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Comparative Evaluation of the Proximate, Mineral and Vitamin Contents of Palm Kernel (E. Guineensis) and Deleb Palm (B. Aethiopum) Nuts

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Abstract

This study aimed at evaluating the relative vitamins, minerals and proximate compositions of Palm kernel and Deleb palm nuts. The proximate parameters (crude fibre, crude protein, crude fat, ash and moisture) were determined using standard analytical procedures. The minerals (Fe, Zn, Mg and Ca) were analyzed using Atomic Absorption Spectrophotometer (ICE 3000 series) while K and Na were analyzed using Flame Photometer (model 405, corning, U.K). The vitamins (A, B_2, and D) were determined using UV spectrophotometer while vitamin C was determined using titrimetric method. The results revealed higher percent crude fibre (12.81%), crude protein (13.13%), crude fat (44.09%), ash (3.05%), moisture (7.05%) energy (2192.33kcal/ 100 g) and fatty acid contents (35.27%) in Palm kernel nut while only carbohydrate was found to be higher in Deleb palm nut (81.71%). The concentrations of vitamin A, B_2 and D were found to be higher in Palm kernel nut while only vitamin C was found to be higher in Deleb palm nut (1.22± 0.06). The minerals composition revealed that calcium (27.79 ± 0.83 mg/100 g), magnesium (19.36 ± 1.22 mg/ 100 g), zinc (0.68± 0.12) and iron (3.35± 0.01 mg/100 g) contents in Palm kernel nut were higher than in Deleb palm nut while only the concentration of potassium (74.75 ± 0.61 mg/100 g) was found to be higher in Deleb palm nut. However, based on the results obtained from this study, the nutritional value of palm kernel nut was found to be higher than that of deleb palm nut and both samples could be used as good sources of some nutrients in a died.

Keywords: Palm Kernel Nut, Deleb Palm Nut, Minerals, Proximate, Vitamins

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INTRODUCTION

The frequent and excessive consumption of edible nuts by many people today, has been associated with their health and nutritional benefits (James, 2013; Jibrin *et al.,* 2021).However, according to literatures, most edible nuts contain concentrated food reserves and are a valuable source of energy, protein, oils, minerals and vitamins suitable for human consumption (Ryan *et al.,* 2006; Okonkwo and Ozoude, 2015; Jibrin *et al.,* 2021). Additionally, edible nuts also contain significant amount of squalane and tocopherols. Squalane has important beneficial effects on health and tocopherols are powerful antioxidants which in high dose may reduce the risk of coronary heart disease (Bogert *et al*., 1994). Furthermore, apart from direct consumption in the raw form as well as coated and salted, edible nuts can also be used in confectionery, ice creams, sweets, beverages, oils, among others (Ewansiha *et al*., 2012) .However, studies revealed that edible nuts are cultivated and grown in a number of growing conditions and are valued according to their sensory, nutritional and health attributes(Ezieshi and Olomu, 2007; Rude *et al*., 2012).

Palm kernel (*Elaeis guineensis*) is a specie of palm commonly called African oil palm and is the principal sources of palm oil. It is native to west and southeast Africa, specifically within the areas of Angola, Gambia and Nigeria(south-east) (Corley and Tinker, 2003). The nut is the edible seed of the oil palm tree which is gotten when a palm kernel's hard shell is broken. The palm tree belongs to the *Arecaceae* family, in order of *Arecales*. In addition, Palm kernel nuts are commonly planted in four tropical regions which include Africa, Southeast Asia, Latin America and South Pacific (Okonkwo *et al.,* 2015). The fruit yields two oils, palm oil and kernel oil each exhibiting differences in composition, properties and applications. Moreover, palm kernel oil has also been reported to be rich in important food properties compared to some other oil seeds and nuts as well as a good source of amino acids for children and adults (Akinniyi and Waziri, 2011). Additionally, Palm kernel nuts constitute some components of the diet of many Nigerians especially in the rural areas, some people take it raw while others prefer to boil it before consuming.

