GLOBAL JOURNAL OF PURE AND APPLIED SCIENCES VOL. 17, NO.1 2011: 47-49
COPYRIGHT© BACHODU SCIENSE CO. LTD PRINTED IN NIGERIA ISSN 118-0579
www.globaljournalseries.com, Email: info@globaljournalseries.com

IODOMETRIC DETERMINATION OF THE ASCORBIC ACID (VITAMIN C) CONTENT OF SOME FRUITS CONSUMED IN A UNIVERSITY COMMUNITY IN NIGERIA

C. J. IKEWUCHI AND C. C. IKEWUCHI

(Received 1 April 2010; Revision Accepted 23 July 2010)

ABSTRACT

The ascorbic acid content of seven different fruits –grapefruit, lime, orange, tangerine, banana, pawpaw and pineapple was determined by iodine titration, in order to know which fruit would best supply the ascorbic acid need for the body. Results showed that tangerine had the highest value of ascorbic acid, 98.851mg/100mL followed by pawpaw, 90.041mg/100g, orange, 75.000mg/100mL, grape, 70.345mg/100mL, lime, 44.138mg/100mL and banana 17.356mg/100g, with pineapple having the least value of 14.036mg/100g. It therefore follows that tangerine would supply more ascorbic acid per serving, for body need compared to the other six fruits. In fact, the percent daily value (%DV) of ascorbic acid in tangerine is more than twice that of lime, and more than seven times that of pineapple.

KEY WORDS: Ascorbic acid, daily value, fruits, iodine titration.

INTRODUCTION

Vitamin C (or ascorbic acid) has come to be known as a "wonder worker." In addition to its role in the formation of collagen and other life-sustaining functions, it serves as a key nutrient for the immune system, and a potent fighter of free-radicals. It has been shown to prevent many illnesses, from everyday ailments such as the common cold to devastating diseases such as cancer [Carr and Frei, 1999; Hwang, 1999; Ohio State University, 2004]. It is reported to lower cancer risk, regenerate vitamin E supplies, improve iron absorption [Mateljan, 2007] and in high doses, protects the eye against cataracts [Robertson *et al*., 1991; Gary, 1997; Sardi, 2000; FAO, 2004]. We depend on ascorbic acid for many aspects of our biochemical functioning; yet human beings are among only a handful of animal species that cannot produce their own supply of vitamin C [FAO, 2004]. Like these other animals, including primates and guinea pigs, we have no choice but to obtain this nutrient from our diet [Gary, 1997]. Vitamin C deficiency (scurvy), which typically causes abnormalities in bones and teeth (due to the accompanying reduction in the hydroxylation of lysyl and prolyl residues of collagen and elastin, and consequent reduction in their cross-linking), was first characterized in sailors in the eighteenth century [Carpenter, 1986]. These abnormalities were eliminated by compelling sailors to eat limes, a source of vitamin C. No wonder it was called "antiscorbutic factor". The use of lime for the prevention of spoilage of palm oil on storage had for long been in practice among the traditional farmers, especially in the western part of Nigeria. Without any formal education they knew that lime contained something that would not allow the oil to go rancid. Vitamin C is a white crystalline highly soluble lactone which owes its acidic properties and ease of oxidation to the presence of an enediol group [Roberts, and Caserio, 1977]. The 1989 recommended dietary allowance (RDA) or recommended nutrient intake (RNI) for an adult is 60mg per day (this is based on the amount of vitamin C needed to prevent clinical scurvy and provide body stores sufficient to prevent scurvy for around 30 days plus "a margin of safety") [Sharp, 1997]. However, based on new information, an official recommendation was made in April 1999, for the upward review of the RDA to 120mg per day [Levine *et al*., 1999]. Consequent upon this, in 2000, the recommended dietary allowance (RDA) or Adequate Intake (AI) for vitamin C was changed to 90mg per day for men and 75mg per day for women [http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/N/Nutrition.html]. The given AI values are for the ages 19 years and above. An extra 35mg of vitamin C per day was recommended for smokers, while pregnant and lactating women have AI values as high as 85 and 120mg respectively for 19 years or older [Food and Nutrition Board, 2000]. The Tolerable Upper Intake Level (UL) for vitamin C for adults 19years or older, is 2000mg (2g) [Levine *et al*., 1999]. Taking too much vitamin C is reported to cause side effects such as nausea and diarrhea [Hwang, 1999]. Many vegetables contain large quantities of vitamin C, but ascorbic acid is commonly destroyed by many cooking processes, and hence fruits are regarded as the most reliable source of vitamin C [http://paws.wcu.edu/bacon/Vitamin_C.pdf]. Citrus fruits, tomatoes, strawberries, bell peppers and broccoli are good examples of fruits rich in vitamin C [Hwang, 1999]. Therefore to prevent loss of vitamin C from foods during preparation, cooking, or storage, the following precautionary measures were recommended by the Department of Human Nutrition of Ohio State University [Ohio State University, 2004]. They include:

- Serving fruits and vegetables raw whenever possible;
- Steaming, boiling, or simmering foods in a very

C. J. Ikewuchi, Department of Biochemistry, Faculty of Science, University of Port Harcourt, P.M.B. 5323, Port Harcourt, Nigeria.
C. C. Ikewuchi, Department of Biochemistry, Faculty of Science, University of Port Harcourt, P.M.B. 5323, Port Harcourt, Nigeria.

small amount of water, or minimizing the exposure to microwave;
- Cooking potatoes in their skins (after freeing hem of dirt);
* Refrigerating prepared juices and limiting their storage time to not more than two to three days;
- Storing cut raw fruits and vegetables in an airtight container and refrigerating-avoiding soaking or storing in water.

The objective of this study was to determine the vitamin C content of some fruits consumed within and around the Benson Idahosa University Campus Community, Benin City, Nigeria, with the view of making recommendations for their intake.

MATERIALS AND METHODS

Some fresh ripe fruits were collected from vendors within the campus community and environs of Benson Idahosa University, Benin City, Nigeria. After removing the peels and cutting them into two transversely, the juices were expressed from the orange, lime, grape and tangerine fruits (before carefully picking out the seeds from the juice); while 2g each of the pineapple, pawpaw (minus seeds) and banana fruits were blended into fine pastes before diluting to 50mL with distilled water. These were all stored for use in this study.

Ascorbic acid determination was carried out by iodine titration. When iodine is added to a starch solution, it reacts to produce a purple color. However, if there is any vitamin C in the solution, it "neutralizes" the iodine, preventing the formation of the purple color. Thus, the amount of vitamin C present in a solution may be measured by first adding a small amount of acidified starch (called "reaction mix"), and then adding iodine drop wise until the solution turns purple. The end point is the appearance of the blue starch-iodine color.

The iodine reagent was standardized by titrating it against 5mL of 1.00% ascorbic acid solution (to which three drops of 1% starch was added) until the appearance of the blue starch-iodine color. 5mL of the samples were then treated the same way. The iodine solution was prepared by dissolving 5.00g potassium iodide (KI) and 0.268g potassium iodate (KIO_3) in 200mL of distilled water, and then adding 30mL of 3M sulfuric acid, before making up the volume to 500mL with distilled water. The concentration of ascorbic acid in the samples was determined as follows:

- Concentration in the juices (g/100mL) = y/b
- Concentration in the pastes (g/100g) = $25y/b$

Where b = titre (mL) from the titration of the standard ascorbic acid solution.
y = titre (mL) from the titration of the sample solution.

RESULTS AND DISCUSSION

The ascorbic acid content of the fruits is shown in Table 1. Among the fruits, grape, orange, pawpaw and tangerine were rich in vitamin C. The value of ascorbic acid observed for grape juice was greater than that reported by Izuagie and Izuagie [2007]. The concentration of ascorbic acid in the lime was higher than those earlier reported [Izuagie, and Izuagie, 2007; http://www.nnc.da.gov.ph/nutfacts/nutqty/vit_c.html]. The oranges had higher ascorbic acid than was earlier reported [Izuagie, and Izuagie, 2007; http://www.nnc.da.gov.ph/nutfacts/nutqty/vit_c.html]. The ascorbic acid content of the tangerines used in this study was higher than what was reported by Izuagie and Izuagie [2007]. The bananas had a lower ascorbic acid content than was earlier reported [http://www.nnc.da.gov.ph/nutfacts/nutqty/vit_c.html]. We found a higher ascorbic acid level in the pawpaw. This was greater than in earlier reports [http://www.nnc.da.gov.ph/nutfacts/nutqty/vit_c.html]. The implication of this result is that a 100mL serving of grape juice can provide about 78% of RDA or RNI, while lime, orange and tangerine about 49%, 83% and 110% respectively (Table 1). That is, about 128mL of orange will be required to meet the RDA or RNI for ascorbic acid, while about 204mL of lime; 121mL of orange and 91mL of tangerine will be required. Similarly, a 100g serving of banana, pawpaw and pineapple will each provide about 19%, 100% and 16% of the RNI or RDA, respectively (Table 1). And so, to meet the RDA or RNI requires the intake of about 526g of banana, 100g of pawpaw and 625g of pineapple respectively.

