RESEARCH ARTICLE

Comparative Studies on Ascorbic acid content in Various Fruits, Vegetables and Leafy Vegetables

Reddy Varsha T [1] and **Naga Padma P**[1*]

Department of Microbiology, Bhavan's Vivekananda College of Science, Humanities and Commerce, Sainikpuri, Secunderabad-94, Telangana State, India.
[1] varshareddythummala@gmail.com
[1*]Corresponding Author : naga_padmathota@yahoo.com

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ABSTRACT

Vitamin C is a naturally occurring complex organic compound predominantly present as ascorbic acid in many fruits and vegetables. It cannot be synthesized by humans hence needs to be supplemented through diet in the natural form only as synthetic ascorbic acid affects the bacterial growth not differentiating between beneficial gut flora and pathogens. The Recommended Daily Intake (RDI) of vitamin C is 100-200mg which can be met with consumption of fruits and vegetables. The present study was done to estimate ascorbic acid in fresh fruits, vegetables and leafy vegetables to determine the necessary dietary requirement of Vitamin C. The ascorbic acid content of some fruits like apple, pine apple, orange, sapota, lemon, pomegranate, vegetables like onion, tomato, beet root, cucumber, carrot, Indian gooseberry, raw tamarind fruit, raw mango and garlic, leafy vegetables like tamarind leaves, amaranthus green and purple, spinach, Malabar spinach, kenaf, methi, sorrel and portulaca were estimated by volumetric method using DCPIP. Ascorbic acid content was found to be highest among fruits in lemon, followed by pomegranate and orange. Among vegetables highest was in goose berry followed by raw mango and raw tamarind. Vitamin C in leafy vegetables was variable with the highest content in amaranthus green followed by purple amaranthus and methi. This study is significant as different combinations of fruits, vegetables and leafy vegetables can be recommended for consumption based on the dietary requirement of ascorbic acid to different people under various conditions.

Key words: Ascorbic acid, fruits, vegetables, leafy vegetables, dietary requirements.

INTRODUCTION

Vitamin C (Ascorbic acid) is the most important vitamin in fruits and vegetables. A wide variety of foods contain vitamin C like fruits, vegetables, leafy vegetables while seeds do not contain significant amounts of ascorbic acid (Gregory,1993; Kumar, 2013; Chaitanya, 2016). Vitamin C is an organic

compound and all its compounds exhibit biological activity such as oxidized, ester and synthetic form. The main biological form of vitamin C is L-ascorbic acid, and it can reversibly change to oxidized form called dehydroascorbic acid (Martinez, 2010). Except human and other primates, most of the phylogenetically higher animals can synthesize vitamin C (L-ascorbate). Human is unable to synthesize their own vitamin C supply, as human cells cannot perform the crucial last step in vitamin C biosynthesis, the conversion of L-gulono-g-lactone into ascorbic acid which is catalyzed by gulonolactone oxidase enzyme (Levin, 1986). Therefore, they require vitamin C for maintaining the physiological functions. More than 90% of the vitamin C in human diets is supplied by fruits and vegetables (including potatoes). Vitamin C is required for the prevention of scurvy and maintenance of healthy skin, gums, blood vessels and prevention of common cold (Pauling, 1971; Harri, 1992). It functions in collagen formation (Boyera *et al*., 1998), absorption of inorganic iron, reduction of plasma cholesterol level, inhibition of nitrosoamine formation, enhancement of the immune system (Wintergerst, 2006), and reaction with singlet oxygen and other free radicals. As an antioxidant, it reportedly reduces the risk of arteriosclerosis, cardiovascular diseases and some forms of cancer. (Anderson, 1990; Rekha, *et al* 2012).

