The Great Fruit Juice Contest

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Topic

Vitamin C concentrations

Time

40 minutes for first test, 20 minutes for each additional test

Safety

Adult supervision is required. Please click on the safety icon to view the safety precautions. Do not taste any of the substances used in this procedure. Iodine is poisonous. Be sure not to contaminate fruit juice containers with iodine solution.

Materials

- stove, hot plate, or gas burner
- small pot
- spoon or stirring rod
- cornstarch
- 1,000 mL distilled water
- 10 mL graduated cylinder
- five 100-mg tablets of vitamin C (ascorbic acid)
- two 100-mL amber-colored storage bottles (or bottles covered with paper)
- 500-mL beaker or jar
- three eyedroppers
- tincture of iodine
- 100-mL beaker or jar
- 16 oz fresh orange juice

Procedure

Part A: Preparing the Solutions Needed for Testing

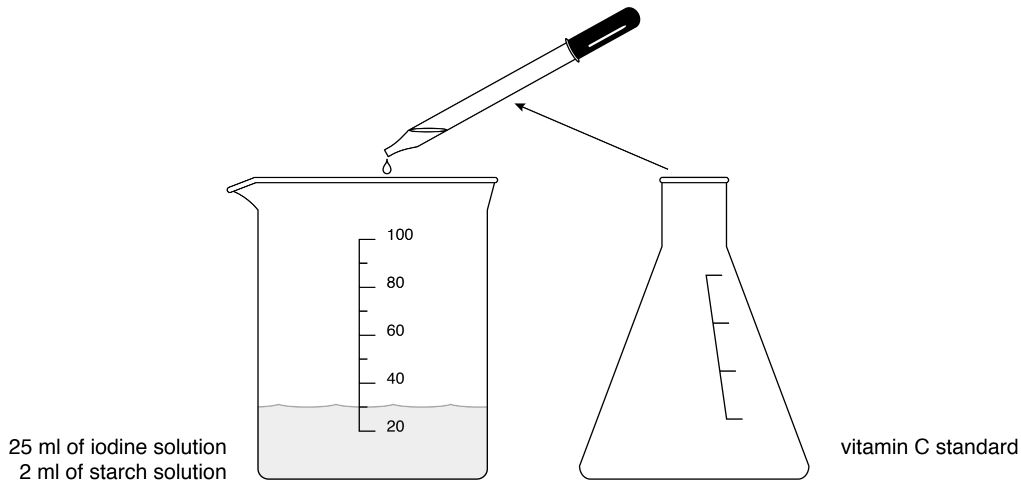
1. Make a paste of 1 g cornstarch and 10 mL distilled water. Then boil 90 mL distilled water in the small pot. Remove the boiling water from the burner, and stir in the starch paste. Mix well. If you are not performing the experiment immediately, refrigerate the solutions.
2. Crush a 100-mg tablet of vitamin C, and add it to 50 mL distilled water. Mix well. Add enough distilled water to produce a total of 100 mL. Store this in a dark-amber, closed bottle in the refrigerator. You will use this solution as your vitamin C standard.
3. Place 200 mL distilled water into a 500-mL beaker or jar. Add 10 drops of the tincture of iodine. Mix the solution well.

Part B: Titrating the Vitamin C Standard

1. Place 25 mL of the iodine solution you made in Part A into a clean 100-mL beaker.

2. Add approximately 2 mL of the 1% starch solution you made in Part A. (The exact amount is not critical, but 2 mL = 2 squirts of dropper.)
3. Now add the vitamin C standard drop by drop to this mixture until the color of the solution changes from black to clear (see figure 1). Record the number of drops used on the data table.

Figure 1



Part C: Titrating the Juice Sample

1. Place 25 mL of the iodine solution into a clean 100-mL beaker.
2. Add approximately 2 mL of the 1% starch solution.
3. Now add the orange juice drop by drop to this mixture until the color of the solution changes from black to clear. On the data table, record the number of drops used.
4. Repeat steps 2 and 3 with other fruit juices. Record on the data table the number of drops needed.

