient-coated sunglass lenses had the smallest ratio. The green gradient-coated lenses had a ratio greater than that of the black lenses yet less than that of the pink lenses. The control quadrant had absolutely no yeast growth, confirming that yeast cannot grow after exposure to UVA rays for ten minutes.

Conclusions/Discussion

Areas lacking yeast growth indicate that UVA rays were able to penetrate the lenses. Thus, the colored lens with the largest ratio is the least effective in blocking out UVA rays. Therefore, the pink-gradient coating sunglass lenses were the least effective. In contrast, the black gradient-coated lenses had the smallest ratio thereby being the most effective. This validated our hypothesis that if black gradient-coated lenses are placed on top of the Petri dish containing yeast, then there will be a smaller region lacking yeast growth after being exposed to UVA rays for ten minutes. The results also show that more opaque lenses tend to be more effective in protecting against UVA rays.

Summary Statement

The objective of this experiment to evaluate the effectiveness of different colored gradient-coated subnglass lenses using UV sensitive yeast as an indicator.

Help Received

Dr. O'Neill and Dr. Fiedler provided a facility for experimentation; Parents provided transportation and funding

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Erik L. Kreeger

Project Number
S1410

Project Title
The Leafy Truth: A Study of Farming Methods and Bacteria Levels

Abstract

Objectives/Goals
The goal of the project was to determine if organic lettuce had higher levels of gram-negative bacteria than conventionally grown bacteria. The hypothesis is if the produce was grown organically, then it will have higher levels of gram negative bacteria.

Methods/Materials
Two heads of conventionally grown lettuce and two heads of organically grown lettuce were bought at the supermarket. They were cultured on 9 MacConkey agar plates, four conventional samples and five organic samples, for four days. After four days, the cultured bacteria were counted. The data was logged in a journal and graphed in Excel. The experiment was repeated using twelve organically and twelve conventionally grown spinach samples which had only been dipped in water and minimally processed and shipped up from Arizona in a cooler.

Results
For the store bought lettuce experiment, the organically grown lettuce samples had an average of 24% more gram negative bacteria than conventionally grown lettuce. For the farm direct spinach experiment, the organically grown spinach had an average of 6% more gram negative bacteria.

Conclusions/Discussion
The hypotheses were shown to be correct. Organically grown bacteria did have more gram negative bacteria than conventionally grown lettuce. One factor that may contribute to organically grown lettuce having more gram negative bacteria is because organic farms use fertilizers with feces. However, the margin between the sample averages in the second experiment (the farm direct) suggests that the difference in bacteria may not be as big as originally thought.

Summary Statement
The goal of my project was to determine whether organically grown lettuce had more gram negative produce than conventionally grown produce.

Help Received
Mr. S. Komar supplied me with the spinach from Arizona. Ms. Kiest helped me revise my project write-ups and helped me refine my project idea.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Aaron E. Lin

Project Number
S1411

Project Title
The Effects of Superinfection on Virulence

Abstract

Objectives/Goals
Because superinfection has clinically been shown to have different effects under various conditions, this research project attempts to determine whether virulence of multiple strains on average increases or decreases and by what degree for selected initial conditions during superinfection.

Methods/Materials
A Java computer simulation, which consisted of a 20 x 20 grid of susceptible cells, was coded based on a combined mathematical model. One control group contained only an avirulent virus on a grid, and the other contained only a virulent virus. The baseline superinfection experimental group contained both viruses on the same grid. Three other test groups included superinfection but varied either initial virulence, competition factor, or mutation rate compared to the superinfection baseline group. Based on multiple simulation runs, the data from the controls and from test groups with different conditions were separately compared to those from the superinfection baseline group.

Results
The computer simulation suggested that both viruses limited each other in superinfection since the virulences and transmissions in the control groups were higher those in superinfection. Additionally, different conditions did impact virulence; lower initial virulence caused more variation in virulence, lower competitive asymmetry decreased virulence over time, and lower mutation rate led to quicker extinction of the virulent virus, greater leaps in average virulence, but more overall consistency in virulence.

Conclusions/Discussion
At almost all medium to high initial virulences for the virulent strain, the virus killed off cells too quickly, so virulence severely decreased. However, the virulence of the avirulent strain increased without causing its extinction, most likely because its transmission was above some threshold. The data suggest that virulence of one strain increases if initial transmission exceeds some threshold but decreases if below that threshold, especially with little competitive asymmetry, a high mutation rate, or an initial virulence that nearly maximizes the transmission.

Summary Statement
My computer simulation suggested that initial virulence, competitive asymmetry, and mutation rate help determine numerical outcomes of superinfection, but superinfection itself limits the virulence and transmission of all viruses involved.

Help Received
I received advice from Dr. Kara O#Keefe (UC Davis), Dr. Paul Turner (Yale), Dr. Jeroen Saeij (MIT), Dr. Ileana Cristea (Princeton), and Dr. Joshua Plotkin (U Penn).

