CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Vivek A. Banerjee

Project Number
J0401

Project Title
Sequence Comparison across Species as a Predictor of Gene Function

Abstract

Objectives/Goals
This study viewed the evolution of genes related to Serine Protease Inhibitor Activity throughout several species of Drosophila. The goal was to extend the theoretical predictions of sequence comparisons by appropriate molecular and genetic experiments.

Methods/Materials
Blast searches were done of the sequences of all genes related to serine protease inhibitors. E values and scores of all Drosophila species were recorded and missing spaces were filled with repeated in-depth blast searches. Drosophila melanogaster species was grown in lab cultures and analyzed for gene expression. Materials included Drosophila cultures, molecular biology equipment, reagents, and computer.

Results
Results showed in genes: Spn43Ad-PA, Acp62F, CG12807, and CG6663; in one or two drosophila species, the gene was either completely absent, or very close to non-existent. Species pseudoobscura turned out much different from any other species for several of the genes. Genes: Spn43Aa, Cg3790, PlxA, Tep11, Az2, Spn27a, CG14470, and CG1342 were very slow evolving and were found with seemingly no change between all species. Genes Acp76-Pa and Bg642378-Pb evolved very rapidly, and were found with varying change between all species. I attempted to demonstrate experimentally that the fastest evolving genes have functions related to reproduction.

Conclusions/Discussion
Sequence analysis across species was found to be a powerful method to identify genes with similar functions. In particular, the demonstration that some of the previously uncharacterized fastest evolving genes may have to do with reproduction, is consistent with their species specific function.

Summary Statement
Predicting gene function by sequence comparison and expression analysis.

Help Received
My father helped introduce me to the problem; Dr. Mukherjee at UCLA helped with experimental set up.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Alyssa L. Chan

Project Number
J0402

Project Title
Alzheimer's Disease: Inhibitory Effects of Metals and Metal-EDTA Complexes on Peroxidase Activity

Abstract

Objectives/Goals
There are two main physical symptoms of Alzheimer's disease: plaque formation resulting from the aggregation of beta-amyloid protein and abnormal deposits of tau protein called neurofibrillary tangles. The plaques have been found to mediate the formation of hydrogen peroxide in the presence of some metal ions. Peroxidase enzyme breaks down reactive hydrogen peroxide into oxygen and water and may be useful in the prevention of Alzheimer's disease.

Methods/Materials
I tested the effects of metal salts and their EDTA complexes on peroxidase activity using the Guaiacol method. Guaiacol is readily oxidized by oxygen in the presence of the heme iron of peroxidases to yield a colored product, tetraguaiacol, which can be measured at 470 nm using a spectrophotometer. A total of 14,640 absorbance readings were made in 240 tests performed with five metal ions and their EDTA complexes. A microplate spectrophotometer was used to allow rapid absorbance measurements as a function of time.

Results
Three of the metal ions tested: aluminum, zinc, and manganese had a concentration dependent effect on peroxidase activity. Aluminum lowered peroxidase activity by 36%, while zinc and manganese enhanced activity by 12% and 8%, respectively. Two other metals, calcium and magnesium, had no significant effect. EDTA alone did not have a significant effect on peroxidase activity, but when combined with manganese and zinc, it nearly shut down peroxidase activity, reducing it by 93% and 98%. EDTA complexes of aluminum, calcium, and magnesium also significantly lowered enzyme activity by 67%, 43%, and 14%, respectively. These observations are consistent with my earlier findings in which metal-EDTA complexes had a devastating effect on the activity of catalase, another enzyme that breaks down hydrogen peroxide.

Conclusions/Discussion
My results from this two-year study show that the widely suggested EDTA chelation therapy for Alzheimer's disease may not be helpful, but may in fact be detrimental. Metal-EDTA complexes consistently inhibited peroxidase and catalase activity, which may have implications on the ability of catalases and peroxidases to protect cells from death.

Summary Statement
The aim of this project was to evaluate the effects of various metal ions and a chelating agent (EDTA) on peroxidase activity using an automated microplate reader to accurately measure the rate of reaction.

Help Received
I would like to thank my father for teaching me correct lab technique and explaining how to operate the microplate reader. I would also like to thank my mother and my science teacher for their constant support of me and my project.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
John Michael G. Ferrer

Project Number
J0403

Project Title
Anti-Oxidized Apples: The Effects of Vitamin C on Oxidation in Apples

Abstract

Objectives/Goals
The objective of this project was to determine the effects of various levels of ascorbic acid (Vitamin C) on the oxidation in apples. The experiment observed the antioxidant's effectiveness at retarding both area of oxidation and intensity of oxidation.

Methods/Materials
50 apple samples were observed during a 6 day period in this experiment. The samples were equally distributed among 5 variable levels: 0 mg of ascorbic acid, 250 mg, 500 mg, 750 mg, and 100 mg. Water and the appropriate level of antioxidant were mixed to form 5 solutions in which to contain the samples. The solutions were poured into specimen jars, where the samples were then placed.
Data was taken over the next 5 days. Statistics collected were for area of oxidation (% of surface oxidized, measured via a 10x10/sq. in. transparency) and intensity of oxidation (color of affected area, measured with a color scale).

