

Experiments: to thicken substances, measure vitamin c, and create cheese

[Science](#), [Biology](#)



Introduction:

A group of students on the date 9/11/18 were selected to perform various experiments to in order to find the effects of thickeners on vinegar, how ascorbic acid differs in a variety of different orange juice products, and how cheese is created through the use of enzymes. All these tasks had various objectives attached to them and taught different ideas. To complete the objectives a class of 24 students was broken up into groups of 4. The experiments were broken up into three different parts, A, B, and C.

Part A included the use of thickeners such as a cornstarch, modified food starch, and two different amounts of guar gum on an 83% vinegar and a 17% vegetable oil mixture. An emulsifier is an additive in foods that allow the ability to mix two substances that are not able to be easily mixed (Himler, slide 5). The combination of the emulsifier of guar gum, the vegetable oil, and the vinegar allowed mixture to occur. A thickener is a product that creates a solidified attribute to something by the linking of glucose chain in starch (Himler, slide 5). Cornstarch is a group of polysaccharides made up of mostly carbohydrates found in corn, when these starches connect to the carbohydrate chains when wet it kept the vinegar and vegetable oil together. The original source of corn, however will create different effects than to the modified food starches source. The source of modified food starch can be in many materials such as potatoes, wheat, or corn (Stockton, lines 17-18) The instructor and supervisor of the experiments, Heidi Himler, states the objective for this particular experiment was to “ Determine which thickener/emulsifier would work best in product such as salad

dressing”(Himler, slide 4). While this question is taken from a subjective point of view these views must be validated with reasoning and results from the experiment, such as texture, smell, and appearance.

Part B of the experiment was focused on the measurements of ascorbic acid in different brands and mediums of orange juice. Ascorbic acid is also known as vitamin C, a nutrient in different foods that provide immune system support and other benefits and was determined in this experiment. The main objective for this experiment by the instructor was explained as, “ Determine which orange juice sample has the highest concentration of ascorbic acid (mg/L)” (Himler, slide 11). The students were supposed to use three samples of orange juice, two of which were from concentrate. Using the idea that air can affect the amount of ascorbic acid in the sample, students were also supposed to consider the reasoning behind the different ascorbic acid levels. This idea is called oxidation and is due to the loss of electrons when substances interact according to Himler’s slideshow discussing these properties (Himler, slide 12). However, the difference between the samples were revealed after the experiments were finished in order to have conclusions drawn from the different samples to see if their findings before the reveal were correct. The students were getting the findings for this experiment through semi-quantitative data, Himler describes it as, “ Assessing a value involving less than quantitative precision” (Himler slide 12). The cause was the materials used involving looking at strips of modified paper that displays the value of ascorbic acid and pH through color change and a key to the value of each color. More key questions students were

required to answer were whether or not pulp affected the amount of ascorbic acid in the beverage and if the pH level affected the amount of ascorbic acid as well. The main idea of this scientific test was to show the amount of vitamin C in different samples with different attributes.

Part C and final stage of the set of experiments was turning a mixture of milk into cheese using an enzyme called renin. Renin is an enzyme found in the stomach of baby cows that solidifies cheese. An enzyme is “ a protein that speeds up the chemical reaction of functions in a living organism” according to Himler in her class slideshow (Himler, slide 18). These enzymes are used in the body for functions such as breaking down food or producing energy, but in this instance the conductors of the experiment were using it for another matter, the creation of cheese from milk. Using the idea that renin is found in the stomach of calves, its main purpose was most likely a digestion agent that allowed milk to become solid to keep excess nutrients to be solid rather than liquid when it is excreted. The main objective of this experiment was to find if more cheese would be produced in an environment of 25 degrees celsius or 37 degrees celsius (Himler, slide 17). This can suggest that the temperature directly relates to the efficiency level of enzymes or perhaps just certain functions of them. These functions are performed by the reshaping and changing of molecules within a substance. With these changes new material may form allowing processes to proceed without issue.

Methods:

Part C, the experiment that was using the enzyme renin to create cheese was conducted first for a certain group of students and they started part A, the experiment using thickener to determine which would create the best salad dressing in the passive state of waiting for a section of part C to complete. Part C's materials included a 37° celsius water bath, 40 milliliters of milk treated with buttermilk, 16 drops of 5% renin, a spatula, 2 cheesecloths, 2 graduated cylinders, and 4 50-100 milliliter beakers. The group of 4 students proceeded to fill 20 milliliters of the milk and buttermilk mixture into 2 beakers. From here, they labelled one beaker " 37°C" and the other, " 25°C". Then, they added 8 drops of rennin into each beaker and mixed both beakers separately. After that the beaker labelled, " 37°" was taken to the 37° water bath as the other beaker was left in the open room. From here students were to wait 15 minutes for both mixtures to stand.

They started part A, the experiment to use thickeners to find the best salad dressing in this time of the experiment while waiting. After 15 minutes have passed they picked up the beaker sitting in the water bath to their table and broke up the curd up cheese pieces into cloth for both beakers. They then poured the labelled beakers into unlabelled beakers, being careful not to confuse them, and filtering the useable cheese from the whey, or still liquified milk, using cheesecloth. They then recorded the volume of useable cheese to whey.

