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Vitamin C composition and mineral content of some Nigerian packaged juice drinks

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ABSTRACT
Vitamin C composition and minerals (Cu, Fe, Mg and Zn) were determined in some Nigerian packaged fruit juice (PJ). Samples were analysed on the bases of fruit juice types: single or mixed fruits. Determination of vitamin C was achieved by oxidation-reduction methods using standardized 2, 6-Dichloroindophenol (DCP), while minerals were determined by flame atomic absorption spectrometry (FAAS). Results revealed an average ratio of 30:70 % single to mixed fruit juice type from total sample analysed. Vitamin C concentrations in the PJ ranged from 7.8 to 27.3 mg/100 mL, with an average concentration of 16.6 ± 4.97 mg/100 mL. Average concentrations of Cu, Fe, Mg and Zn in PJ were 0.12 ± 0.08, 0.10 ± 0.03, 1.61 ± 0.43 and 1.18 ± 0.18 mg/L respectively. These results were compared with the USDA (SR21) database and it is deduced that mixed fruits juice do not necessarily indicate enhanced vitamin C and minerals but perhaps flavor and colour intensity. Also that most PJ studied provide less adequate vitamin C content than their natural counterpart, but may however provide good source of mineral supplement such as Cu and Zn.

Keywords*: Fruit juices, package, vitamin C, mineral content,*

INTRODUCTION

Packaged juice drinks are good and ready sources of fluids, carbohydrates (sugars), vitamins and minerals (USDA, 2003; Dosumu *et al.*, 2009). They are prepared from fruits such as orange, mango, guava, black currant, apple, apricot, pineapple, lemon, lime and peach, because The fruits have been a part of human diet and food supplement over the years. They are considered as healthy food supplements because they contain high quantity of water, carbohydrates, proteins, vitamins A, B1, B2, C, D and E; and minerals such as Ca, Mg, K, Zn and Fe (Okwu and Emenike, 2006). Besides their dietary importance, they are also useful as nutrient supplements and recommended internationally. Nutritionists have advised that eating at least five portions of fruits and vegetables a day can help people to maintain good health throughout their lives, protecting them from heart disease and cancer (Wenkam, 1990; Food Commission, 2009). Over the last decade packaged juice drinks have become more acceptable due to a number of factors such as convenience, low cost; environmental factors and manufacturers' competition style (Marsh and Bugusu, 2007).However during the process of concentration the quality of the fresh products undergo remarkable modification which could reduce the nutritional value of the drinks (Lee and Sohn, 2003). Fruit juice concentrates are an important ingredient in the manufacture of many packaged fruit juices (Hong and Wrolstad 1990). It is still not clear if this packaged and handy fruit drinks especially those produced in Nigeria do provide the adequate requirements of vitamin C and minerals and whether this packaged products would compare favourably with their counterparts when compared to reference standards. Therefore this work attempts to present a comparative evaluation of vitamin C composition and mineral content of some Nigerian packaged fruit juice in relation to the United States Department of Agriculture, USDA reference standard database version SR21.

MATERIALS AND METHODS

Packaged Juice Samples: Packaged juice samples (PJ) were purchased from retail shops in Maiduguri, Nigeria. Samples were collected on the bases of fruit juice types (single or mixed) and on package (tetra pack, metal; glass). Three samples of each PJ type, from different batches were made into a homogenized composite sample. Nineteen (19) different types of PJ were collected. Sampling was carried out between October 2008 and February 2009. Samples were obtained from the packages for preparations by decantation into well labelled laboratory wares.

Vitamin C Content Determination: Oxidation-reduction titration method described by Gillette *et al*. (2000) was used in the determination of vitamin C content of the PJ. Five milliliters of each PJ, was treated with 10 ml, 3% metaphosphoric acid and filtered to remove possible protein interference. The filtrate was then titrated against freshly standardized 2, 6-Dichloroindophenol (DCP). The standardization was with 10 ml of standard ascorbic acid (OxyMin®, Krpan Queensland). Triplicate titration was conducted for all samples.

Mineral Content Determination: PJ were prepared and analysed according to SC (2000). The standard calibration method of flame atomic absorption spectrometry (FAAS) was used to determine the minerals (Cu, Fe, Mg and Zn) in the PJ, with the Shimadzu AA-6800 equipped with ASC-6100 auto sampler and air-acetylene atomization gas mixture. Two milliliters of each PJ was digested by wet ashing method using 10 ml of HCl (2M) and the mixture heated on a hot plate until the content was reduced to about 1 ml and made up to 50 ml volumetric flask with 1% acidified distilled water.

USDA-Healthe Tec SR21 database: The United States Department of Agriculture, USDA Food Search for Windows, version 1.0, database version SR21 was used for comparative quantitative evaluation of vitamin C and mineral content of the PJ. The USDA Food Search was developed through cooperative research and development agreement between the U.S. Department of Agriculture Nutrient Data Laboratory and Healthe Tech, Inc.

Data Analysis: Results are presented as mean ± standard deviation. Statistical analyses were performed using coupled Microsoft Excel+Analyse- it® version 2.2 (2008). Variations were considered significant at $p<0.05$.