Deleb palm is a species of *Borassus* palm grown in many part of African countries including Nigeria. However, in Nigeria, it is called "Agbonoludu" by the yorubas, "Ubiri"by the igbos and "Giginya" by the Hausas (Akinniyi *et al.,* 2011). *Borassus aethiopum* is a solitary palm growing up to 25m in height and 1m in diameter at the base. The fan-shaped leaves are 3m wide with petioles 2m long, the margins are armed with spins. In male plants, the small flowers are largely concealed within the scaly catkins; the much larger female flowers reach 2cm wide and produce yellow to brown fruits. Each fruit contains 1-3 seeds, each enclosed within a woody endocarp(Akinniyi *et al.,* 2011).According Aremu *et al.*(2012), the fruit also contains sugar, provitamin A and vitamin C. However, little information is available on the nutritional compositions of these nuts especially the deleb palm nut. Therefore, this study is aimed at comparative evaluation of the nutritional compositions (proximate, mineral, and vitamins) of palm kernel(*Elaeis guineensis*) and deleb palm(*Borassus aethiopum*) nuts to add to the available information.

MATERIALS AND METHODS

Sample Collection and Preparation

Samples of deleb palm and palm kernel nuts were purchased from ultra-modern market Lafia, Nasarawa State, Nigeria. The samples were purchased in batches at week interval (market days) for a month in order to have better representation. Stones and bad ones were screened out completely from the samples. The samples' shells were first broken and removed from the nuts. The nuts were collected, washed thoroughly and air dried. Due to the hardness of the

nuts, manual blender was used to grind the samples. The ground samples were stored in polyethylene bags for further analyses.

Proximate Analysis

For proximate analysis, moisture, ash, crude fibre, crude protein (% N x 6.25) and ether extract (EE) were determined in accordance with the standard methods described by Association of Official Analytical Chemists (AOAC, 2010). The total carbohydrate content was estimated by difference. All the parameters in the samples were determined in triplicates and were expressed in percentages. The chemicals used were all of analytical grade.

Determination of Mineral Content

Mineral analysis was carried out after acid digestion of 2 g of the ground samples with 10 cm^3 of a mixture of nitric and hydrochloric acid (aqua regia 15 cm^3: 5 cm^3) until a clear solution was obtained. The digest was allowed to cool and then transferred into a 100 cm^3 standard flask and made up to mark with deionized water (Verma, 2003). The mineral elements were analyzed using Computer Control Thermo Fisher Scientific ICE 3000 series Atomic Absorption Spectrophometer (AAS) and Flame Photometer (model 405, corning, U.K).

Determination of Vitamins

Vitamin C was determined using titrimetric method described by Barakat *et al.*((1973) with slight modifications. For this method, the vitamin C was determined by titration. A 50 g of each sample was dissolved in 250 cm^3 beaker containing 100 cm^3 of distilled water and made up to mark with distilled water. The sample solution was strained via chesse cloth and the filtrate was collected. The filtrate (25 cm^3) was pipetted into a conical flask and 10 drops of 1% starch indicator solution were added. The content was titrated with standard iodine solution (0.05 M) until a persistent blue-black colour was observed. Other vitamins (A, B and D) were determined using spectrophotometric method (Verma, 2003).

