CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Christara Avaness

Project Number

J0401

Project Title

The Effect of Temperature on an Enzyme's Ability to Digest Protein

Abstract

Objectives/Goals

I conducted this experiment to test the effect of temperature on the ability of the proteolytic enzyme bromelein (found in pineapple) to digest protein. My independent variable is the different temperatures measured in Kelvin. The dependent variable is the proteolytic activity measured as solid or liquid. I hypothesized, as the temperature increases the efficiency of enzyme decreases.

Methods/Materials

First I numbered the test tubes 1-10, and labeled the remaining test tube as "RT" room temperature. Second I designed a temperature gradient ranging from 273.15-373.15 Kelvin, in increments of 10. Then I recorded the test tube numbers and corresponding temperatures assigned for each. Afterwards, I added 3 ml pineapple juice to each tube, and heated (or cooled) each test tube to the appropriate temperature, (leaving test tube "RT" at room temperature). Then, I added 10ml gelatin to each test tube and refrigerated them overnight.

On day two, I checked each test tube for liquidity of the contents and recorded my obeservations.

Results

I found that the bromelein enzymes that were exposed to temperatures 353.15 Kelvin and above, lost their efficacy for digesting protein, as shown by the contents' solid state. However it is interesting to note that the test tube exposed to the temperature of 343.15 Kelvin did contain a minor amount of solidification at the bottom.

Conclusions/Discussion

The data supported my hypothesis, that as the temperature increases, the enzyme's ability to digest protein decreases. An enzyme's function is related to the 3-dimensional structure of its molecule. This structure can be altered by heat, thus causing the enzyme to lose its normal function.

Summary Statement

The purpose of this experiment was to determin the effect of temperature on the ability of the proteolytic enzyme bromelein to digest protein.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Samantha L. Bates

Project Number

J0402

Project Title

Do Mutations in the GAG Gene Impact the Ability of HIV-1 to Kill T-Cells?

Abstract

Objectives/Goals

Human Immunodeficiency Virus (HIV) is the cause of the Acquired Immune Deficiency Syndrome (AIDS). HIV causes disease by killing the T-cells of the host and destroying the host's ability to fight infection. Replication Capactiy (RC) is an approximate measure of the virus' ability to kill T-cells. The purpose of my project is to determine whether or not mutations present in the 3' end of the Gag gene of HIV are reponsible for changes in RC, and may possibly account for differences in the ability of individual viruses to kill T-cells.

Methods/Materials

Sequenced 12 viruses (plasmid DNA) on an ABI DNA sequencer, that had no drug resistance and had not been sequenced before. In the lab I used primers and a sequencing kit, pipettemen, tubes & 96 well plates. I compared the their Gag sequences with 68 Gag sequences in the database (half had high RC >90th % and low RC <10th %). These sequences were aligned to a reference Gag sequence (NL4-3) to determine if there were mutations present that were responsible for differences in RC in wild-type HIV.

Results

The amino acid sequences from 80 different patients, 43 with low RC and 37 with high RC, were aligned on Vector NTI and analyzed. I was looking for similar mutations present in one group and not in another. There were slightly more mutations in the low RC viruses than in the high RC viruses, however; there were no obvious mutations that are present in only one of the two groups that would explain the RC differences.

Conclusions/Discussion

After aligning and comparing the sequences, I concluded that there is no clear evidence that mutations in the 3' region of Gag explain the differences in RC that are seen in wild-type HIV. Other regions of the HIV genome could be responsible for the differences in RC. Another possible explanation is that we do not have a large enough data set to see the differences.

Summary Statement

I wanted to see if mutations in the Gag gene of HIV-1 are responsible for drug sensitivity or resistance in HIV infected patients.

Help Received

Father supervised sequencing & database computer program, Virologic, Inc. allowed me the use of their lab space, database & software, Cheryl Bryan ran samples on DNA sequencer, Colombe Chappey helped me identify WT viruses in the database, Jeanette Whitcomb helped with technical problems with the

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Adam C. Darbonne

Project Number
J0403

Project Title
mRNA and Cell Division: Is There a Connection?

