

Notes to Instructors

Stability of Vitamin C

A laboratory exercise for CH121 General, Organic, and Biological Chemistry laboratories

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Waste Disposal: The authors determined that all wastes from this experiment could be flushed down the sink with plenty of water in our case. Check your local requirements for waste disposal.

Laboratory Equipment: One UV-Vis spectrophotometer, such as the Spec 20, for every four students is adequate. Each spectrophotometer should be equipped with at least five cuvettes.

Each lab group will need eight 35- or 50-mL beakers for mixing solutions.

Plastic disposable pipets that are marked with one, two and three milliliters are adequate for this lab. Each group will need eight of these pipets.

Circulating water baths controlled at approximately 50 °C are most convenient. We used immersion circulators in 5-gallon tanks and provided two set-ups for 24 students. External ring stands equipped with thermometer clamps can be used to hold the test tubes that need to stay immersed for 15 minutes.

Color Reagent: Weigh 1.0 g of 1,10-phenanthroline monohydrate (molar mass = 198 g/mol) and transfer it to a 500-mL bottle. Weigh 0.8 g of ammonium iron (III) sulfate dodecahydrate (molar mass = 482 g/mol) and transfer it to the 500-mL bottle. Add 10 mL of 1 M hydrochloric acid. Add some deionized (DI) water and mix the contents very well. Dilute to 500 mL with DI water. This 500 mL batch is enough for 35 students. The reagent is stable for several days and may be prepared ahead of time. Although it is not necessary to prepare this reagent in volumetric glassware, it is important that the final volume be consistent at 500±5 mL from batch in order to maintain the precision of student results throughout the experiment.

Preparation of Standard Solutions of Vitamin C: Weigh 0.040 g (40 mg) of reagent grade L-ascorbic acid (molar mass 176.13 g/mol) and transfer it to 1-L volumetric flask. Add some DI water and mix it well until all ascorbic acid dissolves. Then, dilute to the mark with DI water. (Note: boiled DI water is not required for this experiment. The instructor or stockroom will need to prepare a total of four solutions of the standard as follows:

1. Prepare one solution one week ahead of time and leave open. Label **“I. Open Solution”**
2. Prepare one solution one week ahead of time and leave closed. Label **“II. Closed Solution”**
3. Prepare one batch just before lab time. Label **“Standard Vitamin C Solution”**.
4. Leave some of the reagent grade solid L-ascorbic acid out in an open beaker or dish one week ahead of time. Prepare one solution of standard the day of the lab from this this solid that was left open. Label **“Open Solid”**

Vitamin C Tablet or Nutritional Supplement Analysis: A good learning exercise is to have the students test a vitamin C tablet or a nutritional supplement for vitamin C using this procedure. Our students successfully tested a commercial vitamin C tablet and determined that, by this test, the label slightly understated the vitamin C content. It is suggested that instructors test tablets or nutritional supplements ahead of time to scout for interferences and expected results.

Instructors need to carefully explain the laboratory procedure for tablet or supplement analysis, especially the calculations. The students will weigh one whole tablet or one unit of the supplement, then grind, in the case of a tablet, and weigh out a calculated fraction of the supplement that should contain 40 mg of vitamin C, based on the labeled content for the whole tablet or one unit. This weighed fraction is then diluted to one liter with DI water and then tested for vitamin C using this procedure. After testing the students must calculate the amount of vitamin C in the whole tablet or unit of supplement, accounting for the dilution factors. These are not simple calculations for GOB students.

Sample Calculations:

Parts I and II

Concentration of vitamin C in the diluted sample from the calibration curve, mg/L: 5.89

Multiply by 6.25 to obtain concentration of vitamin C in original sample, mg/L: 36.8

Percent decrease in vitamin C concentration in original sample: $\frac{(40 \text{ mg/L} - 36.8 \text{ mg/L})}{40 \text{ mg/L}} \times 100\% = \underline{8.0\%}$

Part III

Mass of one tablet, g: 0.690

Mass of ground tablet (used in experiment), g: 0.0552

Concentration of vitamin C from standard calibration curve, mg/L: 6.7

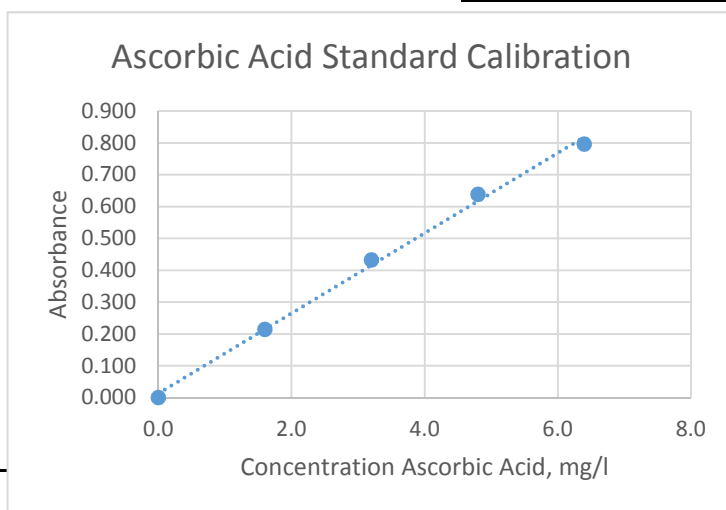
Experimental vitamin C in whole tablet, mg: $(6.7 \text{ mg/L} \times 6.25 \times 0.690 \text{ g}) / 0.0552 \text{ g} = \underline{523 \text{ mg/L}}$

Solution is prepared in a one-liter volumetric flask. Tablets were labeled 500 mg vitamin C. The 6.25 factor in the equation is the dilution factor.

Typical Data obtained by one group of students is shown on the next page:

Vitamin C Stability Experiment

Sample	Concentration Ascorbic Acid, mg/L	Absorbance @510nm
Blank	0.0	0.000
1	1.6	0.214
2	3.2	0.432
3	4.8	0.638
4	6.4	0.796
Solution @50°C water for 1 min	5.71	0.735
Solution @50°C water for 15min	4.59	0.590
I. Opened Stability Solution	0.65	0.083
II. Closed Stability Solution	0.14	0.018
III. Solid Stability Solution	6.03	0.776



Solution @50°C water for 1 min	28.7	28.4
Solution @50°C water for 15min	4.0	89.9
I. Opened Stability Solution	0.9	97.8
II. Closed Stability Solution	37.7	5.8

Slope of calibration curve line =
0.12867

Actual temperature of 50°C water bath 50.3

Part C. Analysis of 500 mg Vitamin C Tablet

Mass of one tablet, grams	0.513
Mass to be taken for 40 mg/L solution, grams	0.0410
Absorbance for 4.0 mL sample of tablet soln.	0.930
Concentration of Vitamin C from Std. Calib.	7.2
Amount of Vitamin in original tablet, mg	565