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Mikael H. Matossian

Project Number
S1412

Project Title
Gamma Irradiation Studies of Spinach Leaves

Abstract

Objectives/Goals
My project studied the effects of gamma irradiation on reducing bacteria levels of E.Coli-contaminated spinach leaves, extending the shelf life of non-contaminated spinach leaves, and determining any adverse effects on smell, appearance, and texture. The results could have application to commercial treatment of spinach leaves.

Methods/Materials
Organic spinach leaves from Whole Foods Market were divided into 3 groups: E.Coli contaminated group 1, non-E.Coli contaminated group 2, and sensory assessment group 3. Non-pathogenic E.Coli (0157:H7) was used to inoculate the group 1 spinach leaves. Gamma irradiation of all spinach leaf groups were conducted at Sterigenics in Tustin, California.
Experiment 1: Elimination of E.Coli Bacteria
E.Coli contaminated spinach leaves were irradiated with gamma rays at 4 doses (0, 0.5, 1.4, and 2 kGy). E.Coli bacteria counts were measured over 11 days to determine the effectiveness of gamma irradiation in killing off E.Coli bacteria colonies.
Experiment 2: Spinach Shelf Life, Smell, Appearance, and Texture
Non-contaminated spinach leaves were irradiated at the same 4 doses. Over 11 days, the appearance, smell, and texture of the leaves were recorded to determine undesirable sensory changes to the spinach leaves. Spinach shelf-life improvements were estimated by measuring the aerobic (naturally occurring) bacteria levels on the leaves as a function of gamma dose.

Results
1. A 2 kGy gamma dose caused a 500x reduction in E.Coli levels. A 0.5 kGy gamma dose caused a 5x reduction.
2. A 2 kGy gamma dose caused a 10x reduction in Aerobic (naturally occurring) bacteria levels, thus extending shelf life, while a 0.5 kGy dose caused a 4x reduction.
3. A 2 kGy gamma dose caused the color of spinach leaves to change from dark green to pale green, a dry texture, and a less fresh smell. A 0.5 kGy dose had little change on color, texture, and smell.

Conclusions/Discussion
Gamma irradiation is effective in eliminating E.Coli bacteria from infected spinach leaves, and extending the shelf-life of non-contaminated spinach leaves. However, it can adversely affect spinach leaf smell, texture, and appearance, if the dose level is high. I found that 0.5kGy is the near-optimum level for eliminating bacteria and extending shelf-life, while retaining good sensory attributes of spinach leaves,

Summary Statement
Gamma irradiation of spinach leaves can effectively eliminate bacteria, extend shelf-life, but may have an adverse effect on the smell, appearance, and texture.

Help Received
Professors Antonio Machado and John Schillinger of California State University at Northridge (CSUN) provided E.Coli bactera for inoculation; Professor Anuradha Prakash at Chapman University critiqued the test methodology; Jeremy Bolnick of Sterigenics conducted the gamma irradiation tests.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Phoebe G. Ng

Project Number
S1413

Project Title
Between the Bristles

Abstract

Objectives/Goals
My objective was to discover which method of cleaning one's toothbrush was most effective in eliminating pathogenic bacteria.

Methods/Materials
I chose to test the following methods: rinse with water, wash/rub with water, soak in mouthwash, soak in baking soda, zap in microwave, and no treatment/action after brush, which serves as the control. Before the start of each cleaning method, the subject toothbrush will be swiped across a #simulated mouth# bacteria bed for thirty seconds. After uniform treatment of all the toothbrushes, then the methods (the dependant variable) will be tested; samples will be then taken and transferred to nutrition agar petri dishes, which will be incubated and monitored for three days.

Results
Listerine mouthwash allowed no bacteria colonies to grow. The bacteria bed reached 883 colonies; Rinse with Water multiplied the bacteria colonies to an average of more than 1000 bacteria colonies. Wash/Rub with water averaged of 39 colonies. Soak in Baking Soda and Microwave 237.5 and 220.5, respectively. The control grew 2.5 bacteria colonies.

Conclusions/Discussion
The results of my investigation support my hypothesis that soaking a toothbrush in Listerine mouthwash is the most effective method at eliminating the number of bacteria colonies that can be grown on toothbrushes. Rinsing one#s toothbrush was actually more harmful than leaving the toothbrush alone The two #myth methods#, Soak in Baking Soda and Microwave, were proven to be un-effective because they produced over 200 bacteria colonies.

Summary Statement
My project is about discovering what is the most effective method of eliminating bacteria on a toothbrush.

Help Received
Mother and sister provided infinite moral support

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Laika D. Roy

Project Number
S1414

Project Title
Antibacterial Effects of Low Voltage Electricity on E. coli and S. epidermidis

Abstract

Objectives/Goals
The antibacterial effects of electrical stimulation on bacteria cultures have been examined to see if infections can be prevented or treated. Low-voltage pulsed current has been shown to promote tissue repair in vitro and in vivo. This experiment is focused on inhibitory effects of low voltage elecetricity on Escherichia coli and Staphylococcus epidermidis.

Methods/Materials
Different low voltage amounts were applied to agar plate cultures with stainless steel electrode pairs. The voltage amounts were 0V (0mA), 1.5V (6mA) and 3V (20mA). There were two groups: "Immediate treatment" meaning the agar plate culture was incubated for 24hrs with treatment and the second group was "Delayed treatment" meaning the agar plate culture was incuated for 24hrs (without treatment) and then after 24hrs of growth, it was treated for 24hrs. The results were measured by the area of the zone of inhibition.