Results
The general trend appeared to be that the higher the potency of ascorbic acid in the solution, the less pronounced the effects of oxidation were, both in area and intensity. In "area" statistics, the final averages were: (with potency levels in ascending order) 0 mg yielded 100% surface area oxidized, 250 mg yields 89.5% oxidized, 500 mg yields 60 % oxidized, 750 mg yields 54.5% oxidized, and 1000 mg yields 28% oxidized. The same results appeared in "intensity" statistics, with 0 mg yielding a Level 4.4 color (referring to color scale) and the rest of the levels yielding a Level 2 color.

Conclusions/Discussion
The antioxidant worked both to delay the oxidation reaction as well as lessen its overall effect. Increasing levels of antioxidant caused decreasing oxidation effects. Based on these results, it can be concluded that the higher the level of antioxidants in a specimen, the more effective the retardation of oxidation.

Summary Statement
This project observes the effects of various levels of ascorbic acid (Vitamin C) on retarding the oxidation in an apple.

Help Received
Mother and father helped obtain materials and assemble sections of display board. Parents also supervised experimentation when chemicals (ascorbic acid) were involved. Science teacher, Mrs. Chiang, helped provide ideas and feedback on certain aspects of the project before and during experimentation.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Michael D. Gonsalves

Project Number
J0404

Project Title
Do Different Parts of a Plant Yield Different Amounts of DNA?

Abstract

Objectives/Goals
The main purpose of my project is to determine whether different parts of a plant will yield different amounts of DNA.

Methods/Materials
Materials: A·Blender; A·Hot plate; A·Thermometer; A·Ice bucket; A·Balance; A·95% ethanol solution; A·Plastic gloves; A·100ml liquid dishwashing detergent; A·Table salt; A·Cutting board; A·Plant leaves; A·Plant stem; A·Plant roots; A·Knife; A·Funnel; A·Cheesecloth or coffee filter; A·2 100ml graduated cylinders; A·3 beakers; A·Glass rods.

Procedure:
1.Wearing plastic gloves, cut leaves/stems/roots into cubes
2.Weigh 50g of diced plant material and put in 250ml beaker
3.Prepare a detergent/salt solution by dissolving 2g of salt in 90ml of water, and 10ml of detergent
4.Add detergent/salt solution to diced plant material and maintain incubation at 60 degrees Celsius for 15 min
5.Cool to 15-20 degrees Celsius in an ice bath
6.Pour into blender and homogenize for 45 seconds at low speed, and 30 seconds at high speed
7.Pour into 1L beaker and cool in ice bath for 15-20 min
8.Filter through cheesecloth or other filter into 500ml beaker
9.Place beaker into ice bath, let it cool until it reaches 10-15 degrees Celsius
10.Put 80ml of ethanol into a cold graduated cylinder and add down the side of the beaker containing the solution until white stringy DNA precipitate appears
11.Spool DNA onto a glass rod by rotating it in one direction in the beaker of DNA.
12.Ease it into vial filled with 50% ethanol and seal

Results
I found that the stem and leaf material yielded some DNA whereas the root material didn't produce any visible strands of DNA. I was shocked to find that my hypothesis seemed incorrect because no DNA was visible in the root liquid container but there was some in the other containers. From my observations I can see that the leaves and stems yielded more DNA than the roots by a considerable amount.

Conclusions/Discussion
The above results of the experiments proved that my hypothesis was incorrect. After further research, and

Summary Statement
The main purpose of my project is to determine whether different parts of a plant will yield different amounts of DNA.

Help Received
I would like to thank my father for helping me research my topic and ordering the materials needed for the procedure over the internet for me. I would also like the thank Jim Rayburn for listening and giving me information about my topic. I would like to thank Mr. Hobbs for pointing out the flaw in my first topic

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Samantha M. Guhan

Project Number
J0405

Project Title
A Behind the Scenes Look at the Idli Fermentation

Abstract

Objectives/Goals
Idli, a popular Indian snack, is a steamed rice cake made from a fermented batter containing ground parboiled rice and lentil. I became curious when I realized that a fermentation was occurring without adding any live cultures to the batter.

My first goal was to determine what is responsible for the fermentation. The quality of idli varies widely in taste, flavor and texture; my second goal was to try different ratios of rice to lentil found in recipes to determine which worked the best and why. The third goal was to investigate the truth in the claim that adding fenugreek improves product quality.

Methods/Materials
I performed fermentations using three ratios of rice to lentil, namely 1:1, 2:1, and 3:1, both with and without fenugreek. I followed the fermentation over time by taking batter samples and measuring batter volume. I plated the samples, determined the identity of the involved species by performing several tests and obtained their count. At the end of the fermentation, I evaluated the quality of the batter and idli. I made every type of batter in duplicate and repeated the experiments to improve data reliability.

