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Temperature dependence study of Vitamin C invarious Citrus Fruits

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ABSTRACT

Temperature effects on Vitamin C content in citrus fruits were determined using iodometric titration method under three temperature regimes (room temperature, 60°C and 90°C), representing the range oftemperatures the fruits may be exposed to during processing and storage. It was observed that Vitamin C content was decreased as it was exposed to higher temperature. The decrease was observed high when the temperature of the juice was raised and kept at 60°C, which was further decreased when the temperature was raised to 90°C. This paper showed light on the effect of processing and storage on the ascorbic acid content of citrus fruits.

KEYWORDS: *Vitamin C, iodometric titration, ascorbic acid, citrus fruits.*

INTRODUCTION

Citrus species (Rutaceae) were the most popular fruits, originated in South-East Asia and then gradually spread to different parts of the world. These fruits contained a variety of sugars, citric acid, ascorbic acid, carotenoids, minerals, essential oils, etc and play an important role in human nutrition as excellent source of antioxidants (ascorbic acid, carotenoids and phenolic compounds). These constituents were considered to be essential components of functional foods. Many of these substances prevent damage to cell membrane and other structures by neutralizing free radicals.

Ascorbic acid was the most important antioxidant in citrus fruit juices and it protects the organism from oxidative stress. Vitamin C cannot be synthesized through body cells, nor does it store it. It was therefore important to include plenty of vitamin C containing foods in daily diet. More than 90% of the vitamin C in human diets is supplied by fruits and vegetables (including potatoes)1-6.

OBJECTIVES

One of the objectives of the present study was to relate the content of ascorbic acid of six citrus fruits namely Citrus sinensis (Orange), Citrus limon (Lemon), Citrus paradisi (Grape), Citrus maxima (Babloos naranga), Citrus limetta (Mosambi) and Punica granatum (Pomegranate) with the view of making recommendations for their intake.

A redox titration, involving an Iodometric method7-9, has been used to do the analysis. The redox reaction was better than an acid-base titration since there were additional acids in a juice, but few of them interfere with the oxidation of ascorbic acid by iodine. Vitamin C is a weak acid and a good reducing agent. Iodine is a weak oxidizing agent, so that it will not oxidize substances other than the ascorbic acid in the sample of fruit juice. As a strong reducing agent, vitamin C will reduce I_2 to I^- very easily. The excess of iodine reacts the starch as indicator in redox

reaction. In this reaction, the ascorbic acid molecule gains oxygen. Each iodine atom in the I_2molecule accepts an electron and become negatively charged to form iodide ion. Thus, the ascorbic acid molecule was oxidized and the iodine molecule was reduced. Excess iodine reacts with iodide ions (I^-) to form triiodide ion (I^{3-}) which forms a very intense blue color when it reacts with starch. To detect the end point, starch must be added at the beginning of the titration in the conical flask. When all ascorbic acids have finished, the excess of iodine solution will react the starch to form blue-black colour in the solution.

I^{3-} + starch → starch (I^{3-})

(Blackish-blue color)

Starch indicator is biodegradable and so fresh starch indicator must be prepared.

Various reports have shown fruits to be excellent sources of vitamin C. But it was lost from foods during preparation, cooking or storage10-12. To find out the effect of temperature on stability of Vitamin C, a temperature dependence study of vitamin C was carried out under three temperature regimes representing the ranges the fruits may be exposed to during processing and storage.

MATERIALS AND METHODS

Sample collection and preparation

Citrus fruits namely Citrus sinensis (Orange), Citrus limon (Lemon), Citrus paradisi (Grape), Citrus maxima (Babloos naranga), Citrus limetta (Mosambi) and Punica granatum (Pomegranate) were collected from local market. The selected fruits were then washed thoroughly with water. The 200g sample of citrus fruits were squeezed in a juicer together with 50ml of distilled water. After blending, strain the pulp and seed, washing it with a few 10ml portions of distilled water and make the extracted solution up to 250ml in volumetric flask.

Preparation of iodine solution

4.50 g Potassium iodide (KI) and 0.203 g potassium iodate (KIO3) were dissolved into 500 ml beaker with 200 mL of distilled water. 25 ml of 5 N sulfuric acid was added into the beaker and then diluted with distilled water until 500 ml solution.

Preparation of Vitamin C Standard Solution

0.250 g Ascorbic acid was dissolved in the beaker with 100 ml distilled water. The solution was transferred quantitatively into 250 ml volumetric flask and diluted to the mark with distilled water.

