http://dx.doi.org/10.4314/bajopas.v10i2.29

Bayero Journal of Pure and Applied Sciences, 10(2): 172 - 176
Received: November, 2017
Accepted: December, 2017
ISSN 2006 – 6996

PROXIMATE AND MINERAL ELEMENTS COMPOSITION OF FIVE LOCALLY CONSUMED FRUITS IN KANO STATE, NIGERIA

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ABSTRACT
A number of tropical fruits are cultivated in almost all parts of northern Nigeria with high nutritional value that plays important role in human nutrition. This study was aimed at evaluating the proximate and mineral element composition of the five tropical fruits (Shea-fruit, Mango, Guava, Water melon and Orange) that are widely consumed in Kano state Nigeria. The proximate composition of the studied fruits were determined by the standard methods of Official Analytical Chemists, while the Mineral Elements (Ca and Mg) were analyzed using Atomic Absorption Spectrophotometry. The levels of Na^+ and K^+ were determined using Flame photometry and the level of P was determined by Vanadomolybdate method. The result of the proximate analysis shows that water melon has the highest moisture and protein contents (95.3±0.7% and 7.7±0.8% respectively). Shea fruit recorded the highest ash, lipid and energy value (7.35±0.5%, 2.12±0.8% and 1516.7±8KJ/100g respectively). Orange has the highest available carbohydrate (86.54±1.7%) while mango has the highest fiber content (13.52±0.2%) among the studied fruits. Similarly, Concentration of Ca was found to be highest in the pulp of orange (0.277±0.025mg/100g). The levels Mg were found to be highest in the peel of water melon (30.0±0mg/100g). More so, the levels of K and P were highest in the peel and pulp of guava (138.9±4.8mg/100g and 48.6±0.2mg/100g respectively) with significant difference ($p<0.05$) between the studied segments of the fruit. The level of Na was found to be highest in the peel of mango (6.7±0.7mg/100g). The results obtained show that the studied samples of fruits are rich in total protein, available carbohydrate and crude fiber. Likewise, the fruits also have appreciable amounts of K, Mg, Na and P but poor sources of Ca. Hence, consumption of such fruits could improve the nutritional status of the consumers.
Keywords: Fruits, Proximate, Mineral, Atomic Absorption Spectrophotometry, Flame Photometry.

INTRODUCTION

Several tropical fruits are cultivated in almost all parts of Northern Nigeria with a high nutritional value that plays important role in human nutrition. Also, researches conducted on the estimation of their nutritional value had shown that the fruits are rich in minerals elements, vitamins, dietary fibers, anti-oxidants and diverse compositions of many nutritional and anti-nutritional factors (Rahman *et al.,* 2007; Jahan *et al.,* 2011). A healthy diet should compose of appreciable quantity of fruits and vegetables and regular consumption of sufficient amounts could help to avert major chronic diseases (Maksuda *et al.,* 2016). The diet of the majority of people living in this part of the world is mostly made up of cereals and carbohydrate as many cannot afford the cost of animal protein and therefore largely depends on plant sources to augments their daily nutritional requirements thereby preventing incidences of protein-energy malnutrition such as kwashiorkor and marasmus particularly in children (Adekunle and Ayorinde, 2004). Food safety and security is a major public concern (Afshin and Masoud, 2008) and the quest to promote healthy nutrition of the populace must therefore be a point of priority for all nutritionists and food scientists. Fruits and vegetables are frequently used by humans as sources of food because they provide nutrients that are essential for body building and regulation of body function (Muhammad *et al.,* 2011). Their contribution to the dietary need and nutritional requirement of people cannot be overemphasized as they are very beneficial to nutritionally marginal population or to certain vulnerable groups within the population (Olujobi, 2012; Vunchi *et al.,* 2011).In view of the above, it is essential to conduct research in order to assess the proximate and mineral element composition of some locally consumed fruits (Guava, Water melon, Mango, Shea-fruit and Orange) in Kano state.

MATERIALS AND METHODS

Chemical reagents

All chemical and reagents used for this study were pure and of analytical grade

Sample collection and preparation

Freshand ripe samples of guava *(Psidium guajava)*, watermelon *(Citrus lanatus)*, mango *(Mangifera indica)*, Shea-fruit *(Vitellaria paradoxa)*and Orange (*Citrus sinensis*) were obtained at Na'ibawa market in the metropolitan city of Kano, Nigeria. They were initially washed in a running tap water and later with distilled water to remove dust and dirt. The samples were then sliced using a knife to separate the pulp and peel.

