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QUALITY EVALUATION OF SOME SELECTED BRANDS OF FRUIT JUICES PRODUCED IN NIGERIA

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ABSTRACT

Fruit juices are found to contain some vitamins and minerals which are required for normal physiological growth. Despite the need for processing, reports have shown that processing by heat reduces the nutrient contents particularly vitamins. This research therefore investigated the physicochemical properties of some selected brands of fruit juices produced in Nigeria. The proximate analysis revealed that moisture content ranged from 82.00±0.01-82.53±0.01%, ash 0.01±0.004-0.07±0.001%, crude protein 1.10±0.04-1.27±0.03% and fat content 0.01±0.001–0.05±0.005%. Vitamin analysis revealed that vitamin A ranged from 82.41±0.05-107.35±0.01 mg/100ml, vitamin B 15.95±0.06-40.30±0.01mg/100ml and vitamin C 23.60 ±0.07-37.54±1=0.01mg/100ml. The mineral analysis revealed that calcium ranged from 5.24±0.01-18.45±0.07mg/100ml, zinc 0.28±0.001-0.64+0.005mg/l00ml, magnesium 7.08±0.11-15.23±0.03mg/100ml, potassium 96.86±0.08-138.20±0.02mg/100ml, sodium 6.70±0.10 -17.00±0.01mg/100mland iron 8.31±0.09-15.34±0.02±mg/100ml. The samples were found to contain high values of vitamins A, B and C with respect to RDA requirements. Moderate values were found for protein, ash, iron and zinc. The study observed the need for standardization of the juices particularly in the area of fortification with more vitamins and minerals to guarantee minimum requirements being met by all products.

Keywords: Fruits, juices, vitamins, minerals, proximate, fortification

INTRODUCTION

Fruit juices are extracts from fruits and consumed directly without further processing. Some of these juices are packed in bottles or laminated papers and sold which undergo heat processing before consumption. Fruit drink concentrates are concentrated forms of the juice extracted from natural fruits. Since it is expensive to package and store single strength juice, it is often desirable to remove a part or all of the water from the juice (Kim *et al.*, 1988). Such concentrates are diluted with water prior to consumption. Concentration reduces the storage volumes, thereby reducing the transport costs, and facilitates preservation which is achieved by improved shelf life with increased relative solid concentration, However, during the process of concentration, a large part of the characteristics determining the quality of the fresh products undergoes remarkable modification which could reduce the nutritional value of the drink (Hur and Choi. 1993; Lee and Sohn, 2003; Choi *et al.*, 1995). 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 (Wenkam, 1990; Okwu and Emenike, 2006). Besides their dietary importance, they are also useful as nutrient supplements and recommended internationally as superior to processed foods (Wenkam, 1990).

Fruit consumption has been reported to be beneficial to health and to contribute to the prevention of degenerative processes, particularly lowering the incidence and mortality rate of cancer and cardio- and cerebro- vascular diseases (Rapisararda *et al.,* 1999). Fruits are also rich sources of vitamins and antioxidants which are essential as health foods in the building up of body immune system and in preventing of diseases (CTA, 2001). Fruit juice is unfermented but fermentable liquid or juice intended for direct consumption, obtained from the edible portion of sound, appropriately mature and fresh fruit by mechanical extraction process and preserved, exclusively by chemical and physical means (Woodroof and Luh, 2000; FAQ/WHO, 2005). The juice may have been concentrated and later reconstituted with water suitable for the purpose of maintaining the essential composition and quality factor of the juice. The addition of sugar or acids can be permitted but must be endorsed in the individual standard (FAQ/WHO, 2005). Juice is classified as pure or pulp and are prepared to contribute vitamins to diet, serve as pleasant tasting beverage drink or as a form of preservation technique (Saiunkhe and Kadam, 1995).