Standardization of Iodine Solution

25 mL of Vitamin C solution was pipetted into a 125 ml Erlenmeyer flask. 10 drops of 1% starch solution were added and then titrated against iodine solution until blue-black colour was observed. Titrations were repeated for concordency.

Estimation of Vitamin C in juice samples

40 mL of Juice samples were pipetted into a 125 mL Erlenmeyer flask. Following by 10 drops of 1% starch solution and titrated against iodine solution until blue-black colour was observed. Titrations were repeated.

Estimation of Vitamin C of juice samples at different temperatures

50 ml of selected Juice samples were pipetted out into labeled 250 ml beakers. They were heated to a temperature of 60°C and maintained at that temperature for 2hrs. The second group of juice sample (50 ml) selected in different beakers were heated to a temperature of 90°C and maintained at that temperature for 2hrs. All the 12 selected samples were then cooled. After that 40ml of juice samples were pipetted out into a 250 ml conical flask. 4 ml of 1% starch solution added and titrated against iodine solution until blue-black colour was observed. Titrations were repeated.

RESULTS AND DISCUSSION

The result of the average value of vitamin C in each fruit juice samples under the specified condition were tabulated in Table below. It showed the highest concentration of vitamin C found in Babloos juice, hitting 31.97 mg /100g, the lowest level was found in Grape juice, when it reached 2.34 mg /100 g of juice. The amount of Vitamin C in juices of six different citrus fruits : Orange, Mosambi, Pomegranate, Babloos, Grape and Lemon) were as follows.

Bambloos>Orange>Mosambi>Lemon>Pomegranate>Grape

Fruit Juice Samples	Temperature	Total Vitamin C (mg/100g)
Orange **Citrus sinensis**	32°C	31.24
Lemon **Citrus limon**	32°C	16.56
Grape **Citrus paradise**	32°C	2.3409
Babloos **Citrus maxima**	32°C	31.97
Mosambi **Citrus limetta**	32°C	30.506
Pomegranate **Punica granatum**	32°C	12.77

TABLE 1: TOTAL VITAMIN C CONTENT IN NATURAL FRUIT JUICE SAMPLES

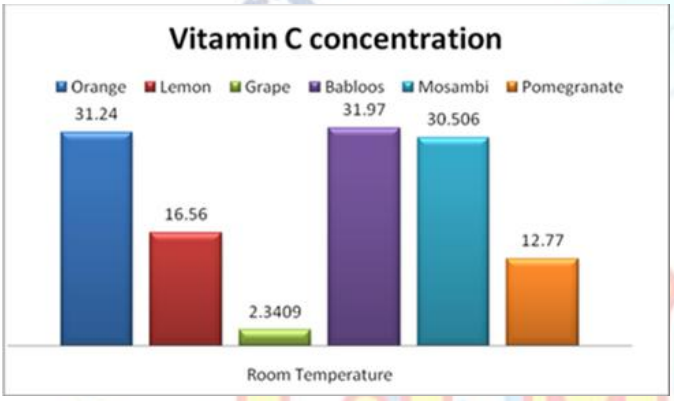


FIG 1: VITAMIN C CONCENTRATION (MG/100G)

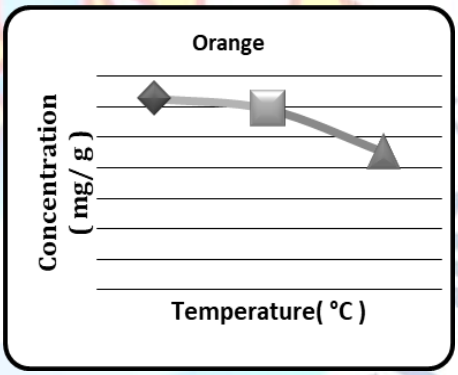
The effect of temperature on the amount of Vitamin C in citrus fruits was also calculated by titrating the juices using iodine solution. It can be seen from analytical results in table 2 that the lower the temperature the better the concentration of Vitamin C in fruit juice.

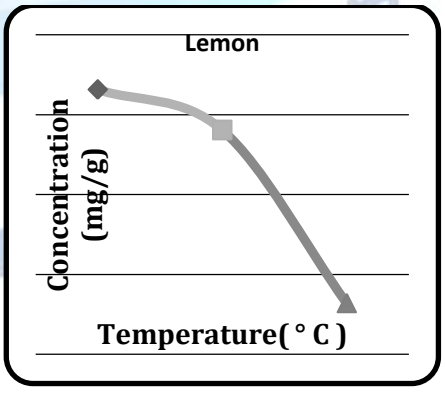
Higher temperature does not favour Vitamin C. It is better to maintain or store Vitamin C in a place below the room temperature. This is consistent with reports that, climate, especially temperature affect vitamin C level. Areas with cool nights produce citrus fruits with higher vitamin C levels.Hot tropical areas produce fruit with lower levels of vitamin C. Vitamin C loss during storage depends on the type of storage methofor example, handling and storage; oxygen is the most destructive ingredient in juice, causing degradation of vitamin C.

