IJABR Vol. 9(2): 32 - 40 (2018)

Original article

Comparative Nutritional Compositions of Raw and Processed Tiger Nuts (*Cyperus esculentus* L.)

Madaki, F.M., Kabiru, A.Y., Muhammad, H.L., Abubakar, A.N., and Bello, A.

Department of Biochemistry, Federal University of Technology, Minna, Niger State, Nigeria

ABSTRACT

Cyperus esculentus L., commonly known as Tiger nut, is a crop of the sedge family found widespread across the world. Comparative nutritional compositions of raw and processed (dankuwa, tiger nut cake) tiger nuts were carried out according to the standard methods. Raw and processed tiger nuts (*Cyperus esculentus* L.) was found to contain high fat, crude fiber, carbohydrate contents but low moisture content. The result of the proximate analysis revealed that the moisture contents of raw tiger nuts (9.67percent), crude fat (28.61percent) and crude fiber (24.94 percent) were significantly ($p<0.05$) higher than, those of the processed tiger nut; (7.86%), (25.53%) and (22.34%) respectively. However, the ash (3.00%), and carbohydrate (35.46%), contents of processed tiger nut was significantly ($p<0.05$) higher than those of the raw tiger nuts; (1.61 %) and (25.53 %) respectively. The Sodium (218.04mg/100g) and Calcium (0.65 mg/100g) contents of raw tiger nuts were significantly ($p<0.05$) higher when compared to Sodium (139.53mg/100g) and Calcium (0.00) contents of processed tiger nuts while the Potassium (38600.46 mg/100g), Iron (10.9), Copper (0.45mg/100g) and Zinc (7.85 mg/100g) contents of processed tiger nuts were significantly ($p<0.05$) higher than those of the raw tiger nuts (1225.50mg/100g), (6.15mg/100g), (0.40 mg/100g) and (4.10mg/100g) respectively. The vitamin C (103.5mg/100g) and vitamin A (0.38mg/100g) contents of raw tiger nut were significantly ($p<0.05$) higher to those, vitamin C (93.16 mg/100g) and vitamin A (0.16mg/100g) contents of processed tiger nut. It can be concluded from the results of this study that raw and processed (dankuwa) tiger nut contain appreciable amounts of micro and micronutrients which could be included in the daily dietary pattern of human. This will help to minimize the risk of nutritional deficiencies.

Keywords: Proximate analysis, Tiger nuts (*Cyperus esculentus* L.) and Processed Tiger nuts (Dankuwa)

Corresponding author: nmmadaki@gmail.com or f.madaki@futminna.edu.ng

INTRODUCTION

Tiger nut (*Cyperus esculentus* L.) belongs to the family *Cyperaceae* and the order, Poales [1]. It is found worldwide in warm and temperate zones, occurring in Southern Europe and Africa [2]. Tiger nut is not really a nut but a small tuber, first discovered some 4000 years ago in ancient Egypt and is cultivated today in China, Spain and West Africa [1]. It has many other names like Zulu nut (Zulus; South Africa), yellow nut grass, ground almond, edible rush and rush nut, earth chestnut, and edible galingale. [3] In Nigeria, the Hausas call it Aya, Yorubas call it imumu, the Igbos call it ofio. Tiger nuts tuber have been cultivated both as a livestock food and for human consumption, eaten raw or baked [2].

The tubers or nuts are spherical in shape and are edible. The varieties of tiger nuts readily available in the market are the brown and yellow varieties. The yellow variety is preferred to all other varieties because of its inherent properties such as larger size, attractive color and fleshy body. The yellow variety is also reported to yield more soluble extracts, contains lower fat, more protein and possesses less anti-nutritional factors such as polyphenols [4]. When eaten raw, they make a very acceptable snack and have a flavor and texture reminiscent of coconut [5].

The lack of adequate information on the chemical and nutritional values of this product has limited their utilization. A number of studies have documented the nutritional composition of processed Tiger nuts drink like *kunun ayah*, however, there is little or no literature on the nutritional and chemical composition of dankuwa. In the light of this, this study was designed to evaluate the proximate, vitamins and minerals content of Dankuwa with the hope that the results obtained from this study will provide answer regarding the nutritional value of tiger nuts and its processed product.

MATERIALS AND METHODS

Sample Collection

The brown varieties of tiger nuts (500g) were obtained from Bosso market Minna, Niger state. The samples were washed and air dried in the laboratory and stored in a clean polythene bag for processing and analysis. Taxonomic authentication of the tiger nuts (*Cyperus esculentus* L.) was carried out by a botanist at the Department of Plant Biology, Federal University of Technology, Minna Niger State, Nigeria. The reagent used in this study were of analytical grade.

