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Full Length Research Paper

Proximate and mineral elements compositions of some selected wild plants fruits (*Borassus aethiopum, Carissa edulis, Chrysophyllum albidum, Detarium microcarpum, and Hyphaene thebaica*)

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ABSTRACT: Mesocarps of five different wild plants fruits (*Borassus aethiopum, Carissa edulis, Chrysophyllum albidum, Detarium microcarpum* and *Hyphaene thebaica*) were subjected to proximate and mineral composition analyses. All the fruits showed some appreciable amounts of the proximate components that were determined such as ash content, crude fibre, crude fat, crude protein, moisture content and carbohydrate content. Similarly, the fruits contained appreciable amounts of some mineral elements such as calcium, sodium, potassium, iron, magnesium, manganese and zinc as observed in this study. The presence of these proximate components and mineral elements in these fruits make them important and considerable sources of nutrient supplements to the public. These observed nutritional components will assist in no small way in providing the basis for the production and the development of these nutritional components industrially to help alleviate the shortage of these components in our day to day growing population.

Keywords: Mesocarp, proximate components, mineral elements, growing population and wild plants fruits

INTRODUCTION

Fruit is the seed-bearing component of a plant that is frequently tasty, colourful, and aromatic, and is formed following fertilization by a floral ovary. Or any delicious edible plant part resembles seed-bearing fruit, even if it does not grow from a floral ovary. Fruits are usually seen as a useful source of nutrient supplements for food in a world where food scarcity is an issue. They are well-known for being high in micronutrients such as minerals and vitamins (Nahar et al., 1990). Mineral elements are crucial in determining the nutritional value of the fruit. The most important are potassium, calcium, and magnesium. Calcium is one of the mineral elements found in the tissue of many fruits and is thought to be an essential role in fruit storage quality (Lechaudel et al., 2005). Calcium has been shown to delay ripening and senescence as well as minimize storage disorder (Ferguson, 1984; Bangeruh, 1979). Minerals such as potassium, calcium, sodium, zinc, magnesium, and manganese are widely known for their importance to human health. These mineral elements must be present in sufficient quantities in the human diet in order to live a healthy life (San, 2009). The mineral element composition of plants is heavily influenced by soil abundance, particularly fertilizer intensity (Kruczek, 2005).

The fruit bearing wild plants

Carissa edulis belongs to the family Apocynaceae. This plant species is native to tropical and subtropical regions of Asia, Africa and Australia. They are cultivated as ornamental plants in America ranging from Florida and California. The ripe fruits are crimson red, edible with tart taste. Common species belonging to this genus are *Carissa carandas, Carissa microcarpa, Carissa grandiflora, Carissa edulis, Carissa spinarum, Carissa lanceolata, Carissa opaca, Carissa congesta and Carissa bispinosa*.

Borassus aethiopum (African Fan Palm Fruit) is a perennial plant in the family Borassaceae (Arecaceae). A plant found in hot tropical areas with low to medium rainfall, typically at elevations less than 400 meters. The fruits, as well as the sensitive roots produced by the young plants, are edible. Each fruit has 1-3 seeds encased in a woody endocarp (Keay et al., 1964). *Borassus aethiopum* is utilized for both medical and non-medical reasons around the world. *Chrysophyllum albidum* (African Star Apple) is a wild plant that belongs to the family Sapotaceae. The plant grows naturally in the forest habitat of Africa extending from Sierra Leone through Guinea, Sudan to East African countries such as Kenya and Uganda.

It is distributed in low and tropical rain forests especially in South Western Nigeria. The fruit is seasonal and globose, ovoid to sub-globose in shape, pointed at apex. The skin or peel is orange to golden yellow when ripe and pulp within the peel may be orange, pinkish, bricked or light yellow (Okafor, 1975).

Detarium microcarpum (Guill. and Perr.) It belongs to the family Caesalpiniaceae. It is a savanna tree which attains a height of up to 9m with a twisted bole and widely spreading crooked branches (Keay *et al.,* 1964). Fruits (November – May) more or less circular and disc-shaped, 2.5-5cm across and 2.5cm thick with brown-fairy smooth skin, brittle when dry, enclosing the sweet greenish pulp mixed with tangled network surrounding the hard disc-shaped wrinkled stone containing one seed. Galled fruits 1-2.5cm across commonly occur mixed with the normal fruits. Other species of *Detarium* indigenous to Africa include *Detarium senegalense* (Keay *et al.,* 1964).

