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Analysis of Effect of Heating and Storage Time on Vitamin C Concentration of Selected Fresh Fruits juices by Colorimetry

Jayanti S. Rajora
Department of Chemistry, Government Science Collge-Gandhinagar, Gujarat, India

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ABSTRACT

Vitamin C is an important component of food that is needed for all animals and humans. It occurs naturally in many fruits and vegetables like citrus fruits, pineapples, melons, mangoes, tomatoes, cabbage, broccoli, green pepper and potatoes. The Vitamin C present in these food materials is easily impaired by exposure in air and light, by cooking or with storage. In present study, the degradation of Vitamin C content in fresh fruit juices with storage time and heating temperature was investigated by colorimetry in terms of absorption. Results from standard curve method show that vitamin C content was found to be maximum in Guava (Psidium guajana), and lowest in Sweet Lime (Citrus limetta). It was also concluded that there was a significant loss in Vitamin C concentration with heating at different temperatures and with storage timing.

Keywords: Vitamin C, Fresh Fruit Juices, Colorimetry, Storage Time

I. INTRODUCTION

Vitamin C is an essential nutrient for certain animals including humans. The term vitamin C encompasses several vitamers that have vitamin C activity in animals. Citrus fruits contain major quantity of ascorbic acid [1], which is an essential nutrient [2]. Ascorbate salts such as sodium ascorbate and calcium ascorbate are used in some dietary supplements. These release ascorbate upon digestion. Ascorbate and ascorbic acid are both naturally present in the body, since the forms interconvert according to pH. Oxidized forms of the molecule such as dehydro-ascorbic acid are converted back to ascorbic acid by reducing agents. Vitamin-C encompasses very different physiological processes ranging from facilitation of iron absorption through involvement in hormones and carnitine synthesis for important roles in epigenetic processes [3].

For determination of Vitamin C content and effect of heating and storage timing on absorbance colorimetric method is easy and useful. Colorimeters help to detect colour and determine the concentration of the solutions. For example, when a wavelength goes through a sample, some of the light is absorbed and some passes. This device detects the wavelengths of light that passes through. The colorimeter makes use of the Beer-Lambert law for the purpose of detecting the wavelength absorbance. We write Beer-Lamberts law as:

$$A = \varepsilon c l$$

Where, A is the absorbance, ε is the molar absorptivity, c is the concentration of the solution and l is the length that the light passes through (the mean free path). If the concentration of the solution is greater, it absorbs more light, which we can identify by measuring the difference between the amount of light at its starting point and that after passing the solution [4].

Optical density is the degree to which a refractive medium retards transmitted rays of light. Absorbance is a measure of the capacity of a substance to absorb light of a specified wavelength. The optical density measurement takes both, the absorption and scattering of light, intoconsideration. The relationship between the optical density and the absorbance value is that both measure the light absorption when a particular light wave passes through a specific optical material. Since both are not similar but measure the same entity, absorption of light. Regarding optical density, it significantly measures the light speed while passing through any transparent material. On the other hand, absorbance is an essential factor used in Beer Lambert's law to calculate the amount of light absorbed by the sample mixture. So, Optical density (O. D.) is referred to as absorbance, Absorbance is a property that describes a material's ability to absorb the power of a given light (called "radiant power") that is passed through that material [5, 6].

Optical density (O.D.) ≈ Absorbance (A)

In the present study, colorimetric analysis of vitamin C (chemically ascorbic acid) content in fruits is done with by using methylene blue with oxalic acid and buffer solution having pH 4.2.

This method is more appropriate to determine the quantity of ascorbic acid [7]. Methylene blue is a water soluble dye molecule. Under acidic condition, it can be easily reduced to colourless hydrogenated molecule leucomethylene blue by ascorbic acid [8].

II. MATERIALS AND METHODS

Sample collection and preparation:

Fully ripened fruits Lemon, Orange, Guava and Sweet lime were collected from local fruit market of Nava Naroda, Ahmedabad during winter season. Fresh Fruits (Lemon, guava, orange, Sweet lime) were washed thoroughly with distilled water, manually sliced and pulped using a blender and filtered. Sample is divided into six portions, weighing five grams each and labelled as samples A-D. All these samples are diluted and exposed to heat treatment at 50 ^{o}C for 5, 10, 15, 20, 25 and 30 minutes respectively. Then absorbance is measured.

Standard Ascorbic acid solution

Standard ascorbic acid solution was prepared by dissolving 25 mg of AA in 100 ml of distilled water.

Oxalic acid: 0.63gm of oxalic acid was weighed and transferred in 100 ml volumetric flask, dissolved in distilled water and make upto the mark.

Buffer solution: 100 ml solution of Acetate buffer having pH 4.2 was prepared from buffer tablet. pH of solution was counter checked with the help of pH meter.

Methylene blue (0.01%): 100 ml solution of 0.01% Methylene blue was prepared in distilled water.

Instruments: Photoelectric Colorimeter, pH meter

Preparation of calibration curve

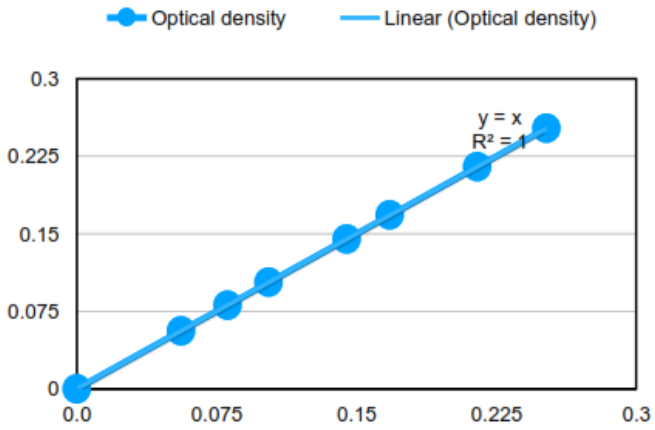
Calibration curve of different concentrations i.e. 0.5, 1, 1.5, 2, 2.5, 3.0, 3.5 mg/ml was prepared by proper dilution method.