Preparation of the Tiger-nut flour

Tiger-nut flour was prepared by sorting out all unwanted objects and other rotten nuts, washed and rinsed in distilled water and then dried at room temperature for 24hrs. The dried sample was pulverized using electronic blending machine and stored in plastic container at -4 °C until analyzed. The tiger-nut flour was divided into two parts, one part of the sample was analyzed raw and the other part was use for the production of *dankuwa* as shown below

Production of tiger nut cake (dankuwa)

The pulverized tiger-nut flour (250g) was mixed with grinded pepper (5 g), Ginger (5 g), the mixture was stirred vigorously and fried with vegetable oil. The product (dankuwa) was stored under room temperature until required.

Proximate Analysis

Moisture and crude fat content were determined according to the standard methods of [6]. Ash content was determined at 550ºC. Crude nitrogen was determined by Kjeldahl method [7] and crude protein determined by using the formula Crude protein = Crude nitrogen × 6.25 [8]. The carbohydrate content was determined by subtracting the summed up percentage compositions of moisture, protein, lipid, fibre, and ash contents from 100 [9].

%Carbohydrate = 100 – (%Protein + %Moisture + %Ash + %Fiber). All the analysis was performed in three replication.

Mineral Analysis

The method of [10] was employed for the determination of mineral content. One gram of the pulverized samples (raw and processed tiger nuts (dankuwa) was placed in a crucible and ignited in a muffle furnace at 550 ^{O}C for 6 hours. The resulting ash was dissolved in 10 ml of 10 % HNO_3 and heated slowly for 20 minutes. After heating, it was filtered and the filtrate was used for the determination of mineral content. Atomic absorption spectrophotometer (AAS) was used to determine Calcium, Magnesium, Copper, Zinc, and Iron, while flame photometer was used for the determination of Sodium and Potassium in the filtrate.

Determination of Vitamin C

This was determined using the [10] method. Five grams of the each samples (raw and processed tiger nuts (dankuwa) was diluted with 10% trichloro acetic acid (TCA) to 100.0ml mark of 100ml volumetric flask. 2, 6- dichlophenol indophenol was titrated to 10.0ml of the sample filtrate.

Determination of Vitamin A

One gram (1g) of samples (raw and process tigernut dankuwa) was weighed using the weighing balance. 10ml of distilled water was added into the sample and hemogenized using ceramic mortar. The solution was sieved with filter paper. 2mls of the filtrate was pipetted and discharged into a test-tube. 2mls of 1M KOH was added to the filtrate in the test-tube. The solution was shaken thoroughly for 1 minute. The solution was heated in a water bath at 60 ^{o}C for 20minutes. After cooling, 20mls of xylene was added to the solution. The solution was mixed thoroughly using the cyclo-mixer or vortex mixer. After mixing, it was centrifuged for 10minutes. The absorbance was taken at 335A. The solution was radiated and absorbance was taken again.

Data analysis

The data obtained were subjected to student t-test using SPSS statistical package ($p<0.05$). The data is given as mean $\pm$SEM.

RESULTS

Proximate Composition of Raw and Processed Tiger nut

The results of the proximate compositions of Raw and Processed (Dankuwa) Tiger Nuts *(Cyperus esculentus* L.) are

presented on table 1. Raw and Process (Dankuwa) tiger Nuts (*Cyperus esculentus* L.) was found to contain high fat content, crude fiber carbohydrate but low moisture content .The moisture (9.67) crude fat (28.61) and crude fiber (24.94) contents were significantly ($p<0.05$) higher in raw tiger nuts as compared to the moisture (7.86 $\pm$ 0.10) crude fat (25.53) and crude fiber (22.34) contents of Process (Dankuwa) tiger nuts while the ash (3.00), and carbohydrate (35.46) contents of Process (Dankuwa) tiger nuts were significantly ($p<0.05$) higher than ash (1.61), and carbohydrate (25.53) contents of processed (Dankuwa) tiger nuts.