Water is the predominant component of fruit juice, Carbohydrate including sucrose, fructose, glucose and sorbitol varies (Heldman and Lund, 1998). It contains small amount of protein, no fat, cholesterol and unless the pulp is included, contains no fiber (Parish, 1991; Pao *et al.,* 2000). Fruit juices are rich in Minerals and Vitamin A and C, and could be fortified with more minerals and vitamins. The anti-oxidant components of fruit juice have beneficial long term health effects, such as decreasing the risk of cancer and heart disease (Boyer and Liu, 2004; AICR, 2010). Increased iron absorption from food by Ascorbic acid is essential for children who consume diet with low iron bioavailability (Salunkhe and Kadam, 1995; Heldman and Lund, 1998; Ray, 2001). In spite of the high consumption rate of these juices, their various compositions are probably not well documented. This work therefore was designed to examine and provide information on the physicochemical properties of some of these drinks in order to ensure standardization.

MATERIALS AND METHODS

Sample Collection

Sample selection was based on popularity (most demanded) and each sample was analysed. The samples of different brand of commercially available fruit juice packed in tetra pack were purchased from street vendors, and shopping malls within Osogbo metropolis. Information on the labels was recorded to include manufacturer's addresses, brand names. manufacture and expiry dates, batch numbers, NAFDAC numbers, type of preservative(s) and compositions. The preservatives for some of the products were not indicated. Samples were kept in the refrigerator in sample bottles with tight-fitting lids and kept at room temperature before commencement of analysis. Five brands of fruit juices packed in laminated paper were used in this study and labeled NNN, OOO, PPP, QQQ, and RRR respectively.

PROXIMATE ANALYSIS

Moisture, fat, carbohydrate, crude fibre, protein and ash content were determined by AOAC, 2010.

Determination of Vitamins

Vitamin C (ascorbic acid) was determined by titration with 2, 6-dichlorophenol indophenol (Plummer, 1978). Ten milliliters of each sample was treated with 0.4% oxalic acid and titrated with 2, 6-dichlorophenol indophenol to a faint pink end point. A blank of a standard solution of ascorbic acid was treated similarly. The content of ascorbic acid in the malt drink was then obtained by calculation. The Car-Price reaction (Jayaraman, 1992) was used to estimate vitamin A. Ten milliliters of the sample was extracted with chloroform. The extract was treated with a saturated solution of antimony trichloride. The absorbance of the resulting solution was read at 620nm against a reagent blank. The concentration of vitamin A in the sample was deduced from a calibration curve prepared with a standard solution of vitamin A while vitamin B was determined according to AOAC, 2010.

Mineral content determination

Each juice sample was digested by the wet ashing method prior to mineral content determination as described by Abulude *et al.* (2007). 1 ml of sample was measured into a beaker and 10 ml of 1% HC1 was added and the mixture heated on a hot plate until the content was reduced to about 1 ml. The solution was then made up to 50 ml with 1% HC1 and stored in plastic containers until analyzed for K, Na, Ca, Zn, Fe and Mg using atomic absorption spectrophotometer (AAS) Buck scientific East Norwalk, CT, USA. While operating the AAS, all controls on the left front panel, right front panel and the pressure regulator were set at zero mark. Thereafter, required hollow cathode (HC) lamp corresponding to the required mineral and the holders in the lamp compartments was installed. On turning on the switch and utilizing the appropriate lamp current meters, the concentrations of the various metallic mineral elements were determined and the analysis done in triplicates.

RESULTS AND DISCUSSION

Proximate Composition of the Selected Fruit Juices

The proximate compositions of the selected fruit juices investigated are shown in Table 1.

The samples had high moisture contents which varied from (82.00 ± 0.01- 82.53 ±0.01) %. The high moisture content of most fruit juices had been reported by *(Health and Reineccius, 1986).* Also higher moisture contents were reported for *A. comosus* (87.3%), *C. papaya L.* (85.03±4.32%). P. guava (83.53±3.54%) and P. guava (82.00%) respectively (Falade *et al.,* 2003; Ashave *et al.,* 2005). All the juices studied had high moisture content as reported by Umoh (1998). The high moisture contents in fruit juices provide part of the medium for normal functioning of enzymes and general metabolic processes (Kohier and Bickott, 1970).

