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The impact of processing on the nutritional, mineral and vitamin composition of palm kernel nut (*Elaeis guineensis*)

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Proximate, vitamin and mineral compositions of palm kernel nut (*Elaeis guineensis*) in the raw and processed form was investigated using standard analytical methods. The proximate composition (g/100g) for the raw palm kernel nut was as follows: moisture 7.15±0.21, dry matter 92.86±0.21, ash 2.90±0.00, crude fibre 11.38±0.04, ether extract 52.40±3.11, crude protein 8.69±0.01 and carbohydrate 19.59±0.00. The mineral composition (mg/100 g) revealed for calcium 21.47±0.01, magnesium 28.29±0.54, sodium 37.80±0.07, potassium 20.30±0.023, phosphorus 5.78±0.02 and iron 1.14±0.08. The vitamin composition (mg/100 g) was as follows: vitamin B_1 0.09±0.01, vitamin B_2 0.05±0.01, vitamin C 1.51±0.01, vitamin E 6.16±0.23 and vitamin A 2.49±0.00. For the processed palm kernel nut had the following from the proximate composition (g /100 g): moisture 6.35±0.078, dry matter 93.66±0.078, ash 2.87±0.035, crude fibre 11.32±0.120, ether extract 49.56±0.057, crude protein 8.58±0.177 and carbohydrate 21.34±0.40. Results show that processing has little effect on the nutritional contents of palm kernel nuts. The vitamin composition was affected by processing; while the proximate and mineral compositions were not significantly altered. Palm kernel nuts may thus be consumed in any forms preferred by an individual except for patients deficient in certain vitamins. The nuts are good sources of energy and trace elements.

Key words: Palm (*Elaeis guineensis*) kernel, nutrient composition, mineral, vitamin.

INTRODUCTION

Edible nuts are cultivated and grown in a number of growing conditions and climates, and are valued for their sensory, nutritional, and health attributes. Nuts also contain significant amounts of squalene and tocopherols. Squalene has important beneficial effects on health and tocopherols are powerful antioxidants, which in high doses may reduce the risk of coronary heart disease (CHD) (Ryan et al., 2006). Nuts are nutritious and are abundant in Nigeria and Africa for example, Nigerian walnut (*Tetracarpidium conophorum*), palm kernel nut (*Elaeis guineensis*) and cashew nut (*Anarcadium occidantale*).

Due to high cost of food substances or unavailability of food substances containing the essential classes of food

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and other needed nutrients, there is need to diversify our source of nutrients using nuts. Nuts form a major part of the diet of Nigerians consumed as a meal as well as ingredients of local soups. Several nuts are eaten as snacks such as cashew nuts, palm kernel nuts and walnuts.

Palm kernel (*Elaeis guineensis*) is a specie of palm commonly called African oil palm or macaw fat and is the principal source of palm oil. It is native to West and Southwest Africa, specifically the area between Angola and the Gambia. Oil palm is a species of particular economic importance as it provides one of the most important sources of edible oil for use in a wide range of edible products (Nakkaew et al., 2008). Besides its use in food and feed, palm oil is also one of the most cost-effective feedstock for biodiesel (Lim and Teong, 2010).

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 the order of Arecales (Corley and Tinker, 2003). Palm kernel nut are commonly planted in four tropical regions, Africa, Southeast Asia, Latin America and South pacific (Atasie and Akinhanmi, 2009). The main objective of the palm industries is to generate oil from palm kernel nut. Palm kernel cake from the nuts of palm fruits are generated as by-products along with oil as a main product. Palm kernel meal (PKM) is found in large quantities in a number of tropical countries and is available at competitive prices. Four million metric tonnes of palm kernel cake were produced in the world in 2002 with annual growth of 15% of PKM within the last two decades (FAO, 2002). Palm kernel meal has been widely used in ruminant feed, pigs and rabbit diets. However, some anti-nutritional components such as mannan, galactomannan, xylan and arabinoxylan have been reported to be present in the nut (Atasie and Akinhanmi, 2009), as a result, efforts have been made to improve Palm Kernel Meal (PKM) through supplementation with biotin (Oloyo, 1991), NaOH (Nwokolo et al., 1976) and enzymes (Dingle, 1995). Palm kernel is also a good source of potassium (Ekpa, 1995). The oil from palm nut contains organic food substances and inorganic elements upon which life and industries depend. The fruit yields two oils, palm oil and kernel oil each exhibiting differences in composition, properties and applications. Palm kernel oil is similar to coconut in composition and both are the only sources of lauric oil available in the world market (Berger et al., 1991). Almost 90% of the world's palm oil is used for edible purposes (Sambanthamurthi et al., 2000). 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 (Atasie and Akinhanmi, 2009). These oils are used industrially and medicinally as antidotes for poisoning and as surface protectants for minor wounds (Ekpa, 1995). Little information is however available on the impact of processing on the nutritive composition of palm kernel nuts.

