

Comparative Study of the Content of Vitamin C in Fresh Fruits and Different Types of Food Prepared from them

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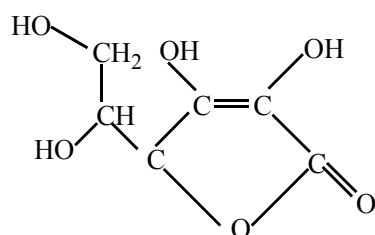
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Abstract

Vitamin C, also known as ascorbic acid is essential nutrients particularly in many multi-cellular organism, and humans. The deficiency of vitamin C in human results the disease called scurvy, whose symptoms include hemorrhaging (especially in the gums), joint pain and exhaustion. The human body cannot produce ascorbic acid, and it must be obtained entirely through one's diet. So, the objective of the study was to investigate the content of vitamin C in the fresh as well as preserved food available in our market. The following food items are selected in our investigation: i) Fresh fruits and vegetables, ii) Fruit juices, iii) Powdered materials of fruits used for the preparation of instant drinks and iv) Different types of food items prepared from fruits like jelly, jams, achar (pickle), sauces and etc. The effect on cooking of vitamin C would be observed by comparing the content of Vitamin C of the fresh fruits with their respective prepared food derivatives. The findings of the study produced the quality of Vit. C in the locally available different types of fresh as well as preserved foods for common people and make those food items nutritionally and physiologically more important. It was found that the citrus fruits content more vitamin C as compared to fruit like mango, boroi etc.

I. Introduction

Vitamins are a small group of organic compounds that are essential nutrients in many multi-cellular organisms, and humans in particular. Ascorbic acid is the chemical nomenclature of vitamin C which is necessary for the formation and maintenance of the substance found between the cells which helps to hold them together, especially in the capillary walls, cartilage, bones and teeth.



Structure of vitamin C (ascorbic acid)

Thus the deficiency of vitamin C in humans results in the disease called scurvy, whose symptoms include hemorrhaging (especially in the gums), joint pain and exhaustion¹. In its final stages scurvy is characterized by a profound exhaustion, diarrhea, and then pulmonary and kidney failure, which results in death². A very small daily intake of vitamin C (10-15 mg/day for an adult) is required to avoid deficiency and stave off scurvy³. However, there has been, and continues to be, vigorous debate on what the optimum daily intake of vitamin C is. Some have argued that 200 mg/day is an optimal daily intake for adult humans. Others have suggested 1-2 g/day is best². Despite this studies that show that the blood is saturated with vitamin C at 100 mg/day, and any excess is excreted in the urine. In an attempt to balance the competing claims, and ensure the general populations good health, the Federal Food and Drug Administration has adopted the recommended dietary allowance (RDA) of 60 mg/day for adults (aged 15 or older), less for children, and more for pregnant and lactating women¹. The human body cannot produce ascorbic acid, and so it must be obtained entirely through one's diet. Fruits, vegetables, meats of organs like liver and kidney are generally the best sources of ascorbic acid. However, muscle meats and most seeds do not contain significant amounts of ascorbic acid⁴. The amount of

ascorbic acid in plants varies greatly, depending on such factors as the variety, weather, and maturity⁵. But the most significant determinant of vitamin C content in foods depends on how the food is stored and prepared. Since vitamin C is easily oxidized, storage under normal condition and cooking leads to the eventual oxidation of vitamin C by oxygen in the atmosphere. In addition, ascorbic acid's water-solubility means that boiling it and then discarding the cooking water can lose a significant amount of vitamin C present in a food.

In the present investigation the content of vitamin C, in different food items including fresh fruits, and different food items prepared from these fruits like jelly, jams, achar (pickle), sauces etc was determined by spectroscopic methods. This will enable us to evaluate the role of the fresh fruits / vegetables as well as different types of food items prepared from them in human health and nutrition.

II. General Methods

Solvents and chemicals used in the experiments were commercially available and reagent grade (Sigma, E. Merck or BDH).

Preparation of the reagents

5% Metaphosphoric acid-10% acetic acid solution: 50g of solid metaphosphoric acid (E.Merck) were dissolved in a mixture of 40 mL glacial acetic acid and 450 mL of distilled water in a 500 mL volumetric flask.

85% Sulphuric acid solution: 180 mL of concentrated sulphuric acid was added to 20 ml of water in an ice bath

10% Thiourea solution: 1g of thiourea was dissolved in 9 mL of distilled water.

2,4- Dinitrophenylhydrazine solution: 2g of 2,4-dinitrophenylhydrazine were dissolved in 80 mL of distilled water and 14.67 mL of concentrated sulphuric acid (specific gravity 1.84). The solution was filtered and stored.

Aqueous Bromine solution: 5 mL of liquid bromine was added to 100 mL of distilled water and shaken vigorously. The solution was filtered and stored.