Part D: Calculating Vitamin C Concentration

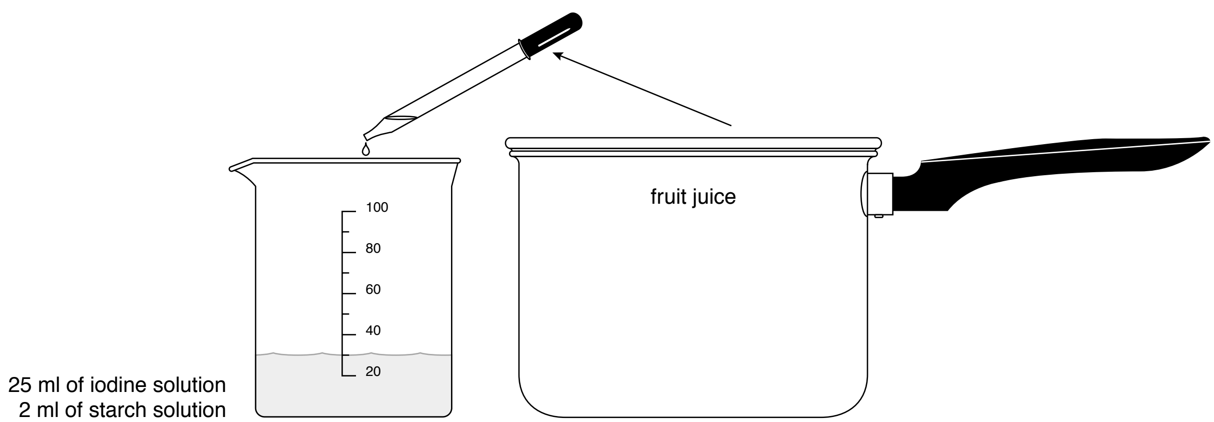
There is an inverse relationship between the vitamin C concentration and the drops of juice used to reach the end point.

$$\frac{\text{milligrams vitamin C}}{\text{100 mL juice}} = \frac{\text{drops of vitamin C standard needed in Part B 2 100 mg}}{\text{drops of juice needed in Part C}}$$

Calculate the vitamin C concentration of each juice using this formula.

DATA TABLE	
Tested substances	Number of drops needed to change color of iodine solution
Vitamin C standard	
Orange juice	
Juice 2: ________________	
Juice 3: ________________	
Orange juice heated to boiling	
Orange juice boiled 5 min	

Figure 2



PART E: DETERMINING THE EFFECT OF HEAT ON VITAMIN C CONCENTRATION

1. Heat 8 oz orange juice until it just starts to boil. Remove from heat and repeat Part C.
2. Boil 8 oz orange juice for 5 min and repeat Part C. Record your results on the data table.
3. Which fruit juice had the highest concentration of vitamin C? Which had the lowest?
4. What happened to the vitamin C concentration of the orange juice when you heated it? Did the amount of heating have any effect? Explain.

What's Going On

Different fruit juices will have different vitamin C concentrations. When vitamin C is added drop by drop, the iodine is gradually removed from the blue-black complex. When all of the starch has been separated from the complex, the solution turns clear. Thus, there is an inverse relationship between the number of drops of juice required to reach the end point (when the solution becomes clear) and the concentration of the vitamin C in the juice. Heat will destroy vitamin C.

Connections

Vitamin C, also known as ascorbic acid, is vital for human health. It can be obtained by eating a balanced diet containing fruits and vegetables, especially citrus fruits. In this procedure, we compared the vitamin C concentration of different fruit juices and noted the effect of heat on vitamin C. Humans must get all their vitamin C from their diet. Scurvy, a disease caused by the lack of vitamin C, was common in sailors because their diet lacked fruit, which is a common source of vitamin C. When it was discovered that the disease was caused from the lack of vitamin C, the British navy included limes in the diet of sailors at sea. The term "Limey" originated from this use of limes by British sailors to ward off scurvy.

