Vitamin C Testing

Chemistry of Food

Introduction

Vitamin C (ascorbic acid) is water soluble and is a strong reducing agent. In this laboratory activity, ascorbic acid reduces an indicator, 2,6-dichloroindophenol. The indicator solution will change from a blue color to an intermediate pink/purple color, then to a colorless/very faint amber endpoint with the addition of ascorbic acid.

Concepts

- Oxidation–reduction
- Consumer chemistry

Materials

2,6-Dichloroindophenol, sodium salt, $NaOC_6H_4N:C_6H_2(Cl_2):O$, 0.25 g
L-Ascorbic acid, 0.1 g
Various fruit juices, including: orange, grapefruit, lemon, lime, etc.
Water, distilled
Graduated cylinder, 10-mL
Magnetic stirrer
Mortar and pestle
Pipets, Beral-type, thin-stem, 50
Stirring rod
Test tube rack
Test tubes, 16 × 125 mm, 48
Volumetric flasks, 100-mL, 2

Preparation

1. Solutions should be prepared no more than one day in advance and refrigerated until use.
2. Prepare 0.025% dichloroindophenol solution by dissolving 0.025 g of dichloroindophenol in 100 mL of distilled water in a volumetric flask.
3. Place the cap on the volumetric flask and invert to mix.
4. To prepare vitamin C solution measure 0.1 g of L-ascorbic acid.
5. Place 0.1 g of L-ascorbic acid into a clean 100-mL volumetric flask and dilute to 100 mL mark. Mix thoroughly using a magnetic stirrer.

Safety Precautions

Although L-ascorbic acid (Vitamin C) and 2,6-dichloroindophenol are considered nonhazardous, students should wash their hands thoroughly after handling. Food items, once brought into a lab, are considered chemicals and, as such, should not be ingested. Wear chemical-splash goggles. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information. Wash hands thoroughly with soap and water before leaving the laboratory.

Procedure

1. Using a 10-mL graduated cylinder, measure out 10 mL of 0.025% dichloroindophenol solution. Transfer to one of the test tubes provided.
2. Using a Beral-type pipet, add the Vitamin C solution drop by drop, counting each drop added to the test tube until the color changes from blue to the colorless/very light amber endpoint. Be sure to stir or swirl the solution after each drop is added. Record the number in a data table. Repeat the procedure two more times to obtain more accurate results.
3. Repeat the procedure using fruit juice as the Vitamin C source. Be sure to ignore the intermediate pink color; continue adding drops until the clear-amber color appears. Record the drop counts for the fruit juice sample in the data table.
4. Repeat with other juices. Try other vitamin supplements or make solutions with Vitamin C rich fruits or vegetables (like limes).

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Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. Dispose of all solutions down the drain with an excess of water according to Flinn Suggested Disposal Method #26b.

Discussion

Figure 1 illustrates the reaction when ascorbic acid is added to 2,6-Dichlorindopehnnol indicator solution.

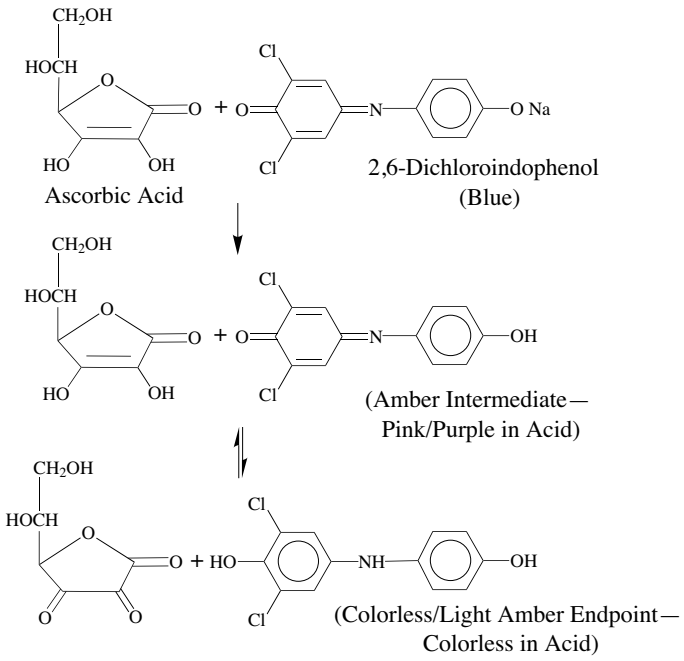

Figure 1.

Using the Vitamin C solution as a standard, the amount of Vitamin C in fruit juices can be calculated. If it takes 29 drops of Vitamin C solution and 77 drops of orange juice to neutralize 10 mL of dichloroindophenol solution, the calculations are as follows:

(Drops standard)(Concentration standard) = (Drops unknown)(Concentration unknown)

(29 drops) (100 mg/100 mL of Vitamin C) = (77 drops) (n mg of Vitamin C/100 mL of orange juice)

n = 37.6 mg of Vitamin C

Therefore, the concentration of Vitamin C in the orange juice is 37.6 mg/100 mL.

Listed below are a few juices and their ranges of Vitamin C content.

Juice	Vitamin C content
Orange	20–80 mg/100 mL
Grapefruit	35–65 mg/100 mL
Lemon	30–70 mg/100 mL
Lime	5–40 mg/100 mL

Vitamin C, ascorbic acid, is important nutritionally. There are numerous natural sources including citrus fruits and some green plants such as spinach and green peppers. All plants and animals except humans, other primates, and guinea pigs, produce Vitamin C naturally; therefore, Vitamin C must be a part of our daily diet. The Recommended Dietary Allowance (RDA) of Vitamin C for teens is 60 mg per day, which is provided by one 8 oz. glass of fresh orange juice. Many medical and dietary professionals believe that higher daily doses of Vitamin C have a positive effect on the immune system, helping us to stave off a variety of infections and diseases, including the common cold.

A deficiency in Vitamin C can result in a disease known as scurvy, the symptoms of which are bleeding, spongy gums and a tendency to bruise easily. You may have heard of British sailors historically referred to as "limeys." The name limey was given to the sailors because, during long voyages, they would eat limes to prevent scurvy.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12
Evidence, models, and explanation
Content Standards: Grades 5–8
Content Standard B: Physical Science, properties and changes of properties in matter
Content Standard F: Science in Personal and Social Perspectives; personal health
Content Standards: Grades 9–12
Content Standard B: Physical Science, structure and properties of matter
Content Standard F: Science in Personal and Social Perspectives; personal and community health

References

Boyer, R. F. *Modern Experimental Biochemistry*; Addison-Wesley: Reading, MA, 1986.

Morholt, E. and Brandwein, P. F. *A Sourcebook for the Biological Sciences*. Harcourt Brace Jovanovich, San Diego, 1986.

Recommended Dietary Allowances, 10th ed.; National Research Council; National Academy: Washington, D.C., 1989; pp 118–124.

Flinn Scientific—Teaching Chemistry™ eLearning Video Series

A video of the *Vitamin C Testing* activity, presented by Steve Long, is available in *Chemistry of Food*, part of the Flinn Scientific—Teaching Chemistry eLearning Video Series.

Materials for *Vitamin C Testing* are available from Flinn Scientific, Inc.

Materials required to perform this activity are available in the *Vitamin C Testing Kit* available from Flinn Scientific. Materials may also be purchased separately.

Catalog No.	Description
AP9121	Vitamin C Testing Kit
GP4030	Flask, volumetric, Borosilicate Glass, 100 mL
D0009	2,6-Dichloroindeophenol, 1 g
A0070	L-Ascrobic Acid, 25 g

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.