PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 7 (6): 730-732, 2008
ISSN 1680-5194

Effect of Storage Time on Ascorbic Acid Content of Some Selected "Made in Nigeria" Fruit Preserves

SANUSI, Rasaki A.[1], OGUNRO, Yetunde[1] and NWOZOH Sarah[2]
[1]Department of Human Nutrition, [2]Department of Biochemistry,
College of Medicine, University of Ibadan, Ibadan, Nigeria

Abstract: The vitamin C content of many "Made in Nigeria" fruit products is not known for sure, since Nutrition Labeling is usually absent. Furthermore the change in the concentration with increasing shelf-life is not certain. Ascorbic acid (vitamin C) content of sixteen different fruit preserves made in Nigeria was assessed, on the day of production and after different lengths of storage time ranging from 3 to 8 months. Six fruit juices, six fruit squashes and four marmalades/jams were analyzed for ascorbic acid contents using the 2,6 *dichlorophenol indophenol* visual titration method. Ascorbic acid content varied with the type of fruit preserve, grapefruit juice having the highest (42.0mg/100g), while pineapple juice had the lowest (10.3mg/100g) on the first day of manufacture/production. Other juices had values ranging from 20.0mg/100g to 41.5mg/100g sample. There was minimal loss in ascorbic acid content with time. Fruit squashes generally had higher ascorbic acid content than the juices. Mango had the highest (62.0mg/100g), while pineapple squash had the lowest (18.1mg/100g) on the first day of production/manufacture. The percentage loss in ascorbic acid content of squashes was lower than that found in similar fruit juices. Other fruit preserves also had values ranging from 13.1mg/100g to 50mg/100g. Ascorbic acid loss was more than 10% in marmalades and jams after storage for 12 months at ambient room temperature. While processing of fruits reduce post-harvest loss and provides nutrients from these fruits, it will be beneficial to apply nutrition labels to the containers and also print 'best before' date conspicuously. Nutrition education is necessary to increase market demand and monitoring to ensure quality. The effect of ambient conditions should be considered in manufacture procedures.

Key words: Fruit preserves, ascorbic acid, vitamin C, storage time

Introduction

Ascorbic acid is widely distributed in fresh fruits and green leafy vegetables. In Nigeria, vegetables cannot be relied upon to supply ascorbic acid since almost all vegetables are thoroughly cooked before consumption, thereby destroying the heat-labile ascorbic acid content. However fruits are consumed raw, thereby conserving the ascorbic acid content. Although most fruits are sweet due to the sugar content, they supply very minimal energy and are associated with maintenance of health and prevention of diseases (Shibata *et al*., 1992; James *et al*., 1997; Rababah *et al*., 2005).

While fruits also contain some dietary fibers, simple sugars, vitamins and minerals they must be consumed fresh to derive maximum benefits. This is because prolonged storage and careless handling can destroy the nutrient content and also affect the texture, colour and flavour (Serrano *et al*., 2006). Reduction in post-harvest losses and all-year-round fruit availability has prompted storage in refrigerators and warehouses with increased carbon dioxide and other methods to prevent wastage (Kalt *et al*., 1999, 2001; Zheng *et al*., 2003). Ascorbic acid content of harvested fruit had been used to monitor freshness and fruit spoilage has been associated with loss of functional compounds such as phenolics and vitamin C. Ascorbic acid (also known as vitamin C) is an anti-oxidant and with other anti-oxidants is noted for inhibiting reactive oxygen species and their harmful effects (Minnunni *et al*., 1992; Knekt *et al*., 1991; Ferraroni *et al*., 1994).

Reactive oxygen species (ROS) are generated in cells during oxidative metabolism and are considered toxic to cell. But cells protect themselves from ROS via anti-oxidant enzymes and low molecular weight dietary anti-oxidants like vitamin C and E (Incerpis *et al*., 2007). ROS and/or free radicals cause damage to cells by snatching electrons from their DNA, proteins, carbohydrates or unsaturated fatty acids resulting in change of structure and functions. These changes explain the increase in cancer incidence and atherosclerosis (Halliwell, 1997; Smolin and Grosvenor, 2003).

Ascorbic acid is not synthesized in humans; therefore the requirement must be satisfied through dietary intake. However, vitamin C is unstable and heat-labile and most thoroughly cooked sources are practically devoid of the nutrient at consumption. Fresh fruits and fruit preserves may therefore guarantee adequate vitamin C nutrition.