Table 1: proximate compositions of raw and processed (dankuwa*)* tiger nuts (*Cyperus esculentus)*

PARAMETERS	Raw (%)	Dankuwa (%)
Moisture	9.67 ± 0.84^{b}	7.86 ± 0.10^{a}
Ash	1.61 ± 0.05^{a}	3.00 ± 0.17^{b}
Crude fat	28.61 ± 0.08^{b}	25.53 ± 0.47^{a}
Crude fibre	24.94 ± 0.05^{b}	22.34 ± 0.61^{a}
Crude protein	8.39 ± 0.14^{a}	7.24 ± 0.17^{a}
Carbohydrate	25.53 ± 1.09^{a}	35.46 ± 1.31^{b}

Values follow by the same superscript along the row are not significantly difference at $p<0.05$, values are Mean $\pm$ SEM of triplicate determination

Minerals Compositions

The results of the minerals compositions of Raw and Processed (Dankuwa) Tiger Nuts (*Cyperus esculentus*) as shown in table 2 revealed the Sodium (218.04 mg/100g) and Calcium (0.65) contents of raw tiger Nuts was significantly ($p<0.05$) higher as compared with the Sodium (139.53 mg/100g) and Calcium (0.00) contents of Processed (Dankuwa) tiger nuts while the Potassium (38600.46), Iron (10.9), Copper (0.45mg/100g) and Zinc (7.85) contents of Processed (Dankuwa) tiger nuts is statistically significantly higher than Potassium (1225.50mg/100g), Iron (6.15mg/100g), Copper (0.40mg/100g) and Zinc (4.10mg/100g) contents of raw tiger nuts.

Table 2: Minerals compositions of raw and process (dankuwa*)* tiger nuts (*Cyperus esculentus)*

PARAMETERS	Raw(%)mg/g	Dankuwa (%)mg/g
Sodium	218.04 ± 3.14^{b}	139.53 ± 2.71^{a}
Potassium	1225.50 ± 8.72^{a}	38600.46 ± 32.62^{b}
Iron	6.15 ± 0.70^{a}	10.9 ± 0.09^{b}
Calcium	0.65 ± 0.23^{b}	0.00 ± 0.00^{a}
Copper	0.40 ± 0.23^{a}	0.45 ± 0.12^{b}
Zinc	4.10 ± 0.20^{a}	7.85 ± 0.34^{b}

Values follow by the same superscript along the row are not significantly difference at $p<0.05$, values are Mean $\pm$ SEM of triplicate determination

Vitamins Compositions

The results of the vitamins compositions of Raw and Processed (Dankuwa) Tiger Nuts (*Cyperus esculentus*) was shown in table 3. The vitamin C (103.5 mg/100g) and vitamin A (0.38mg/100g) contents of raw tiger Nuts was significantly ($p<0.05$) higher as compared with the vitamin C (93.16mg/100g) and vitamin A (0.16mg/100g) contents of Processed (Dankuwa) tiger nuts .

Table 3: Vitamins compositions of raw and processed (dankuwa*)* tiger nuts C*yperus esculentus)*

Sample	vitamins (mg/100g)	
	Vitamin C	Vitamin A
Raw	103.5 ± 0.14^{b}	0.38 ± 0.88^{b}
Dankuwa	93.16 ± 0.16^{a}	0.16 ± 0.91^{a}

Values followed by the same superscript along the row are not differ significantly at $p<0.05$, values are Mean $\pm$ SEM of triplicate determination

DISCUSSION

The observed moisture content in this study was considered moderately good as water has been reported to enhance ease transportation of nutrient and other necessary metabolic reaction. The moderately low moisture content of raw and Processed (Dankuwa) tiger nut will favor their preventive properties against microbial attacked and thus the storage life will be high [11]. The moisture contents of raw tiger nut in this study is higher than (4.69) reported by [12].

The protein content of raw (8.39%), and processed (Dankuwa) (7.24%) tiger nut is an indication that these by-product could support growth and movement, body defence in both livestock and human being. This value is comparable with (8.50) reported by [12].

The lipid content of raw (28.61%), and processed (Dankuwa) (25.53%) tiger nut was high, a diet providing 1- 2% of its caloric of energy as fat is said to be sufficient to human beings as excess fat consumption is implicated in certain cardiovascular disorders such as cancer and aging [13]. Although it has been reported that The oil from tiger nut reduces low density lipoprotein-cholesterol (LDL-C) and increases high density lipoprotein-cholesterol (HDL-C) , reduces levels of triglycerides in blood and the risk of forming bloody clots, thereby preventing arteriosclerosis ([12];[4]; [14]; [15]).

The high carbohydrate content of raw (25.53%) and processed (35.46%) is an indication that they could serve as a good source of energy for both livestock and human being. These study also revealed that the raw ($24.94\pm0.05\%$) and processed ($22.34\pm0.61\%$) tiger nut are excellent source of fiber this is an important consideration for people who suffer from elevated cholesterol level [16]. Fiber aid absorption of trace element, reduce the absorption of cholesterol, starch and guard against metabolic disorder such as hypertension and

diabetes mellitus [17]. Fiber also binds to cancer-causing chemicals keeping them away from the cells lining the colon providing yet another line of protection from colon cancer [16]. The ash content give a measure of total amount of inorganic compounds like minerals present in a sample. The high ash content of raw tiger nut as compared with the processed tiger nut is an indication that dankuwa could serve more than raw tiger nut as an source of minerals for humans.