Abstract

Objectives/Goals
I decided to find out if actively dividing cells would have more messenger RNA (mRNA) than cells that are not actively dividing. Messenger RNA is one of the most important parts of the cell because without it, none of the other parts could do their jobs. The mRNA takes the cell's DNA instructions from the nucleus to the cytoplasm, where proteins are made. Proteins made from these instructions can then carry out the jobs of the cell.

Methods/Materials
In my project, I cultured two different kinds of cells in flasks with growth media, kept in a 37°C incubator. The cultures were started at high density (less actively dividing) and low density (more actively dividing) cell concentrations. I counted the cells each day and then purified and measured the amount of mRNA in the two different kinds of actively and non-actively dividing cells.

Results
I found that there was less than a two-fold difference in the amount of mRNA/cell I purified from the inactively and actively dividing cells. In one of the kinds of cells I studied, there was more mRNA in the actively dividing cells than the inactively dividing cells. However, in the other cell type, I purified more mRNA/cell from the inactively dividing cells than the actively dividing cells.

Conclusions/Discussion
From my results, I concluded that you can not tell if a cell is actively dividing or not by the amount of mRNA in the cell.

Summary Statement
I wanted to figure out whether you can tell if a cell is actively or non-actively dividing by the amount of mRNA per cell.

Help Received
My father showed me how to culture and count cells, and how to purify and measure mRNA. My project was done using reagents and equipment provided by Genentech, Inc. My father also showed me how to graph my data.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Jonathan T.C. Haile; Riley McCluskey

Project Number

J0404

Project Title

Does Red Clover Contain an Effective Phytoestrogen? Do Extracts of Red Clover Bind to the Estrogen Receptor?

Abstract

Objectives/Goals

The purpose of the experiment is to test how effectively red clover binds to the estrogen receptor (ER), and to see if the fresh plant extracts of red clover flowers and leaves bind to the ER more effectively than over-the-counter supplements. The hypotheses are that extracts of red clover will bind to the ER (as effectively as 17 beta-estradiol, a naturally active form of estrogen), and that the fresh plant extracts will bind more effectively than extracts from over-the-counter supplements.

Methods/Materials

MCF-7 cells were first transfected with ER plasmids and then test solutions (different concentrations of red clover from different sources) were mixed with the MCF-7 cells in 24-well plates and allowed to incubate for 48 hours to induce gene expression. Then the liquid media was aspirated (sucked out), and the cells remaining at the bottom were lysed with a bleach to get access to the DNA. The samples were then transferred to 240 Eppendorf tubes. Half the samples were treated with beta-galactosidase (an internal control) and the other half were treated with luciferin. The luciferase assay involves a reporter gene coupled to an estrogen response element so that light is produced by the presence of bound estrogen. So, the amount of ER binding was measured by the amount of light produced as measured by a luminometer.

Results

The results indicate that extracts of red clover from various sources do bind to the ER. The greatest luciferase activity was observed for the leaves of red clover. The flowers of red clover did not show as much activity as the leaves. Over-the-counter sources also showed luciferase activity but less than the leaves of red clover.

Conclusions/Discussion

This experiment demonstrated that extracts of red clover from various sources bind the ER. The leaves of red clover appeared to be the most effective. This is generally consistent with the hypotheses stated above. The results suggest that red clover may contain an effective phytoestrogen and further studies are warranted.

Summary Statement

This study addressed the question of whether red clover may contain an effective phytoestrogen by testing whether extracts of red clover bind to the estrogen receptor.

Help Received

This study was conducted at the UCLA Center for Human Nutrition. Dr. David Heber is Director of the Center and approved the project. Emily Besselink served as our mentor and helped us learn how to conduct all of the technical aspects of the experiment.

Name(s)

Lorena S. Hill

Project Number

J0405

Project Title

Does Dieting, Age, and/or Gender Stimulate Your Sugar Level?

Abstract

Objectives/Goals

The objective is to determine if age, dieting, and/or gender stimulates your sugar level or health.