Results
I found that the fermentation is carried out by lactic acid bacteria from the Leuconostoc and Lactococcus species. Idlis made using 3:1 ratio were superior due to their sponginess resulting from a well fermented batter. Fenugreek improved not only the flavor but also the texture. Most importantly, it changed the microbial population distribution by favoring growth of L. mesenteroides and Lactococcus lactis.

Conclusions/Discussion
An analysis of the biochemical pathways led to neat insights into the role played by each species. The heterofermentative Leuconostoc are likely responsible for the rise of the batter and its aroma, while the homofermentative Lactococcus provide flavor. Fenugreek was able to alter flavor by stimulating the growth of Lactococcus while its ability to promote smoother texture arose from its stimulation of L. mesenteroides, a producer of dextran. In future, these effects of fenugreek could be verified through a dose response study as the results could have a far reaching impact on commercial food fermentations.

Summary Statement
This project is an in depth study of the wild fermentation that occurs in the process of making the popular Indian snack idli, which is a steamed rice cake made from a fermented batter of ground parboiled rice and lentil.

Help Received
Mother provided guidance; Obtained a few items such as LB broth from Amgen Inc.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Lindsay M. Harrison

Project Number
J0406

Project Title
Oranges to Oranges: Which Orange Juice Has the Most Vitamin C: Fresh Squeezed, Premium, or Frozen Concentrate?

Abstract

Objectives/Goals
I want to determine which orange juice has the most Vitamin C (ascorbic acid): fresh-squeezed orange juice, premium not-from-concentrate orange juice or juice made from frozen concentrate. I think the fresh-squeezed orange juice will have the most Vitamin C.

Methods/Materials
I will use titration to test the Vitamin C (ascorbic acid) content in the 3 juices. An equal amount of juice and starch solution will be used for each juice type tested. A variable amount of iodine solution will be added to each juice type until the ascorbic acid is eliminated and a reaction occurs between the iodine and the starch. This reaction will be indicated by a color change and it signals that the juice has run out of Vitamin C. I will determine which orange juice has the most Vitamin C based upon the greatest number of iodine drops needed to create a color change in the orange juice.

Results
The fresh-squeezed orange juice had 43% more Vitamin C (ascorbic acid) than the premium orange juice and 40% more Vitamin C than the orange juice made from frozen concentrate. It took 65 drops of iodine solution to make the fresh-squeezed orange juice change color (run out of Vitamin C). In comparison, the orange juice made from frozen concentrate required only 39 drops to change color and the premium orange juice needed only 37 iodine drops to change color.

Conclusions/Discussion
My conclusion is that fresh-squeezed orange juice has more Vitamin C (ascorbic acid) than premium not-from-concentrate orange juice or orange juice made from frozen concentrate. Manufactured juices are subject to pasteurization and/or freezing processes that may have a destructive effect on their Vitamin C content. Even though some manufacturers add Vitamin C after pasterurization, it appears that the benefits of Vitamin C are best found in a diet including fresh-squeezed orange juice.

Summary Statement
My project determines which orange juice (fresh-squeezed, premium not-from-concentrate or from frozen concentrate) has the highest Vitamin C content.

Help Received
My mother helped me with this project by purchasing the supplies, by taking pictures and by proofreading.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Justin G. Lee

Project Number
J0407

Project Title
Tomatoes, Cell Defenders!

Abstract

Objectives/Goals
Antioxidants help defend our body against free radicals from damaging our cells by donating their electrons to the free radicals. Lycopene and Vitamin C are two potent antioxidants found primary in tomatoes. Studies have shown that Lycopene in cooked tomatoes can be absorbed easier by our body. The objective of this project is to find out what tomato products has the highest level of antioxidants and what effect do cooking time and temperature have on the level of antioxidants.

Methods/Materials
Seven tomato products plus fresh tomato were tested through titration analysis to determine the amount of antioxidants in each products. A 1% starch solution was prepared as indicator and 0.1% iodine was used as reagent. Vitamin C tablet was used as reference to calibrate iodine. Distilled water was added into each tomato product to extract antioxidants. Drops of iodine were added to a mixture of tomato solution and starch solution until the solution turned and remained purple color. Half cup of tomato sauce was baked in 9 bowls covered with foil at 325F, 350F, and 375F for 15min, 30min and 45min respectively to test the effect of cooking condition. The same titration tests were preformed on each sauce solution after they were baked. Six sets of trials were done for each solution.

Results
Tomato juice with 9.5 mg of antioxidant and tomato paste with 9.2 mg of antioxidant have much higher levels of antioxidant than the rest of the tomato products which have a range of 2.0 mg to 3.7 mg of antioxidants. The level of antioxidants in tomato product increased at a lower bake temperature and with longer bake time.

Conclusions/Discussion
My hypothesis that ketchup has the highest level of antioxidant was incorrect. Tomato juice has the highest level of antioxidants followed by tomato paste. Ketchup has a similar level of antioxidant as tomato sauce, tomato soup and canned tomatoes.

