Question
How much vitamin C is in different types of orange juice?

Project Overview and Background

Vitamin C is an essential nutrient used by the body for many forms of biosynthesis. Biosynthesis is the process by which a living organism produces a chemical compound. Because vitamin C is used to produce these essential compounds, problems arise when we lack sufficient amounts of it. When you have a vitamin C deficiency, you can develop scurvy and anemia. This need for vitamin C is why so many people eat fruits and drink things like orange juice. This project is all about finding out the amount of vitamin C in three different orange juices to find out which type is the most efficient for getting our needed vitamin C. Orange juice number one was made of only naval oranges squeezed the night before the experiment. Orange juice number two was from Edwardsville, Illinois, and was a Prairie Farms brand. It had a mix of juices from Florida, Brazil, Mexico, and Costa Rica. The third orange juice was from Florida and was a Tropicana brand; it had no pulp and contained juices from both the U.S. and Brazil.

Hypothesis
If vitamin C is so important for our diets and well-being, then if there's more vitamin C in Tropicana orange juice, then it’s the most efficient way to get vitamin C.

Variables
Control: Fresh-Squeezed Orange Juice
Dependent: The amount of Vitamin C in each serving of Orange juice
Independent: The types of orange juice

Materials
Distilled water
Soluble starch
Potassium iodide (Lugol’s solution)
Orange juice
Scoopula
Flasks
Beakers
Metric Scale
Heating plate
Sturrer
500 mL Glass graduated cylinder
1 mL Dropper
Lab notebook
Vitamin C powder
Graduated cylinder

Procedures

1. Gather materials:
Potassium Iodine (Lugol's solution)
Distilled water
Vitamin C powder
Calculator
Scale
Hot plate
Glass stirrer
Flasks
Glass graduated cylinder
Scoopula
Magnetic Stirrer

2. Collect the different types of Orange juice/Vitamin C
Buy as many kinds of orange juice as you want
Buy 4 to 8 oranges, depending on the amount of juice you want, and juice them

3. Dilute Lugol's Iodine Solution

a) Make sure to wear gloves and goggles when dealing with iodine. Also, if you don't want to stain your clothing, wear an apron. Iodine could also stain the area you're working in, so set down some newspaper or old towels.
b) Measure out 15 mL of Lugol's Iodine solution with a 500 mL glass graduated cylinder, put it in a beaker, and fill the beaker with distilled water till it reaches 150mL
c) If you need to store this solution, carefully funnel it into an amber glass bottle; if you don't, you can keep it in the beaker and cover it with plastic wrap and a plastic bag. Just make sure it's tightly sealed.

4. Make a Starch Indicator Solution

a) Bring 100 mL of distilled water to a boil in a beaker on a stove or hotplate. When it reaches a boil, add .5 gram of corn starch. Continue to let it boil while stirring constantly.
a) When the water turns clear again, take the beaker off the stove or hotplate and let it cool.
b) If you need to store it, tightly cover the beaker and store it at room temperature.

5. Make a fresh Vitamin C Standard Solution (make a new one each day that you're testing the orange juice)

a) You use this solution to standardize your titration system. You will measure how much of the iodine solution it takes to oxidise a measured amount of vitamin C

b) Use a knife and cutting board(and a metric scale) to measure out 250 mg of the tablet and crush it. Then transfer the powder into a separate bowl
c) Dissolve the vitamin C tablet in 100 mL of distilled water using your magnetic stirrer
d) Pour the water and vitamin C mixture into a 500mL graduated cylinder and bring the total volume to 300 mL using distilled water. The concentration is now 1 mg/mg

6. Set up a 50 mL buret on a ring stand

a) Screw the metal rod into the metal base, then slowly turn the circular flat key to open up the first clamp. Slide the clamp onto the metal rod and twist the key the opposite way to close it. Then twist the bow-shaped key to open the clamp. Then slowly slide the buret into it and twist the opposite way to close it.

