NAME

SECTION DATE

STEM ACTIVITY 3 HOW MUCH VITAMIN C?

DETERMINING ASCORBIC ACID CONCENTRATION

USING TITRATION TO DETERMINE ASCORBIC ACID CONCENTRATION IN RELATION TO VARIOUS FACTORS

What factors affect the amount of vitamin C (ascorbic acid) in foods?

Being halfway across the Atlantic on a wooden sailing vessel sounds like an adventure. The challenge increases when the entire crew falls prey to weakness, exhaustion, bleeding gums and skin, and sore limbs. The crew has scurvy—a disease first recognized by the Egyptians and still commonplace on sailing vessels well into the 1700s. In 1753, Scottish surgeon James Lind found that scurvy struck people with a vitamin C deficiency, and in the 1790s the British navy began carrying lemons on its war ships to combat the disease. Almost unheard of in industrialized nations today, scurvy remains a significant disease throughout the underdeveloped world and among refugee populations. What types of food help combat this disease?

Key Questions ?

- Can the amount of vitamin C in foods be measured?
- What factors affect the amount of vitamin C in foods?
- How can you test a particular factor's effect on vitamin C levels?
- Which factor has the greatest impact on amounts of vitamin C in foods?

Equipment E

Goggles
Food for testing
Orange juice
Iodine potassium iodide solution
Vitamin C standard solution
Starch solution
Graduated cylinders, 10 mL, 25 mL
Beakers (2), 100 mL
Eye dropper or optional micropipette or buret
Distilled water
Stirring rod or magnetic stirrer, if available
Filter funnel, holder, and stand (for foods with particulate material)
Filter paper (fast, ashless; for foods with particulate material)

PROCEDURE

Note: Record all notes, hypotheses, data, calculations, analyses, and conclusions in a project log.

Testing the Standard Solution

1. Using the 25 mL graduated cylinder, measure 25 mL of the vitamin C solution supplied by your teacher. Pour the solution into the 100 mL beaker.
2. Using the 10 mL graduated cylinder, measure 10 mL of the starch solution. Add this to the vitamin C solution in the 100 mL beaker.
3. Stir the mixture continuously. If a magnetic stirrer is available, put a stir bar in the mixture, place the beaker on the stirrer, and turn it on.
4. If using a graduated micropipette or buret, note the volume of liquid in the tube, then add the iodine potassium iodide solution drop by drop, counting the drops until the solution turns dark blue and, when stirred continuously, stays blue.
5. Determine the number of drops that equals 1 mL. Record the volume (or number of drops) of iodine solution per mg of vitamin C needed to change the color.

Testing a Food (Orange Juice)

1. Using the 25 mL graduated cylinder, measure 25 mL of orange juice and pour it into a clean 100 mL beaker.
2. Using the 10 mL graduated cylinder, measure 10 mL of the starch solution. Add this to the orange juice in the 100 mL beaker.
3. Stir the mixture continuously. If a magnetic stirrer is available, put a stir bar in the mixture, place the beaker on the stirrer, and turn it on.
4. If using a graduated micropipette or buret, note the volume of liquid in the tube, then add the iodine potassium iodide solution drop by drop, counting the drops until the solution turns dark blue and, when stirred continuously, stays blue. This should require 5–20 drops from an eyedropper, depending on how fresh the orange juice is. If using a graduated micropipette or buret, note the volume of liquid in the tube.
5. Based on the results of the vitamin C standard, calculate the orange juice's amount of vitamin C in mg. After calculating the mass of vitamin C, divide the mass of vitamin C by the volume of juice in mL so that comparisons are equivalent.

Conduct Independent Investigation

1. Based on class discussion, choose a factor which your group thinks will affect vitamin C levels.
2. Each member should write a hypothesis.
3. Using what you have learned, devise an experiment to test the factor your group chose.
4. Your experiment should test each student's hypothesis. Focus on obtaining quantitative data to support each hypothesis.
5. Write a complete description of your experiment (including the factors tested, all data collected, and calculations).
6. Record your conclusions from your data and justification for whether it supported each hypothesis or not.

NAME

Data Table

Type of Sample	Volume of sample (mL)	Number of drops (Use next column if using a graduated micropipette or buret)	Volume of iodine solution (mL) (calculated from the number of drops or measured with micropipette or buret)	Mass of vitamin C (mg)	Equivalent mass per volume of vitamin C in mg/mL
Vitamin C standard					
Orange juice					