

Rev. 2/01

GA/5 Iodimetric Titration of Ascorbic Acid in Vitamin C Tablets

Purpose:

The objective of this laboratory experiment is to determine the ascorbic acid content of Vitamin C tablets using an iodimetric titration. Ascorbic acid is a mild reducing agent that reacts rapidly and quantitatively with iodine to reduce it to iodide ion. In this experiment, a known excess of iodine is formed by the reaction of an accurately weighed amount of iodate ion in the presence of excess iodide ion. Once the ascorbic acid has quantitatively reacted with the iodine, the remaining iodine is back-titrated with thiosulfate. The titrant, thiosulfate, is standardized against iodine using the same iodate and iodide ion reaction. To indicate the end point, the disappearance of a blue starch color is used. It is believed that the blue starch color is caused by the formation of a surface, colored complex between iodine and the β -amylose molecule found in the starch. For more details refer to the text, G. Christian, **Analytical Chemistry**, 5th ed., Chap. 12 pp. 363-365 and experimental part of pp. 711-713.

Solutions and Chemicals Required:

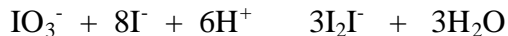
- sodium thiosulfate ($\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$)
- sodium carbonate
- potassium iodide (KI) and potassium iodate (KIO_3), all in solid form
- starch indicator (containing HgI_2 as the preservative)
- 0.50 M and 0.30 M sulfuric acid

Special Equipment:

Separate 2 and 50 mL volumetric pipets provided. Use the 10 mL volumetric pipet and the glass rod from your own drawer. Approximately ten Vitamin C tablets each containing 250 mg of vitamin C needed by each student.

Equations:

For the Standardization of the $\text{Na}_2\text{S}_2\text{O}_3$:



For the Determination of the Ascorbic Acid:

1. Preparation of the Thiosulfate Titrant

Prepare a solution of approx. 0.100 M Sodium Thiosulfate by dissolving about 12.40 g. of solid $\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}$ in 500 mL of freshly boiled, deionized water containing about 0.05 grams of Na_2CO_3 . (In your lab report explain why Na_2CO_3 used.) Use your 500 mL volumetric flask. Store this solution in your amber bottle taking pains to rinse the bottle out ahead of time with the boiled (sterile) deionized water. Keep the bottle tightly capped. (Explain why.)

2. Preparation of the Potassium Iodate Solution

Next carefully prepare a 0.013 __ M Potassium Iodate solution by carefully weighing out 1.39 __ g. of predried, primary standard KIO_3 . Carefully dissolve the weighed amount and quantitatively dilute in your 500 mL volumetric flask. This solution can be kept in your 500 mL volumetric flask.

3. Standardization of the Thiosulfate Solution

Standardize the thiosulfate solution as follows: Carefully pipet 50.00 mL of the KIO_3 solution into a 250-mL Erlenmeyer flask. Add approximately 2.0 grams of solid KI and 10 mL of 0.50 M sulfuric acid. Swirl and immediately titrate with the thiosulfate, titrant solution, until the solution has lost almost all of its color (has a straw yellow color). (If the solution is clear and no blue color is seen after addition of the starch, the trial must be discarded and redone). At this point add 2-mL of the starch indicator and carefully complete the titration until one drop of titrant removes the blue color. Repeat this titration with at least two additional 50.00 mL volume of KIO_3 solution. Calculate the **Normality** of the thiosulfate solution. The average relative deviation should be less than 3 parts per thousand. The gram formula weight of $\text{Na}_2\text{S}_2\text{O}_3$ is 158.11 g. and 214.00 g for KIO_3 . **Note all of these titrations should be performed carefully but rapidly to minimize air oxidation of the iodide ion.**

4. Analysis of ascorbic acid in the Vitamin C Tablets.

In a 250 mL Erlenmeyer flask, dissolve one of the 250 mg ascorbic acid tablets in 60 mL of 0.3 M sulfuric acid. Use your glass rod to help break-up the tablet. Some solid binding material may not dissolve. Add about 2.0 g. of KI and exactly 50.00 mL of the standard KIO_3 solution. Swirl to mix and then carefully titrate with the standardized thiosulfate as done above. Remember to add the 2 mL of starch only when the solution is light yellow in color. Perform the analysis three times. Calculate the each individual and the average milligrams of ascorbic acid (vitamin C) found in each per tablet. A suggested average relative deviation is less than 3 parts per thousand should be possible. The gram formula weight of ascorbic acid is 176.12. In your conclusion summarize the results of your analysis as to the amount of ascorbic acid found in each tablet. (If you were working for the manufacturer of the vitamin tablets would your be comfortable with your results? Yes, no? Why? And finally comment about the use of iodimetric titrations and the starch indicator used.

Note: An important part of our lab report for GA/5 should include a clear discussion of the pertinent oxidation/reduction and indicator equations that are involved with this lab experiment. Show balanced chemical equations and explain why is the pH of solutions critical for those chemical equations. For a perfect lab report you will need to have only accurate and precise

results but also a clear explanation as to the chemistry occurring and clearly presented series of calculations used to obtain those results.