The volumetric analysis of the amount of vitamin c in a tablet essay example

Health & Medicine

Introduction

Vitamin C also referred to as L-ascorbic acid is an essential component of nutrients that is needed by both human and animal species. Ascorbic acid has a molecular formula of C6H8O6 and a molecular weight of 176. 13. The term vitamin C refers to the various vitamers which have the vitamin C activity. These vitameters include ascorbic acid together with its salts. Some of the functions that are associated with vitamin C include keeping the cells health and giving them protection and maintaining healthy connective tissue that are involved in supporting and giving shape to other tissues as well as organs. Vitamin C is also involved in facilitating wound healing, and lack of it in the body may lead to the development of a condition called scurvy (NHS Choices, 2012).

Some of the useful applications of ascorbic acid and its esters and salts include their use in agriculture where it is used to promote seed germination, plant growth and root growth on cuttings. When plants like petunias, lettuce, spinach, celery, and roses are sprayed with ascorbic acid, they are able to withstand damages that may result from smog and ozone exposure. Ascorbic acid is also sprayed on trees or bush fruits in order to synchronize maturation. This also helps the fruits to fall off in an easy way in mechanical harvesting (Seib & Tolbert, 1982)

L-Ascorbic acid is also used in the food industry to fortify either natural or fabricated foods that have little or no vitamin C. This may help in restoring lost vitamin or help in standardizing a certain class of food products that have vitamin quantity that is preselected. Vitamin C is also used as a preservative or a processing agent. Other areas where ascorbic acid is used

include in the synthetic polymer industries, metal technology and in photoprocessing. Other areas include cosmetic, preservation of cut plants, cleaning agents, blood preservation among others (Seib & Tolbert, 1982). Various techniques are applied in the determination of the quantity of different conpound in products in ordre to acertain the clains that are made by the producers on their content. Some of these procedure such as calorimeter, back titration, titration among others. The main reason why products such as those produced in pharmaceutical companies should be monitored is to monitor their quality in the market. This is maily due to the fact that most of the pharmaceutical products ubdergoe changes when they stay for long or are exposed to factors such as sunlight and this may compromise their quantity as well as quality. Products such as hydrogen peroxide that is used in disinfectants is usually reduced to water through a degradation process that takes place slowly. In the analysis of the amount of vitamin C, the technique of back titration is used. The exercise starts by the standardization of sodium thiosulfate against a standard potassium iodate. A standard potassium iodate of known volume is reacted with acidified potassium that is in excess producing yellow iodine.

$KIO3+5KI+3H2SO4 \rightarrow 3I2+3K2SO4$

The ascorbic acid is naturally a reducing agent and is usually oxidized by elements that are oxidizing agents in nature such as iodine and bromine. The ascorbic acid is usually reacted with the produced iodine from the above reaction. The iodine is always in excess and is thus not exhausted by ascorbic acid. The iodine just like bromine oxidizes the ascorbic acid forming dehydroascorbic acid through the following reaction:

The remaining iodine is then titrated against the thiosulfate solution with a known concentration, and the volume of the thiosulfate solution used and concentration are used to determine the moles of sodium thiosulfate concentration. This is then used to determine the moles of iodine that is in excess and finally determination of the iodine that reacted with ascorbic acid. The reaction of iodine and thiosulfate solution occurs as illustrated below.

$I2+2Na2S2O3 \rightarrow 2NaI+S4O6$

The iodine that is used in the above titration is usually generated through the addition of excess KI to the acidified solution.

This experiment aimed at determining the amount of ascorbic acid through a back titration. The ascorbic acid was reacted with iodine, and the excess iodine was reacted with a standard thiosulphate solution to determine the quantity of the ascorbic acid.

Methods

The procedures for this experiment were followed as indicated in the laboratory manual on the volumetric analysis (Laboratory Manual, 2013). In a clean 250 mL beaker, the tablet was dissolved in 100 mL of distilled water with continuous stirring. Stirring was done thoroughly for several minutes to ensure that all the Vitamin C content was dissolved. The residues gravity filtered into a 250 mL volumetric flask. The beaker and the filter paper were washed using small aliquots of distilled water and the content made up to the mark using distilled water. The flask was covered using a stopper and the content mixed thoroughly by converting the flask for at least 10 times. Using the concentrated standard solution of KIO3 previously prepared and the

content made up to 250 mL. The burette was rinsed with sodium thiosulphate solution and the concentration noted.