The samples were then air dried at room temperature for 5 days and later in the microwave oven at 65°C until constant weight was obtained. The dried samples of fruit were grounded using pestle and mortar to tiny particles, stored in a tight plastic container prior to analysis (Afshin and Masoud, 2008).

Proximate analysis

Determination of crude lipid: Determination of crude lipid was performed using the Soxhlet extraction method. Ten grams (10g) of the powdered form of each sample were weighed and wrapped with a filter paper and placed in a thimble. The thimble was covered with cotton wool and placed in the extraction column that was connected to a condenser. About 200 ml of n – Hexane was used to extract the lipid (A.O.A.C, 1990).

Determination of crude protein: The crude protein was determined by the Kjeldahl method with slight modification. About 0.5 g of the powdered form of each sample was digested with 5 ml of concentrated sulphuric acid in the presence of Kjeldahl catalyst. The nitrogen from the protein in the sample was converted to ammonium sulphate that reacted with 2.5 ml of 2.5 % Brucine reagent, 5 ml of 98% sulphuric acid to give a coloured derivative and the absorbance read at 470 nm. The percentage nitrogen was calculated and multiplied by a factor of 6.25 to obtain the value of the crude protein(A.O.A.C, 1990)..

Determination of crude fiber: Crude fiber was also determined using the method described by the Association of the Official Analytical Chemists(A.O.A.C, 1990).. Five grams (5g) of each of the fruit samples and 200 ml of 1.25 % H_2SO_4 were heated for 30 min and filtered with a Buchner funnel. The residue was washed with distilled water until it was acid free. About 200 ml of 1.25% NaOH was used to boil the residue for 30 mins, it was then filtered and washed several times with distilled water until it was alkaline free. It was then rinsed once with 10% HCl and twice with ethanol. Finally it was rinsed with petroleum ether three times. The residue was put in a crucible and dried at 105°C in an oven overnight. After cooling in a desiccator, it was ignited in a muffle furnace at 550°C for 90 mins to obtain the weight of the ash.

Determination of ash content: The ash contents of the fruit samples were also determined as described by A.O.A.C (1990). The total ash content of a substance is the percentage of inorganic residue remaining after the organic matter has been ignited. About 2 g of the pulverized samples was placed in a crucible and ignited in a muffle furnace at 500°C for 6 hours. It was then cooled in a desiccator and weighed at room temperature to get the weight of the ash.

Determination of available carbohydrate: Carbohydrate content was determined by difference. This was done by subtracting the summed up percentage compositions of protein, lipid, fiber, and ash contents from 100(A.O.A.C, 1990)..

Determination of moisture content: The moisture contents of the samples were determined using automated moisture analyzer (MB 23, OHAUS Corp. USA)(A.O.A.C, 1990).

Determination of energy value: Energy value in kilocalorie per gram (Kcal/g) was estimated by multiplying the percentage contents of crude protein, crude lipid and available carbohydrate (otherwise called nitrogen free extract, NFE) by the recommended factors of 4, 9 and 4 respectively and then taken the sum of the product. The value of energy in Kilocalorie per gram ($Kcalg^{-1}$) was then multiplied by 4.2 to be converted to Kilojoule per gram (KJg^{-1}) (NRC, 1989).

DETERMINATION OF MINERAL ELEMENTS

Five gram (5g) of fine powdered sample of each fruit segment (pulp and peel) was digested using a mixture of analytical grade acids HNO_3: HCl (1:1).

Calcium (Ca) and magnesium (Mg) levels were determined using atomic absorption spectrophotometer (210 VGP model). Sodium (Na) and potassium (K) levels were determined using flame photometric method while phosphorous (P) level was determined colorimetrically using vanadomolybdate method (Kitson, and Mellon, 1944).

Statistical analysis

The result is presented as mean $\pm$ standard deviation of triplicate readings. Student t-test at ($p<0.05$) was used to compare the significant difference between the pulp and peel of the fruit samples.

RESULTS AND DISCUSSION

Table 1 shows the proximate composition of samples of fruits studied. Moisture content varied between 36.1±0.6% to 95.0±0.7% in guava and watermelon respectively. The highest moisture content was observed in water melon while guava recorded the lowest moisture content (Table 1). The moisture content obtained for guava in this study is quite very low compared to 88.21% reported by Onibon *et al.,* (2007).The moisture content of any food is an index of its water activity and is used as a measure of the stability and susceptibility to microbial contamination (Edem and Miranda, 2011).Water melon having high moisture content may have a faster tendency for microbial growth and eventual contamination. Likewise, the studied samples have been shown to contain appreciable amounts of protein. Water melon recorded the highest protein content (7.7±0.8%) whereas orange has the lowest crude protein content (1.9±0.1%). The protein content in guava (2.3±0.3%) obtained in this study closely corroborate with the result (2.19%) reported by Udeme *et al.,* (2013). The percentage crude lipid contents of the studied fruit ranged between 0.75±0.1% to 2.12±0.8% in orange and shea-fruit respectively. The observed low fat content in these fruits has been found to be beneficial, since low fat containing foods have been recommended to avoid problem of obesity (Lintas, 1992).All samples contain appreciable amounts of crude fiber (Table 1).