Methods/Materials

Informed consent was taken from sixteen people eight diabetic, and eight non-diabetic. They ranged in age from ten to sixty-two. Blood was drawn twice a day to determine if the diet they were on stimulated their sugar level. They were put on two diets each for two weeks, one fruits and the other vegetables. Those results were compared to their normal sugar level.

Results

My results proved that the vegetable diet had an increasingly lower level than the fruit diet did. This was because fruits in general still have a lot of sugar in them, so it really doesn't help you. The age or gender made little difference. The adults did have a slightly higher sugar level. Both genders had about the same average sugar level.

Conclusions/Discussion

My conclusion was vegetables have a better effect on the human bodies sugar level. The human body needs sugar to survive it changes the food your body takes in into energy. Without energy you can't live. The amount of time spent on a different eating habbit changes your sugar level.

Summary Statement

My project tests which food fruits or vegetables is better for your sugar level.

Help Received

Stephanie Herrera helped draw blood

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Benjamin N. Kletzer

Project Number

J0406

Project Title

Extracting DNA at Home: Can I Do It?

Abstract

Objectives/Goals

The objective is to determine if I can extract DNA from animal and plant specimens at home using common household materials, and to show that my sample extractions contained DNA.

Methods/Materials

Extractions were conducted using three plant specimens (russet, red and sweet potatoes) and one animal specimen (calf thymus). A sequential process of combining minced potato, meat tenderizer, detergent, heat, blending, and filtering was used to produce the plant filtrate samples. For the thymus extraction, the process involved combining minced thymus, sucrose solution, blending, detergent, salt, and filtering to produce a filtrate sample. The final extraction step for both plant and animal samples involved pouring cold ethanol into the filtrate to precipitate out the DNA. A spectrophotometer was used to measure the quantities of DNA in the samples.

Results

Of all the specimens, the spectrophotometer readings for the thymus extract showed the greatest quantities of DNA. At each higher temperature, the thymus sample absorbed more light, indicating the presence of more DNA due to the unraveling of the double helix with heat.

The samples of all three potatoes all absorbed UV light in the spectrophotometer. The readings did not rise as the specimens of russet potato and sweet potato were heated. Only the red potato sample absorbed more UV light as the temperature increased.

Conclusions/Discussion

The rise in UV light absorption with rising temperature confirmed the presence of DNA in the thymus and red potato samples. The thymus extraction was the most successful as it produced visible strings of DNA in the test tube and the sample absorbed the most UV light at any temperature. None of the potato extractions produced visible strings of DNA.

I think that the potato DNA experiments were less successful because plant cells have cell walls composed of carbohydrates that dissolve with the DNA. Animal cells do not have cell walls, but can contain lots of protein molecules which could dissolve with the DNA. I do not know why the red potato experiment was more successful. Maybe there are some chemical differences between the starches in the different types of potatoes. I conclude that thymus cells are a good choice for DNA extraction because I was able to separate the DNA from the protein molecules easily.

Summary Statement

My project is an attempt to extract DNA from animal and plant specimens at home using common household materials, and to show that my sample extractions contained DNA.

Help Received

Dr. Michael Dalbey of the University of California, Santa Cruz Biology Department offered to help me use the spectrophotometer in his lab. He gave me some reading to do first, taught me how to use the spectrophotometer and centrifuge and helped me measure the absorption of UV light by my samples.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

David I. Marash-Whitman

Project Number

J0407

Project Title

Enzyme-Catalyzed Reactions: What Affects Their Rate?

Abstract

Objectives/Goals

I wanted to look at how we can control the rate of an enzyme-catalyzed reaction such as the breakdown of hydrogen peroxide into water and oxygen (2H2O2>>H2O + O2) which is catalyzed by the enzyme catalase. I hypothesized that an enzyme-catalyzed reaction can be speeded-up, slowed down, or even stopped, by changing enzyme or substrate concentration, temperature, pH, or exposed area (between source of enzyme to substrate).