My hypothesis that high temperature and long bake time have the lowest level of antioxidants was partially correct. The level of antioxidants does decrease with higher temperature. However, the level increases with longer bake time. The test shows that antioxidant level of tomato product can be controlled by bake time and temperature.

Summary Statement
My project tested the level of antioxidants in different tomato products and the effect of cooking time and temperature on the antioxidant level.

Help Received
Mother purchased materials (tomato products, iodine, pipettes, and flasks). Chemistry teacher in a local high school lent me the buret and metal stand. Mother helped edit the report. Father provided advice on the layout of the display board.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Malia A. Packer

Project Number
J0408

Project Title
Dazed by a Taze: An Examination of the Effect of an Electrical Control Device on Human Cell Salts and Proteins

Abstract

Objectives/Goals
My father is a police officer so I know that there are a lot of law suits that claim a Taser can do serious or lasting harm to a person. Some lawsuits claim that a Taser discharge is a form of deadly force. I decided to test whether there are long term effects on human protein as well as the conductivity of the salts in human tissue by testing similar solutions outside the body. My goal was to create saline solution samples and protein samples, subject the samples to a measured electrical discharge and record any changes in conductivity and protein structure.

Methods/Materials
I created a distilled water control sample. I also created five saline solution samples that closely replicate the salts in a human cell using distilled water and a product named Instant Ocean. I created five protein samples using the egg whites from ten grade AA eggs.

I used a conductivity meter to measure the conductivity of the control sample, saline solution samples, and protein samples before, immediately after and ten minutes after a 5 second Taser (electrical) discharge.

I used a YSI 30 Conductivity meter, 200 and 250 ml beakers, a Thermo-tech digital thermometer, a Sartorius Balance, a Taser X26 with probe cartridge, egg whites, Instant Ocean (cell salts), and distilled water.

Results
All of the samples showed an immediate increase in conductivity. After 10 minutes the conductivity of the saline solution returned to ~2.63 mS on average from the original conductivity. After 10 minutes the protein samples returned to ~.31 mS on average from the original conductivity reading.

Conclusions/Discussion
I originally thought that the electrical discharge would cook the protein samples. There was, however, only a small amount of denaturing in the protein samples. This suggests that there would be minimal denaturing to human tissue protein. I was correct in my belief that there would be no permanent, long-term damage or change to human cell salts.

Summary Statement
An examination of the effect of an electrical control device (Taser) discharge on human cell salts and proteins.

Help Received
Laboratory equipment and materials at Humboldt State University were provided by Dr. Terry Jones and Dr. Dustin Poppendieck. I worked in the HSU engineering laboratory under the supervision of Colin Wingfield. Tasers were provided by Humboldt County Correctional Facility and Taser International.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Marie J. Plecha

Project Number
J0409

Project Title
How Does Temperature Affect the Amount of Vitamin C in Citrus Fruit Juice?

Abstract

Objectives/Goals
The purpose of my experiment was to find out how the amount of vitamin C in fruit juice is affected when thte juice is heated, refrigerated, or stored at room temperature.

Methods/Materials
I tested four different types of juices: orange, lemon, lime, and grapefruit. To test the amount of vitamin C in the juice, I performed a simple titration--after adding about ten drops of a solution made of baking soda and water to the juice, I added drops of iodine to the juice until it had dramatically changed color. The more drops of iodine it took for the solution to change color, the more vitamin C there was in the juice.

Results
I hypothesized that the juice stored at room temperature would have the most vitamin C. This was correct in all of the juices except grapefruit, in which the juice that was heated had the most vitamin C. What surprised me about my results was that with all four juices, the juice that was stored in the refrigerator had the lowest amount of vitamin C. While this is how fruit juice is generally stored, my experiment shows that storing juice this way can actually damage the vitamin C content.

Conclusions/Discussion
Through my experiment, I discovered that although many people may prefer fruit juice that has been refrigerated, the nutrients in the juice would be better preserved if it was stored at room temperature.

Summary Statement
The purpose of my experiment was to find out how the amount of vitamin C in fruit juice is affected when the juice is heated, refrigerated, or stored at room temperature.

Help Received
none

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Taimur M. Rehan

Project Number
J0410

Project Title
Exploring Transgenics: Phenotypic Detection of Gene Activity in Fruit Flies

Abstract

Objectives/Goals
My goal was to design a method for identifying transgenic lacZ positive fruit fly larvae by their appearance, using a reporter gene assay. I used the E. coli gene set Lac Operon, which produces the beta galactosidase enzyme. A compound called 'X-Gal' reacts with beta galactosidase to produce a blue color. The blue color is used to detect gene activity in the transgenic organisms. In fruit flies and other eukaryotes, the blue color can only be detected after the organism is killed, and stained with X-Gal. This then eliminates the possibility of 'in-vivo' studies. I had watched my father staining the dead flies, and wondered if there was a way to 'stain' the live ones. My hypothesis was that transgenic Lac Z positive fruit flies could display blue color (gene activity) if X-Gal was in their diet. The right concentration of X-Gal and beta galactosidase might produce live larva displaying the blue color. This would then permit in-vivo research!