Table 1: The ascorbic acid content of some Nigerian fruits.

Fruit	Composition	
	Amount/100units	%DV
	mg/100mL of juice	
Grape	70.345±1.889	78.161
Lime	44.138±1.542	49.042
Orange	75.000±5.172	83.333
Tangerine	98.851±10.535	109.834
	mg/100g fresh fruit	
Banana	17.356±6.333	19.284
Pawpaw	90.041±0.000	100.046
Pineapple	14.086±0.000	15.651

Values are means ± SD of seven determinations. Percent Daily Values (%DV) are for adults or children aged 4 or older, and are based on a 2,000 calorie reference diet. The daily values may be higher or lower based on individual needs [FAO, 2004; Simon, 2007; NutritionData, 2008].

CONCLUSION

In conclusion, our result shows that tangerine would supply more ascorbic acid per serving, for body need compared to the other six fruits, with its %DV being more than twice that of lime, and more than seven times that of pineapple. Taking vitamin C especially

during meal will assist in reducing Fe^{3+} to Fe^{2+}, which is of benefit to the body.

REFERENCES

Carpenter, K. J., 1986. The history of scurvy and vitamin C. Cambridge University Press, Cambridge.

Carr, A. C. and Frei, B., 1999. Toward a new recommended dietary allowance for Vitamin C based on antioxidant and health effects in humans. Am. J. Clin. Nutr. 69(6): 1086-1107.

FAO, 2004. Vitamin and mineral requirements in human nutrition, Second edition: report of a joint FAO/WHO expert consultation, Bangkok, Thailand, 21–30 September 1998. ISBN: 92 4 154612 3. http://whqlibdoc.who.int/publications/2004/9241546123.pdf

Food and Nutrition Board, 2000. Dietary reference intakes for vitamin C, vitamin E, selenium and carotenoids. A report of the Panel on Dietary Antioxidants and Related Compounds. National Academy Press, Washington, DC.

Gary, N., 1997. The Antioxidant Vitamin- Vitamin C - GARYNULL: Your Guide to Natural Living. http://www.garynull.com/vitaminc.htm

Hwang, M. Y., 1999. How much vitamin C do you need? J. Am. Med. Assoc. 281(15): 1640.

Izuagie, A. A. and Izuagie, F. O., 2007. Iodimetric Determination of Ascorbic Acid (Vitamin C) in Citrus Fruits. Res. J. Agric. Biol. Sci. **3**(5): 367-369. http://www.insinet.net/ajbas/367-369.pdf

Levine, M., Rumsey, S. C., Daruwala, R., Park, J. B. and Wang, Y., 1999. Criteria and recommendations for vitamin C intake. J. Am. Med. Assoc. 281(15): 1415-1453.

Mateljan, G., 2007. The world's healthiest foods: Vitamin C. http://www.whfoods.org/vitaminC

NutritionData, 2008. Know what you eat: Nuts, cashew nuts, oil roasted, without salt added. http://www.nutritiondata.com/

Ohio State University, 2004. Ohio State University, Department of Human Nutrition and OSU Extension 2004. Vitamin C (Ascorbic Acid), HYG-5552-05.

Roberts, J. D. and Caserio, M. C., 1977. Basic Principles of Organic Chemistry. W.A. Benjamin, Inc., California.

Robertson, J. M., Donner, A. P. and Trevithick, J. R., 1991. A possible role for vitamins C and E in cataract prevention. Am. J. Clin. Nutr. **53**(Suppl.): S346–S351.

Sardi, B., 2000. Is high-dose vitamin C risky? Knowledge of Health, Inc. www.vitamincfoundation.org/bsardi.html.

Sharp, G. J., 1997. The Final (?) Word on Nutrition: Phytochemicals, RDA and Other Nutrients. http://default/HSF/Miscellaneous/Article 97-10-4

Simon, H., 2007. Vitamins. http://adam.about.com/reports/Vitamins.htm