Calibration Curve of ascorbic acid: (concentration vs optical density)

Analysis:

The processed samples were subjected to the following analysis immediately after sample preparation for vitamin C determination.

20 ml oxalic acid solution, 0.2 ml of 0.01 % methylene blue solution and 1 ml of acetate buffer of pH 4.2 were taken in a 50 ml beaker. To this fresh and heated ripened sample at 50°C of 1 ml solution was added separately and measured for absorbance



Periodically after 5, 10, 15, 20, 25 and 30 minutes of boiling. Absorbance of each solution was read using photo colorimeter of ChemiLine at wavelength 540 nm.

III.RESULTS AND DISCUSSION

From calibration curve method, amount of ascorbic acid was determined in chosen fruit samples which is mentioned in Table 1.

Table 1. Amount of vitamin C in samples of fresh fruit juices

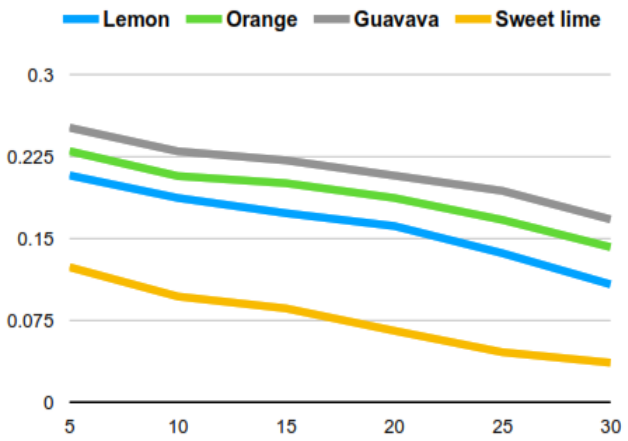
Code No.	Sample Name	Absorbance	Amount of Vitamin - C (mg/ml)
A	Orange	0.338	54.04
B	Guava	0.619	108.50
C	Lemon	0.225	32.20
D	Sweet lime	0.142	16.24

Table 2. Change in absorbance with heating time

Heating time (mins)	Lemon (O.D.)	Orange (O.D.)	Guava (O.D.)	Sweet lime (O.D.)
5	0.2076	0.2298	0.2513	0.1236
10	0.1870	0.2070	0.2298	0.0969
15	0.1730	0.2006	0.2216	0.0861
20	0.1611	0.1870	0.2074	0.0655
25	0.1366	0.1670	0.1934	0.0457
30	0.1079	0.142	0.1674	0.0362

Curve 2: Change in absorbance with heating time vs optical density

The absorbance in terms of optical density of vitamin C after heating times of 5, 10, 15, 20, 25 and 30 minutes at 50°C was plotted.

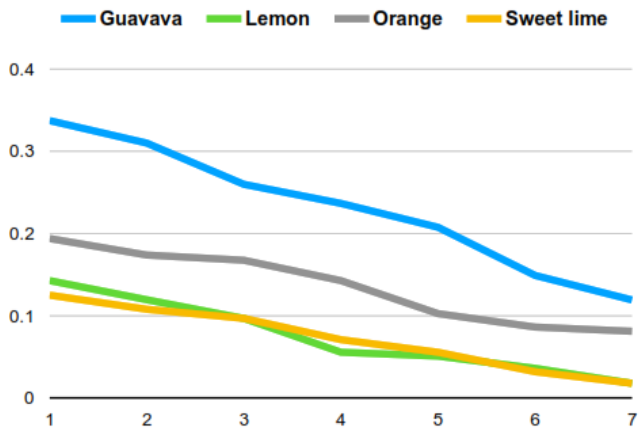


It was found that absorbance of guava (Psidium guajana), orange (Citrus sinensis), lemon (Citrus limon) and mausambi (Citrus limetta) were decreasing with temperature.

Table 3. Day wise change in absorbance

Days	Lemon	Orange	Guava	Sweet lime
1	0.1426	0.1938	0.3372	0.1249
2	0.1191	0.1739	0.3098	0.1079
3	0.9690	0.1674	0.2596	0.0969
4	0.0555	0.1426	0.2365	0.0706
5	0.0506	0.1023	0.2076	0.0555
6	0.0362	0.0860	0.1487	0.0315
7	0.0177	0.0810	0.1191	0.0177

Curve 3 : Day-wise change in absorbance:



The absorbance of different fruit samples was plotted against day. It was found that absorbance (concentration) was continuously decreasing from day 1 to day 7. It indicated that the vitamin C level declined until the end of the 7 days storage period.

IV.CONCLUSION

In the present study, a simple colorimetric analysis of ascorbic acid content in different fruits was done for different heating times and on different days. It was observed that a significant decrease in concentration of ascorbic acid occur with increase in processing time. After dilution of fruit juices taken at ripened stage during processing time after 20, 25 and 30 minutes the concentration of ascorbic acid was completely reduced to nearly zero. From the present investigation, it is also concluded that content of ascorbic acid decreases with storage time from day one to seven and it reaches almost zero on day seven in lemon and orange. It is also found that guava has more concentration of vitamin C than other fruits. Processing of a fruit into juice and pulp involves thermal exposure which leads to deterioration of quality of fruit so it is recommended to take fresh fruits than stored pulps and juices.

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