The increase in industrial food processing in Nigeria in the last few years is a welcome change since it has resulted in availability of a variety of processed foods including fruit juices, squashes and jams. The effect of this on employment opportunity, the economy and

Table 1: Ascorbic acid content of fruit juices

Fruit Juice	Mean (mg/100g) At Production	Shelf-Life (months)	Mean (mg/100g) After storage	Vitamin C Loss (%)
Grape Fruit	42.0 (±0.1)	3	40.5 (±0.1)	3.5
Orange	41.5 (±0.1)	8	39.9 (±0.1)	3.9
Lime	40.5 (±0.1)	6	38.0 (±0.1)	6.2
Lemon	35.2 (±0.1)	8	32.5 (±0.1)	7.6
Mango	20.0 (±0.0)	5	18.5 (±0.1)	7.5
Pineapple	10.3 (±0.1)	8	9.8 (±0.10)	4.8

Table 2: Ascorbic acid content of fruit squashes

Fruit Squashes	Mean (mg/100g) At Production	Shelf-Life (months)	Mean (mg/100g) After storage	Vitamin C Loss (%)
Mango	62.0 (± 0.0)	7	59.0 (±0.1)	4.8
Orange	56.0 (±0.0)	7	52.5 (±0.1)	4.5
Grapefruit	47.0 (±0.1)	6	44.1 (±0.1)	6.2
Lemon	41.0 (±0.1)	8	39.0 (±0.0)	7.3
Pineapple	18.1 (±0.1)	8	17.6 (±0.1)	2.8

Table 3: Ascorbic acid content of other fruit preserves

Fruit Preserves	Mean (mg/100g) At Production	Shelf-Life (months)	Mean (mg/100g) After storage	Vitamin C Loss (%)
Orange marmalade	50.0 (±0.0)	12	45.0 (±0.2)	10.0
Lemon Shred	30.0 (±0.1)	12	26.0 (±0.1)	13.3
Pineapple Pieces	14.5 (±0.1)	5	14.0 (±0.1)	3.6
Pineapple Jam	13.1 (±0.1)	17	10.0 (±0.2)	23.7

reduction in post-harvest losses of fruits is yet to be quantified. Also there is a lack of nutrition labeling and inadequate information on the nutrient contents of these processed foods. This study was therefore undertaken to assess the ascorbic acid content of selected fruit preserves and its stability with increasing shelf life or storage with time.

Materials and Methods

This study is descriptive in design to assess the ascorbic acid content of fruit preserves at production and at various time intervals to explore the extent of loss while on the shelf. Sixteen brands of different fruit preserves were purchased on the day of productions from two industries in Lagos and three industries in Ibadan (south-west Nigeria). They were stored in an air-conditioned storage daytime temperature range of 24-27^{0}C. The selection was made to reflect brands that are available in the market and frequently consumed. All purchases and analyses were done in triplicates. The ascorbic acid contents of the preserves were carried out twice; on the day of production and a latter date which ranged from 3 months to 12 months.

Ascorbic acid/vitamin C content of the products was determined using the method of Bessey and King (1933).

Safety precautions and good quality assurance procedures were taken to ensure reproducibility of the result. Ascorbic acid was extracted from the fruit preserves by addition of a 5% solution of acetic acid to inhibit ascorbic acid *oxidase*. Five grams of solid fruit preserves (marmalade, jams and fruit pieces), were blended with 50ml of the 5% acetic acid until free of lumps. The mixture was decanted into a 100ml volumetric flask, shaken properly, filtered and made up to the mark with distilled water. The *indophenol* dye tablet was dissolved in 50ml distilled water. The *indophenol* dye solution was titrated against 10ml of the fruit preserve solution until a faint pink endpoint persisted for about 10 to 15 seconds. The ascorbic acid content was calculated from the amount of dye added (Fisher and Bender, 1975).

Results and Discussion

Table 1 shows the mean content of ascorbic acid of the various fruit preserves on the day of manufacture and the percentage loss of vitamin C at different length of shelf life. Grape fruit juice had the highest vitamin C content. The vitamin C content of orange juice and lime juice were similar ($p>0.05$), while those of lemon juice, mango juice and pine-apple juice were significantly lower than these two ($p<0.05$). The ascorbic acid content of these fruit preserves were similar to those reported by FAO (1968). Values obtained for pineapple juice was much lower than those of earlier reports (Akinyele *et al.*, 1978) this might be because fruits used in factory processing may not be at the same stage of ripeness. As fresh fruits used for processing were not accessible it was not possible to assess ascorbic acid loss due to processing. The ascorbic acid content of these fruit preserves after different length of shelf life were consistent with earlier reports by Oyenuga (1968), Akinyele *et al.* (1978) Ihekoronye and Ngoddy (1985) Mucambi and Rajagopal (1997). The observed loss of ascorbic acid with time varied from 3.5% to 7.5% in the products which had a shelf life of 12 months. These losses are negligible when compared to those of fresh fruits left unprocessed for a similar length of time. Vitamin C has been reported to be stable after being canned in tin or glass (Fisher and Bender, 1975). Other methods of reducing vitamin C loss in foods had been suggested (Komorova and Navrat, 1968).

Table 2 shows the ascorbic acid content of fresh fruit squashes and stored products. The squashes had

higher vitamin C content, although they are diluted with water before being consumed. The loss in their ascorbic acid content was also negligible when compared to the loss from unprocessed raw fruits and also with their fruit juices.

The obtained data for ascorbic acid content of marmalades and jam and fruit pieces are shown in Table 3. The products were much lower in ascorbic acid than those of the juices and squashes of the same fruits. This may be due to the prolonged heating time involved in their production (Ihekoronye and Ngoddy 1985).