Fruit Juice samples	Concentration		
	Roomtemp (mg/g)	60°C (mg/g)	90°C (mg/g)
Orange **Citrussinensis**	31.24	29.507	22.59
Lemon **Citrus limon**	16.56	14.035	3.196
Grape **Citrus paradise**	2.341	2.161	1.639
Babloos **Citrus maxima**	31.97	28.071	23.096
Mosambi **Citrus limetta**	30.506	28.229	24.35
Pomegranate **Punica granatum**	12.77	12.77	9.295

TABLE 2: TOTAL VITAMIN C CONTENT IN NATURAL FRUIT JUICE SAMPLES AT DIFFERENT TEMPERATURE

Juice should be discouraged from being display in the hot weather above room temperature in order to maintain production concentration.Our temperature dependence study on citrus fruits were found to follow a similar pattern of loss. This is because the vitamin C is more sensitive to temperature. Degradation was observed high in our selected samples as the temperature was raised to 90°C.





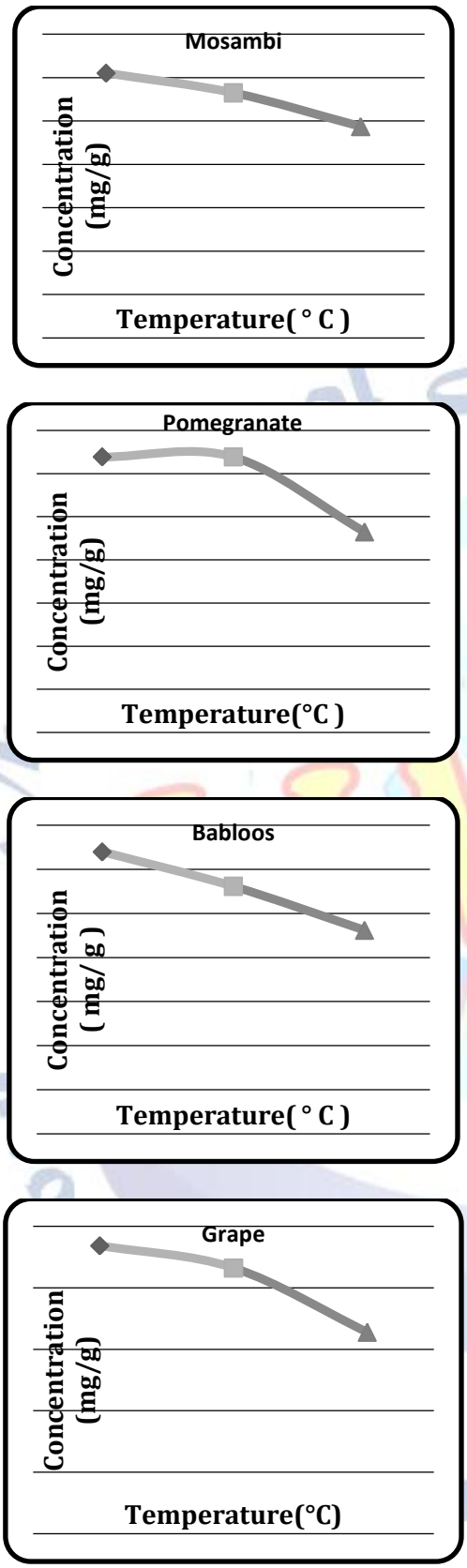


Fig 2: Temperature Dependence Of Vitamin C Concentration

CONCLUSION

Determination of ascorbic acid content by iodometric titration is an easy, safe, and fast method. The redox reaction is preferable to an acid-base titration because a number of other species in juice can act as acids. This would help in quickly determining an estimate of ascorbic acid content of fruits. Results showed that Bambloos had the highest value of ascorbic acid, 31.97mg/100g followed by Orange, 31.24 mg/100 g and then Mosambi, 30.50 mg/100 g. Grape had the least value, 2.34 mg/100g. It therefore follows that Bambloos would supply more ascorbic acid per 100 gm for body need compared to the other fruits. It was observed that Vitamin C content was decreased as it was exposed to higher temperature. The decrease was observed high when the temperature of the juice was raised and kept at 60oC. This was as a result of increase in oxidation of ascorbic acid with increase in temperature, as higher temperature favours redox reaction.

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