Into a 250 mL Erlenmeyer flask, 25. 00 mL of the dilute standard KIO3 was measured using a pipette and 0. 2 g of KI added into the solution. Using a plastic transfer pipette, 1 mL of 1 M sulfuric acid was added. Into the solution, 10. 00 mL of Vitamin C solution were added using a pipette. The initial burette readings were recorded, and the content of the Erlenmeyer flask titrated slowly while stirring until a yellow color was obtained. One milliliter of starch solution was added, and titration continued until the blue color just disappeared. The final burette reading was recorded. The titration was repeated at least twice more in order to obtain consistent results, and the average of the titration volume determined.

Results

The molar concentration of stock KIO3 solution: 0. 0047 M

The molar concentration of dilute KIO3 solution:

The molar concentration of Na2S2O3 solution: 0. 0009975 M±0. 5%

A yellow color was obtained after titration had been initiated and the blue color appeared after starch was added to the solution. The end of the reaction was noted by the disappearance of the blue color.

Calculation

The calculations for the determination of the amount of ascorbic acid in the tablet were done as follows.

The concentration of the standardized KIO3 was 0. 009975 M, and the volume used was 25 mL. The moles of KIO3 can then be calculated using the

formula

moles= molarity×volume (in Liters)

= 0. 0047001×251000

the moles of KIO3= 0. 0001175 moles

The stoichiometry of the reaction between the KIO3 used and the iodine produced is 1: 3, and, therefore, the moles of Iodine produced can be calculated by multiplying the moles of KIO3 by 3 as follows

moles of Iodine produced were= 0. 0001175×3

= 0. 000353 moles

The moles of Na2S2O3 can then be calculated using the formula

moles= molarity×volume (in Liters)

= 0. 0009975×17. 771000

the moles of Na2S2O3= 0. 0000177 moles

The stoichiometry of the reaction between the iodine and Na2S2O3 is 1: 2, and, therefore, the moles of Iodine used can be calculated by dividing the moles of Na2S2O3 by 2 as follows

moles of excess Iodine used in Na2S2O3 titration were= 0. 00001772

= 0. 00000886 moles

The net moles of I2 that were used in titrating the ascorbic acid can be calculated by the difference of moles of iodine produced minus the moles of excess iodine to titrate Na2S2O3. This is given by

= 0. 000353-0. 00000886

= 0. 000344 moles

The stoichiometry of the reaction between the iodine and vitamin C is 1: 1, and thus the moles of vitamin C in the 10 mL used were 0. 000344 moles.

The mass of ascorbic acid that was used in titration was calculated using the formula

mass= moles×Molar Mass

= 0. 000344×176. 13

= 0. 0605 g

In the 100 mL of the solution that was prepared, the mass was

0. 0605×10

0. 605 grams

In milligrams, the mass of ascorbic acid was 605 mg.

Discussion

Most of products from pharmaceutical need to have their shelf half tested in a routine manner. This is because most of the pharmaceutical products are known to undergo degradation or other changes that compromise their quantity as well as quality. Products such as hydrogen peroxide that is used in disinfectants is usually reduced to water through a degradation process that takes place slowly. Vitamin C, on the other hand, is very unstable and is usually oxidized by the air. The procedures in this experiment are, therefore, important in the dermination of the quality and quantity of pharmaceutical products.

The procedure of quantifying the amount of ascorbic acid in a tablet involves the use of back titration using iodine and standardized thiosulphate. The

initial reaction involved the titration of vitamin C with iodine. The end of Vitamin C in the solution was indicated by the appearance of pale yellow color after the solution has lost the reddish-brown color. Addition of starch to the solution makes the color change from pale yellow to blue color. This color results from the complex made by starch and iodine. Addition of sodium thiosulphate solution consumed the remaining iodine in the solution and this eliminated the starch-iodine complex that made the solution blue, and this made the solution to have a colorless appearance.

The amount of ascorbic acid that was calculated was 605 grams, and this was much higher than the amount that was indicated of 250 mg per one tablet. The difference in the amount may have resulted from errors in measuring the solutions used in the experiment.

Conclusion

This experiment aimed at determining the amount of ascorbic acid through a back titration. The ascorbic acid was reacted with iodine, and the excess iodine was reacted with a standard thiosulphate solution to determine the quantity of the ascorbic acid. The experiment successfully determined the amount of ascorbic acid in the tablet as 605 mg. This value is much higher than the value indicated by the manufacturer.

Reference List

NHS Choices. (2012). Vitamins and minerals - Vitamin C. Retrieved June 16, 2013, from http://www. nhs. uk/Conditions/vitamins-minerals/Pages/Vitamin-C. aspx

Seib, P. A., & Tolbert, B. M. (1982). Ascorbic Acid: Chemistry, Metabolism, and Uses. Washington: American Chemical Society.