Hyphaene thebaica (doum) of the family Arecaceae is a desert palm with common names doum palm and ginger bread (Reda, 2015). This plant is found in countries such as Egypt, Senegal, Sudan, Central Africa, Nigeria, Tanzania and Mauritania. The trunks of the palm is used for construction, as well as for manufacture of various domestic utensils and the leaves are used to make mats, bind parcels and writing paper (Reda, 2015). The oblong, yellow-orange apple sized fruit has a red outer skin, a thick, spongy and rather sweet, fibrous fruit pulp that tastes like gingerbread and a large kernel. To the people of the desert where doum palm are found, it is life sustaining and is listed as a famine food. The fruit pulp is used in cooking in various ways, and the different varieties differ in their edibility. While the unripe kernel is edible, the ripe kernel is hard and used only as a vegetable ivory.

Objective of the study

The objective of this study is to determine the proximate and mineral elements compositions of some wild fruits obtained from some wild plants such as *Borassus aethiopum*, *Carissa edulis, Chrysophyllum albidum, Detarium microcarpum* and *Hyphaene thebaica.*

MATERIALS AND METHODS

Five fruit samples devoid of contamination and mechanical injury were collected from Girei market in Girei local government area of Adamawa State. These fruit samples were identified and authenticated by a botanist in the plant sciences department of Modibbo Adama University of Technology, Yola. The samples were thoroughly washed, dried at room temperature and Mesocarp of each fruit sample was scrapped using a sterile scalpel. The dried samples were ground to powder using mortar and pestle and kept in a clean sterile container.

Determination of crude ash

Crude ash content was determined by method described by the Association of Official Analytical Chemists (AOAC, 2000).

Principle: Ash is the inorganic residue remaining after water and organic matter have been removed by heating in the presence of oxidizing agents, which provides a measure of the total amount of minerals within a food sample.

Procedure: Three grammes {3g) of the sample was put into an empty crucible that has been washed, dried in an oven and weighed. The crucible containing the sample was put into an oven at 600^{o} C for three hours, removed and cooled in a desiccator and the weight of the crucible with its content was recorded. The ash content was determined as shown below:

$$\text{Percentage (\%) crude ash} = \frac{\text{Weight of crucible with sample after ashing} - \text{weight of empty crucible}}{\text{Original Weight of sample}} \times 100$$

Moisture content determination (AOAC 2000)

Principle

Moisture content determination method quantitatively determines the dry-matter percentage in samples based on the gravimetric loss of free water associated with heating at 105^{o} C a period of two hours. The moisture and low volatile materials were removed by heating. Moisture analysis determines the amount of water/moisture present in a sample.

Procedure: Two grammes of the sample were put into a Petri dish previously weighed. The Petri dish containing the sample was put into a moisture extraction oven and dried for about three hours at a temperature of about 105^{o} C. The Petri dish containing the sample was transferred to a desiccator and cooled for 30min. The weight of the dish containing the sample was taken until a constant weight was obtained. Percentage moisture content was calculated as:

$$\text{Percentage (\%) moisture content} = \frac{W1 - W2}{W}$$

Where W = Original weight of the sample.
W1 = Weight of Petri dish containing the sample before drying.
W2 = Weight of Petri dish containing the sample after drying to a constant weight.

Crude fibre determination

The method described by Association of Analytical Chemists (AOAC, 2010) was used. Two grammes of the sample and one gramme of asbestos were put into 200ml of 1.25% of H_2SO_4 and boiled for 30min. The solution and content was then poured into a Buchner funnel equipped with muslin cloth secured with elastic band. It was filtered and the residue transferred into 200ml of 1.25% NaOH and boiled for 30min. This was transferred again into the Buchner funnel and filtered. The filtrate was washed twice with ethyl alcohol and then washed three times with petroleum ether. The residue obtained was put into a clean dry crucible dried in the moisture extraction oven at 105^{o} C to constant weight.

$$\text{Percentage (\%) crude fibre} = \frac{\text{Weight of sample before incineration} - \text{weight of sample after incineration}}{\text{Weight of original sample}}$$