Methods/Materials

For the reaction 2H2O2>>2H2O + O2, I observed oxygen output which is proportional to the reaction's rate, by dipping filter disks in catalase enzyme extract (prepared from ground potato filtered through cheesecloth), and placing them at the bottom of a beaker with hydrogen peroxide (H202). The oxygen bubbles produced by the reaction "lifted" the filter disks, and I recorded the 'time-to-rise' which is inversely proportional to the reaction rate. I performed over 150 trials including variations (3-5 trials per variation for accuracy) on dilutions of enzyme or substrate, temperature, and pH, as well as a number of control runs.

Results

The rate of the reaction (1) increased with stronger catalase enzyme concentrations and leveled off at enzyme concentrations >60%; (2) increased with increasing concentrations of substrate (H2O2) and leveled off at 1.5% H2O2; (3) had optimum temperature range around 30C with lower temperatures decreasing the rate and higher temperatures decreasing the rate and even stopping the reaction (at >65C) when the enzyme was denatured; and (4) showed an optimum pH of 7 with the rate decreasing for lower pH. Control trials with enzyme-free disks showed that O2 production is only observable in the presence of catalase enzyme. Separately, placing different shapes of potato in H2O2 showed that the rate of the reaction is proportional to the exposed area between source of enzyme (potato) and H2O2 substrate.

Conclusions/Discussion

All variables observed were important for optimum enzyme activity, emphasizing the importance of being able to manage them to best control reactions in life processes, food preservation, and other applications. I was able to determine the optimum ranges for catalase (that I extracted from potatoes) as a catalyst in the breakdown of hydrogen peroxide to water and oxygen. The method I used to compare rates was reliable and I was able to duplicate results when I repeated similar conditions on different days.

Summary Statement

This project showed how enzyme-catalyzed reactions can be speeded-up, slowed down, or even stopped by adjusting certain key variables, and determined optimum ranges for the enzyme catalase

Help Received

My mother helped me get supplies, paste the board and enter this form online, and supervised my experiments. Ron Kalman helped me take digital photos of my techniques and results.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Shaine D. Millheiser

Project Number

J0408

Project Title

Search for the Seven Repeat Sequence

Abstract

Objectives/Goals

The objective of my project is to see if the ENTP (Extroverted, Thinking, iNtuitive, Perceiving) Brain Type shows a higher correlation with a 7 repeat sequence on the fourth dopamine receptor gene than other Brain Types.

Methods/Materials

Materials:

FTA swab card
Foam Swab
Desiccant
Pouch/Envelope
Brain Type Test
Brain Type Questionnaire
55 subjects
Access to the Brain Type Institute lab

Method:

1. Give each subject a Brain Type detecting test and have them answer according to its questionnaire.
2. Add up the answers and determine brain type of each subject.
3. Label one FTA card with your name and brain type on the lines provided at the bottom of the card.
4. Take on swab. Remove the swab from its package carefully to be sure to not touch the foam tip. Swab mouth collecting as much saliva as possible by vigorously swabbing under the tongue, on top of the tongue, and inside both cheeks. Also be sure to swab between gum line.
5. Remove the swab from the mouth and transfer the sample to the FTA card by pressing the foam tip within the appropriate circle. Press firmly to transfer as much saliva as possible.
6. Once the sample has been applied to the FTA card, close the paper flap and place it into the barrier pouch.
7. Place desiccant (moisture absorber) into pouch and seal the pouch.
8. Store at room temperature.
9. Send to the Brain Type Institute lab
10. Compare results of Brain Types versus gene presence.

Results

Summary Statement

My project is about finding a link between the ENTP Brain Type and the (DRD4 7R) gene.

Help Received

My father helped me to find addresses to a genetics lab and where to buy my materials: Dr. Nobel, UCLA geneticist, helped explain many of the consepts I needed to know: The UCLA genetics lab and the Brain Type Institute tested my samples for the gene.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Alexis J. Nahigian

Project Number

J0409

Project Title

A Study of Osmosis and Diffusion through a Simulated Cell Membrane

Abstract

Objectives/Goals

My project was to determine whether or not iodine molecules will be able to diffuse through a plastic sandwich bag (cell) containing a starch solution.The second objective was to determine whether or not glucose molecules will diffuse out of the "cell." The third objective was to determine whether or not osmosis occurs in this experiment.