RESULTS AND DISCUSSION

Proximate Compositions

The result of the proximate analysis is presented in Table 1. The value of the percentage moisture content in *B. aethiopum* nut (1.45 %) was found to be lower than the moisture content (7.05 %) in *E. guineensis* nut. The low moisture content of *B. aethiopum* remains an asset in terms of storage and preservation of the nutrients (Ibrahim *et al.,* 2016).Thus, high moisture content could lead to food spoilage through increasing microbial activities (Aremu *et al.,* 2012). Average moisture content of ≤ 12% was recommended for shelf stability and long storage(Jatto *et al.,* 2010).The ash contents of the samples were found to be 2.25 % in *B. aethiopum* and 3.05% in *E. guineensis.* The values of the ash indicate that *E .guineensis* has higher percent ash content which implies that higher concentration of mineral elements in *E.guineensis* compared to *B. aethiopum* (Olaofe *et al.,* 2010) . Crude fibre compositions of the samples were found to be 7.91% and 12.81 % in *B. aethiopum* and *E.guineensis* respectively. The result indicates that *E. guineensis* has higher fibre content than *B. aethiopum.* However, fibre plays a vital role in providing roughage that aids digestion (Ogungbenle, 2003). Dietary fibre reduces the risk of cardiovascular diseases. Investigation had shown that increase in fibre consumption might have contributed to reduction in the incidence of certain diseases such as diabetes, coronary heart disease, colon cancer and various digestive disorder (Aremu *et al.,* 2012).This implies *B. aethiopum* will aid digestion faster than *E.guineensis* when consumed in a diet. Fat is important in diets as it promotes fat soluble vitamin absorption and it is also a high energy nutrient (Ogungbenle and Adu, 2012).This study revealed 44.09 % crude fat in *E. guineensis* nut which was found to be much higher than 2.30 % obtained in *B. aethiopum.*

This result is also in close agreement with 49.87% in *Cocos nucifera* and 3.25% in *B. aethiopum* (Jibrin *et al.,* 2021).This indicates that *E. guineensis* is a rich source of fat and can facilitate fat soluble vitamin absorption. The result also showed 4.38% crude protein concentration in *B. aethiopum* which is lower than 13.13 ± 0.67 % obtained in *E. guineensis*. However, the low protein content in *B. aethiopum* nut is an indication that the sample is not suitable for animal feed that requires high amount of protein. This study reported that the carbohydrate compositions were 81.71 % in *B. aethiopum* and 19.87 % in *E. guineensis* nuts respectively. Carbohydrate supplies energy to the cell such as brain, muscle and blood (Ogungbenle and Adu, 2012). It also contributes to fat metabolism and spare proteins as an energy source and act as mild natural laxative for human beings and generally add to the bulk of the diet (Oyarekua and Eleyinmi, 2004).This signifies that *B. aethiopum* could serve as a good of source of carbohydrate for consumers. The calculated metabolizable energy obtained from this study revealed that *E. guineensis* nut has higher energy (2192.33 Kcal/ 100 g) than *B. aethiopum* nut (1548.63 Kcal/ 100 g). However, the high energy obtained in *E. guineensis* nut is attributed to its high percent crude fat and protein when compared with *B. aethiopum* nut. This study also revealed higher percent fatty acid composition (35.27%) in *E. guineensis* nut than 1.84% in *B. aethiopum* nut. However, high fatty acid value in oil indicates that the oil may not be suitable for cooking or edible but could be used for both medical and industrial purposes (El-Adawy, 2002). This suggests that the oil obtained in *E. guineensis* nut may not be suitable for use in cooking but may be suitable for both medical and industrial purposes (Oyarekua and Eleyinmi, 2004).