Methods/Materials
My experiments involved growing strains of LacZ positive flies (D91, D105, & F273) with varying concentrations of X-Gal in their diet, totaling over 300 flies in my experiment. I also performed a control study using wild type flies cultured in the same media. The fly vials were observed under a dissecting microscope to look for larvae with any signs of blue color. 60 vials were prepared using X-Gal concentrations of 0.4 ppm, 2ppm, 4 ppm, 8 ppm, 10 ppm and control (no X-Gal). Each vial had a minimum of 2 pairs of flies.

Results
In the experiment, it seemed that a few of the experimental larvae/pupae expressed blue colored areas, indicating expression of beta gal enzyme.The results showed promise, but more specialized equipment will be needed to clearly view the blue color.

Conclusions/Discussion
Although the outcomes of the first experiment yielded inconclusive results, I was able to conclude that the Lac Operon is possibly only active during the pre-pupa to pupa stage. The pupae expressed the Lac Operon in the abdomen and tail areas, and survived in concentrations from 0.2ppm to 0.8ppm. This showed me that at these concentrations of X-Gal, transgenic screening through phenotypic detection was possible. Unfortunately, I was unable to develop a reliable screening method for LacZ positive fruit flies, but I have demonstrated that it is possible. I will continue my experiments, and hopefully, a new screening method will be available soon!

Summary Statement
My project examined whether live transgenic Drosophila melanogaster could be given X-Gal in their diet to produce blue color in their body, indicating in-vivo expression of Lac Z activity.

Help Received
Thanks to my father for letting me use his laboratory supplies. I also want to give special thanks to Dr. Larry Marsh, a Professor in the Dept. of Developmental and Cell Biology of the UC Irvine for providing me with transgenic fruit flies. I also thank Molecular Biologicals Inc., for allowing use of laboratories.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Meagan I. Shea

Project Number
J0411

Project Title
Extracting Apple Juice with Pectinase and Cellulase

Abstract

Objectives/Goals
The objective is to determine what combination of Pectinase and Cellulase will produce more apple juice in my experiment.

Methods/Materials
Materials:Apples, Sharp knife for cutting apples, Balance for weighing out apple pieces, Pectinase and Cellulase (available at Carolina Biological), Strainer, Disposable plastic spoons for stirring, Two 1 mL syringes, Three small funnels, Three 100 mL graduated cylinders, Three 100 mL beaker, Water bath, Distilled water, Timer or clock.
Methods: Chop the apples into cubes that are roughly 5 mm on a side. Use the balance to weigh equal amounts of chopped apple (about 50 g) into each beaker. Prepare Pectinase and Cellulase enzyme according to the manufacturer's instructions. Use the syringe to put the amount of Pectinase and/or Cellulase in the beaker according to the results chart. Stir the chopped apple pieces in each beaker with a separate plastic spoon. Be sure to wet all of the pieces. Put both beakers into a 40°C water bath for 15#20 minutes. With water at 40°C, the water should come up to the level of the chopped apples, but you don't want so much water that the beakers float and tip over. Take the beakers out of the water bath. Put the funnel on top of the Graduated cylinder. Now put the strainer on top of the funnel. Pour the apples onto the strainer and record the amount of juice produced.

Results
When I tested with Pectinase only the results showed that it produced about 14ml of juice. When I tested with Cellulase only the results showed that it produced about 11ml of juice. When I tested with equal amounts of Pectinase and Cellulase the results showed that it produced about 20ml of juice. When I tested mostly Pectinase the results showed that it produced about 17ml of juice. And when I tested mostly Cellulase the results showed that it produced about 15ml of juice.

Conclusions/Discussion
In my experiment I tested to see if the right combination of Pectinase and Cellulase would produce the most amount of apple juice. In my experiments I tested; Pectinase only, Cellulase only, Equal amounts of Pectinase and Cellulase, Mostly Pectinase, and Mostly Cellulase. I conducted each of these tests three times in order to get the most accurate results. My test results proved that equal amounts of Pectinase and Cellulase produced the most apple juice. These test results support my Hypothesis

Summary Statement
In my experiment I tested to see if the right combination of Pectinase and Cellulase would produce the most amount of apple juice.

Help Received
Mother helped supervise; My teacher, Mrs. Mchale, for helping me obtain my Chemicals.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Divya Siddarth

Project Number
J0412

Project Title
Got DNA? Investigating the Effect of Temperature on DNA Extraction

Abstract

Objectives/Goals
The purpose of my experiment is to investigate the effect of temperature on DNA extraction from bananas. My hypothesis is that the amount of DNA extracted will increase as the temperature of the banana is decreased.