Mango has the highest fiber content (13.52±0.2%) while shea-fruit has the lowest concentration (5.06±0.3%) of fiber among the sampled fruits. Food rich in dietary fiber contributes to the prevention of various diseases such as constipation, hemorrhoids, colon cancer, excess cholesterol, diabetes and diverticulosis (Hassan *et al.,* 2009).

The ash content, which is often regarded as an index of mineral content in biological mass (Effiong and Udo, 2010), was quite low in these fruits. The value ranged between 2.61±0.2% to 7.35±0.5% in mango and shea-fruit respectively. The results show that mango has the lowest ash content whereas; shea-fruit recorded the highest ash content (Table 1). The available carbohydrate or nitrogen free extract (NFE) contents of the studied fruits varied. In this study, orange was found to contain the highest carbohydrate (86.54±1.7%). This is followed by guava (82.10±0.3%),shea-fruit (81.47±10%) then mango (78.82±0.5%) and finally water melon having the least available carbohydrate (78.31±2.1%). The low carbohydrate content implies that water melon provides more calorific (energy) value with respect to available carbohydrate than the other fruits investigated in this study. Energy is needed to drive the metabolic activity by cells such as active transport, respiration, circulation, physical work and maintenance of body temperature among others (Effiong and Udo, 2010).The energy values obtained in this study were1,516.7±8KJ/100g in shea-fruit and 1,514.14±8 in orange. Likewise, water melon and guava recorded 1,508.1±12KJ/100g and 1,457.3±3KJ/100g respectively and finally mango, 1,437.4±7KJ/100g in order of their magnitude (Table 1). Table 2 shows the mineral element composition of fruits investigated. However, unlike the proximate analysis which was determined only in the pulps of the fruit, the mineral contents were investigated in both the pulp and peel segments of the studied fruits (Table 1). Calcium levels were found to be very low in all the studied fruits and the concentration was higher in the peel than the pulp segment of fruits except in orange which at the same time has the highest calcium content (0.277±0.025mg/100g and 0.247±0.025mg/100g in the pulp and peel portions of the fruit respectively). This is followed by water melon (0.116±0.05mg/100g and 0.073±0.03mg/100g) in the peel and pulp respectively. More so, shea-fruit, mango and guava also recorded low calcium contents in this study (Table 2). Furthermore, with the exception of shea-fruit, there was no significant difference ($p<0.05$) between the studied segments of the fruits(Table 2). Calcium functions as constituent of bones and teeth, regulation of nerve and muscle function and takes part in milk clotting (Aremu and Ibrahim, 2014). Moreover, for good intestinal absorption of calcium, Ca and P ratio should be 1:1 (Umar *et al.,* 2007).However, values obtained for calcium in this study are very low compared to the values obtained for phosphorous (Table 1). Therefore, there is the need to supplement calcium by those who consume a lot of these fruit as alternative sources of food to avoid calcium deficiency diseases. Potassium is essential in the maintenance of cellular water balance, pH regulation in the body and also associated with protein and carbohydrate metabolism (Onibon *et al.,* 2007). The highest concentration of potassium was obtained in peel of guava (138.9±4.8mg/100g), followed by the peel of mango (133.3±0mg/100g). However, the lowest potassium content (16.7±0mg/100g) was recorded in the mango pulp (Table 2). Similarly, statistical analysis shows that with the exception of mango, there exists a significant difference ($p<0.05$) in all the studied fruits. Magnesium was found to be highest in the pulp of water melon (30±0mg/100g) and lowest in both the pulp (2.5±0mg/100g) and peel (7.5±0mg/100g) of shea-fruit respectively. More so, there was a significant difference ($p<0.05$) in mango and guava (Table 2). Mbogo *et al.,* (2010), reported magnesium content in two varieties of orange in Tanzania, the values were 42.3±1.05 and 48.24±0.38 in Valencia and Navel oranges respectively. These values however, are higher than those (19.2±1.4 and 20.8±1.4 in pulp and peel) obtained for orange in this study. Magnesium plays a vital role in muscle relaxation along the airways to the lungs thus, allowing asthma patients to breathe easily (Muhammad *et al.,* 2011).In the same vain, the values of 5.9±0mg/100g of sodium were recorded in the pulps of guava and water melon with significant difference (Table 2). Mango has 6.7±0.7mg/100g and 6.1±0.3mg/100g in the peel and pulp respectively, while orange was found to contain the lowest concentration (1.6±0.3mg/100g and 1.4±0.3mg/100g) of sodium in the peel and pulp segments of fruit respectively (Table 2). Sodium regulates plasma volume and acid-base balance, involves in the maintenance of osmotic pressure of the body fluids (Murray *et al.,* 2000; Aremu and Ibrahim, 2014). Levels of phosphorous were also observed in all samples with significant difference ($p<0.05$) between the pulp and peel of all fruits (Table 2). Unlike other elements found to be more concentrated in the peels of the studied fruits, phosphorous contents were found to be higher in the pulp than the peel. Guava pulp was found to contain the highest concentration of phosphorous (48.6±0.2) while water melon peel recorded the lowest concentration (6.7±0.4) of phosphorous in this study. Similarly appreciable amounts of phosphorous were recorded in mango, shea-fruit and orange (Table 2). Phosphorous serves as a constituent of adenosine triphosphate (ATP) and nucleic acids.