Mineral Composition

The result presented in Table 2 showed the mineral compositions of *B. aethiopum* and *E. guineesis* respectively. The least concentrated mineral was zinc (0.34 ± 0.02 mg/100 g) in *B. aethiopum* and 0.68 ± 0.12 mg/100 g in *E. guineensis* while the highest concentrated mineral was found to be K (74.75 ± 0.61 mg/100 g) in *B. aethiopum* and 67.08± 0.72 mg/ 100 g in *E. guineensis*. However, zinc is an essential micronutrient, it supports a number of functions in the human body as well as supporting the immune system, it enable the body to make proteins and DNA, contributes to wound healing, and play a role in childhood growth and development. However, according to literature, low level of zinc in the body can increase the risk of infection, such as pneumonia and diarrhea, especially in those who do not have nutritious diets (Janet *et al.,* 2016). Literature reveals that potassium helps in regulating the body fluid, send nerve signals and regulate muscle concentrations (Cheng *et al.,* 2013). Another investigation shows that roughly 98% of the potassium in the body is found in the cells (Anderson and McLaren, 2012). The results obtained for potassium in this study indicates that both samples are good sources of potassium. The iron concentrations were found to be 2.43 ± 0.02 mg/100 g in *B. aethiopum* and 3.35 ± 0.01 mg/100 g in *E. guineensis* respectively. However, iron is required for blood formation and it is important for normal functioning of the central nervous system. It also facilitates the oxidation of carbohydrates, proteins and fats (Akubugwo *et al.,* 2007).The recommended dietary allowance of iron in adult and children is l0 mg/day, while female adult is 15mg/day (Otten *et al.,* 2006).However, the values obtained were below the standard. Calcium is also paramount in blood clothing, muscle contraction and in certain enzymes in metabolic process (Bailey *et al.,* 2010). The recommended daily intake of calcium is 800 mg/day for adult and 500 mg /day for children (FAO, 2002). This study indicates that the values obtained in *B. aethiopum* (20.72 ± 1.34 mg/kg) and *E. guineensis* (27.79 ± 0.83 mg/kg) were below the recommended standard. Magnesium concentration ranged from 10.95 ± 0.31 mg/ 100 g to 19.36 ± 1.22 mg/ 100 g. Magnessium plays a crucial role in prevention of metabolism in bones and also involves in prevention of circulatory diseases. It also aids in regulating blood pressure and insulin releases (Bender, 2003).The recommended dietary allowance (RDA) for magnesium in an adult is 350 mg/day, while

children is 170mg/day(FAO, 2002).The result obtained from this study indicates that the values from *B. aethiopum* nut and E. guineensis nut were below the recommended values. This suggests that both samples cannot be considered as rich sources of magnesium. This study showed the concentration of sodium in *B. aethiopum* to be 6.33 ± 1.02 mg/ 100 g and 6.46 ± 0.06 mg/100 g in *E. guineensis*.The values were more than 0.21 mg/ kg in *Cocos nucifera* nut and 0.16 mg/ kg in *B. aethiopum* reported by Jibrin *et al*.(2021).However, sodium is an important mineral that assists in the regulation of body fluid and in the maintenance of electric potential in the body tissue(Larsen *et al.,* 2006). The recommended intake of sodium per day is 500 mg for adults and 400 mg for children (FAO, 2002). The result indicates that sodium concentrations in both *B. aethiopum* and *E. guineensis* were below the recommended standard.