Calcium is necessary for the strong bones and teeth. It is relatively high in cereals, nuts and vegetable [18]. The RDA value of calcium is 600-1400mg/kg [18]. Raw tiger nut contain very low Ca (0.65mg/100g) while the Dankuwa has no Ca. Considering the importance of Calcium, its low concentration in tiger nut implies that this by product can slightly contribute to the amount of dietary calcium. Sodium is the principal extracellular cation and is used for acid – base balance and some osmo-regulation in the body fluid [20]. The recommended daily value for sodium is 1100- 3300mg/kg for adults [21]. The Na concentration in raw and processed tiger nut was found to be within the recommended level.

Iron is essential for transport of oxygen in haemoglobin and also involves in energy metabolism. Iron is an important element in the diet of pregnant women, nursing mothers, infants, convalescing patients and the elderly to prevent anaemia and other related diseases [22]. The recommended daily requirement of iron for man is 6-40 mg/kg [19], thus tiger nut, from the result obtained can be used in improving the anaemic condition in iron deficient diabetic patients.

Potassium is responsible for nerve action and is very important in the regulation of water and electrolyte balance and acid – base balance in the blood and tissues [23]. It also helps to maintain body weight. Of the minerals analyzed in this study, potassium was the most abundant (1225.50 mg/100 g for raw and 38600.46mg/100g for processed tiger nut) element, and this is in agreement with many reports that potassium is the most abundant mineral in Nigerian agricultural products [24].

Zinc is involved in normal functioning of immune system [25] and is associated with protein metabolism. The processed tiger nut (dankuwa) were found to be a good source of zinc (7.85mg/100g) because it is above 6.23 recommended by RDA [26], however the zinc contents of raw tiger nut (4.10 mg/100g) is below the RDA recommended value. Both raw and processed tiger nut were found to contain low amount of Cu (0.40 & 0.45mg/100g for raw & processed tiger nut respectively.) However, it has been reported that lead and copper are highly toxic even at low concentrations [27].

The vitamin A & C contents especially of the raw tiger nuts could serve as a good source of antioxidant and It is also recommended for infants and the elderly because of its high content in Vitamins and its antioxidant benefits in the cell membrane ([14]; [28]). Vitamin C has anti-infective properties, promotes wound-healing, may boost the immune system and help to ward off infections, while vitamin A helps to maintain good sight and prevents certain diseases of the eye. Both vitamins also have antioxidant properties and may protect against some forms of cancer [29].

CONCLUSION

From this study it can be deduced that the raw tiger nut possessed higher macro and micronutrients than the processed tiger nuts. However, both the raw and processed (dankuwa) tiger nuts contain appreciable amounts of micro and micronutrients which could be included in the daily dietary pattern. This will help to minimize the risk of nutrients deficiency in both human and animals.

REFERENCES

1. Sánchez-Zapata, E; Fernández-López, J; Angel Pérez-Alvarez, J (2012). "Tiger Nut (*Cyperus esculentus*) Commercialization: Health Aspects, Composition, Properties, and Food Applications". *Comprehensive Reviews in Food Science and Food Safety*, 11: 366–77.

2. Nwaoguikpe, R. N. (2010). The phytochemical, proximate and amino acid compositions of the extracts of two varieties of tiger nut (*Cyperus esculentus*) and their effects on sickle cell hemoglobin polymerization. *Journal of Medicine and Medical Sciences,* 1(11):543-549.

3. Belewu, M.A. and Belewu, K. (2007). Comparative physicochemical evaluation of tigernut, soybean and coconut milk sources*. International Journal Agricultural Biology,* 5, 785- 787.

4. Okafor, J.N.C. Mordi, J.I. Ozumba, A.U. Solomon, H.M. and Olatunji, O. (2003). Preliminary studies on the characterization of contaminants in tiger nut (Yellow variety). *In Proceedings of 27th annual Nigerian Institute of Food Science and Technology (NIFST) Conference*.

5. Sanful, R.E. (2009). Production and sensory evaluation of tigernut beverages. *Pakistam Journal Nutrition,* 8(5): 688–90.

6. Association of official Analytical Chemist (1990). Method of analysis (ised). Published by association of official analytical chemist Washington D.C.

7. Elinge CM, Muhammad A, Atiku FA, Itodo AU, Peni IJ, Sanni OM. Proximate mineral and antinutrient composition of pumpkin (*Cucurbita pepo* L) seeds extract. *International Journal Plant Res.*, 2(5):146-150.