The presence of crude fibre contents of the selected fruit juices ranged from (0.08±0.01-1.25±0.04) %. This could make it an easily digestible food especially for children. This is because low fibre content in foods can enhance nutrient availability (Chikwendu and Obizoba. 2003). However, high fibre foods are also desirable in the daily diet because of their numerous nutritional benefits.

Table 1: Proximate Composition of the Selected Fruit Juices (%)

Samples	M. C.	C. P.	C.F	C. F2	A.C.	CHO
NNN	82.00±0.01	1.27±0.03	0.05±0.005	1.25±0.04	0.07±0.004	14.87±0.05
OOO	82.11±0.02	1.23±0.01	0.04±0.004	1.20±0.03	0.06±0.003	14.92±0.04
PPP	82.42±0.03	1.20±0.01	0.03±0.003	1.15±0.02	0.04±0.002	14.70±0.03
QQQ	82.34±0.02	1.14±0.02	0.02±0.002	1.10±0.01	0.03±0.001	15.04±0.02
RRR	82.53±0.01	1.10±0.01	0.01±0.001	0.08±0.01	0.01±0.001	14.93±0.01

Values are means of triplicate determination ±SD for each M.C. rep. moisture content, C.P. rep. crude protein, CF1 rep. crude fat, A.C., rep. ash content, CF2 rep crude fibre. Mean ± standard deviation of triplicate determinations. NNN rep Five Alive, OOO rep Chivita, PPP rep Happy Hour, QQQ rep Mr Fruit and RRR rep Fumman

The protein contents in the juices ranged between (1. l0±0.01-1.27+0.03) % The low protein content of the juices is not surprising as reported by [Umoh 1998; Brain and Alan, 1992]. In adults, the FAO/WHQ/U safe intake of proteins has been reported to be 0.80 g/Kg for females and 0.85 g/kg for males (Latham, 1997). For a 70kg man, this translates into a protein requirement of 59.5g/day. Thus, the contribution of fruit juices to the daily requirement of protein appears to be minimal. The crude protein contents of the juices were generally low but however higher than 0.29±0.01% for *M domestica* and lower than 1.28±0.10% for P. Guajava juices (Ashaye *et al.,* 2005). Proteins are essential component of diet needed for survival of animals and human beings whose basic function is to supply adequate amounts of required amino acids for nutrition [Pugalenthal *et al.,* 2004]. Protein deficiency causes growth retardation, muscle wasting, edema, abnormal swelling of the belly and collection of fluids in the body [Perkins-Veazje *et al.,* 2005].

The ash contents of the selected fruit juices varied between (0.07±0.001-0.01±0.004) %. The percentage ash of the samples gave an idea about the inorganic content of the samples from where the mineral content could be obtained. Samples with high percentages of ash contents are expected to have high concentrations of various mineral elements, which are expected to speed up metabolic processes and improve growth and development (Bello *et al.,* 2008). The ash content value compared favourably with most juices' value (Brain and Alan 1992) but lower than those reported by (Amoo and Lajide, 1997). The percentage ash of the sample gave an idea about the inorganic content of the samples from where the mineral content could be obtained. Samples with high percentages of ash contents are expected to have high concentrations of various mineral elements, which are expected to speed up metabolic processes and improve growth and development [Bello *et al.,* 2008].

The carbohydrate content of these fruits ranged from (14.70±0.03 to 15.04±0.02) %. Samples with low carbohydrate content might be ideal for diabetic and hypertensive patients requiring low sugar diets.