Vitamin Composition

Table 3 shows the mean concentrations of the vitamins in *B. aethiopum* and *E. guineensis*. The results showed that the vitamins concentrations fell within the following ranges: vitamin A (3.09 - 6.04 mg/100 g), vitamin B_2 (0.65 -2.63 mg/100g), vitamin C (0.55 -1.22 mg/100 g) and D (0.46 - 0.82 mg/100 g). These vitamins are useful for the normal functioning of the body. Thus, vitamin A is needed for eye health, vision, immune function, cell growth, reproduction and fetal development (Sudha and Reshma, 2017). However, it was recommended that for adults, it should not exceed the tolerable upper limit of 3 mg/day in order to prevent toxicity (Bender, 2003). Additionally, the recommended dietary allowance for vitamin A is 0.7 to 0.9 mg/day for adults and 0.3 to 0.4 mg/day for children (WHO, 2009). This implies that both samples are rich sources of vitamin A since their vitamin A concentrations were more than the recommended dietary allowance. Vitamin C can be used for the treatment of common cold and other diseases like prostate cancer (Sudha and Reshma, 2017). There is also an interesting ability of ascorbic acid as an antioxidant to prevent or minimize the formation of carcinogenic substances from dietary material (Bender, 2003). Literature revealed that deficiency of ascorbic acid is associated with pains in the joint and defect in skeletal calcification, anaemia, manifestation of scurvy haemorrhage from mucous membrane of the mouth and gastrointestinal rations of track (Sudha, and Reshma, 2017). However, the concentrations of vitamin C obtained from this study were found to be lower than the recommended dietary intake for adult (90 mg/ day) and children (25 mg/day). This implies that both samples cannot be recommended as rich sources vitamin C. The concentration of vitamin D (4.82 ± 0.04 mg/100 g) in *E. guineensis* is higher than 3.46 ± 0.07 mg/100 g in *B. aethiopum*. The concentrations of vitamin D in both samples were found to be higher than the recommended dietary allowance (RDA) of 0.025 to 0.1 mg for adults and 0.15mg/day for children (FAO, 2002). Investigation has shown that vitamin D is needed for growth and overall good health. It also aids the body to break down carbohydrates, proteins and fats to produce energy and it allows oxygen to be used by the body (Pazirandeh *et al.,* 2008). Studies had shown that vitamin B complex helps in prevention of infections and promotion of the growth of red blood cells, good eyesight, good digestion, healthy appetite hormone and proper nerve function (Bender, 2003). This study revealed that vitamin B_2 content in *E. guineensis* and *B. aethiopum* fell within the range of 0.65-2.63 mg/100 g. However, the concentrations of vitamin B_2 in both samples were found to be lower than recommended dietary allowance of 2.4 mg in adults and 1.2 mg/day in children (FAO, 2002). This also indicates that both samples may not be considered as rich sources of vitamin B_2.

Table 1: Proximate Composition (%) of *B. aethiopum* and *E. guineensis* Nuts

Parameters (%)	*B. aethiopum*	*E. guineensis*
Moisture	1.45 ± 0.01	7.05 ± 0.02
Ash	2.25 ± 0.042	3.0 5 ± 0.07
Crude protein	4.38 ± 0.17	13.13 ± 0.67
Crude fat	2.30 ± 0.06	44.09 ± 1.05
Crude fibre	7.91 ± 1.02	12.81 ± .026
Carbohydrate	81.71± 0.82	19.87 ± 1.08
Energy(Kcal./100 g)	1548.63	2192.33
Fatty acid	1.84 ± 0.048	35.27±0.84

Each value represents the mean ± standard deviation of three determinations.

Table 2: Mineral composition of *B. aethiopum* and *E. guineensis* Nuts

Minerals (mg/ 100 g)	*B. aethiopum*	*E. guineensis*
Fe	2.43 ± 0.22	3.35± 0.01
Zn	0.34 ± 0.02	0.68± 0.12
Na	6.33 ± 1.02	6.46 ± 0.06
K	74.75 ± 0.61	67.08± 0.72
Ca	20.72 ± 1.34	27.79 ± 0.83
Mg	10.95 ± 0.31	19.36 ± 1.22

Each value represents the mean ± standard deviation of three determinations.

Table 3: Vitamin Composition (mg/100 g) of *B. aethiopum* and *E. guineensis* Nuts

Vitamin (mg/100g)	*B. aethiopum*	*E. guineensis*
A	3.09 ± 0.02	6.04 ± 0.01
B	0.65± 0.31	2.63 ± 0.12
C	1.22± 0.06	0.55± 0.00
D	3.46± 0.07	4.82± 0.04

Each value represents the mean ± standard deviation of three determinations.

CONCLUSION

The results revealed that all the parameters for proximate analysis were found to be higher in palm kernel nut than deleb palm nut except for carbohydrate. The concentrations of minerals also showed that among all the minerals analyzed, only the concentration potassium was found to be higher in deleb palm nut while others were higher in palm kernel nut. The concentrations of vitamin A, B_2 and D were found to be higher in palm kernel nut while vitamin C were found to be higher in deleb palm nut. However, based on the results obtained from this study, the nutritional value of palm kernel nut is higher than that of deleb palm nut and both samples could be used good sources some nutrients in a diet.

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