



RESEARCH PAPER

Comparative Nutritive Evaluation of *Cyperus esculentus* and *Cyperus rotundus* Nuts

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ABSTRACT

Tiger nut, locally known as 'aya', is a common delicacy in Nigeria, eaten raw or processed. Two species of tigernut; black (*Cyperus rotundus*) and yellow (*Cyperus esculentus*) were evaluated to determine their comparative nutritive composition. The nutritive evaluation was carried out by proximate analysis and mineral analysis. Calcium (Ca), Copper (Cu), Zinc (Zn) and Cobalt(Co), were evaluated using Atomic Absorption Spectrophotometric method and Phosphorus (P) was determined using spectrophotometer. For the Black tigernut variety, the moisture content, ash, lipid, crude protein, and carbohydrate content, were 9.20%, 3.81%, 24.59%, 3.95% and 58.45% respectively. For the Yellow variety of tigernut, the moisture content, ash, lipid, crude protein, and carbohydrate were 8.93%, 3.41%, 24.59%, 3.95% and 59.12 respectively. The mineral composition obtained from the analysis of Black Tiger nuts in parts per million (PPM) was; Cu= 0.065, Zn = 0.79, Ca = 0.02, Co below 0.03 and phosphorus was 0.52mg/100ml. The mineral composition of the yellow tigernut was of the same value to that of black tigernut, but with only difference in Phosphorus, which was 0.15mg/100ml. The result of this work shows that, although both species tigernut have reasonable amount of lipid, carbohydrate and ash content, they cannot in any way be used as a whole or complete diet, due to their low protein content. From this investigation, there is no comparative nutritive advantage of one of the two species of tigernut over the other.

Keywords: *Cyperus rotundus*, *Cyperus esculentus*, Tigernut, Nutritive value

INTRODUCTION

The rapid growth of world population coupled with defective food production and other factors has resulted into food shortages resulting in mineral or nutritional deficiency in a large population especially in places like Africa. The search for lesser known or underutilized crops which may be of potentially valuable has been intensified to maintain a balance between population growth and agricultural productivity (Adejuyitan, 2011). Here in Nigeria, the pervading poor economy has forced many poor individuals to seek for cheaper sources of food to meet their daily nutritional and mineral requirements. Some of the cheaper sources available food includes grain, fruits, tubers, vegetables and nuts. Thus, there has been an increase in consumption of lesser known foodstuff such as tigernut. This is authenticated by the very visible increase in the Nigerians consumption of the nut and other processed forms of the nut.

Tigernut is a grass like plant of family Cyperaceae (sedge family) widely distributed in tropical and subtropical regions of the world. (Takhatajah, 1992; Qasim *et al.*, 2014). Other names of the plant includes Zulu nut, yellow nutgrass, ground almond, chufa, edible rush and rush nut (Eteshola and Oraedu, 1996). In Nigeria, it is known as Aya in Hausa, ofio in Yoruba and akihausa in Igbo (Umerie *et al.*, 1997; Ekeanyanwu and Ononogbu, 2010). Tigernut can be eaten raw or processed in the form roasting, drying, baking, extraction of milk and using many other methods (Oladele and Aina, 2007).

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In Nigeria, tigernut is mostly eaten raw as snack and un-identified nutritional benefits. Malnutrition in a population result from contributory factors such as poverty, defective personal hygiene, rigid customs, taboos and traditions, and often lack of knowledge on nutritional value of certain food is the major contributory factor (Devadas, 1970). Tigernut may have potential in managing, preventing and eliminating malnutrition (macronutrient and micronutrient deficiencies) or food insecurity problems as It has been demonstrated by nutritionist that the major nutritional problems could be solved through exploitation of the nutrition and economic potentials of the local food resources (Ndubuisi, 2009).

This work was therefore aimed at investigating some nutritional values of Tiger nuts; *Cyperus esculentus* and *Cyperus rotundus*. The rationale for this work lies on the fact that most work on this area were carried out outside this country using different varieties and ecotypes of *Cyperus* grown under different soil and climatic condition. Thus the result obtained from such chemical analysis may be different from values of our local environment and varieties. Therefore, the result from this study will be of profound value as a nutritional guide to the teaming members of 'Aya' consumers who are conscious of what they consume and hence may be interested in knowing the nutritional values of tigernut. The result obtained may also serve as a reference material to other researchers who may be doing some further work along this line. It may also serve as source of information to industrialist who may be interested in processing of tigernuts, since the parameters like mineral composition determines the type of processing method to be employed. Furthermore, chemical analysis is not only useful in assessing the nutritional value of a given foodstuff, but also of value to securing information on the effect of storage, processing and preservation and preservatives on the nutritional value.

MATERIALS AND METHOD

Sample Collection

The two species of the Tiger nuts samples analyzed; the Yellow and black or dark brown nut sedges, *Cyperus esculentus* (CE) and *Cyperus rotundus* (CR) respectively, were obtained from Minna Central market, but were said to be produced in Mashi and Jibbia of Katsina state. The samples were obtained in the

month of December. The samples were crushed in the mortar with pestle and preserved in polythene bags for subsequent analysis.

