

Indirect Atomic Absorption Spectrophotometric Methods for the Determination of Ascorbic Acid in Tablets

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Summary: Two indirect atomic absorption spectrophotometric methods for the determination of 0.2 – 3.0 μ mole ascorbic acid are described. In one, silver ions are reduced by ascorbic acid to metallic silver and in the other copper (II) ions are reduced to copper (I) ions which are then precipitated as copper (I) thiocyanate. The latter method is applied for the determination of ascorbic acid in some tablets.

Introduction

Determination of ascorbic acid in vitamin preparation and natural products is of great importance. Macro and semi-macro amounts have been determined titrimetrically by iodimetric methods⁽¹⁻³⁾. Several gas chromatographic, polarographic and spectrophotometric methods have been reported for the determination of micro amounts of ascorbic acid⁽⁴⁾.

No detailed investigation of determination of organic compounds by atomic absorption spectrophotometry appears to have been undertaken. Some of the general indirect atomic absorption methods involve the formation of an insoluble precipitate and the determination of either the metal incorporated in the precipitate or the excess metal ion in the filtrate⁽⁵⁻⁷⁾.

Several titrimetric methods for the determination of ascorbic acid are based on the reduction of copper(II)⁽⁸⁾ and silver⁽³⁾. This paper describes for the first time, two indirect atomic absorption methods for the determination of ascorbic acid which are based on the ascorbic acid reduction of copper(II) or silver.

Experimental

Apparatus: The atomic absorption measurements are made with a Varian Model AA-475 Atomic absorption Spectrophotometer using an air-acetylene flame. The copper and silver atomic absorptions are measured at lamp currents of 4 mA, slit width of 0.5 nm and wavelengths of 324.7 nm and 338.3 nm respectively.

Reagents: Analytical reagent grade ascorbic acid is used to prepared approximately 0.1 M stock solution of the acid (100 ml) in 0.5% oxalic acid. The latter is used as stabilizer. This solution is standardized iodimetrically and stored at about 5°C. It is stable for more than 8 hours.

Copper (II), silver and thiocyanate stock solutions (0.1 M of each) are prepared from A.R. copper (II) sulphate, silver nitrate and potassium thiocyanate, respectively in distilled water. The silver stock solution which is stored in amber glass bottle and the ascorbic acid stock solution are freshly prepared for daily use.

Tablets solutions are prepared by dissolving each tablet in 100 ml of distilled water. A 2 ml aliquot of each solution is diluted to 50 ml with distilled water and 1 ml of this solution is taken for analysis.

General Procedure for Copper Method: The sample solution containing 0.2 – 3.0 μ mole ascorbic acid is added to a 50 ml conical flask containing 5 ml of 1.3×10^{-3} M copper(II) and 5 ml of 5×10^{-3} M thiocyanate solutions. After 15 min. the copper(I) thiocyanate precipitate formed is filtered off by passing the solution through a 25 ml burette, 10 ml of which has been packed with glass wool. The filtrate is diluted to 50 ml and then atomized into the air-acetylene flame.

General Procedure for Silver Method: The sample solution containing 0.2 – 1.7 μ mole ascorbic acid is added to a 50 ml conical flask containing 5 ml of 1×10^{-3} M silver solution. The reaction

mixture is heated in a water bath (60°C) for 10 min. the solution is allowed to cool to room temperature and then the formed silver metal is filtered off. The filtrate is diluted to 50 ml and then atomized into the air-acetylene flame.

Results and Discussion

The procedures used in both methods are found to be optimum for complete reaction. A study of the filtration process showed that a better separation is obtained when using glass wool for the copper method and three filter papers No. 41 for silver method.

The calibration graphs are linear from 0.2 to 3.0 μ mole and from 0.2 to 1.7 μ mole of ascorbic acid in the sample test solution for copper and silver methods, respectively (Fig. 1). An estimate of the precision of these methods is ascertained from the results obtained for 10 samples each containing 1 μ mole of ascorbic acid. The relative standard deviations obtained are 4.9% and 7.0% for copper and silver methods, respectively. The former method is applied to the determination of ascorbic acid in some tablets. The results (Table 1) compare reasonably well with those obtained by the iodimetric titration method.

The above methods as all other oxidation-reduc-

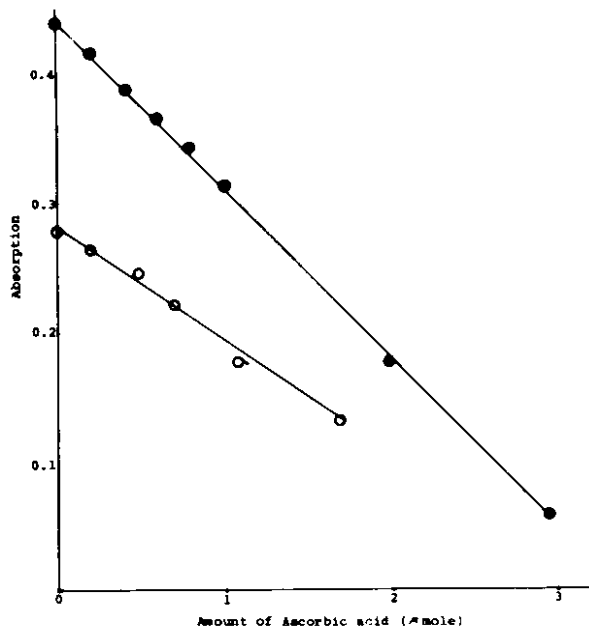


Fig. 1. Calibration graphs for the determination of ascorbic acid by copper method (●) and silver method (○),

Table 1. Analysis of Ascorbic Acid in Tablets by Copper Method

Sample	Iodimetric Method (mg per tablet)	Atomic Absorption Method (mg per tablet)
Redoxon	1005	989
Redoxon Quiksolv	1012	975
Cebion 1 gm	1016	998
Cebion Calcium	978	991
Cal-De-Ce	1008	1000
Cal-C-Vita	1003	1018

tion methods for the determination of ascorbic acid are not selective. However, the described methods are simple and sensitive and do not require uncommon or expensive chemicals. When needed, the sensitivity of the silver method can be improved by using more dilute silver solutions and measuring at the more sensitive silver line 328.1 nm.

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