Part A of the experiment was performed by the use of weight scales, weigh boats, 8 milliliters of vegetable oil, 4 stir sticks, 0. 3 grams of cornstarch, 0. 3

grams of modified food starch, 4 10 milliliter transfer pipets, 2. 2 grams of guar gum, 30 milliliters of vinegar, 4 sample vials, and 1 marking pen. The first section of part A involved the use of the cornstarch and modified food starch. The students filled 2 of the sample vials with 10 milliliters of vinegar each, they labelled one modified food starch and the other corn starch, after this they added 2 milliliters of vegetable oil to each vial using the transfer pipets, then they weighed out 0. 3 grams of cornstarch and 0. 3 grams of modified food starch adding them to their respective vials and shook them for 15-20 seconds. The students then sniffed, observed, and touched the sample to find the different attributes of each. Working in groups of 4, they all agreed on their observations unanimously or explained their own observations for others in the group to consider. The observations about each combination were made and recorded. The same process was performed with the two different quantities of guar gum. The conductors of the experiment took the last two vials, and labelled them “ 0. 2 g guar gum” and “ 2 g guar gum”.

From here they filled both vials with 10 milliliters of vinegar using 2 transfer pipets, after that they filled each vial with 2 milliliters of vegetable oil. Then they weighed out 0. 2 grams of guar gum and 2 grams of guar gum using the weight boats and the scale. They proceeded to put the different amounts of guar gum into their correct vials based on the labels they put on them earlier. The vials were shaken for 15-20 seconds after that they waited approximately 10 minutes to create observations on the new substance in the middle of the waiting time for the guar gum’s observations, 2 of the

group members went on to start part B of the lab, the experiment involving finding how much ascorbic acid was in each orange juice sample, for time was running short to complete all 3 experiments. The 2 students left to finish part A conversed on the observations they were creating based on the smell, appearance, and feel of the substance then recorded them with the 2 groups members that left to finish part B eventually came back to confirm and agree upon these observations.

Part B, the experiment involving the measurements ascorbic acid in different orange juices, involved the use of 3 Quantofix Test Strips, 3 vials of different unknown orange juice samples, 1 long range pH paper rolls, 3 transfer pipets, 1 paper towel, and 3 test tubes. The two students used the pipets to collect 15 milliliters of each orange juice sample and transferred each sample to different test tubes being mindful of which tubes contained the different samples that had stickers with " 1", " 2", and " 3" written on them. From here they dipped the Quantofix Test Strips into the samples one at a time for 5 seconds and laying the moistened paper onto the paper towel for 30 seconds. The group recorded the finding using observation of the color on the strip and comparing it to the color key on the box to find the concentrated amount of ascorbic acid in sample 1. The process from dipping the Quantofix Test Strip into the sample and recording the semi-quantitative data was repeated for samples 2 and 3. The next step was finding the acidity of each orange juice sample by dipping the pH paper into each sample. The conductors ripped off three pieces of pH about 5 centimeters long. The 2 students dipped the torn off pieces of pH paper from the roll into one sample

each for 2 seconds and evaluated the pH level of each by looking at a key on the roll for pH strips. These results were written and shared with the other group members that were currently working on part A at the time.

Results:

Part A - Different food thickeners effects and attributes

Substance

Observations after shaking

Cornstarch

Smell: Ranch

Appearance: Milky white, oil seems to have stayed on top of mixture, foam under oil

Feel: Slimy, mucus-like

Modified Food Starch

Smell: Mayonnaise

Appearance: Translucent white, Oil on top, foam under oil

Feel: Slippery, Smooth
0.2 g guar gum

Smell: Glue or Mayonnaise

Appearance: Yellow, shiny

Feel: Thick, Slimy 2 g guar gum

Smell: Bread/yeast

Appearance: Tan/yellow comparable to applesauce in color

Feel: Gelatinous, chunks imbedded

Part B - Determining concentration of ascorbic acids in orange juices

Sample

Concentration of Ascorbic Acid (mg/L)

Tropicana from concentrate (Sample 1) (With Pulp)

100mg/L

Simply Orange not from Concentrate (Sample 2) (Little Pulp)

500mg/L

Minute Maid frozen from concentrate (Sample 3) (No Pulp)

300mg/L Sample

pH Level Tropicana from concentrate (Sample 1) (With Pulp)

Simply Orange not from concentrate (Sample 2) (Little Pulp)

Minute Maid frozen from concentrate (Sample 3) (No pulp)

Part C - Using renin to create cheese from milk

37°C Buttermilk renin mixture
Liquid fraction (whey): 17.9 mL

Original Volume: 20 mL
 $17.9/20 = .895$

Liquid fraction (whey): $89.5\%100 - 89.5 = 10.5\%$

Liquid fraction (whey): 89.5%

Useable cheese: 10.5%

25°C Buttermilk renin mixture

Liquid fraction (whey): 18.5 mL

Original Volume: 20 mL
 $18.5/20 = .925$

Liquid fraction: $92.5\%100 - 92.5 = 7.5\%$

Liquid fraction (whey): 92.5%

Useable cheese: 7.5%

Conclusions:

Part A of the lab, the experiment involving the use of different substances to create thickeners has shown that 2 grams of guar gum as the thickener in a product would allow it to keep the same consistency when shipping from a manufacturing plant. Over time it has shown that it would stay together, preventing the oil from coming afloat the top as the other samples presented in the experiment. Because the guar gum is an emulsifier, in which its main purpose is to mix two products that under normal conditions would not mix,

it shows why the substance is able to stay together for longer, as that is its practical use. This is evident of the chunks of guar gum that did not mix in with the rest of the combination, it shows that the remainder chunks didn't have a large supply of oil molecules to bind to allow more mixing. If a manufacturer were to attempt to create a low calorie salad dressing however, the better use would be the 0.2 gram amount of guar gum. The modified food starch and cornstarch would be higher in calories from carbohydrates and the 2 gram amount of guar gum is a greater amount of the same substance creating more calories. The best thickener for salad dressing in terms of taste, texture, and appearance would be the cornstarch mixture. With the smell similar to ranch dressing, the texture being a slime-like substance these qualities would likely give similarities to ranch, which tastes better and offers more calories for energy.

Part B, the experiment to find the most ascorbic acid in different types of orange juice was able to show that orange juice that is not from concentrate will most likely yield the highest amount of ascorbic acid. Simply Orange not from concentrate or sample 2 showed the highest results of ascorbic acid content at 500mg/L which is about .5mg/mL. The RDA recommends 90 milligrams of vitamin C for adult males and 72 milligrams for adult females (Vitamin C, 1). If someone were to drink a 120 milliliter serving of orange juice it would not reach the RDA daily requirement for vitamin C. A 180 milliliter serving of orange juice would provide the RDA requirements for males and a 144 milligram serving of orange juice would reach the requirements for females. Concentrate was made from the juices from the

fruit, causing it to be exposed to air at some time during the processing. This caused a process called oxidation to occur where the oxygen in the atmosphere created a loss of electrons in the juice slightly changing the molecular composition of vitamin C into something else.

The Tropicana from concentrate projected the least amount of ascorbic acid as the container it was in was exposed to a large amount of air when poured. The Minute Maid from concentrate that was frozen likely got oxygen atoms from the composition on water where two hydrogen molecules link to one oxygen molecule also causing oxidation to happen. There was no correlation between the amount of acidity in the samples and the amount of ascorbic acid in the samples. The result may show a small correlation between the pH levels and ascorbic acid through the Tropicana from concentrate sample, but it was likely due to limitations and different interpretations of the semi-quantitative data. The amount of pulp had no correlation to the amount of ascorbic acid as well. This can boil down to the idea of processing the juice to create concentrate for preservation or not processing it to get more vitamins and minerals for a shorter shelf life.

Part C of the lab was to create cheese from the use of a milk and buttermilk mixture and the enzyme renin. The mixture of milk, buttermilk, and renin that sat in the 37°C water bath produced the most useable cheese when compared to the same mixture kept in a room temperature of 25°C. The 37°C beaker kept in the water bath left 17.9 milliliters of liquid fraction out of a volume of 20 milliliters. This leaves 2.1 milliliters that has turned into useable cheese, but because volume doesn't transfer between liquid and

solid units due to the changing of shape percentages can be used. The 25°C beaker had 18.5 milliliters of liquid out of the original 20 milliliters giving 1.5 milliliters of the mixture that turned into useable cheese. 10.5% of the milk, buttermilk, and renin mixture became useable cheese in the 35°C water bath experiment while the 25°C mixture had 7.5% useable cheese. These results were most likely created as the renin was able to work in temperatures closer to the the original environment it was meant to work in, a calves stomach. The internal temperatures of mammals are warm for homeostasis and renin is produced in this temperature so it works most effectively here.

These experiments had limitations that prevented the results and data to be exact. The limitations of part A, the thickener experiment was the possibility of insufficient time shaking by the students. With the oil still on top after the shaking it raises a few questions when comparing it to a salad dressing with separated oils, with the fact that they usually mix after a while of shaking. The students may have not shaken the vials for a longer enough time for the oils and vinegar in the cornstarch and modified food starch mixes to completely combine. The limitations of part B, the ascorbic acid experiment in orange juice was the fact that the legend to determine the level of ascorbic acid on the paper had similar colors for the alternating levels of vitamin C. The same problem may have occurred when measuring the pH of the different samples, as the key has similar colors in determining the level of acidity. Part C's limitations was likely correlated with the milk and buttermilk mixture used, it is possible that the ratios of ingredients was

incorrect when making it. Another limitation for part C was the temperature of the room, one beaker was supposed to have sat in a temperature of 25°C for 15 minutes, but no knowledge on the exact temperature of the room was given.