Vitamin Composition of the Selected Fruit Juices

Vitamin A is essential for normal growth, vision, immune response and cell' differentiation (Sommer and West, 1996). The intake of vitamin A recommended by FAO is 7501g retinol per day for adults, with lactating mothers require less (FAO, 1988; Latham, 1997). The deficiency of this vitamin is of public health concern in many developing countries. Available data (UNICEF, 1994) indicates that in Nigeria, vitamin A deficiency affects 9.2% of children and 7.2% of mothers. Vitamin A deficiency has been associated with increased respiratory infections, risk of diarrhea and decreased immune response (Sommer and West, 1996).

The vitamin compositions of the selected fruit juices are shown in Table 2. In this research work, the level of vitamin A in the fruit juices has been found to range between (82.41±0.05-107.35±0.01) mg/100ml. Therefore, the fruit juices contribute substantially to the RDA of vitamin A. When these amounts of beta-carotene in the samples are combined with other foods that are not considered very good sources of beta carotene it could provide cumulative importance. Beta-carotene is the carotenoids with the most vitamin A activity and because of its chemical nature, it has been suggested that beta carotene may be an antioxidant within tissues protecting them from damage by free radicals (Wardlaw *et al.,* 2004).

Table 2: Vitamin Compositions of the Selected Fruit Juices (mg/l00ml)

Samples	Vitamin A	Vitamin B	Vitamin C
NNN	107.35±0.01	40.36±0.01	37.54±0.01
OOO	105.20±0.02	36.40±0.02	36.21±0.02
PPP	100.13±0.03	30.24±0.03	34.38±0.03
QQQ	99.05±0.04	24.31±0.05	30.17±0.05
RRR	82.41±0.05	15.95±0.06	23.60±0.07

Values are means of triplicate determination ±SD for each, NNN rep Five Alive, OOO rep Chivita, PPP rep Happy Hour, QQQ rep Mr Fruit and RRR rep Fumman

Vitamin C is an important antioxidant in the human body fluid (Halliwell and Gutteridge, 1990). This vitamin is also required for the proper formation and maintenance of intracellular material, especially collagen (Latham, 1997). It has been found to play a preventive role in the development of cardiovascular disease (Mebra *et al.,* 1995). Benzie and Stain (1997) reported that the ingestion of vitamin C causes a dose-related increase in plasma ascorbic acid concentration. The above mentioned authors demonstrated that a dose of 50mg of vitamin C is optimal and cost effective in terms of increasing the plasma concentrations of this vitamin. The RDA for vitamin C is 40 mg (Weber *et al.,* 1996). The amounts of vitamin C in the selected juices were estimated to range between 23.60±0.07 and 37.54±0.01 mg/100ml. Producers advertise fruit juices as having been fortified with vitamin C. The values obtained in this study are varied but generally below 1/3 RDA. The vitamin C content of the selected juices is lower than that of the Pitanga cherry juice (27.59 mg/100m1) and comparable to the values reported for orange (49 mg/100ml), pineapple (24 mg/l00ml), sour sop (26 mg/100ml), bananna (18 mg/100ml), and mango (25 mg/l00m1) as reported by Nnam and Njoku, 2005; Obizoba *et al.,* (2004). When consumed alongside other vitamin C rich foods each day, it can help an individual to meet the recommended daily allowance of 30 — 95 mg distributed within different age, sex and physiological status [NHMRC, 1991].