The Recommended Daily Intake (RDI) of vitamin C is 100-200mg and this can be easily attained through the diet if appropriate fruits and vegetables are consumed. Higher doses of vitamin C, up to 2,000mg, are used to support the immune system (for athletes) or reduce the duration of the common cold. (Marti *et al*., 2009; Chakraborthy *et al*, 2014).Vitamin C is most commonly supplemented because of its potential protection against the common cold, and purported anticancer effects. Athletes report using vitamin C for both the antioxidant properties and potential immune support. The current recommendations for vitamin C intake (according to the FDA) appears to be 75-90mg daily (females and males, respectively) for adults with increases of 10mg for pregnancy, 45mg for lactation, and 35mg for smokers. Children require around 15-45mg daily and adolescents 65-75mg, while infants (12 months or less) appears to require 40-50mg daily; youth do not have differences in dosage based upon gender until adolescence is reached (Abubakar, JA *et al*,1990; Carr, AC,1999).Vitamin C is outright vital for cognitive development of infants during pregnancy, and there are higher dietary requirements of vitamin C during pregnancy and lactation which have to be met wholly through dietary intake of vitamin C, and any deficiency may result in cognitive impairment to the child. In the present study, ascorbic acid content was evaluated in some selected fruits, vegetables and leafy vegetables by titration method using DCPIP.

MATERIAL AND METHODS

Fruits like tomato, pine apple, orange, pomegranate, tamarind fruit, sapota and lemon vegetables like onion, carrot, raw mango, cucumber, beet root, goose berry, raw tamarind and garlic were purchased from local market in Hyderabad city. The leafy vegetables like spinach, tamarind leaves, sorrel, kenaf, amaranthus green and purple, portulaca, methi and Malabar spinach were purchased from local market.

Sample extraction

Before the extraction procedure, all the samples were thoroughly cleaned with deionized water to remove any adhering contaminants if present and then subjected to extraction procedure. 5g of sample was accurately weighed and ground in a mortar and pestle or electric grinder with the addition of 10 ml of 4% oxalic acid. The mixture was further ground and strained through four layers of muslin cloth. The final volume of the extract was made up to 25 ml with 4% oxalic acid in a standard flask (Pauling, 1970). All the samples were similarly treated. Vitamin C in the samples was determined on the same day of purchase to avoid the instability of vitamin C.

Ascorbic acid assay

Ascorbic acid content in fruits, vegetables and leafy vegetables was determined by 2, 6-dichlorophenol indo phenol (DCPIP) titration method (CoSeteng, *et al*. 1989). 5 ml of working standard (500µg/5 ml) of ascorbic acid and 10 ml of 4% oxalic acid were pipetted out into a 100 ml conical flask. The contents in the flask were titrated against the dye solution (V1) until the appearance of a pale pink colour that persisted for a few minutes. 5 ml of the test sample was similarly titrated against the dye solution (V2). Ascorbic acid content present in the test samples were determined using the formula:

$$\text{Amount of ascorbic content (mg/100g)} = \frac{500 \times V_2 \times 25 \times 100}{V_1 \times 5 \times 5}$$

Where; 500 = µg of standard ascorbic acid taken for titration

V_1 = Volume of dye consumed by 500µg of standard ascorbic acid

V_2 = Volume of dye consumed by 5 ml of test sample

25= Corresponds to total volume of the extract

100 = Ascorbic acid content/100g of the sample

5 = Weight of sample taken for extraction

5 = Volume of the test sample taken for titration.

RESULTS AND DISCUSSION

The present study concentrated on evaluation of ascorbic acid content in fruits, vegetables and leafy vegetables by titration method. The studies indicated that different fruits had different content of ascorbic acid in their juice concentrates (Figure 1). The highest ascorbic acid content was in *Citrus limon*(lemon) - 40mg/100g, followed by *Tamarindus indica* (tamarind fruit) -32.6mg/100g and *Citrus sinensis* (sweet orange) - 30.2mg/100g (Figure 1).

Among the vegetables highest content was observed in *Phyllanthus emblica* (big goose berry) - 55mg/100g followed by *Mangifera indica* (raw mango)- 54mg/100g, *Tamarindus indica* (raw tamarind) - 53mg/100g and so on (Figure 2).

The highest ascorbic acid content in leafy vegetables was in *Amaranthus retroflexus* (green amaranthus) - 37.25 mg/100g*Amaranthus cruentus* (purple amaranthus) -34 mg/100g and *Trigonella foenum* (methi) -29.3mg/100g (Figure 3).