Results
Immediate treatment was more effective than delayed treament. In each trial for immediate treatment there was a zone of inhibition at both the anode and the cathode. In the trials of the delayed treatment, there was about a 17-33% chance that there would be a zone of inhibiton around the anode/cathode.

Conclusions/Discussion
There is not a significant difference between th ares of the inhibition zone for E. coli positive/negative electrode and the S. epidermidis positive/negative electrode. 3V and 1.5V showed a difference in the area of the zone of inhibition compared to the 0V (control) in immediate treatment but the voltage amount did not make a difference in delayed treatment. The areas of the inhibition zone around the positive and negative electrodes in immediate treatment yeilded similar areas within its group and so did the delayed treatment. There is a difference between the areas of the ihibition zones for immediate vs. delayed treatment. Immediate treatment was more effective in inhibiting the growth of E. coli and S. epidermidis.

Summary Statement
This experiment is focused on the inhibitory effects of low voltage electricity on E. coli and S. epidermidis in realtion to see if bacterial infections can be prevented or treated.

Help Received
Mr. Linke ordered materials; under supervision of Mr. Linke; used epuipment from Mt. Miguel Science department

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Tiana N. Takenaga

Project Number
S1415

Project Title
The Effect of Constant Application of Different Disinfectants on the Resistance of E. coli

Abstract

Objectives/Goals
The objective of my project was to observe the effect of two applications of different disinfectants on the resistance of E. coli.

Methods/Materials
E. coli was plated onto ten petri dishes. Antibacterials were plated onto the dishes by means of filter paper disks. The diameters of the zones of inhibition wa observed. The antibacterials was applied to the bacterial lawns once more. The zones of inhibition were observed once more to find the difference between the two rounds.

Results
The data shows that the bacteria became resistant to the Purell. On the disks with Purell, fifty percent of the disks had overgrowth of the bacteria. The Purell was not effective at all in these cases. The conclusion that the E. coli became resistant to the Purell can be made because of the fact that every dish had a significant amount of regrowth of the bacteria. Even though some disks did not have the total overgrowth on the disks, all zones of inhibition became smaller. In the Betadine solution, the bacteria was becoming resistant to the solution, however, there were not enough trials to conclude this information. Most of the zones of inhibition were reduced. After more trials, the Betadine solution would become ineffective as an antibiotic fighting against this strain of E.coli. The Hibiclens solution was the most effective. It withstood the R plasmid in the E. coli. In most cases, the zone of inhibition stayed the same. This means that this solution would be the most effective for the longest amount of time.

Conclusions/Discussion
Based on my observations, I can infer that the Hibiclens remained effective against the E. coli, the Betadine solution would become more resistant if given more rounds, and the Purell became ineffective against the E. coli bacteria.

Summary Statement
This project compares the effectiveness of different antibiotics on the resistance in E. coli bacteria.

Help Received
Mother helped paste papers on board; Dr. Oniell let me use her classrom to conduct my experiment.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
David K. Tang-Quan

Project Number
S1416

Project Title
Antimicrobial Peptide Susceptibility of Candida albicans Kinase Mutants

Abstract

Objectives/Goals
Disseminated candidiasis occurs in hospitalized patients when the fungus, Candida albicans, enters the bloodstream and infects almost all organs of the body. The mortality rate of this disease is close to 40%. Immunocompromised patients can also develop oropharyngeal candidiasis, or Candida overgrowth in the mouth. Although the mechanisms behind C. albicans defense against reactive oxygen intermediates have already been discovered, the mechanisms for resistance to antimicrobial peptides are still unknown.

Methods/Materials
Sixty-four kinase mutants were screened with protamine containing antimicrobial peptides to discover mutant strains that were hyper-susceptible. Serial dilutions of each strain were pipetted onto protamine and YPD plates, starting at 10^8 cells/ml and decreased by a factor of 10 until the final concentration of organisms was 10^3 cells/ml. Hyper-susceptible strains were retested and the validity of results was further confirmed in a trial using a second, independent clone.

Results
Results from the first 96-well microtiter plate of kinase mutants showed three genes that are responsible for hyper-susceptibility to antimicrobial peptides: PBS2, YCK2, and HST7. Findings from the second 96-well plate of kinase mutants were unconfirmed, but six possible hyper-susceptible strains and some likely hypo-susceptible strains were identified.

Conclusions/Discussion
It was concluded that the genes PBS2, YCK2, and HST7 play a significant role in C. albicans resistance to antimicrobial peptides. Further research to confirm the validity of these results includes gene complementation and a clean knock out of genes. Pharmacologists and other medical researchers can use these findings to determine which genes need to be inhibited when developing medications for Candida infections.

Summary Statement
This study focuses on identifying the genes responsible for Candida albicans resistance to antimicrobial peptides.

Help Received
Used lab equipment at Los Angeles Biomedical Research Institute; mentored by Dr. Scott Filler; supervised by Norma Solis.