Mineral Composition of the Selected Fruit Juices

All the minerals analyzed were within the standard acceptable range when compared with the 2008 standard specification of Standard Organization of Nigeria (SON, 2008). The selected juices contained significant quantities of some of the minerals. Natural fruits and vegetables are good sources of potassium and are low in sodium, an advantage reported to protect against arterial hypertension as opposed to meat derivatives (Pamplona- Roger, 2004). Potassium is the most abundant element in all the juice samples followed by calcium and then sodium. The levels of potassium in the selected juices ranged from (96.86±0.08-138.20+0.02) mg/100ml which is higher than (26.15±4.21) mg/100ml obtained for *Annona muricata* juice and 38.05±6.85 mg/100ml for *Musa paradisiaca* juice Onibon, *et al.,* (2007) and Holland *et al.,* (1997). The values obtained for *Ananus comosus* juice (16.45±1.50 mg/100ml), Citrus lanatus juice (7.00±0.04 mg/100ml), *M. paradisiaca* juice (7.24± 0.05 mg/100ml) obtained by Ihekoronye and Ngoddy, (1998) were lower than that obtained for the selected juices. Also, the calcium content of the selected fruit juices (5.24±0.01-18.45±0.07) mg/100ml is comparable to that obtained by Onibon *et al.,* (2007) for *Psidium guajava* juice (14.56 mg/100ml) and C. papaya juice (29.64 mg/100ml) but higher than that obtained by *M. paradisiaca* juice (0.016 mg/100ml), *Malus domestica* juice (0.88 mg/100ml) and *Citrus sinensis* juice (0.93 mg/100ml) respectively. Magnesium, iron and zinc are present in trace amounts in all the samples. This result is in agreement with the result reported by Onibon *et al.,* (2007) who worked on some fruit juices and also reported that potassium was the most abundant mineral in the fruits while magnesium and iron were present in minute quantities. Potassium and sodium are macro-elements required for the maintenance of cellular water balance, acid-base balance and nerve transmission and are required in large amounts in the body (Wardlaw, 1999; Worthington-Roberts, 2007). The magnesium content for the selected juices ranged between (7.08 ± 0.11 – 15.23 ± 0.03) mg/100ml which is higher than that reported for *M domestica* (13.29 mg/100ml), *P. guajava* (13.29 mg/100ml), *C. papaya L.* (28.24 rng/100ml) but lower than C. sinensis, (26 mg/100ml) and *A. comosus* (36mg/100m1) as reported by Falade *et al.,* 2003 and Onibon *et al.,* (2007). Also, magnesium is required for our body's muscular contraction. Deficiencies of these macronutrients lead to muscle cramps, mental confusion, loss of appetite and irregular cardiac rhythm (Worthington-Roberts, 2007). However, there is a direct relationship between sodium intake and hypertension in humans (Dahl, 1972). The mineral compositions of the selected fruit juices are shown in Table 3.

Table 3: Mineral Compositions of the Selected Fruit Juices (mg/l00ml)

Sample	Ca	Zn	Mg	K	Na	Fe
NNN	18.45±0.07	0.64±0.005	15.23±0.03	138.20±0.02	17.00±0.01	15.34±0.02
OOO	16.34±0.06	0.52±0.004	13.14±0.06	127.94±0.03	15.81±0.02	14.01±0.03
PPP	13.31±0.04	0.49±0.003	12.11±0.07	107.79±0.06	12.80±0.08	12.64±0.06
QQQ	9.27±0.02	0.40±0.002	9.10±0.09	100.70±0.07	10.73±0.06	09.23±0.08
RRR	5.24±0.01	0.28±0.001	7.08±0.11	96.86±0.08	6.70±0.10	08.31±0.09

Values are means of triplicate determination ±SD for each, NNN rep Five Alive, OOO rep Chivita, PPP rep Happy Hour, QQQ rep Mr Fruit and RRR rep Fumman

Therefore, it is desirable that the concentration of sodium in foods is not as high as that of potassium. These results therefore indicate a desirability of the consumption of these beverages because they contain a high concentration of sodium and potassium but the concentration of sodium is lower than that of potassium. Calcium is essential in bone and teeth formation (Wardlaw, 1999) and a deficiency of calcium causes rickets and osteoporosis (Hunt *et al.,* 1980). Meeting calcium needs has been associated with reduced risk of hypertension, colon breast cancer, kidney stones, lead exposure, premenstrual syndromes and obesity/overweight (Wardlaw *et al.,* 2004). Consumption of these beverages is therefore desirable as they serve as good sources of this macronutrient.