Crude fat determination

Crude fat was determined according to the method described by AOAC, 2010. Two grammes of the sample was loosely wrapped with a filter paper and put into a thimble fitted to a round bottom flask 120ml of petroleum ether which has been cleaned, dried and weighed. The round bottom flask was heated with a heating mantle and allowed reflux for 5hours. The flask containing the fat residue was dried in an oven at about 100^{o}C for 30min. The thimble with its content was put into a beaker and dried in an oven to a constant weight, cooled and weighed again. The crude fat content is calculated as:

$$\text{Percentage (\%) crude fat} = \frac{\text{Weight of flask and extracted fat} - \text{weight of an empty flask.}}{\text{Weight of the sample taken}}$$

Crude protein determination

Crude protein determination was carried out according to method described by AOAC, 2000. Nitrogen content of the sample was determined by Kjeldahl's digestion method using Markham's apparatus. Two grammes of the sample were weighed into a 50ml Kjeldahl’s flask and 20ml of conc. H_2SO_4 was added and a tablet of K_2SO_4 was added as a catalyst. The sample was heated at 200^{o} C for 30min and later increased to 350^{o} C for 5 – 6 hours to obtain a clear digest. Twenty-five millilitres (25ml) of sample digest were pipetted into Kjeldahl's flask and mixed with 25ml of 40% NaOH solution. The mixture was mounted unto the distillation unit, then heated with a constant flow of water and the liberated ammonia was collected with 10ml Boric acid-indicator mixture in a conical flask placed at the condenser end of the Markham distillation unit. When the Boric acid-indicator mixture turns green, the distillation was allowed to go on for another 5min. At the end the conical flask was removed and its content titrated with 0.01N HCl until the original colour of the Boric acid-indicator mixture is restored. Percentage crude protein is calculated as:

$$\text{Percentage (\%) Crude nitrogen} = \frac{1.4(V1 - V2)\ M \times 100}{W}$$

Percentage (%) Crude protein = Percentage (%) Nitrogen x F
Where F = Protein factor 6.25; V1 = Vol. of acid used in blank titration; V2 = Vol. of acid used in sample
Titration; M = Molarity of acid; W = Weight of the sample used.

Carbohydrate content determination

Carbohydrate content was determined by difference as described by AOAC, 2010. This was obtained by taking the difference between 100 and the sum of crude ash, crude fibre, crude fat, crude protein and moisture content. Percentage (%) Carbohydrate (Nitrogen Free Extract) = 100 – (Crude protein + Crude fat + Crude fibre + Crude ash + Moisture content).

Energy Values of the samples were determined according to the method described by Osborne and Voogt, (1978).
Food Energy value = (4x protein) + (4 x fat) + (4 x carbohydrate).

Determination of mineral elements

Mineral elements were determined by method described by AOAC, (2005). Five grammes of the sample was put into a muffle furnace, ashed at 550^{o}C and cooled. The ash was boiled with 10ml of 20% HCl in a beaker and filtered into a 100ml volumetric flask. It was made up to mark with deionized water. The mineral elements were determined from the solution using atomic absorption spectrometry (AAS)(VGP-210).The elements Mg, Ca, Zn, P, K and Fe were determined Atomic Absorption Spectrometry at the appropriate wavelength, temperature

Table 1: Proximate Composition of the Mesocarp of some selected Wild Fruits (mg/100g).

Type of plants	*Borassus aethiopum*	*Carissa edulis*	*Chrysophyllum albidum*	*Detarium microcarpum*	*Hyphaene thebaica*
Moisture	11.93±1.61	19.02±0.01	4.64±1.01	4.00±0.02	12.00±0.12
Ash	20.06±1.45	8.50±0.01	2.50±0.72	3.50±0.01	0.04±0.01
Crude fibre	24.16±2.10	3.50±0.03	32.80±2.55	13.31±0.03	0.39±0.11
Crude fat	0.08±0.02	0.50±0.03	12.71±1.11	2.40±0.02	1.10±0.10
Crude protein	4.70±0.46	8.30±0.01	1.85±0.40	3.41±0.01	2.78±0.15
Carbohydrate	57.07±2.47	60.18±0.06	45.50±1.94	73.38±0.67	83.69±0.14

Key: Values are means ±standard deviation for three determinations.

Table 2: Mineral elements Composition of some selected Wild Fruits (ppm).

Type of plants	*Borassus aethiopum*	*Carissa edulis*	*Chrysophyllum albidum*	*Hyphaene thebaica*
Calcium	21.51±0.98	89.78±0.00	0.31±0.03	1.40±0.11
Potassium	18.30±0.09	160.00±0.04	0.19±0.01	1.10±0.09
Iron	-	5.05±0.00	1.95±0.16	1.02±0.16
Sodium	2.45±0.32	45.00±0.02	-	1.15±0.12
Manganese	-	-	1.08±0.06	0.27±0.13
Zinc	6.24±0.47	1.09±0.00	0.12±0.02	0.54±0.10
Magnesium	3.85±0.67	29.99±0.01	-	-

Key: Values are mean ± standard error of mean for three determinations.
- = Not determined.

and lamp current for each element.

