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هيئـــــــة التحريــر

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Determination of (ascorbic acid) in Vitamin C Tablets by Redox Titration

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Abstract

The goal of this study is to determine the amount of ascorbic acid (the active integredient) in commercial products in Vitamin C tablets by using Redox titration. Aredox titration, involving an Iodometric method, has been used to do the analysis. The results of the amount of ascorbic acid in each table was measure in mg ⁄ 100ml. The values of this study showed that Brands 01 ,02, 03, and 04 had 480 ,464,988,937 mg ⁄ 100ml respectively.

Key words: Vitamin C , active integredient ,Redox titration .

Introduction

Vitamins are a group of small molecular compounds, that are essential nutrients in many multi –cellular organisms, and humans in particular [1]. Among the vitamins, vitamin C (also called ascorbic acid) is an essential micronutrient required for normal metabolic function of the body [2]. Human and other primates have lost the ability to synthesize Vitamin C as a result of a mutation in the gene coding for L – gluconolactone oxidase, an enzyme required for the biosynthesis of Vitamin C via the glucuronic acid pathway [3]. Thus, vitamin C must be obtained through the diet. Vitamin C plays an important role as a component of enzymes involved in the synthesis of collagens and carnitine. Vitamin C is the major water – soluble antioxidant within the body [4,5,6]. It lowers cholesterol level and blood pressure [7]. Not only does a Vitamin C intake markedly reduce the severity of a cold, it also effectively prevents secondary viral or bacterial complications many studies have shown that an adequate intake of Vitamin C is effective in lowering the risk of developing breast cancer, cervix, rectum, mouth, prostate and stomach [8,6,9]. A lack of Vitamin C in the diet causes the deficiency disease scurvy [5]. This potentially fatal disease can be Prevented with as little as 10 mg Vitamin C per day [10].

An amount easily obtained through consumption of fresh fruit and vegetables. Some recommended dietary allowances for Vitamin C are listed in Table 1 .

Age	Male	Female	Pregnancy	Lactation
0 -6 months	40 mg	40 mg		
7 -12 months	50 mg	50 mg		
1 -3 years	15 mg	15 mg		
4 -8 years	25 mg	25 mg		
9 -13 years	45 mg	45mg		
14 -18 years	75 mg	65mg	80 mg	115 mg
19+ years	90 mg	75mg	85 mg	120 mg
Smokers	Individuals who smoke require 35 mg ⁄day more Vitamin C than nonsmokers			

Table 1. Recommended Dietary Allowances (RDAS) for vitamin C .

The chemical formula of Vitamin C is (R) -5-((S) -1 ,2 –

dihydroxyethyl) -3,4 – dihydroxyfuran -2 (5H) – one ,molar mass 176.12 g ⁄ mol ,Density 1.65 g ⁄cm^3 ,Melting point 190 -192 c^0 , with solubility in water about 33g ⁄100 ml [11] .

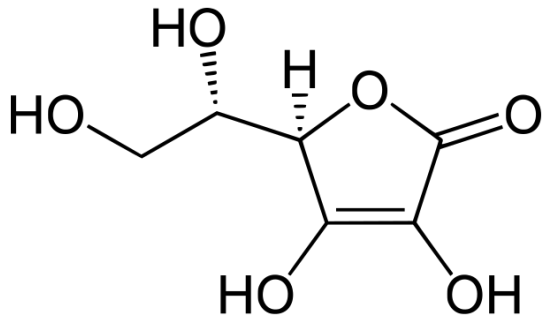
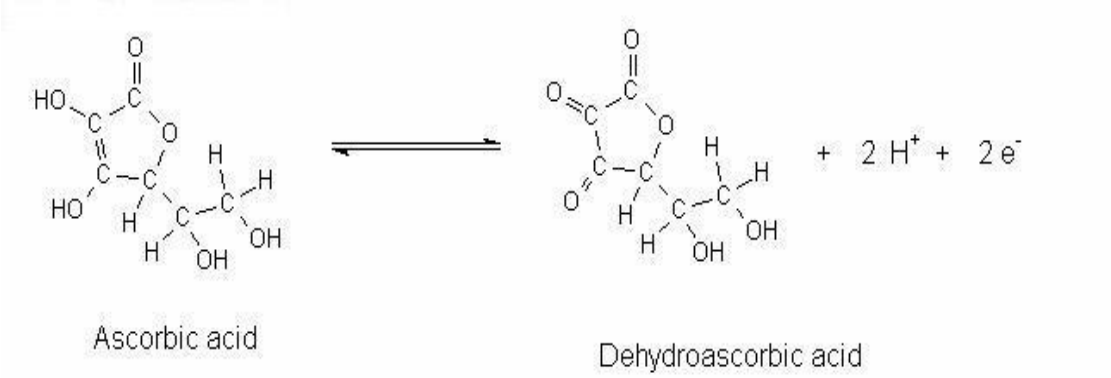


Figure 1. The structure of ascorbic acid, $C_6H_8H_6$

(MW = 176.12 g/mol) Ascorbic acid is a mild reducing agent. for this reason, it degrades upon exposure to oxygen, especially in the presence of metal ions and light. It can be oxidized by one electron to a radical state or doubly oxidized to the stable form called dehydroascorbic acid [12] .The following equation shows oxidation of reduced form of ascorbic acid [13].



There are numerous methods for the determination of Vitamin C in a variety of natural samples, biological fluids and pharmaceutical formulations. These method are spectrophotometric methods and non – spectrophotometric methods [14]. For non – spectrophotomtric methods are such as high - performance liquid chromatography (HPLC), direct titration with iodine solution, enzymatic method [15]. In the present research, the amount of ascorbic acid (the active ingredient) in commercial Vitamin C tablets were determined by using Redox Back Titration.