The levels of iron and zinc in the fruit juices were found to be generally low. There are traces of iron in fruit juices produced from lime, lemon and grape as reported by Nnam and Njoku, 2005. The level of iron in the selected juices ranged between 8.31±0.09-15.34±0.02 mg/100ml. These are similar to the reported values of iron in Nigerian lager beers (Okon and Akpanyung, 2000). For an average consumption rate of 600 ml per day, this amounts to a maximum of 1.5 mg of iron per day. The RDAs for iron are 10 mg/day for men and 15 mg/day for women (NRC, 1989). Obviously, fruit juices do not contribute substantially to the RDA for iron but are however a good source. The deficiency of iron is a problem of global concern (UACC/SCN, 1991). Iron deficiency reduces learning and working capacity as well as appetite (Pollit, 1993). Hence the inclusion of iron as one of the food fortificants which is aimed at reducing micronutrient deficiencies (Blum, 1997). The iron content in the selected juices (8.31±0.09 and 15.34±0.02) mg/100ml were lower than that reported for C. *papaya L.* (0.40 mg/100ml), *C. lanatus* (0.20 mg/g), *A. comosus* (0.30 mg/g), C. *sinensis* (0.40 mg/g), *M. paradisiaca* (0.93 mg/g) Ihekoronye, and Ngoddy, (1998).

In the selected juices, zinc ranged between (0.38±0.00 and 0.57±0.02) mg/100ml. The values were generally higher than that in lager beer (Okon and Akpanyung, 2000). The RDA for zinc in adults is 15 mg (NRC, 1989). Sandstead (1995) reported that Zn deficiency is a public health problem. The effects of Zn deficiency include delayed wound healing, suboptimal immune functions, increased plasma lipid peroxides and reduced taste/smell acuity (Fortes *et al.,* 1997). The zinc concentration of the selected juices (0.28±0.001 and 0.64±0.005) mg/100ml was lower than 22.9 mg/100ml for P. guajava but higher than 0.1 mg/100ml, 0.10 mg/100ml reported for *C. sinensis* and *C. papaya L.,* by Onibon *et al.,* 2007. The values were comparable to *M paradisiaca,* 0.45 mg/100ml, *M domestica,* 0.51 mg/100ml, P. guajava 0.06 mg/100ml but higher than *C. sinensis* 0.35 mg/100ml, and *C. papaya L.,* 0.24 mg/100ml reported by Onibon *et al.,* 2007.

Copper was not detected in any of the samples of the juice analyzed. This element is an essential component of many enzymes including the antioxidant enzyme, superoxide dismutase (Valentine and De Freitas, 1985). The antioxidant defense protects the body against the deleterious effects of free radicals (Halliwell and Gutteridge, 1989), hence, the need for adequate body stores of copper. Unfortunately, suboptimal intake of copper is common in developing countries (Olivares and Uauy, 1996).

The macro nutrient contents of the selected juices in this study compared favourably with some other fruit juices like orange, pineapple and sour-sop juices (Wardlaw *et al.,* 2004; Obizoba *et al.,* 2004. The micro nutrient values of the selected juices were low compared with the recommended daily allowance and so the consumption of a combination of the selected juices with other fruits and vegetables and any other food group that contains certain amounts of the different minerals may meet individual recommended micronutrients daily allowance.

CONCLUSIONS

All the analyzed chemical parameters and heavy metals conform to the standard specifications (SON, 2008). The level of mineral and vitamin compositions reported is within standard specification and in agreement with the reports of Malo *et al*. (2006), Gazdik *et al*. (2008) and Okiei *et al.* (2009). The proximate composition of some analyzed fruit juices sold in Nigeria complied with standard specifications; however, the wide variations in the level of these vitamins in the fruit juice call for proper standardization in the extent of fortification and the need to consider additional fortification of fruit juices with essential mineral nutrients.

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