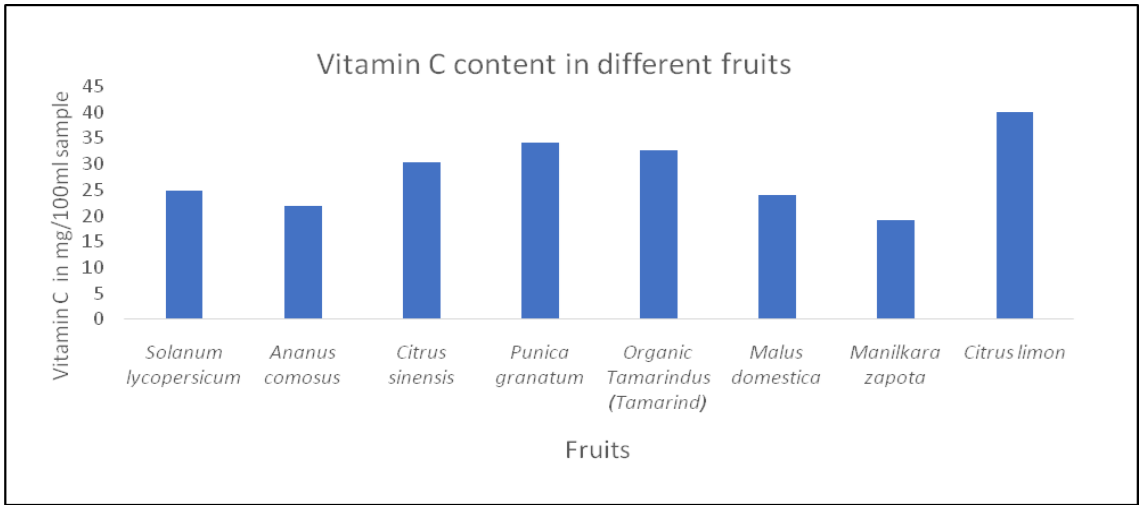

Figure 1: Vitamin C content in different fruits in mg/100mg of fresh sample.

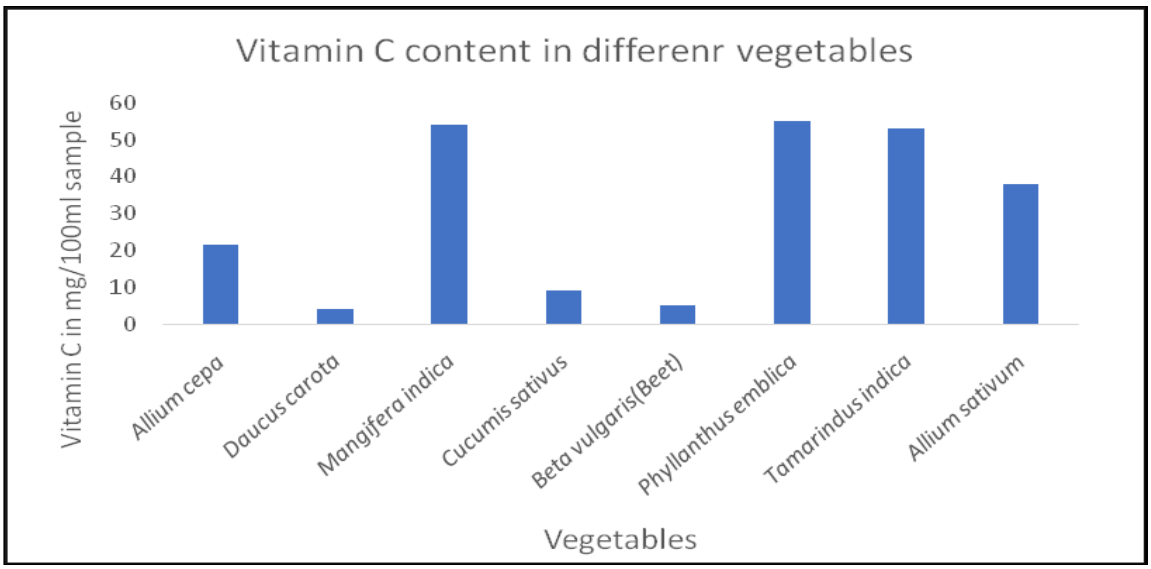

Figure 2 : Vitamin C content in different vegetables in mg/100mg of fresh sample.