Palm kernel nuts constitute a major component of the diet of many Nigerians especially in the rural areas; some people take it raw while others prefer to boil it before consuming. Also, these nuts are very useful in formulating feed for poultry (Ao et al., 2011). It is therefore very important to investigate the level of nutrient in these nuts and the best form in which they can be consumed. Owing to ignorance and lack of manpower especially in the rural areas as a result of migration of most youth to the urban towns, many Nigerians especially those in the urban areas have neglected these natural and wholesome foods, resorting to more processed, less nutritive and more toxic foods adulterated with synthetic vitamins, minerals and preservatives. It is high time therefore, that we returned to basis by consuming more natural and wholesome foods for better nutrition and good health in general.

The aim of this study was to investigate and evaluate the nutrient composition of palm kernel nut and the effect of processing on these nutrients. To evaluate the proximate, mineral and vitamins composition of palm kernel nut in order to ascertain its possible usefulness as food.

MATERIALS AND METHODS

Materials

Palm-kernel nuts were collected from Aku village in Igboetiti L.G.A of Enugu state, Nigeria. The nuts were thoroughly screened to remove the bad ones and stones. The nuts were thereafter divided into two groups, one group was cracked releasing the kernel which was then ground into powder. The second group was boiled for 45 min, after it had cooled, it was cut open to release the nuts which were also ground and sun dried for two days. The samples were stored in tightly screwed glass bottles at -20°C until used for analyses.

Methods of analyses

Proximate composition

Moisture, ether extract (crude fat), crude protein (%N × 6.25), ash and crude fibre contents of the samples were determined in accordance with the standard methods of AOAC (1999). Carbohydrate content was estimated by the NFE method described by James 1995. Data were expressed as percentage of dry weight (DW).

Mineral analysis

The levels of Ca, Mg, Na, K, P (Macro-element) and Fe (Micro-element) in the raw and processed palm kernel nuts were quantified by procedure of James (1995). The sample for the determination of the element was subjected to acid digestion using concentrated percloric acid and hydrochloric acid and subsequently the different elements were determined using appropriate methods as described by James (1995). Calcium and magnesium content of the sample was determined by complexiometric titration. Sodium and potassium

Table 1. Proximate composition of the raw and the processed palm kernel nut.

Constituents (% dry weight)	Palm kernel nut	
	Raw	Processed
Moisture	7.15 ± 0.21[e]	6.35 ± 0.078[e]
Dry matter	92.86 ± 0.21[b]	93.66 ± 0.078[a]
Ash	2.90 ± 0.00[d]	2.87 ± 0.035[d]
Crude fibre	11.38 ± 0.04[a]	11.32 ± 0.120[a]
Ether extract (crude fat)	52.40 ± 3.11[a]	49.56 ± 0.057[a]
Crude protein	8.69 ± 0.01[e]	8.58 ± 0.177e
Carbohydrate	19.59 ± 0.00[a]	21.34 ± 0.40[a]

Means in same row followed by different letters are significantly different ($p < 0.05$).

Table 2. Mineral content of the raw and the processed palm kernel nut.

Constituents (mg/100g dry weight)	Palm kernel nut	
	Raw	Processed
Macro-elements		
Calcium	21.47±0.01[d]	21.46 ±0.042[d]
Magnesium	28.29 ±0.54[e]	28.68±0.113[e]
Sodium	37.80±0.07[a]	37.82±0.028[a]
Potassium	20.3 ±20.3[e]	21.82±0.028[e]
Phosphorus	5.78 ±0.02[e]	5.78±0.028[e]
Micro-element		
Iron	1.14 ±0.08[d]	1.09±0.021[e]

Means in same row followed by different letters are significantly different ($p < 0.05$).

were determined by flame photometry method. The phosphorus in the sample was determined by the ranado-molybdate (yellow) spectrometry described by James (1995). The mineral concentration was expressed as mg/100 g of dry weight.

Vitamin content

The spectrophotometric method by Onwuka (2005) was employed in the determination of vitamin content. Vitamin C content of the sample was determined by the Barakat titrimetric method (Barakat et al., 1973). Vitamin content was expressed as mg/100 g dry weight.

