

Analysis of Vitamin C in Fruits and Food Products

An Inquiry-Based Experiment

Summary

References

1. "Official Methods of Analysis of AOAC International", edited by W. Horwitz, 17th ed., 2000, Ch. 15, p.16-17.
2. <http://chemlab.truman.edu/CHEM120Labs/VitaminC.htm>
3. <http://faculty.leeu.edu/~pmauldin/Experiments/Experiment4.doc>
4. http://www.baruch.cuny.edu/wsas/departments/natural_science/chemistry/chm_1000/vitamin_C.doc

Vitamin C, also known as ascorbic acid, is a water-soluble vitamin. It is vital to our body and can be found in various fruits and vegetables. Therefore, the determination of vitamin C becomes increasingly important in areas such as pharmaceutical, clinical and food industries.

In the present experiment, you are going to determine the vitamin C content in various fruits using a redox titration. An organic dye, 2,6-dichloroindophenol (DCIP), is employed to titrate with the vitamin C in the extracted sample solution. A solution mixture of metaphosphoric acid and acetic acid is used to extract vitamin C from the samples. This solution can stabilize the extracted vitamin C by inhibiting its oxidation. The DCIP serves as the indicator as excess DCIP turns the solution to pink after the end point has passed through.

By participating in this project, students will have the opportunity to analyze real life samples. Students will learn

1. how to do sample preparation in order to retain the integrity of the analyte.
2. the use of organic dye as titrant as well as indicator for a redox titration.
3. how to compare the vitamin C content of different fruits.

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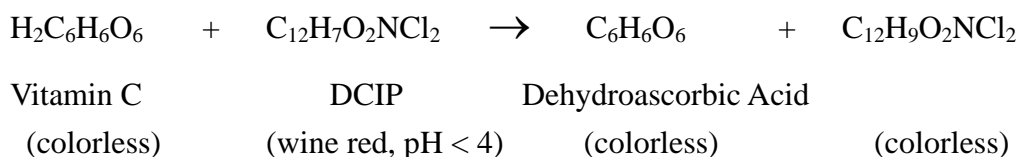
Lab Documentation

Introduction

Vitamin C (ascorbic acid) is vital to our body. It can strengthen our body to resist against infection. It is known that deficiency of vitamin C can cause scurvy. Vitamin C is present in various fruits. Since vitamin C is a reducing agent, it can be deactivated by a wide range of oxidizing agents including atmospheric oxygen. Therefore, precautions are needed to prevent or minimize the degradation of vitamin C during sample preparation.

In this experiment, you are going to determine the vitamin C content in various fruits. The first step is sample preparation. In order to maintain the stability of the vitamin C, the extracting solution should be able to denature and precipitate the protein, to prevent oxidation of vitamin C as well as to remove some interferences. Metaphosphoric acid is employed for these purposes.

The vitamin C content is then determined using a redox titration. The reaction is shown below.



In the titration of vitamin C with 2,6-dichloroindophenol (DCIP), the added DCIP will react with the vitamin C in the sample to form colorless products. During the course of the titration, the solution remains colorless until all the vitamin C has been reacted. A few drops of excess DCIP will turn the solution to wine red. Therefore, DCIP can serve as its own indicator.

DCIP decomposes with time and the decomposition products may affect the observation of end point. It is recommended that the stock solution should be freshly prepared and also be filtered through filter paper before using it for the titration. The DCIP solution needs to be standardized against standard ascorbic acid solution.

Experimental Procedure

Chemicals:

Ascorbic acid

2,6-Dichloroindophenol sodium salt (DCIP)

Metaphosphoric acid/acetic acid solution

Sodium bicarbonate

Preparation of DCIP solution

Weight ~0.08 g of DCIP in a beaker. Add 50 mL of deionized water and 0.042 g of NaHCO_3 . Stir the mixture to dissolve the solids. Filter the solution and wash the residue with deionized water. Make up the solution to a final volume of 200 mL.

Standardization of DCIP solution

Weight accurately ~0.05 g of ascorbic acid. Dissolve it in deionized water and make up to 100.00 mL in a volumetric flask. Pipette 5.00 mL of the ascorbic acid standard solution into a 250-mL conical flask. Add ~20 mL of deionized water and 10 mL of metaphosphoric acid/acetic acid solution. Titrate the ascorbic acid solution with DCIP solution until the first appearance of pink color that can persist for about 5 seconds. Repeat the titration twice. Perform a blank measurement using 5 mL of deionized water instead of ascorbic acid. Put the blank aside for comparison of color.

Sample Analysis

Cut the fruit sample (orange, kiwi ... etc.) and weigh accurately ~5 g into a 100-mL beaker. Squeeze the sample using a glass rod and then add 15 mL of metaphosphoric acid/acetic acid solution. Stir the mixture for a while and then transfer only the solution to a 250-mL conical flask. Wash the residue in the beaker with 30 mL of deionized water and combine the washing with the sample solution. Titrate immediately the extracting sample solution with DCIP until the first appearance of pink color that can persist for ~5 seconds. Repeat the procedure twice for the sample.

Result and Discussion

First calculate the concentration of DCIP solution. Then use the result to determine amount of vitamin C (mg/g) in the fruit samples. Comment on the amount of vitamin C present in different fruits.

References

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Data Sheet

Name of Participants: _____

Preparation of Standard Ascorbic Acid Solution:

Weight of ascorbic acid + weighing paper	(g)	
Weight of weighing paper	(g)	
Weight of ascorbic acid	(g)	
Volume of ascorbic acid solution	(mL)	
Molecular weight of ascorbic acid	(g/mol)	176.126
Molarity of ascorbic acid solution	(M)	

Standardization of DCIP solution:

Trial	I	II	III
Final buret reading (mL)			
Initial buret reading (mL)			
Volume of DCIP solution used (mL)			
Volume of ascorbic acid solution used (mL)			
Molarity of DCIP solution (M)			
Average molarity of DCIP solution (M)			

Real Sample Analysis:

(1) Sample Type: _____

Trial	I	II	III
Weight of sample + beaker			
Weight of beaker			
Weight of sample			
Final buret reading (mL)			
Initial buret reading (mL)			
Volume of DCIP solution used (mL)			
Molarity of DCIP solution (mL)			
Amount of vitamin C in sample (mg/g)			
Average amount of vitamin C (mg/g)			

(2) Sample Type: _____

Trial	I	II	III
Weight of sample + beaker			
Weight of beaker			
Weight of sample			
Final buret reading (mL)			
Initial buret reading (mL)			
Volume of DCIP solution used (mL)			
Molarity of DCIP solution (mL)			
Amount of vitamin C in sample (mg/g)			
Average amount of vitamin C (mg/g)			

[illegible]