RESULTS AND DISCUSSION

Table 1 shows percentage composition of the proximate components such as moisture content, ash, crude fibre, crude fat, crude protein and carbohydrate. These parameters are determined at various concentrations as depicted in the table. Table 2 shows the mineral elements detected in four wild fruits instead of five as earlier shown in (Table 1). The wild plants fruits without any doubt contained appreciable amounts of the various parameters so far determined. These parameters seemed to fall within the same range throughout except in rare cases where some of the values are a little high. For instance, Crude fibre content observed in *Borassus aethiopum* (24.16±2.10) and *Chrysophyllum albidum* (32.80±2.55) were high when compared with what was observed in the case of other fruits despite the fact that the two fruits have fleshy Mesocarp. Fibre, also known as roughage, is the part of plant based foods (grains, fruits, vegetables, nuts, and beans) that the body can't break down. It passes through the body undigested, keeping the digestive system clean and healthy, easing bowel movements, and flushing cholesterol and harmful carcinogens out of the body. Equally, it was observed that the carbohydrate contents of these fruits (*Borassus aethiopum* and *Chrysophyllum albidum*) were lower compared to the remaining three fruits. This observation may not be unconnected with the fleshy nature of these fruits. *Chrysophyllum albidum* showed high crude fat content compared to the remaining fruits which correspond with what was reported earlier by Christopher and Dosunmu, (2011) on the same type of fruit. The moisture content observed in these fruits is low compared to the moisture content usually observed in indigenous fruits (Mapongmetsem *et al.,* 2012). Fresh fruits and vegetables contain 85% water (Jenson, 1978, Eromosele *et al*., 1991). Low moisture content helps to reduce microbial activity and confers longer storage time without spoilage (Isengard, 2001). The fruit species with considerably high moisture content such as *Carica papaya, Sclerocarya birrea, Annona senegalense* and *Aframomum latifolium* are often traditionally used for the production fruit juices. The high moisture content in *Carica papaya, Sclerocarya birrea, Annona senegalense* and *Aframomum latifolium* indicates the difficulties involved in conserving them. Out of the five wild fruits studied, *Carissa edulis* have the highest crude protein content (8.30±0.01) followed by *Borassus aethiopum* (4.70±0.46), *Detarium microcarpum* (3.41±0.01), *Hyphaene thebaica* (2.78±0.15) and *Chrysophyllum albidum* (1.85±0.40). In the case of ash, the values obtained in this study seemed to be within the normal range of 0.19 to 11.50% as reported by authors like Goenster *et al*. (2011) and Ismail, (2017) except that of *Borassus aethiopum* having almost 20% ash. Mineral elements are essential nutrients, which are required in small amounts in the body. They play some important roles in the metabolic processes of the body and their absence can cause deficiency symptoms in human (Gafar and Itodo, 2011). Considering the dietary recommended intake (DRI) of some of these mineral elements, it can be deduced that more quantities of these fruits needed to be consumed to meet the threshold, and for some elements such as Na, K, and Ca that have higher dietary recommended intake, consuming more quantities of these fruits may not meet up the recommended allowance per day. However, nutrients and minerals intake should not strictly be dependent on a single type of food, hence the need to combine different types of food in the appropriate proportion that will supply the needed amount of respective nutrients. It was observed that mineral elements such as calcium, potassium, iron, sodium, manganese, zinc and magnesium are detected in all the wild fruits except in one or two cases where an element was not determined in some of the fruits. A typical example could be seen in *Borassus aethiopum* where iron was not determined, like wise sodium was not determined in *Chrysophyllum albidum*, manganese was not determined in *Borassus aethiopum* and *Carissa edulis* while magnesium was not determined in *Chrysophyllum albidum* and *Hyphaene thebaica fruits*. The mineral elements of *Detarium microcarpum* which was one of the five wild plants were not determined due to some unforeseen circumstance that was why table 2 does not contain the column for the plant. It was observed that *Carissa edulis* showed high concentrations of all the mineral elements detected when compared with the remaining three plants. Calcium being one of the mineral elements detected in all the fruits have been implicated in the maintenance of fruits and its requirement in fruits are related to cell wall stability and membrane integrity (Soetan and Oyewole, 2009).