Methods/Materials

A starch solution was poured into ten Glad sandwich bags. These bags(cells) were placed into ten beakers containing an iodine solution. The bags were observed for color change at fifteen minute intervals for one hour. The bags were weighed to determine mass gain or loss. The testing was conducted in different environmental temperatures.

A glucose solution was poured into ten Glad sandwich bags. The bags were placed into ten beakers containing distilled water. At fifteen minute intervals, up to one hour, distilled water from each beaker was poured into test tubes containing Benedict's solution. These test tubes were heated to watch for the presence of glucose. Results were recorded and bags were weighed to determine mass gain or loss. This testing was conducted in the same environments mentioned above.

Results

For the starch and iodine experiment, the greatest rate of diffusion occurred in the heated environment and the least in the refrigerated environment. However, the bags in the heated starch/iodine experiment showed the least mass gain. Temperature appeared to have no affect on the glucose experiment because no presence of glucose was found in any of the testing. However, the bags in the heated glucose experiment showed the highest mass gain.

Conclusions/Discussion

The results partially supported my hypotheses. I thought that the iodine solution would diffuse through the "cell" membrane and the glucose solution would not. This was correct. The results for the various temperature environments were partially correct. I stated that the starch grains would show the most coloring in the heated environment, and this was correct. In the glucose experiment, greater osmosis occurred in the heated environment. In the starch experiment, greater osmosis/diffusion occurred in the refrigerated environment.

In conclusion, this experiment helped me gain a better understanding of how a cell membrane controls the osmosis and diffusion of molecules, and it helped me understand how molecular motion can be affected by varying temperatures.

Summary Statement

My project is about how a cell membrane controls osmosis and diffusion and how osmosis and diffusion are affected by temperature.

Help Received

Mother helped with board; Dad helped type.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Michelle K. Reed

Project Number

J0410

Project Title

Protecting DNA (The Code of Life) from Oxidation Damage by using Antioxidant Pills

Abstract

Objectives/Goals

Cancer is a genetic disease, and Genes are made of DNA. DNA is continually being damaged by oxygen free radicals generated in the air that we breathe. I sought a scientific way and direct method to prove if antioxidant supplements actually protected your DNA.

Methods/Materials

Three major components are required, (1) a liquid substance to damage and digest DNA, (2) pure chromosomal DNA, and (3) antioxidants to protect the DNA. My first method was to obtain a unique, natural and safe model system for damaging DNA. I researched, read and studied that Fluid in the Venus Fly Trap (VFT) plants could degrade proteins but discovered on my own that such fluid degrades DNA. I grew VFT plants and placed bugs or small objects in the "trap" to stimulate release of digestive fluid. Secondly, I isolated chromosomal DNA from onions, beef muscle and other cells. Thirdly, I made separate solutions from several antioxidant pills. I used an electric DNA gel to analyze my samples and a black/white camera to record the gel results. These pictures were scanned and made into numbers for graphs.

Results

To test my DNA damaging system I took VFT digestive fluid (sequential dilutions) and mixed it with mouse cell DNA in a small tube. These digested DNA samples and a negative control (without digestive fluid) were electrically moved within a 1% agarose testing gel to size separate the DNA into large undamaged pieces of DNA and small damaged, digested DNA fragments. It worked, VFT digestive fluid degraded DNA into small pieces. I now conducted my key experiments and produced a reaction by adding a panel of antioxidant solutions together with VFT digestive fluid and DNA. After a set time I revealed the extent of DNA protection by running the samples on a new 1% agarose testing gel. The DNA in the gel was large (Not degraded) in many of the exotic antioxidant solutions, but chopped up small (degraded) in many of the popular antioxidants tested.