8. Alfawaz, M. A. (2004). Chemical composition and oil characteristics of pumpkin (*Cucurbita maxima*) seed kernels. *Resilient Bulletin*, 2(1) 5-18.

9. Otitoju, G. T. O. (2009). Effect of dry and wet milling processing techniques on the nutrient composition and organoleptic attributes of fermented yellow maize (Zea mays). *African Journal of Food Sciences,* 3: 113-116.

10. Association of official Analytical Chemist (1996). Official Method of Analysis of the Association of Official Analytical Chemists. AOAC International, Arlington.

11. Adeyeye, E. I. and Ayejuyo, O. O. (1994). Chemical composition of Cola accuminata and Grarcina kola seed grown in Nigeria. *International Journal*

of Food Science and Nutrition, *45,* 223-230.

12. Oladele, K.A., Osundahunsi, F.O. and Adebowale, A.Y. (2009). Influence of Processing Techniques on the Nutrients and anti-nutrients of Tigernut (*Cyperus esculentus* L.). *World Journal of Dairy and Food Science*, 2, 88-93.

13. Antia, B. S., Akpan, E. J., Okon, P. A. and Umoren, I. U. (2006). Nutritive and antinutritive evaluation of sweet potatoes (Ipomoea batatas) leaves. Pakistan. *Journal of Nutrition*, 5,166-168.

14. Mohamed, L.S., Mohsen, Z. and Imaizumi, K. (2005). Dietary supplementation with *Cyperus esculentus L* (tiger nut) tubers attenuated atherosclerotic lesion in apolipoprotein E knockout mouse associated with inhibition of inflammatory cell responses. *Am Journal of Immunology*; 1: 60-67.

15. Ezebor, F., Igwe, C.C., Owolabi, F.A.T. and Okoh, S.O. (2005). Comparison of the physico-chemical characteristics, oxidative and hydrolytic stabilities of oil and fat of *cyperus esculentus L.* and *butyrospermum parkii* (shea nut) from Middle-Belt States of Nigeria. *Nigerian Food Journal,* 23: 33-39.

16. Ensminger, A.H. and Esminger, M.K.J. (1996). Food for Health: A Nutrition Encyclopedia. Pegus Press, Clovis, California.

17. Mensah, J.K., Okoli, R.I., Ohaju-obodo, J.O., & Eifediyi K. (2008). Phytochemical,nutritional and medical properties of some leafy vegetables consumed by Edo people of Nigeria. Africa. Journal of Biotechnology, 7, 2304-2308.

18. James, C.S. (1996). Analytical chemistry of foods. Blackie Academic and Professional, New York, 219p

19. Bolt, G. H. and Bruggenwert, M. G. M. (1978). Solid chemistry, basic elements. *Elsevier* Scientific publishing Co., New York, p. 145

20. Odoemena, C. S. and Ekanem, N. G. (2006). *Journal of science and Technology,* 5 (2):51-54.

21. Margaret, L. and Vickery B. (1997): Plant Products of Tropical Africa. Macmillan in Collage Ed. London.

22. Oluyemi, E. A., Akilua, A. A., Adenuya, A. A., and Adebayo, M. B. (2006). Mineral Contents of Some Commonly Consumed Nigerian Foods. *Science Focus,* 11(1), 153-15.

23. N.R.C. (1989): National Research Council Recommended Dietary Allowance, National Academy Press, Washington D.C.

24. Afolabi, G., Oluwade, A., and Tunde, O. (1995). Estimation of Proximate and Mineral Composition of Some Tropical Crops. *African Agricultural Journal,* 21*,* 103.

25. Borgert, I., Briggs, G.M. and Calloway, H. (1975). *Nutritional and physical fitness.* W. B saunder and Co., philadephia, USA, 34-50.

26. Adeleye E. & Otokiki, MKO (1999). "Proximate composition and some nutritionally valuable minerals of two varieties of Capsicum annu," Discovery Innovations 11, 75-81.

27. Ghosal, S., Krishna-Prasad, B.N. and Laksmi, V. (1996) Anti amoebic activity of Piper longum fruits against *Entamoeba histolytica* in vivo. *Journal of Ethno-pharmacology,* 50, 167-170.

28. Innih, S.O., Ubhenin, A.E. and Lawal, E.T. (2017). Biochemical and Histological effects of Aqueous extract of *Cyperus Esculentus* in Triton Wr-1339 Induced Hyperglycemic Rats. *Journal of Applied Sciences and Environmental Management*, 21 (4): 673-679.

29. Wright, K., (2002). Healing foods. Geddes and Grosset, Scotland, 8-31