Table 1: Proximate Composition of Fruits

Sample	%Moisture (WW)	%Ash (DW)	%CPr (DW)	%CHO (DW)	%CLi (DW)	%CFi (DW)	Energy value (KJ/100g)
Shea-fruit	75.3±0.7	7.35±0.5	4.0±0.2	81.47±1.0	2.12±0.8	5.06±0.3	1516.7±8
Mango	90.0±1.2	2.61±0.2	3.7±0.6	78.82±0.5	1.35±0.6	13.52±0.2	1437.4±7
Guava	36.1±0.6	5.54±0.3	2.3±0.3	82.10±0.3	1.02±0.1	9.04±0.5	1457.2±3
Water melon	95.3±0.7	5.12±0.2	7.7±0.8	78.31±2.1	1.67±0.1	7.20±0.2	1508.1±12
Orange	87.3±0.3	4.47±0.5	1.9±0.1	86.54±1.7	0.75±0.1	6.34±0.1	1514.14±8

Values are mean ± standard deviation of triplicate results.WW=Wet Weight, DW=Dry Weight, CPr=Crude Protein, CHO=Carbohydrate, CLi=Crude Lipid, CFi=Crude Fiber

Table 2: Mineral Element Content in Pulp and Peel of Fruits (mg100g^{-1} Dry weight)

Sample	Ca	K	Mg	Na	P
Shea-fruit pulp	0.058±0.025^{a}	24.7±0.5^{a}	2.5±0	2.7±0.3^{a}	43.8±0.6^{a}
Shea-fruit peel	0.116±0.025^{a}	42±0.5^{a}	7.5±0	4.3±0.7^{a}	39±0.4^{a}
Mango pulp	0.073±0.025	16.7±0	25.8±1.4^{a}	6.1±0.3	44.2±0.2^{b}
Mango peel	0.102±0.025	133.3±0	29.5±1.4^{a}	6.7±0.7	41.1±0.2^{b}
Guava pulp	0.058±0.025	113.9±4.8^{b}	12.5±0^{b}	4.7±0.6^{b}	48.6±0.2^{c}
Guava peel	0.102±0.025	138.9±4.8^{b}	18.3±1.4^{b}	5.9±0^{b}	45±0.2^{c}
Water melon pulp	0.073±0.025	88.9±4.8^{c}	25.8±1.4	3.3±0.3^{c}	8.3±0.4^{d}
Water melon peel	0.116±0.05	102.8±4.8^{c}	30±0	5.9±0^{c}	6.7±0.4^{d}
Orange pulp	0.277±0.025	82.2±0.9^{d}	19.2±1.4	1.4±0.3	43.4±0.2^{e}
Orange peel	0.247±0.025	100±0^{d}	20.8±1.4	1.6±0.3	27±0.5^{e}

Values are mean ± standard deviation of triplicate results. Figures followed by the same superscript in the same column are statistically significant ($p<0.05$).

CONCLUSION

Results from the current study revealed that fruits that are consumed in Kano state are rich in terms of proximate composition such as dietary fibers, protein, lipids and mineral elements. The values of mineral elements obtained in this study shows that the sample fruits are within the safe limits of consumption whereas, some are far below the recommended limits as observed in calcium. Therefore, careful selection and supplementation will undoubtedly meet the nutritional requirements of the populace.

Recommendation

The current study centered on the determination of nutritionally available composition of the four locally produced fruits in Kano state. Further studies should be undertaken to evaluate the composition of anti-nutritional factors of these fruits.

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