Methods/Materials
A mixture of banana (250g), salt (5g) and water (500 ml) was blended and strained to yield a banana solution. This solution was separated into seven containers and each container was heated or cooled to a different temperature, which was measured with a temperature probe. Liquid detergent was added to each container to lyse the cells and release the DNA. After letting the solution sit for 10 minutes, equal amounts of the solution were poured into four different test tubes, in order to conduct four extractions at each of seven temperatures. Meat tenderizer (which contains papain, an enzyme used to separate nucleic acid from proteins) was added to each test tube. Then, cold ethanol was poured slowly down the side of the test tube. The DNA precipitated from the banana solution into the alcohol layer and was removed using a glass rod. The extracted DNA was put into a pre-weighed microcentrifuge tube and this tube (containing the DNA) was then weighed, thereby obtaining the weight of the extracted DNA.

Results
The amount of DNA extracted increased as the temperature of the banana was decreased. The rate of increase was not constant, with the amount of DNA increasing rapidly as the temperature was decreased below 65°F. The greatest amount of DNA was obtained at the lowest temperature studied, 32°F. However, even at the highest temperatures studied, namely 95°F and 105°F, it was possible to extract DNA from the bananas.

Conclusions/Discussion
Temperature has a significant effect on the amount of DNA that can be extracted: the lower the temperature, the greater the yield of DNA. Hence, whenever possible, specimens should be kept at cold temperatures, preferably frozen. However, the results also suggest that even if a sample has been exposed to temperatures as high as 105°F, one can still extract DNA from it and use available technology (such as polymerase chain reaction) to obtain sufficient quantities of DNA for research and other purposes.

Summary Statement
My experiment demonstrated that cold conditions are ideal for DNA preservation and storage.

Help Received
My mother assisted me with the blending.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Merima Tricic

Project Number
J0413

Project Title
DNA Dilemma: To Modify or Not to Modify?

Abstract

Objectives/Goals
Extracting DNA is the first step in testing GMOs or genetically modified organisms. My experiment#s goal was to test the method of home-based DNA extraction by comparing the yield of DNA matter extracted through the use of different household detergents and protein-breaking enzymes. My hypothesis was that the best results would be made with the strongest detergent, which was X-14 cleaner with no enzymes added.

Methods/Materials
After blending ½ cup of peas, 1/8 tablespoon salt, and 1 cup of warm water for 15 seconds, I strained the cell material, and added 2 tablespoons of detergent. After 15 minutes, I added in a small amount of an enzyme, and 1 tablespoon alcohol. The controlled variables were salt, DNA source, water and alcohol. The manipulated variables were the detergents and enzymes used to purify DNA.

Results
Out of all the eight detergents used, Ultra Joy with surfactants Sodium Laureth Sulfate and Cocamide Mea, acting with an enzyme Polyaminopropyl Biguanide, brought out the most DNA.

Conclusions/Discussion
In order to speedily identify genetically modified organisms, there has to be a procedure which will extract DNA with accessible household materials, preserving the purity at the same time. In my experiment with household chemicals. I used eight different detergents, which were all picked for their different chemicals components (see report for analysis). I investigated which detergent brought out the largest quantity of DNA, and the purest yield of DNA

The best results came out to be with Ultra Joy dish detergent, because of the amount of surfactants present. Thus, my hypothesis was not proven. As I continue working with spectrometer, additional information on DNA purity will become available.

Summary Statement
Using widely available chemicals, it is possible to obtain the quantity of DNA needed for the amplification procedures, of the purity that allows further analysis for the GMO presence.

Help Received
I thank Dr. Prince for allowing me to use his laboratory, especially the spectrometer needed for measurements of DNA matter. I thank my parents for their help on reading my work and helping me edit it. And finally, I thank my coach for all of her support and guidance.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Chloe B. Warinner

Project Number
J0414

Project Title
DNA vs. Hair Analysis: Should They Be Admissible in a Court of Law?

Abstract

Objectives/Goals
The objective of my experiment was to determine which method is more reliable: forensic DNA analysis or microscopic hair analysis. I wanted to learn whether or not both these methods should be admissible in court and if they are reliable enough to convict a criminal suspect.

Methods/Materials
I used a Buccal Swab kit to do a PCR reaction, and a microscope for the hair analysis. During the DNA analysis, I took cheek swab samples, ran them in a thermal cycler to multiply them, and then ran a gel to find their length. Finally, I placed the gel under UV light to measure the number of base pairs.During the hair analysis, I took hair samples from 15 individuals and examined under the microscope such as reflectivity, medulla, cortex, and many others.

Results
I was able to identify 9 out of 15 individuals using hair analysis. With DNA analysis, I could correctly identify all of the "suspects." I determined that people within a certain ethnicity and hair color tend to have similar characteristics which make them hard to discriminate from eachother.

Conclusions/Discussion
When my tests were complete, I concluded that my hypothesis was correct. I could correctly identify 100% of my subjects using DNA, compared to 54% of my subjects during hair analysis. Therefore, hair analysis should not be admissible in court when used as evidence to convict a criminal, but DNA analysis can be relied on as an accurate method of identification.