Conclusion

This study found that the fruits *of Borassus aethiopum, Carissa edulis, Chrysophyllum albidum, Detarium microcarpum, and Hyphaene thebaica* have potential and significant amounts of proximate components and mineral elements that could be harnessed industrially to meet our daily nutritional requirements in times of scarcity. Overall, these fruits could be considered as untapped treasure troves of vital nutrients.

REFERENCES

AOAC. (Association of Official Analytical Chemists) (2000). Official methods of analysis. 17th edition. Washington DC

AOAC (Association of Official Analytical Chemists) (2005). Official methods of analysis. 18th edition. Washington DC

AOAC (Association of Official Analytical Chemists) (2010). Official methods of analysis. 20th & 21st editions. Washington DC.

Bangeruh F (1979). Calcium related physiological disorders in plants. *A Review of Phytopathology*. 17: 97 – 122.

Christopher EA, Dosunmu MI (2011). Chemical Evaluation of Proximate Composition, Ascorbic acid And Anti-nutrient Content of African Star Apple (Chrysophyllum africanum) fruit.

Eromosele IC, Eromosele CO, Kuzhkuzha DM (1991). Evaluation of Mineral Elements and Ascorbic acid Contents in Fruits of some Wild Plants.

Ferguson IBN (1984). Calcium in Plant Senescence and Fruit Ripening. *Plant Cell Environment*. 7: 397 – 405.

Gafar MK, Itodo AU (2011). Proximate and Mineral Composition of Hairy Indigo Leaves.

Goenster S, Wiehle M, Kehlenbeck K, Jamnadass R, Gebauer J, Buerkert A (2011). Indigenous Fruit Trees in Home Gardens of the Nuba Mountains, Central Sudan: Tree Diversity and Potential For improving the Nutrition and Income of Rural Communities. *Acta Horticulture*. 911: 355 – 364.

Isengard, H. (2001). Water Content, one of the most important Properties of Food. *Journal of Food Control, 12(7)*: 395 – 400.

Ismail B (2017). Ash Content Determination. Food Analysis Laboratory Manual, pp. 117 – 119.

Jenson, N.F. (1978). Wild Plants Fruits Production. A Research Symposium on Wild Plants. No. 32, pp. 1 – 5.

Keay, R.W.J., Onochie, CFA, Stanfield DP (1964).Trees of Nigeria. Revised edition, Oxford University Press, New York. Pp 191 – 192.

Kruczek A (2005). Effect of row fertilization with different kinds of fertilizers on the maize yield. Acta. Sci. Pol. Agric. 4(2): 37 – 46.

Lechaudel M, Joas J, Caro Y, Genard M, Jannoyer M (2005). Leaf-Fruit ratio and how irrigation supply affect seasonal changes in minerals, organic acids, and sugars of mango fruit. *Journal of Science, Food and Agriculture*. 85: 251 – 260.

Mapongmetsem PMI, Kapchie VN, Tefempa BH (2012). Diversity of local fruit trees and their contribution in sustaining the rural livelihood in the Northern Cameroun. *Ethiopian Journal of Environmental Studies and Management*. 5 (1): 101 – 105.

Nahar N, Rahman S, Mosihuzzaman M (1990). Analysis of carbohydrate in seven edible fruits of Bangladesh. *Journal of Science, Food and Agriculture*. 5: 203 – 212.

Okafor JC (1975). The place of wild (uncultivated) fruits and vegetables in the Nigerian diet. Proceedings, Recommendations and Papers of the First Seminar on Fruits and Vegetables. Ibadan, Nigeria. Pp. 153 – 154.

Reda AA (2015). Physicochemical Properties of Doum (Hyphaene thebaica) Fruits and Utilization of its Flour in Formulating some Functional Foods. *Alexandria Journal Food Science and Technology*. 12 (2): 29 – 39.

San B,Yildirim AN, Pola TM, Yildirim F (2009). Mineral Composition of Leaves and Fruits of some Promising Jujube (Ziziphus jujube Miller) Genotypes. *Asian Journal of Chemistry*. 21 (4): 2898 – 2902.

Soetan KO, Oyewole OE (2009). The need for adequate processing to Reduce Antinutritional Factors in plants Used for Human Food and Animal Feeds. A Review in *African Journal of Food Science*.3(9): 123 – 132.