Preparation of Standard ascorbic acid (vitamin C) solution: 50 mg standard crystalline ascorbic acid was dissolved in

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100 mL of 5% metaphosphoric acid –10% acetic acid solution.

Sample Collection: The selected fresh fruits and vegetables were collected from local markets. Care was taken to collect fruits/vegetable samples during their peak seasons. After collection the food samples were cleanly washed with tap water and cut so as to collect edible portion only.

Preparation of Samples: The food items were prepared according to reported methods⁶. Amounts of each item were noted separately before the extraction of Vit. C. Weights of cooked samples were taken after cooling to room temperature. Thus 1 to 5g of the edible portion of each fresh fruit or vegetable or different forms of preserved fruits or vegetables was blended and homogenized with about 50 mL of 5% metaphosphoric acid and 10% acetic acid solution. In case of drinks 1.0 to 2.5 mL of each sample was used. This was then quantitatively transferred to a 100 mL volumetric flask and was shaken gently until a homogeneous dispersion was obtained. Then it was diluted upto the mark with 5% metaphosphoric acid and 10% acetic acid solution. The solution was then filtered and the clear filtrate was collected for the determination of vitamin C in the sample.

Estimation of vitamin C: Few drops of bromine water were added to 4 mL of the filtered sample solution until the solution became colored (to confirm the completion of the oxidation of ascorbic acid to dehydroascorbic acid). Then 1 to 2 drops of thiourea solution was added to it to remove the

excess bromine and to get a clear solution. The standard solutions of ascorbic acid (5 ppm, 10 ppm, 20 ppm and 25 ppm) were prepared from 500 ppm stock solution of ascorbic acid by proper dilution. 1 mL of 2,4-dinitrophenylhydrazine was mixed⁷ thoroughly with all standards and also with the oxidized ascorbic acid. For completion of the reaction all the standards and the samples were kept at 37°C for three hours in a water bath. After the incubation, the solutions were cooled in an ice bath and were treated with 5 mL of 85% H₂SO₄ with constant stirring and a colored solution was obtained. The absorbance of these solutions were measured at 522 nm against a reference made identically without ascorbic acid solution. For obtaining a calibration curve the absorbance of the standards were plotted against their corresponding concentrations. The concentration of the sample solution as well as the content of vitamin C of the sample were calculated from the calibration curve for the corresponding absorbance of the sample.

The content of total vitamin C in the fresh fruits and different types of food items like (achar, chatni, bar sauces and ketchup) prepared from these fruits are presented in the following Table. Sixteen different types of food items including fresh fruits a variety of achar and chutney etc were analyzed to determine the content of vitamin C of these food materials and compared its content with their precursor.

Table. Content of Vitamin C in fresh fruits

Name of the fruits (1)	Content of average vitamin C in mg per							
	100 g as fresh edible fruit (2)	250 mL as fruit juice (3)	5 g as dry powder (4)	20 g as achar (5)	20 g as chatni (6)	20 g as fruit jam (7)	20 g as fruit jelly (8)	20 g as bar; gel; kismis; ketchup; etc. (9)
Sweet fruits								
Apple (<i>Malus domestica</i>)	35.1	-	-	-	-	10.5	20.1	-
Banana (<i>Musa paradisiacal</i>)	32.9	-	-	-	-	-	7.5	-
Boroi (<i>Zizyphus mauritiana</i>)	60.0	-	-	-	16.0	-	-	-
Grapes (<i>Vitis vinifera</i>)	85.3	-	-	-	-	-	-	45.6
Guava (<i>Psidium guajava</i>)	128.5	53.0	-	-	-	-	9.5	-
Litchi (<i>Litchi chinensis</i>)	36.6	89.7	-	-	-	-	-	9.1
Mango (<i>Mangifera indica</i>)	75.5	67.5	7.9	-	-	-	-	23.7 (bar); 6.4 (gel)
Sour fruits								
Amloki (<i>Phyllanthus emblica</i> L)	482.4	-	-	121.6	23.2	-	-	-
Lebu (<i>Citrus aurantifolia</i>)	25.3	62.5	4.1	-	-	-	-	-
Malta (<i>Citrus sinensis</i>)	36.0	-	13.2	-	-	-	-	-
Green Mango (<i>Mangifera indica</i>)	56.3	-	-	9.5	14.0	-	-	-
Orange (<i>Citrus reticulata</i>)	15.7	77.1	9.4	-	-	-	3.0	-
Pineapple (<i>Ananas comosus</i>)	35.5	46.8	-	-	-	27.6	21.0	-
Tetul (<i>Tamarindus indica</i>)	178.9	-	-	-	12.9	-	-	-
Sweet vegetable								
Tomato (<i>Solanum lycopersicum</i>)	28.3	-	-	-	-	-	-	10.4
Hot vegetable								
Chili (<i>Capsicum annum</i>)	154.4	-	-	19.8	-	-	-	-