Summary Statement
My project tested the forensic methods of microscopic hair and DNA analysis to determine if they should be admissible in court.

Help Received
Used lab equipment at UCSB with help from and under supervision of Christine Henzler, post-doc.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Jnaneshwar T. Weibel

Project Number
J0415

Project Title
DNA Extraction from Plant and Animal Cells

Abstract

Objectives/Goals
The objective was to determine if it is easier to extract more DNA from animal cells than from plant cells. My hypothesis is that it is more difficult to extract DNA from plant cells due to their stiff cell wall that is not found in animal cells. The amount of DNA extracted from plant cells should increase by adding the enzyme cellulase, which breaks down plant cell walls.

Methods/Materials
I weighed out 10 grams of each of the seven different plant and animal sources that I obtained. I followed a laboratory procedure at Humboldt State University that involved blending each sample, adding buffer solution, detergent, neutralizing solution, and after centrifuging it, isopropanol, to extract the DNA. I made two samples for each source and repeated the procedures for both sets of samples. For each plant source one sample was treated with cellulase and the other sample had no cellulase added.

Results
More DNA was consistently extracted from plant cell samples treated with cellulase. An average of 187% (ranging from 120-300%) more DNA was extracted from plant cells with cellulase added than without. More DNA was extracted from chicken liver than any of the plant sources, even those treated with cellulase. Much less DNA was extracted from shrimp cells compared to chicken liver cells (16%) or any of the plant cells (40%).

Conclusions/Discussion
My observations are consistent with my hypothesis. More DNA was extracted from plant cell samples treated with cellulase than those treated without. This is due to the action of the enzyme cellulase in breaking down the cellulose of plant cell walls. The amount of DNA extracted from animal cells depends on the type of animal tissue being used. The shrimp sample probably resulted in less DNA than chicken liver due to the fact that muscle cell was included, which has a large cell size and less DNA per cell than other types of tissue such as a concentrated organ like chicken liver. Additionally many plants have more than one copy of each chromosome per cell (polyploidy) which could be why more DNA could be extracted from plant cells when compared to some animal cells such as shrimp.

Summary Statement
My project is to see if it is easier to extract more DNA from animal cells than from plant cells and if adding the enzyme cellulase to break down the cell wall increases the amount of DNA extracted from plant cells.

Help Received
Dr. Jacob Varkey of Humboldt State University taught me a lot and supervised my lab work; Michele Kamprath, my science teacher encouraged me and gave feedback; S. Sandige of GATE taught calligraphy; my parents talked with me about my research, criticized my writing, and gave me my DNA.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Kate H. Williamson

Project Number
J0416

Project Title
The Effect of Enzyme Concentration on Apple Juice Production

Abstract

Objectives/Goals
The goal of this project is to measure the amount of juice released when apples are exposed to different concentrations of the enzyme pectinase. The hypothesis is if a more concentrated enzyme solution is used, then the cell walls in the apples will break down faster and produce more juice.

Methods/Materials
The top items needed for this experiment were 20 apples, pectinase, 100 mL graduated cylinders and beakers, a cooler, and a water thermometer. The apples were prepared and treated with various concentrations of pectinase. After sitting for 40 minutes in a 104 degree bath, the apples were filtered through a funnel and coffee filter and the juice was measured in a graduated cylinder. This process was repeated 15 times, and the results supported the hypothesis, but only to a certain point.

Results
The groups with pectinase definitely produced more juice than the group without any added pectinase. The ½ tsp. solution produced more juice than the 0 tsp. solution, but not as much as the 1 tsp. solution. Also, the 2 tsp. solution was too much, and it actually hindered production of the juice. In higher concentrations, more pectinase did not necessarily mean more juice. The results showed that there is an optimal level of enzyme that should be used to get the best juice yield. In the 15 trials, the highest juice producer was consistently the apples treated with a 1 tsp. per gal. of distilled water solution.

Conclusions/Discussion
Using the optimal level of enzymes in juice production helps manufacturers produce more juice from their fruit, and reduce the amount of food waste left after processing.

Summary Statement
This project measures the amount of juice released when apples are exposed to different concentrations of the enzyme pectinase.

Help Received
Jennifer Barber, from BioSun Flavors and Food Ingredients, provided me with a free sample of Rohapect pectinase enzyme. My mom helped me obtain the necessary supplies and assisted in removing apple samples from the water bath at exactly the same time. My sister helped me chop many apples!

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Olivia E. Wong

Project Number
J0417

Project Title
The Effects of Various Amylase Enzymes on the Starch Hydrolysis

Abstract

Objectives/Goals
The objective of this experiment is to compare the effects of human salivary amylase enzymes versus microbial enzymes on starch hydrolysis.