Chemicals

Reagents used of analar grade were obtained from reputable names like Aldrich Chemical Co. USA, BDH Poole, England and Lab M ltd. Lancashire, England.

Determination of Moisture Content (MC)

The method employed is that air oven as outlined by Food and Agricultural Organization (FAO), 1981. The clean crucibles with fitting lids were dried for 3 hours at 105°C in the oven to maintain a constant weight and weighed as (W_1). Exactly 5g of finely crushed sample were then weighed in the crucibles covered with lids and re-weighed (W_2). The crucible and its content were then transferred into the oven (Hot box Oven size 2, Gallenkamp) and dried at 70°C for 24 hours and weighed quickly after cooling in the desiccator. The drying and weighing process were repeated at intervals of 2 hours until a constant weight was obtained from each crucible and its content and weighed (W_3). The moisture content was calculated thus;

$$\% \text{ Moisture Content} = \frac{W_2 - W_3 \times 100}{W_2 - W_1}$$

Determination of Total Ash Content

The method employed was that outlined by TDRI (1984). The crucibles with their lids were dried in the oven at 105°C for 3 hours, cooled in the desiccator and weighed (W_1). Exactly 5 g of crushed sample was weighed in the crucibles and re-weighed (W_2). The samples in the crucibles were then pre-ashed on hot plate in the fume chamber until smoke ceased completely. They were then transferred into the muffle furnace set at 600°C for 8 hours to ash. The crucibles with their contents were cooled in the desiccator and reweighed (W_3). The ash content was then calculated.

$$\text{Total ash content} = \frac{W_2 - W_3 \times 100}{W_2 - W_1}$$

Determination of Protein Content by Micro-kjeldahl Method

Exactly 0.2g of crushed dried sample was weighed into micro-kjedahl flask (50ml size).

3ml of Conc. H₂SO₄ was added to the sample in the flask followed 1 catalyst tablet and some glass beads. The flask was then gently heated to avoid splashing until it became clear with a pale straw colour. The heating was continued for 2 hours. The liquid digest was then cooled and qualitatively transferred carefully into the markam steel and the flask was thoroughly rinsed 3 times with small quantity of distilled water with each washing added to the digest in the steel container. The end of the condenser was then immersed in 10 ml of H₃BO₃ in a conical flask to which 5 drops of bromocresol green and

$$\text{Mean \% of Lipid content} = \frac{W_2 - W_3 \times 100}{W_2 - W_1}$$

1 drop of methyl red were added.

Exactly 15ml of caustic 70% NaOH was added slowly to the content of the steel container, the diluted digest and then distilled for 15 minutes. The distillate in the conical flask was then titrated against 0.1N HCl until it became orange and the volume of the titre was recorded (V₁) ml. Then, 1 catalyst tablet was heated in 3ml of H₂SO₄ and used as blank. The liquid mixture was treated similarly as the digest and titrated against 0.1N HCl and the volume of the titre recorded (V₂) ml. The % protein content was calculated using;

$$\% N = \frac{V_1 - V_2 \times 0.1 \times 0.0014}{M} \times 100$$

Where,

V₁ = Titre value for mean

V₂ = Titre value for the blank

M = Weight of sample in grams

Determination of Lipid Content

The method used was in accordance with the outline of the Thailand Development Research Institute (TDRI) in 1984. A Soxhlet extraction set was fitted up with a reflux condenser and a small round bottomed flask. Exactly 5g of crushed dried sample was weighed into folded whatman filter paper. The one end stapled filter paper was weighed (W₁) before placing 5g of the sample. The open end of the sample containing filter paper was folded and stapled again and reweighed (W₂). The filter paper and its content were then placed in the extractor thimble and placed in the barrel of the extractor. Petroleum

ether was poured into the barrel until it siphoned over twice into the round bottomed flask. The condenser was replaced into the barrel and the round bottomed flask placed on the heating mantle set at 50^oC. The extraction was carried out for 16 hours. After which the petroleum ether was allowed to be siphoned into the flask, thus leaving the extraction barrel empty. The condenser was then removed and the samples were removed and placed on a clean dry surface and then dried to constant weight in the oven at 50^oC. It was cooled in a desiccator and reweighed (W₃). The process was carried out in triplicate. The percentage of Lipid content was calculated

using;

Determination of Carbohydrate Content

The total carbohydrate was determined by using estimation by difference method, which was proved reliable (Fleek, 1976). The total protein, lipid and ash content were subtracted from 100 and the remainder accounted for total carbohydrate.

Determination of Mineral Content

The stock standards solution for Zn, Cu, Co, P and Ca were prepared as outlined in the Pye Unicam Atomic Absorption Data Book (Peter et al, 1984). For each mineral, standards running from 2 ppm, 4 ppm, 20 ppm to 50 ppm were prepared from the standard stock solution and were used to calibrate the equipment in concentration mode.