While abundant fruits are available in Nigeria and at every season, scale of processing is still low, thereby allowing much fruits to waste. Consumption of fruits in the fresh is superior to that of fruit preserves, yet consumption of fruits alongside meals is not customary, since fruits are considered as snacks.

In conclusion, nutrition and health education is needed to promote increased consumption of fresh fruits and fruit preserves. Also attention should be given to the nutrient content of the fruit preserves to ensure wholesomeness of these drinks. Furthermore nutrition labeling of processed products will do a lot to promote consumer education and the nutritional status of the populace.

Acknowledgement

The contribution of Professor Oluremi Keshinro at the onset of this study is hereby acknowledged. We also thank all members of the Research laboratory of the department of Human Nutrition at the time of this study. Lastly the Authors hereby thank Dr. OT Adepoju and Dr. Folake Samuel both of the Department of human Nutrition, university of Ibadan, for going through the manuscript and giving useful suggestions.

References

Akinyele, I.O., O.O. Keshinro and O.O. Akinnawo, 1978. Nutrient losses during processing and storage of pineapple and oranges in Nigeria. Nig. J. Nutr., 1: 33-39.

Bessey, O.A. and C.G. King, 1933. The distribution of vitamin C in plant and Animal tissues and its determination. J. Biol. Chem., 103: 687.

Ferraroni, M., O.P. Heinonen, D. Albanes, M. Heinonen, E. Rikkala and L. Teppo, 1994. Selected micronutrients intake and the risk of colorectal cancer. Br. J. Cancer.,70: 1150-5.

Fisher, P. and A. Bender, 1975. Value of Food. Second Ed Oxford University Press, pp: 37-50.

Food and Agriculture Organization, 1968. Food Composition Table: For Use in Africa. FAO/Rome.

Halliwell, B., 1997. Antioxidants and human disease: A general introduction. Nutr. Rev., 55: 544-52.

Ihekoronye A.I. and P.O. Ngoddy, 1985. Integrated Food Science and Technology for the Tropics. Macmillan Publishers Ltd, London and Basingstoke.

Incerpis, S., A.M. Fiore, P. De Vito and J.Z. Pedersen, 2007. Involvement of plasma membrane redox systems in hormone action. J. Pharm Pharmacol., 59: 1711-20.

James, W.D., M. Nelson, A. Ralph and S. Leather, 1997. Socio-economic determinants of health: The contribution of nutrition to inequalities in health. BMJ., 314: 1549.

Kalt, W.,C.F. Forney, A. Martin and R.L. Prior, 1999. Antioxidant capacity, vitamin C, phenolics and anthocyanins after fresh storage of small fruits. J. Agric. Food Chem., 47: 4634-44.

Kalt, W., D.A. Ryan, J.C. Duy, R.L. Prior, MK. Ehlenfeldt and S.D. Van der Kloet, 2001. Interspecific variation in anthocyanins, phenolics, antioxidant capacity among genotype of high bush and low bush blackberries. J. Agric. Food Chem., 49: 4761-7.

Knekt, P., R. Jarvinen, R. Seppanen, A. Rissanen and A. Aromaa, 1991. Dietary antioxidant and the risk of lung cancer. Am. J. Epidemiol., 1134: 471-9.

Komorova, L. and K. Navrat, 1968. Ascorbic acid content of canned and raw fruits. Ges Hygienna, 13: 185-190.

Minnunni, M., U. Wolleb, O. Mueller, A. Pfeifer and H.U. Aeschbacher, 1992. Natural antioxidants as inhibitors of oxygen species induced mutagenicity. Mutat. Res., 269 : 193-200.

Micambi, Sr. and M.U. Rajagopal, 1997. Vitamin C content of some fruits grown in Eastern Nigeria. J. Food Techn. 12: 189-99.

Oyenuga, V.A., 1968. Nigeria's Foods and Feeding stuff-their chemistry and Nutritive value. 3rd Edn. Ibadan University Press., pp: 20-26.

Rababah, T.M., K.T. Ereifey and L. Howard, 2005. Effect of ascorbic acid and dehydration on the concentration of total phenolics, anti-oxidant capacity, anthocyanins and color in fruits. J. Agric. Food Chem., 53: 4444-7.

Serrano, M., J.M. Valverde, F. Guillen, S. Castillo, D. Martinez-Ronero and D. Valero, 2006. Use of Aloe Vera gel coating preserves the functional properties of table grapes.J. Agric. Food Chem., 54: 3882-8.

Shibata, A., A. Paganini-Hill, R.K. Ross and B.E. Henderson, 1992. Intake of vegetables, fruits, carotene, vitamin C and vitamin supplements and cancer incidence among the elderly: A prospective study. Br.J. Cancer, 66: 673-679.

Smolin, L.A. and M.B. Grosvenor (Eds.), 2003. Watersoluble vitamins: Vit. C in Nutrition: Science and Applications; 4th Edn. John Wiley and Sons Inc.

Zheng, Y., C.Y. Wang, S.Y. Wang and W. Zheng, 2003. Effect of high oxygen atmospheres on blueberry phenolics, anthocyanins and antioxidant capacity. J. Agric. Food Chem., 51: 7162-9.