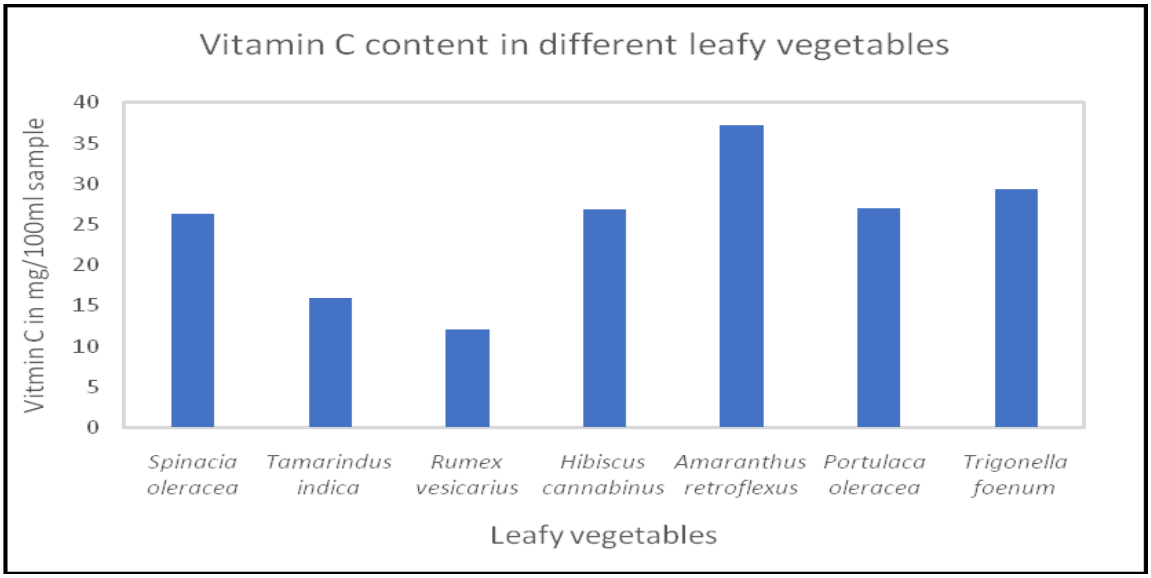

Figure 3 : Vitamin C content in different leafy vegetables in mg/100mg of fresh sample.

In the present study titrimetric method was adopted as this procedure gave good results for most samples exceptfor those that yielded highly intense coloured extracts. In this procedure the results could be influenced by extraction method and so attention should also be paid to ensure that no interfering substances are contributing to the titration results. In spite of these practical difficulties, the titration method has become widely used due to its convenience (Razmi, 2010) and also for the reason that rapid determinations can be carried out with simple laboratory equipment. The present study matched with earlier study reports where also ascorbic acid was highest in lemon juice followed by sweet orange juice, sweetie and white grapefruit (Nour *et al*., 2010). Ranking of fruits, vegetables for highest vitamin C content could match but amount of vitamin C could be variable due to variations in maturity stage and regional varieties of fruits, vegetables and also the different techniques of measuring and squeezing process (Okiei W, 2009). In case of leafy vegetables growth conditions could influence variation of vitamin C content.

CONCLUSION

The study on determination of content of ascorbic acid in fruits, vegetables and leafy vegetables was significant as it gave idea about the selection of source in isolation and also in combination to meet the daily requirement of dietary vitamin C. The highest ascorbic acid content was in *Citrus limon*(lemon) among fruits, *Phyllanthus emblica* (big goose berry) among vegetables and *Amaranthus retroflexus* (green amaranthus) among leafy vegetables. The considerable amount of vitamin C present in these fruits, vegetables and leafy vegetables showed that when they are consumed in relative large amount, they will certainly contribute to the daily human dietary intake of the vitamin C. Since these fruits and vegetables are always available in local markets and they are also not expensive. This knowledge of vitamin C content obtained from this study can also be used to meet the special requirements of the vitamin which increase during pregnancy, lactation, adolescence, hyper-thyroidism, infection and post-surgery.

Conflicts of interest: The authors stated that no conflicts of interest.

REFERENCES

Abubakar JA, Akanya HO and Garba SA (1990) A study of the ascorbic acid intake of children and aged people in selected rural suburban locations in and Enzymes in Health and Disease. World Review of Nutrition and Dietetics , 1990, vol 62, pp 27-58.