The content of Zn, Cu, Co and Ca in the nut samples were determined using the Atomic Absorption Spectrophotometric (AAS Pye Unicam Model 9100, Philips) method. The P content was determined spectrophotometrically using the methods. Pearson, (1970).

All parameters were determined in triplicates and the mean and Standard Error Mean (SEM) was calculated.

RESULTS

Proximate Composition

The results obtained as presented in Table 1 shows that both *Cyperus esculentus* and *Cyperus rotundus* are high in lipid and carbohydrate content, but low in protein content.

Table 1: Proximate Composition of *Cyperus esculentus* and *Cyperus rotundus* nuts

Parameter	<i>Cyperus esculentus</i>	<i>Cyperus rotundus</i>
Moisture Content (%)	8.93 ± 0.06	9.20 ± 0.01
Total Ash Content (%)	3.41 ± 0.02	3.81 ± 0.04
Protein Content (%)	3.95 ± 0.01	3.95 ± 0.01
Lipid Content (%)	24.53 ± 0.02	24.59 ± 0.02
Carbohydrate Content (%)	58.71%	58.37%

Values are mean ± SEM of triplicate determinations

Mineral Composition

Table 2 revealed the mineral composition of both *Cyperus esculentus* and *Cyperus rotundus* nuts.

Table 2: Mineral Composition of *Cyperus esculentus* and *Cyperus rotundus* nuts

Mineral	<i>Cyperus esculentus</i>	<i>Cyperus rotundus</i>
Phosphorus (mg/100ml)	0.15	0.52
Zinc (ppm)	0.79 ± 0.15	0.79 ± 0.15
Copper (ppm)	0.065 ± 0.0005	0.065 ± 0.0005
Cadmium (ppm)	0.002 ± 0.0002	0.002 ± 0.0002
Cobalt (ppm)	< 0.03	< 0.03

Values are mean ± SEM of triplicate determinations

DISCUSSION

The most basic examination of the composition of any food involves proximate analysis (Ikeobe, 1984). Thus this work involved the comparative proximate analysis of two species of tigernuts; *Cyperus rotundus* and *Cyperus esculentus*.

The moisture content of stored foods and food products to a large extent determines the propensity of microorganisms on them, and also affects freshness and physical and chemical stability for long storage. Thus low moisture content is desirable in nuts. Khan *et al.* (2014) reported a moisture content of 5.19% for *C. rotundus*, whereas Ekeanyanwu and Ononogbu (2010) reported a moisture content of 11.19% for *C. esculentus*. The values obtained for both species in this investigation fall within these two reported values. However, *C. rotundus* had a higher moisture content than *C. esculentus* which could mean that the *C. esculentus* variety of tigernut can be stored longer than the *C. rotundus* variety.

Total ash content is a rough indicator of the mineral content of a food sample. It is obtained

after incinerating the organic components of the food sample. *C. rotundus* had higher ash content than *C. esculentus*, this agrees with the findings of Adejuyitan (2011) and suggests that *C. rotundus* have higher mineral content than *C. esculentus*. However, from the mineral analyses, both species of the tigernut appear to have the same mineral content for the minerals analyzed. The higher total ash content in *C. rotundus* may have been as a result of other minerals not analyzed or some other inorganic components such as silicates and silica.

The presence of zinc, copper, cobalt, calcium and phosphorus in both species of tigernut analyzed agrees with the findings of Ekeanyanwu and Ononogbu (2010) and Adejuyitan (2011). The importance of these elements to proper biochemical functions and the possible defect of the mineral deficiencies suggest that regular consumption of tigernut could help mitigate the diseases resulting from these mineral deficiencies. Tigernut consist of some trace elements in reasonable amount as revealed by the result of this work.

The result obtained shows that the tigernuts have high lipid and carbohydrate contents, with carbohydrate being the most abundant in both species. This suggests that both species of tigernuts are energy rich source and have high satiety values, that is, delays emptying of the stomach. Ekeanyanwu and Ononogbu (2010) reported that the lipid found in tigernut is edible, non-drying and suitable for soap making. Local industries may therefore be encouraged to go into the extraction of its oil for consumption and for soap making.

The protein content of approximately 4% in both species is relatively low for such a food of high lipid content of 25%. Adejuyitan (2011) also reported relative low protein content for tigernuts. This suggests that although both species of the tigernut have rich energy source and high satiety values, they cannot be used as complete or whole diet because of the low protein. Thus protein seems to be an apparent limiting factor for such a diet.

Conclusion

From this investigation, there is no comparative nutritive advantage of one of the two species of tigernut over the other. Both species analysed had high carbohydrate and lipid contents and hence high satiety values, as well as good energy source, however, their low protein content means tigernuts cannot be used as a complete or whole diet. Both *C. rotundus* and *C. esculentus* may also not meet the recommended daily requirements for the various minerals; however, the nuts can contribute some significant amount of Zn, Cu, Ca, Co and P when consumed as side dishes.

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