Statistical analysis

All the measurements were replicated three times and the data are presented as mean ± SD. The obtained data were subjected to analysis of variance (ANOVA) accompanied with Duncan test using SPSS software (version 16.0 for Windows, SPSS Inc., Chicago) to identify the significance ($p < 0.05$) between means of treatments.

RESULTS AND DISCUSSION

Results of proximate composition carried out on both the raw and processed palm kernel nuts showed that there were no significant differences between the raw and processed forms of the palm kernel nut (Table 1). Apart from the dry matter content which increased significantly on the processed kernel nut, but all other parameters tested showed no significant difference. The result of the proximate composition is similar to the study of Atasie and Akinhanmi (2009), especially the crude fibre content (11.09%). The fibre content of palm kernel is responsible for the grittiness and poor digestibility of palm kernel cake (Onuora and King, 1985; Alimon, 2004). The crude protein was slightly lower than that reported by Ramin et al. (2010) and Ibrahim (2013) which reported between 10.0 - 19.8%. The slight variation in the other parameters may be due to environmental factors, age and methodology used. Palm kernel cake have been reported to vary considerably in chemical composition (protein, fibre or lipids) depending on the sources (Rhule1996) and methodology of oil removal, the proportion of endocarp remaining (Adesehimwe, 2007) and the efficiency of oil extraction from the kernel (Onwudike, 1986; Onuh et al., 2010).

The proximate composition also agrees with report from Sharmila et al. (2014) especially for crude protein, ash and moisture content, however the crude protein was lower than that earlier reported by Ezieshi et al. (2007), while the crude fibre and oil content was within the range. For the minerals, there was no significant difference in the mineral composition of both samples except for Iron (micro-elemnt) which reduced significantly on processing (Table 2). From the result palm kernel nut is a good source of minerals. Our findings agree with the report of Tan et al. (2013) which reported that palm kernels are rich in potassium, phosphorus, calcium, magnesium and manganese (macro-elements) and are therefore recommended for use in the preparation of diets for individuals who are deficient in these elements. Our results also revealed lower iron levels and higher magnesium levels than was reported by Atasie and Akinhanmi (2009).

However for the vitamins, there was significant decrease in vitamins B_1, B_2, B_3 and E (Table 3). Vitamin B_1 is a co enzyme in decarboxylation reactions of carbohydrate metabolism and a deficiency of it causes Beri-Beri. Vitamin B_2 and B_3 have the same function with other B complex vitamins that is they are constituted of co-enzymes FAD and FMN which are important in metabolic reactions. (AOAC, 1999). This means that processing of palm kernel nut before consumption may affect the rate and efficiency of metabolism in the body negatively when compared to the unprocessed nut.

From the results obtained from this study, while palm kernel may be consumed in the raw or processed forms, individuals who are anemic or prone to anemia may prefer to take it raw since processing reduced the level of iron significantly. Iron is important for the transport of

Table 3. Composition of vitamins in the raw and the processed palm kernel nut.

Vitamins (mg/100 g dry weight)	Palm kernel nut	
	Raw	Processed
B_1	0.09 ± 0.01^a	0.05 ± 0.000^b
B_2	0.05 ± 0.01^b	0.03 ± 0.007^c
B_3	0.07 ± 0.01^c	0.04 ± 0.000^d
C	1.51 ± 0.01^e	1.65 ± 0.042^e
E	6.16 ± 0.23^c	4.48 ± 0.170^e
A	2.49 ± 0.00^e	2.46 ± 0.000^e

Means in same row followed by different letters are significantly different ($p < 0.05$).

oxygen by haemoglobin in the body. Its' deficiency leads to Iron anemia. Iron is also involved in energy producing reactions (Anderson and Fitzgerald, 2010).While processing may have some impact on the vitamin composition of palm kernel, it seems to have little or no effect on the proximate and mineral composition as could be seen from the results. While it may be nutritionally relevant as food for human and animals as a result of its wealth of nutrients whether processed or not.

Conclusions

The present study shows that, the processing has little effect on the nutritional contents of palm kernel nuts. The vitamin composition was affected by processing; while the proximate and mineral compositions were not significantly altered. The authors recommend that individuals who are deficient in some vitamins such as; B_1, B_2, B_3 and E consume it only in the unprocessed form for maximum nutrient benefit and efficiency.

Conflict of interests

The authors did not declare any conflict of interest.

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