7. Titrate the vitamin C standard solution

a) Use a 50 mL graduated cylinder to measure out 10 mL of the vitamin C standard solution.
b) Pour it into a 50 mL Erlenmeyer flask.
c) Add 5 drops of the starch indicator solution to the flask.
d) Adjust the buret to be able to put the flask under it. Leave the flask there.
e) Make sure the bottom of the buret is closed. This is done by making sure the stopper is twisted into a horizontal position.
f) Use a funnel to carefully fill the buret with Lugol's iodine solution. Fill it between the 35 mL and 5 mL markings. No exact measurement is required or important; just make sure the fluid level is not past the markings on the buret.
g) To make the measurements more accurate, fill the tip of the buret with Lugol's iodine solution. To do this, remove the flask and replace it with an extra beaker. Slowly turn the stopper at the bottom of the buret to a vertical position, and let a few drops fall into the beaker. Then make sure the stopper is closed again and put the flask back under the buret.
h) In your lab notebook, write down the initial level of the solution in the buret. Read the measurement from the curved surface of the liquid.
i) Slowly turn the stopper to open and let a drop of the Lugol's iodine solution fall into the flask, then close the stopper again. (Only add one drop of the solution at a time because titration is very sensitive and could be inaccurate if you add more than one drop at a time)
j) After you add each drop, swirl the flask to mix it. (The color of the liquid in the flask might briefly change, but it should go back to normal as you mix it.)
k) Continue adding drops and swirling the flask until the liquid turns a consistent blue-black color that stays that color for more than 20 seconds.
l) In your lab notebook, record the remaining amount of iodine solution in the buret.
m) The difference between the initial and final levels is the amount of iodine solution needed to oxidize the vitamin C
n) Clean out the entire flask and do step 7 three times. The results of each test should be within .2 mL of each other. If they aren't, repeat step 7 until you have three results within

.2 mL of each other. Remember to check the iodine levels in the buret before each trial. Remember to keep the levels between 35 mL and 5 mL.

8. Make some fresh-squeezed orange juice for the testing

a) Use a juicer to juice three or more naval oranges. You'll need 20 mL of juice for each test, so squeeze about 360 mL of juice. Remove all of the pulp and seeds from the juice using a cheese cloth or fine strainer.
b) Titrate the juice by repeating step 7, but use 20 mL of the fresh juice instead of the vitamin C mixture.
c) Again, make sure to check the levels of the iodine solution before every trial. Always record the new level.
d) When the titration is complete, the juice will go from orange to a greyish-brown. It will be harder to notice, but you want to record when you first notice the color change, as the color will continue to darken as you add more iodine.
e) Remember to record the level of the iodine solution after each trial.
f) The difference between where the level starts and ends is how much iodine titration is needed to oxidize the orange juice.
g) Repeat step 7 three times, or until you get three results within .2 mL of each other.

9. Repeat step 9 with your other choices of orange juice

a) Remember that if you test on different days, you need to make a new, fresh vitamin C standard solution

10. For each orange juice, calculate the average amount of iodine solution that's needed to oxidize the 20 mL of juice. Write the results in your lab notebook.

11. Equations used to calculate the amount of vitamin C in the samples. Make sure to solve for vitamin C2

$$\frac{Iodine_1}{Vitamin\ C_1} = \frac{Iodine_2}{Vitamin\ C_2} \qquad Vitamin\ C_2 = \frac{Iodine_2 \times Vitamin\ C_1}{Iodine_1}$$

$$Vitamin\ C_2 = \frac{6.8\ mL \times 20\ mg}{8.5\ mL}$$

Iodine1 = average amount of iodine used to titrade standard solution/control
Iodine2 = average amount of iodine used to titrate the orange juice sample
Vitamin C1= amount of vitamin C in the standard solution
Vitamin C2=amount of vitamin C in orange juice sample(what we're solving for)

My vitamin C standard solution didn't end up working. I believe it was either too diluted or it didn't have enough vitamin C in it to react. The different measurements and trials I used are in the chart below.

Amount of Vitamin C used	The amount of distilled water	The number of drops of the starch Solution	Total volume after the second dilution	Initial levels of diluted iodine	Ending levels of diluted iodine	Result
125mg	50mL	5 drops	300 mL	37.6	40mL	None
25mg	50mL	5 drops	50mL	23.8mL	35.1mL	None
25mg	25mL	5 drops	25mL	13.2	25.1	None
50mg	25mL	0 drops	25mL	24.7	47	None
scoop	0mL	5 drops	Around 1-2mL	47mL	0mL	None

Conclusion

To calculate my orange juice samples, I used the second equation. In this case, my fresh orange juice was my control, so I used that for my iodine 1, but I used the amount of vitamin C I would have used for the standard solution for my vitamin C1. The density of solid vitamin C is 1.65, and the conversion of milligrams to milliliters, for your vitamin C powder, is 0.0758mL. For the tropicana I got that there is 0.0224330218mL of vitamin C in it. For my Prairie Farms, I got that there is 0.04191377694mL of vitamin C in it. In conclusion, Prairie Farms is better to drink if you're trying to efficiently get in your vitamin C.

Sources

Works Cited

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