Safety Precautions

READ AND COPY BEFORE STARTING ANY EXPERIMENT

Experimental science can be dangerous. Events can happen very quickly while you are performing an experiment. Things can spill, break, even catch fire. Basic safety procedures help prevent serious accidents. Be sure to follow additional safety precautions and adult supervision requirements for each experiment. If you are working in a lab or in the field, do not work alone.

This book assumes that you will read the safety precautions that follow, as well as those at the start of each experiment you perform, and that you will *remember* them. These precautions will not always be repeated in the instructions for the procedures. It is up to you to use good judgment and pay attention when performing potentially dangerous procedures. Just because the book does not always say "be careful with hot liquids" or "don't cut yourself with the knife" does not mean that you should be careless when simmering water or stripping an electrical wire. It *does* mean that when you see a special note to be careful, it is extremely important that you pay attention to it. If you ever have a question about whether a procedure or material is dangerous, stop to find out for sure that it is safe before continuing the experiment. To avoid accidents, always pay close attention to your work, take your time, and practice the general safety procedures listed below.

PREPARE

- Clear all surfaces before beginning work.
- Read through the whole experiment before you start.
- Identify hazardous procedures and anticipate dangers.

PROTECT YOURSELF

- Follow all directions step by step; do only one procedure at a time.
- Locate exits, fire blanket and extinguisher, master gas and electricity shut-offs, eyewash, and first-aid kit.
- Make sure that there is adequate ventilation.
- Do not horseplay.
- Wear an apron and goggles.
- Do not wear contact lenses, open shoes, and loose clothing; do not wear your hair loose.
- Keep floor and work space neat, clean, and dry.
- Clean up spills immediately.
- Never eat, drink, or smoke in the laboratory or near the work space.
- Do not taste any substances tested unless expressly permitted to do so by a science teacher in charge.

USE EQUIPMENT WITH CARE

- Set up apparatus far from the edge of the desk.
- Use knives and other sharp or pointed instruments with caution; always cut away from yourself and others.
- Pull plugs, not cords, when inserting and removing electrical plugs.
- Don't use your mouth to pipette; use a suction bulb.
- Clean glassware before and after use.
- Check glassware for scratches, cracks, and sharp edges.
- Clean up broken glassware immediately.

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- Do not use reflected sunlight to illuminate your microscope.
- Do not touch metal conductors.
- Use only low-voltage and low-current materials.
- Be careful when using stepstools, chairs, and ladders.

USING CHEMICALS

- Never taste or inhale chemicals.
- Label all bottles and apparatus containing chemicals.
- Read all labels carefully.
- Avoid chemical contact with skin and eyes (wear goggles, apron, and gloves).
- Do not touch chemical solutions.
- Wash hands before and after using solutions.
- Wipe up spills thoroughly.

HEATING INSTRUCTIONS

- Use goggles, apron, and gloves when boiling liquids.
- Keep your face away from test tubes and beakers.
- Never leave heating apparatus unattended.
- Use safety tongs and heat-resistant mittens.
- Turn off hot plates, bunsen burners, and gas when you are done.
- Keep flammable substances away from heat.
- Have a fire extinguisher on hand.

WORKING WITH MICROORGANISMS

- Assume that all microorganisms are infectious; handle them with care.
- Sterilize all equipment being used to handle microorganisms.

GOING ON FIELD TRIPS

- Do not go on a field trip by yourself.
- Tell a responsible adult where you are going, and maintain that route.
- Know the area and its potential hazards, such as poisonous plants, deep water, and rapids.
- Dress for terrain and weather conditions (prepare for exposure to sun as well as to cold).
- Bring along a first-aid kit.
- Do not drink water or eat plants found in the wild.
- Use the buddy system; do not experiment outdoors alone.

FINISHING UP

- Thoroughly clean your work area and glassware.
- Be careful not to return chemicals or contaminated reagents to the wrong containers.
- Don't dispose of materials in the sink unless instructed to do so.
- Wash your hands thoroughly.
- Clean up all residue, and containerize it for proper disposal.
- Dispose of all chemicals according to local, state, and federal laws.

BE SAFETY-CONSCIOUS AT ALL TIMES

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