Methods/Materials
Subcultures of Bacillus subtilis, Streptoccous agalatae, Sacchromyces cerevisiae, and human saliva were inoculated to the appropriately labeled quadrants on the starch agar plate. The starch agar plate was left at room temperature for 24 hours at 37 degrees Celsius and ph of 7.0. Iodine solution was then flooded on the starch agar plate. The diameters of the starch hydrolysis for S. agalatae, B. subtilis, saliva, and S. cerevisiae were measured in mm. every ten minutes for two hours. The data was then tabulated and graphed. Procedure was repeated for two more trials.

Results
The largest diameter of the clear zone (starch hydrolysis) was found in salivary amylase, 9.7 mm., followed by Bacillus subtilis, 4.4 mm., and 0 mm. for both Streptoccous agalatae (negative control) and Sacchromyces cerevisiae.

Conclusions/Discussion
Human salivary enzymes were more effective in starch hydrolysis than microbial amylase enzymes.

Summary Statement
Effects of various amylase enzymes on starch hydrolysis are being observed.

Help Received
Mr. Mekemson provided necessary information. Dave Mohlenhoff, lab director and May Padiernis-Bognh, microbiologist, donated starch agars and privileged me to use microbiology facility at J.F.K. hospital. Dr. Jolene Abraham, pathologist, developed gram stain photos of bacteria.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Ruth S. Wong

Project Number
J0418

Project Title
Comparing the Rate of Yeast Fermentation on Natural Sugar vs. Artificial Sweetener

Abstract

Objectives/Goals
My objective was to determine if yeast would ferment natural sugar faster than artificial sweetener.

Methods/Materials
Ten same size sanitized glass bottles with fermentation corks with air locks were used. Six of them were controls with two glass bottles containing sanitized water, two other bottles with sugar solution, and the other two bottles with artificial sweetener solution. Two bottles contained sugar solution and the other two bottles with artificial sweetener solution were all inoculated with yeast. All 10 bottles contained the same amount of solution. Both natural sugar and artificial sweetener were brought up to the same brix. All bottles were incubated at 20^0C. A Refractometer was used to measure and record the brix of all the solution in the bottles daily for 18 days along with a hydrometer to measure the potential alcohol. This experiment was repeated twice.

Results
All control samples without yeast remained clear and no air were noticeable in the air fermentation locks. All the bottles with yeast had air in the air fermentation locks and the solution were cloudy at Day 1. The bottles with yeast in the sugar solution had foam around the neck of the bottles unlike the bottles with yeast in the artificial sweetener at Day 1. This remains the same through out Day 18.

Conclusions/Discussion
The absence of foam around the two bottles of the artificial sweetener solution showed that yeast didn't fermented as well as the sugar solution which had foam around the bottles. There is no difference in fermentation rate between natural sugar and artificial sweetener when both began at the same brix. The slow fermentation rate was due to the absence of nitrogen.

Summary Statement
My project is to determine if yeast ferment faster on natural sugar compared to artificial sweetener.

Help Received
Borrow incubator from my school, and refractometer from Fresno State University.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Theodora Yoch

Project Number
J0419

Project Title
Chicken, Chicken, Who's Got the Chicken? A Study of How Different Tissues Affect the Amount of DNA in a Sample

Abstract

Objectives/Goals
The objective of this experiment is to determine which sample of a chicken's body contains more DNA. My question is "How do different types of tissue samples affect the amount of DNA?" From these findings, one can better predict which type of tissue will provide the largest harvest of DNA, as needed for a study. I hypothesized that the skin would have the most volume and weight, because it has the most layers and sub-layers, and the highest cell density of the samples used.

Methods/Materials
A. One pound of chicken gizzard, heart, fat, skin, and liver was processed following a DNA extraction procedure. Samples were processed separately in a blender. A cold buffer of dishwashing liquid, meat tenderizer and salt were added to a blended and filtered liquid of each body part to break up the cells of the samples. Then, cold alcohol was added to the mixture. The alcohol condenses the DNA into a white stringy mass which is removable from a test tube by a pipette or a stick.

B. The tissue type was the manipulated variable. For relatively pure forms of each tissue, I tested samples of chicken muscle tissue (heart and gizzard), chicken connective tissue (fat), and chicken epithelial tissue (skin and liver).

C. The DNA material harvested from the tissue was viewed in the test tube to measure the volume of the sample.

D. The DNA material harvested was removed from the test tube with a pipette, viewed under a microscope and the gram weight was determined.

Results
The data showed the skin sample produced 3.345 grams and 4 ml of DNA material. This was more than any other sample.

Conclusions/Discussion
Based on the volume and weight of DNA harvested from my samples, I conclude that my hypothesis was supported since skin contained more DNA material than muscle, connective tissue, or other epithelial tissue. As expected, the quantity of DNA is highest in tissue samples with the most layers and sub-layers, and highest cell density. These results provide important information to those using DNA samples for tissue typing.

Summary Statement
This project uses chicken tissue to determine which type of tissue (muscle, connective, epithelial) will contain the most DNA material.

Help Received
Dr. Farone helped process the samples to determine the tare weight. Albertson's market provided all the chicken tissue samples. My mother purchased the supplies and helped with the set up of the experiment.