Materials and Methods

Determination of ascorbic acid by redox titration Vitamin C (ascorbic acid), is a mild reducing agent (it accepts electrons from an electron donor, leaving the oxidation state of the donor at a value less than original (reduced) .

The ascorbic acid itself is oxidized to a higher oxidation state. This class of reactions is known as reduction oxidation reaction or simply, a redox reaction. One such redox reaction is the reduction of the aqueous Iodine molecule ($I_{2(aq)}$) with ascorbic acid , as shown below.

$KIO_{3(aq)} + 6H^{+}_{(aq)} + 5I^{-}_{(aq)} \rightarrow 3I_{2(aq)} + 3H_2O_{(L)} + K^{+}_{(aq)}$ generation of I_2 (Eq . 1)

$C_6H_8O_{6(aq)} + I_{2(aq)} \rightarrow C_6H_6O_{6(aq)} + 2I^{-}_{(aq)} + 2H^{+}_{(aq)}$ oxidation of vitamin C (Eq .2)

Reaction one generates aqueous iodine, $I_{2(aq)}$ This is then used to oxidize Vitamin C (ascorbic acid $C_6H_8O_6$) in reaction two. Both of these reactions require acidic conditions and so dilute sulfuric acid, $H_2SO_{4(aq)}$, will be added to the reaction mixture . Reaction one also requires a source of this dissolved iodide ions, $I^{-}_{(aq)}$. This will be provided by adding solid potassium iodide, $KI_{(s)}$, to the reaction mixture .

Reagents

All reagents were of analytical – reagent grade. and all solutions were prepared using distilled –deionized water. Reagents required 0.02M standard potassium Iodate, 0.1M sodium Thiosulfate ,0.5 M Sulphur acid , %0.5 starch solution .

Sample collection

The samples (vitamin C tablets) were collected from local pharmacy stores of AL – Khoms city of Libya . The strength of each Brand is shown below:

Brand 01 : Strength 500 mg

Brand 02 : strength 500 mg

Brand 03 : strength 1000 mg

Brand 04 : strength 1000 mg

Experimental Procedure

Standardization of sodium Thiosulfate Solution pipette 5 ml of the KIO_3 Solution into a 250 ml Erlenmeyer flask. Add 0.5gram of solid KI and 10 ml of (0.5M) Sulfuric acid to the conical flask. Titrate the liberated iodine with Sodium thiosulfate solution from a burette until a faint yellow color is reached. Add 2 ml of starch indicator and continue the titration until the blue – black color of Starch triiodide complex Just disappears. Repeat these Steps for three times and record the mean of sodium Thiosulfate volume for calibration process.

Determination of Vitamin C in a Tablet

The Vitamin C Tablets were crushed into powder by using mortar and pestle. Appropriate amount of powder was taken in a volumetric flask. Treat each Tablet individually as follows:
Into Erlenmeyer flask, pipet 10 ml of 0.5 M H2SO4 and 0.5 g of KI and 10ml deionized water. Titrate with (0.1M) Sodium Thiosulfate Solution as before. Add 7 drops of starch indicator Just prior to the end point .Record the volume of titrant used .

Results and Discussion

The amount of a ascorbic acid for four Brands of Vitamin C Tablet is calculated from the expression :

(meq KIO_3 –meq $Na_2S_2O_3$) =meq ascorbic acid.

To convert to g of ascorbic acid per ml of each Tablet use.

mass $_{(ascorbic\ acid)}$ = meq a scorbic acid × Am

Where

Am is molecular mass of a scorbic acid.

All results of all four Brands of Vitamin C of local Libyan markets is given in Table 1.

Table 1: Amoun of Vitamin C for calculated and labeled in mg/100ml for four commercial Brands.

Commercial Brands	Amount of calculated (mg/ 100ml)	Purity%
Brand 01	480	96
Brand 02	464	93
Brand 03	988	99
Brand 04	937	94

From the Table 1, the Vitamin C contents in each sample which is determined using redox titration do not have much different compared to the lable value. The difference between label value and analysis results Could be caused by errors in judging the end point. The action of light, dust particles or oxygen on standard solution may raise errors . All these factors can be minimized by taking the average of results of more three times or use of coloured glass bottles . Also period storage can be a effect on practical results as in Brand 02, 04 .

Conclusion

The very simple and rapid procedures described in this paper can be an alternative to the more complex and expensive methods for assay of ascorbic acid content in Vitamin C Tablet. The great amount of ascorbic acid recorded in Brand 01 and Brand 03 were 480 and 988 mg / ml respectively.

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الفهـــــــــــرس

يشترط في البحوث العلمية المقدمة للنشر أن يراعى فيها ما يأتي :

- أصول البحث العلمي وقواعده .
- ألا تكون المادة العلمية قد سبق نشرها أو كانت جزءا من رسالة علمية .
- يرفق بالبحث تزكية لغوية وفق أنموذج معد .
- تعدل البحوث المقبولة وتصحح وفق ما يراه المحكمون .
- التزام الباحث بالضوابط التي وضعتها المجلة من عدد الصفحات ، ونوع الخط ورقمه ، والفترات الزمنية الممنوحة للتعديل ، وما يستجد من ضوابط تضعها المجلة مستقبلا .

تنبيهات :

- للمجلة الحق في تعديل البحث أو طلب تعديله أو رفضه .
- يخضع البحث في النشر لأولويات المجلة وسياستها .
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