Conclusions/Discussion

My experimentation provided surprising results. Commonly advertised antioxidant pills such as vitamins A and C exhibited weak DNA protection potency while more exotic antioxidants like green tea extract, grape seed extract and ginseng were extremely potent DNA protection agents. These experiments provide wise choices to those of us who want to save our DNA for years into the future.

Summary Statement

To determine if antioxidant pills protect your DNA from oxidative damage and degradation.

Help Received

Mother helped isolate DNA and provided lab equipment and training, helped with calculations.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Rebecca K. Shields

Project Number

J0411

Project Title

Jell-o or Gel-no: Which Fruits Contain a Protein-Digesting Enzyme that Prevents Gelatin from Solidifying?

Abstract

Objectives/Goals

This experiment was designed to test the hypothesis that food items containing a protein-digesting enzyme will prevent gelatin from solidifying. On a box of gelatin, it states "Do not add fresh or frozen pineapple, kiwi, mango, gingerroot, papaya, figs, or guava because the gelatin will not set". These fruits contain the protein-digesting enzymes papain or bromelain, which are also the active ingredients in meat tenderizers.

Methods/Materials

I prepared the gelatin according to the directions, making samples using the foods mentioned above, as well as fresh orange, banana, strawberries, canned pineapple, canned figs, canned guava juice, and two brands of meat tenderizer. I also tested plain gelatin as a control. I refrigerated the samples and checked the condition of the gelatin mixtures periodically for up to 24 hours. I repeated the entire test three times.

Results

These ingredients support my hypothesis: fresh pineapple, kiwi, gingerroot, McCormick's Meat Tenderizer, and Adolph's Meat Tenderizer. In addition, the gelatin samples that contained canned pineapple, canned figs, or canned guava juice solidified as expected because canning includes a heating process that eliminates the enzyme.

However, some results were contrary to my hypothesis. Gelatin samples containing papaya and mango still solidified, even though they contain papain.

Conclusions/Discussion

Several food items containing papain or bromelain will prevent gelatin from solidifying. With the exception of fruits that have been canned, Jello should not be made with these foods.

As a possible explanation of the contrary conclusions, I read that papain levels can vary with the ripeness of the fruit.

Summary Statement

An enzyme in some foods can prevent gelatin from solidifying.

Help Received

Father helped print photos and graphs.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Carol Y. Suh

Project Number
J0412

Project Title

How to Get the Most Juice from Your Apples: How Pectinase Enzymes Affect Apples

Abstract

Objectives/Goals
My objective was to research how enzymes such as Pectinase and Cellulase increased the amount of apple juice produced, and to find a way to produce the most amount of apple juice possible.

Methods/Materials
For my tests, I used the same type of apple that weighed 50g. Lab materials such as beakers, syringes, cylinders, etc. were used. Pectinase and Cellulase was used depending on the test. For example, in one of my tests, I weighed and cut an apple. Then I added Pectinase and /or Cellulase using syringes. I then incubated the mixture and recorded the amount of juice produced after a certain amount of time. My tests showed that there was an increase in apple juice when Pectinase and/or Cellulase were added in certain conditions.

Results
After a series of tests, there was a significant increase in apple juice when enzymes such as Pectinase and/or Cellulase were added. Unusable leftovers from the squeezed apple produced even more juice when Pectinase was added in certain conditions.

Conclusions/Discussion
The cell wall of a fruit (apple) contains pectin (found in the middle lamella). Small amounts of Pectinase form in the apple when ripening. Adding more Pectinase can speed up the process of breaking down the pectin molecules in the cell wall therefore releasing more juice. Since there is also cellulose in the plant cell wall, Cellulase can break down the cellulose in the cell wall therefore releasing more juice. Even the apple leftovers from squeezing can produce more juice when Pectinase is added, although it doesn't look like it will produce any more juice. If Pectinase can produce juice from unusable leftovers, maybe Pectinase or other enzymes can produce something useful from other types of waste.

Summary Statement
How to get the most apple juice by using Pectinase enzymes.

Help Received
Parents helped retrieve supplies necessary.