RESULTS

Fig. 1 shows the percentage distribution proportions of package and fruit juice type analysed in the work. Tetrapack package recorded the highest (53%) sample proportion, followed by metal (29%) and then glass (17%) recorded the least sample proportion by package type. Also according to package type, the result revealed that mixed fruit juice types were in the greater percentage proportion sampled. An average ratio of 30:70 % single to mixed fruit juice type was recorded from total sample analysed.

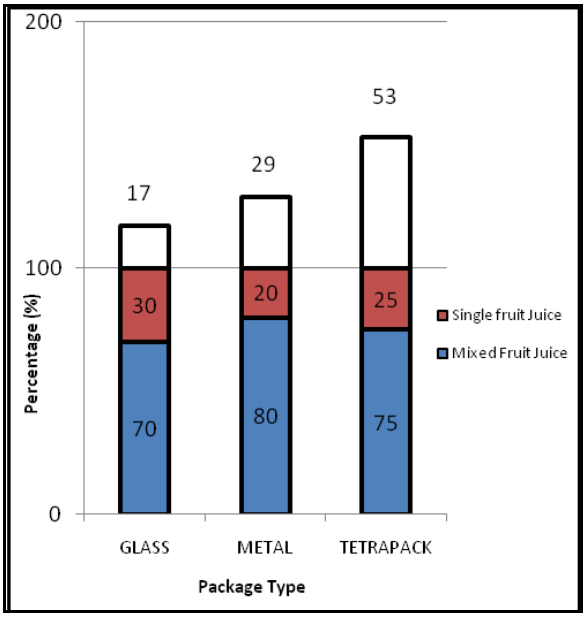

Fig. 1: Percentage proportion of package and fruit juice type analysed

The frequency distribution of vitamin C concentration of the PJ is shown in Fig. 2. The concentration ranged from 7.8 – 27.3 mg/100 mL, with an average concentration of 16.6 ± 4.97 mg/100 mL and < 50% of total sample analysed had vitamin C concentrations in the range of 15 – 20 mg/100 mL. Fig.3 shows mineral composition of the PJ. The average composition of Cu, Fe, Mg and Zn were 0.12 ± 0.08, 0.10 ± 0.03, 1.61 ± 0.43 and 1.18 ± 0.18 mg/L respectively. All PJ were generally rich in Mg and shows the widest concentration variations. Zn shows

moderate concentration, while Fe and Cu contents are low. Table 1 shows comparative summary between the mixed and single fruit PJ. Overall, concentration variations are erratic and are statistically not significant. However, further quantitative comparison between results of this study and the USDA SR21 database values generally revealed that PJ provide less value for vitamin C and minerals than raw natural fruit juices. The database also indicated that vitamin C and mineral contents depends on fruit type and not on fruit mixtures.