III. Results and Discussion

The fresh fruits were divided into two categories sweet and sour. Mainly the citrus fruits of the sour category were

investigated in the present study. Fruits and vegetables are the ready sources of energy. Free sugars and different types of vitamin are the main constituents of the energy of the

fruits and vegetables. Sweet fruits are generally rich in free sugars whereas the citrus fruits are rich in ascorbic acid, commonly known as vitamin C. Other than fresh fruits and vegetables, the dry powder materials of few fruits like mango and orange, considerable number of fruit juices and different types of foods prepared mainly from fruits and vegetables were also investigated to find out the content of vitamin C in these cases. The common people use the powdered food materials and the fruit juices very frequently as soft drinks when they were tired and feel thirsty. Other foods like chatni, achar, jam, jelly, gels and bars prepared from different fruits were taken as a part of the menu with the diet. So it is very interesting to know whether the characteristics of vitamin C in fruits are retained or not during the process of preparations of these foods. It was found that the content of vitamin C of these prepared foods in all the cases possessed lower value than the corresponding fruits. Ascorbic acid is very much heat sensitive so it is very likely that a part of vitamin C was lost during the preparation of chatni, achar or other foods where heat is very much necessary. This expectation is very much reflected in the investigation of chatni, achar and other prepared food from fruits and vegetables.

Our very traditional citrus fruits like amlaki, tetul, boroi, green mango, were found to be the richest sources of vitamin C. Per 100 g fresh edible portion of these fruits contained 482.4 to 56.3 mg of vitamin C. Malta, and orange contained substantial quantity of vitamin C. Guava is one of the richest sources of vitamin C among the sweet fruits those were investigated in the present study Table. Per 100 g edible portion of guava contained 128.5 mg of vitamin C followed by grapes. The rest of the fruits in this category possessed almost equal amount of vitamin C where the values were in the range of 32.9 to 36.0 mg per 100 g fresh edible portion.

Nineteen different types of foods like chatni, achar and jam, jelly bar, gel etc., prepared from various fruits were investigated. Chatni prepared from four different fruits were analyzed and it was found that per 20g of chatni (column 6 of the table) prepared from each fruit like amlaki, boroi, mango and tetul contained significant amount of vitamin C (23.2 to 12.5 mg) but this value is much lower than the content of vitamin C of the corresponding fruits from which those chatni were prepared. Similar results were obtained for achar, jam, jelly and other food products prepared from fruits (column 5, 7, 8 and 9 of the table). From the observation, it may be certain that any types of food prepared from fruits possessed vitamin C of lower value than their precursor fruits. But this quantity of vitamin C per 20 to 25 mg of all these prepared foods (except the jelly of pineapple, where little more amount required) is more than enough to avoid deficiency and stave off scurvy³ where daily intake of vitamin C (10-15 mg/day for an adult) is required. So if the common people take chatni, achar, jelly, jam etc. with their principal meal like rice and bread the daily requirements of vitamin C is almost covered.

Fruit powder like mango, orange and lemons with different trade names are available in the markets were also investigated (column 4 of the table). It was found that the powder materials of the citrus fruits like malta and orange

contained more vitamin C as compared to the fibrous sweet fruit like mango. The content of ascorbic acid i.e., vitamin C per 5.0 g powder of the citrus fruits was found to be 4.1 to 13.2 mg as compared to mango where the value was 7.9 mg. In most of the cases the content of total vitamin C in the pack size was found to be 2.0 to 5.0% lower than that of the stated amount. The main reason for that may be the oxidation of the powdered materials due to the leakage of the packing, and hence the potency of the active ingredient ascorbic acid was decreased.

Finally, different types of citrus and sweet fruit juices were investigated and it was found that per 250 mL of the fruit juice contain a wide range from 46.8 to 89.7 mg of ascorbic acid. The juices of orange and litchi contain the higher proportion of ascorbic acid as compared to others. In most of the cases the total content of vitamin C was not stated on the pack size. If the people take these types of drinks regularly the daily requirement of vitamin C is fulfilled.

IV. Conclusion

Very common fruits and vegetables which were analyzed in the present investigation showed that per 100 g of fresh edible portion of each fruit or vegetable contained significant amount of vitamin C the value of which was more than the optimum required for an adult per day to avoid the deficiency diseases like scurvy, joint pain and feeling exhausted. During the preparation of chatni, achar, jelly, jams etc. from fruits, part of the ascorbic acid content was lost due to oxidation but the vitamin C content was significant and close to optimum level. As these foods are taken as supplementary with the main food. 10g of each item with the main food can easily fulfill the daily requirement. Similarly, the fruit juices and drinks prepared from powdered fruits can fulfill the daily requirements without any doubt.

Acknowledgement

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