Anderson R and Theron AJ (1990) Physiological potential of ascorbate, β-carotene and α-tocopherol individually and in combination in the prevention of tissue damage, carcinogenesis and immune dysfunction mediated by phagocyte-derived reactive oxidants. Bourne GH (ed): Aspects of Some Vitamins, Mineralsand Enzymes in

Health and Disease. *World Review of Nutrition and Dietetics* , 1990, vol 62, pp 27-58.

Boyera N, Galey I and Bernard BA (1998) Effect of vitamin C and its derivatives on collagen synthesis and cross-linking by normal human fibroblasts. *International Journal of Cosmetic Science*, 20, 151–158.

Carr AC, Frei B (1999) Toward a new recommended dietary allowance for vitamin C based on antioxidant and health effects in humans. *American Journal of Clinical Nutritio*n 69:1086–1107.

Chaitanya S and Naga Padma P (2016) Stability Studies on Ascorbic Acid content in various fruits, Vegetables and their Cocktail Juices . *International Journal for research in emerging science and technology*, vol 3, 12: 35-39.

Chakraborthy A, Ramani P, Sherlin H, Premkumar P, Natesan A (2014) Antioxidant and prooxidant activity of Vitamin C in oral environment. *Indian Journal of Dentental Research*, 25(4): 499.

CoSeteng MY et al. (1989) Influence of titratable acidity and pH on intensity of sourness of citric, malic, tartaric, lactic and acetic acid solutions and on the overall acceptability of imitation apple juice. *Canadian Institute of Food Science and Technology Journa*l, 22:46.

Fenoll J and Martinez A (2010) Simultaneous determination of ascorbic and dehydroascorbic acids in vegetables and fruits by liquid chromatography with Tandem-Mass Spectrophotometry. *Food Chemistry* 127(1): 340-344.

Gregory JF (1993) 3rd. Ascorbic acid bioavailability in foods and supplements. *Nutrition Reviews* ;51:301-3.

Harri H (1992) Vitamin C and common cold, British journal of Nutrition, 67, 3-16.

Levin M (1986) New concepts in the biology and biochemistry of ascorbic acid. *New England Journal of Medicine*, 31:892-902.

Marti N, Mena P, Canovas JA, Micol V, Saura D (2009) Vitamin C and the role of citrus juices as functional food. *Natural Product communications*, 4(5): 677– 700.

Nour V, Trandafir I and Ionica ME (2010) HPLC organic acid analysis in different citrus juices under reversed phase conditions. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca* , 38(1): 44-48.

Okiei W, Ogunlesi M, Azeez L, Obakachi V, Osunsanmi M and Nkenchor G (2009) The Voltammetric and Titrimetric Determination of Ascorbic Acid Levels in Tropical Fruit Samples. Int. J. Electrochem. Sci., 4: 276-287. in Tropical Fruit Samples. *International Journal of Electrochemical Science*, 4: 276-287.

Pauling L (1970) Vitamin C and common cold. Freeman, San Francisco, CA. Rao, B. and Deshpande, V. (2006): Experimental biochemistry. Tunbridge Wells, Kent: Anshan pp:1-6.

Pauling L (1971) The significance of the evidence about ascorbic acid and the common cold. *Proceedings q/ the National Academy of Sciences, U.S.A*. 68, 2678-2681.

Razmi H and Harasi M (2010) Vitamin C Contents of Tropical Vegetables and Foods Determined by Voltammetric and Titrimetric Methods and Their Relevance to the Medicinal Uses of the Plants. *International Journal of Electrochemical Science*, 5 105-115.

Rekha C, Poornim G. Manasa M, Abhipsa V, Devi J, Kumar H, Kekuda T (2012) Ascorbic acid, total phenol content and antioxidant activity of fresh juices of four ripe and unripe citrus fruits. *Chemical Science Transactions*, 1(2): 303–310.

Vasanth Kumar G, Ajay Kumar K, Raghu Patel GR, Manjappa, S (2013) Determination of vitamin C in some fruits and vegetables in Davanagerecity, Karanataka - India. *International Journal of Pharmaceutical and Life Sciences*, 4(3): 2489–2491.

Wintergerst ES, Maggini S, Hornig DH (2006) Immune-Enhancing Role of Vitamin C and Zinc and Effect on Clinical Conditions. *Annals of Nutrition and Metabolism Journal* 50:85-94.