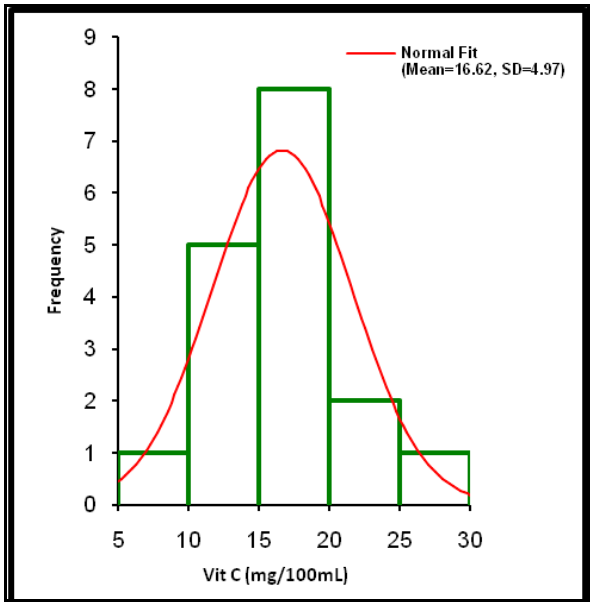

Fig. 2: Frequency distribution of vitamin C composition in PJ

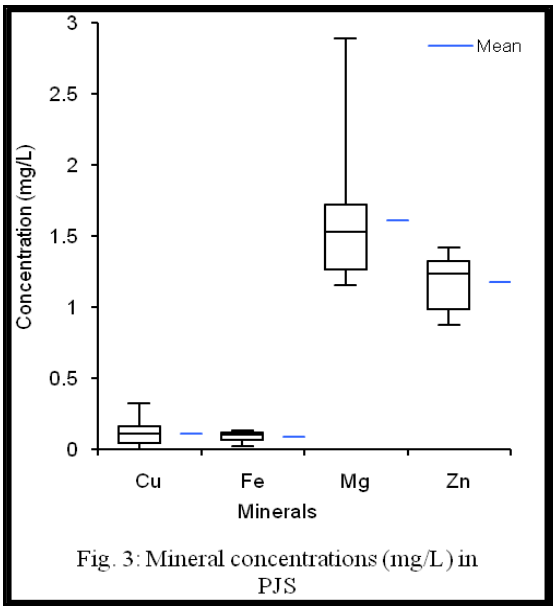

Fig. 3: Mineral concentrations (mg/L) in PJS

Fig. 3: Mineral content (mg/L) of PJ

DISCUSSION

A number of factors affect the selection of product package material and design that best satisfy competing needs with regard to product characteristics, marketing considerations (including distribution needs and consumer needs), environmental and waste management issues, and cost. In this study, Nigerian PJ was found to be largely packaged in tetra packs. According to Hunt *et al.* (1990), food packaging accounts for almost two-thirds of total packaging waste by volume. Therefore in balancing so many factors, fruit juices have been assessed to be suitably packaged in tetra packs due to cost, nature of fruit juices and environmental disposal factors (Marsh and Bugusu, 2007).

The result of this work also indicated that the larger proportion of PJ analysed were mixed fruit juices. This is due to the fact that blending fruit juices harnesses flavor and color (Rutledge, 2001). Mixed fruits in addition to vegetables have epidemiological advantages as high level of mixed fruits and vegetable consumption can reduce the risk of developing diseases, particularly cancers, cardiovascular disease metabolic disorders and stroke (Knekt *et al*., 1996, Joshipura *et al*., 2001). They also contribute significantly in increasing protective serum antioxidants, foliate and decreased plasma homocysteine (Samman *et al*., 2003, Kawashima et al., 2007). However, mixed fruits do not necessarily indicate that the concoctions harness vitamin C and mineral concentration, but fruit type. This is effectively described with black currant based on USDA (SR21) database, which as a single fruit alone contains more vitamin C and minerals than any group of mixed fruits.

Vitamin C contents recorded in this study are generally lower than the USDA (SR21) database, but similar to that reported by Kabasakalis (2000), in which ascorbic acid content of commercial fruit juices ranged from 2.4 to 43 mg/100 ml of juice. Though vitamin C is effective in preventing discoloration in most fruits juices; preserves natural color and flavor of fruits, it also adds nutritive value

as well (Harrison and Andress, 2004). However the reduction of ascorbic acid concentration in packaged fruit juices have been attributed to natural mineral waters and fruit juices due to the acid radical production and decay in aqueous solution (Kalus and Filby, 1979). A number of researchers have attributed factors such as fruit type (Ajibola *et al*, 2009) and storage method (Johnston and Hale, 2005, Ajibola *et al*, 2009), temperature (Zerdin *et al*., 2003, Tiwari *et al*, 2009), microorganism (Bayındırl, 2006) and package type (Maeda and Mussa, 1986; Kabasakalis, 2000) on the stability of vitamin C. Thus taking a pack of PJ may not provide the daily value (60 mg) for vitamin C (Hemila, 1999).

The daily value for Cu is 2 mg. Necessary for energy and respiratory function, copper also supports the formation of bone, collagen, red blood cells, healthy nerves and joints, hair and skin coloring, plus many enzymatic functions of the human body (Turnlund, 1988; Bremner and Beattie, 1995). Fe is required for energy and endurance because it delivers oxygen throughout the body. But it is necessary only in small amounts for optimal health. The daily value for Fe is 18 mg (Weaver and Rajaram, 1992; Waller and Haymes, 1996). Mg is needed for over 300 of our bodies' most important biological processes, not the least of which is ATP energy production and muscular contractions. Nonetheless, it is most typically used by active individuals to prevent muscle cramping; to enhance muscle and nerve functioning; to relieve tight, sore muscles; and to help improve bone density. The daily value for Mg is 400 mg (Tanabe *et al*., 1998). Zn is involved in thousands of bodily functions, such as proper cell growth and testosterone production. Though zinc is most often used as part of a multivitamin/mineral formula, active individuals, especially athletes, have become interested in zinc because of its important role in testosterone production. The daily value for Zn is 15 mg. (Cordova and Alvarez-Mon, 1995; Brilla and Conte, 1999).

In this work, Mg concentration is highest due perhaps to the fact that magnesium sulphate is usually added to fruit juices as preservatives (Buchel *et al*, 2000). This may not be the only factor since this also shows concordance with the trend in the USDA (SR21) database for Mg being consistently higher than other minerals determined. Generally, these minerals are very likely to be supplemented as most people get enough from PJ.

		Vitamin C (mg/100mL)	Zn	Cu	Mg	Fe
MIXED	Mean	18.72	1.22	0.14	1.33	0.09
	SD	5.15	0.20	0.10	0.22	0.04
SINGLE	Mean	16.38	1.15	0.11	2.03	0.10
	SD	5.08	0.16	0.08	0.54	0.03

Table 1: Comparative summary result of vitamin C and mineral compositions in single and mixed fruit PJ

CONCLUSION

From the result of this study, conclusion can be drawn based on the USDA (SR21) that mixed fruits do not necessarily indicate enhanced vitamin C and mineral contents, but perhaps flavor and colour intensity. This study also shows that most PJ do not provide adequate vitamin C content but may provide good source of minerals supplement such as Cu and Zn.

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