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EVALUATION OF NUTRITIONAL CONTENT OF TIGER NUT (*CYPERUS ESCULENTUS*)

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ABSTRACT
Phytochemical screening, elemental analysis, proximate composition, vitamins and amino acid contents were analyzed using standard methods. Alkaloids, saponins, tannins, glycoside, flavonoids, phytates and oxalates were all found to be present. Results of chemical analysis showed that tiger nut is rich in carbohydrate (47.04%) and lipid content (24.50%), it is also a good source of fiber (26.76%) and has a substantial amount of protein (7.82%). Result of elemental analysis in mg/100g showed that it is a good source of Iron (4.75), Magnesium (94.98), Calcium (100.00), Sodium (37.97) and Zinc (3.70). Tiger nut is also a good source of vitamin with vitamin E present at a concentration of (120.5ug/g) and vitamin C at (30.90ug/g), while Vitamin B complexes were also present. The result of amino acid composition revealed that tiger nut is rich in essential amino acid such as lysine, threonine, leucine, phenylalanine and cysteine. The result of this study thus shows that tiger nut is rich in nutritive contents, and therefore provides important information which will enable its enhanced utilization, increased production and help promote food security.

***Keywords**: Tiger nut, Vitamins, Amino acids, Nutrients, Proximate analysis*

1.0 INTRODUCTION
Cyperus esculentus is a monocotyledonous plant and belongs to the family cyperaceae which is made up of over 400 species (Ekeanyawu and Ononogbu, 2010). The common names include; Aya, chufa, sedge, yellow nut sedge, and earth almond. In Nigeria, tiger-nut is known as 'Aya' in Hausa, 'Ofio' in Yoruba, 'isipaccar' in Effik and 'Aki awusa' in Igbo. This Tiger-nut was found to be a widely grown crop having a life cycle of more than two years of the same genus as the papyrus plant (Farhath *et al*., 2001; Belewu and Adedunmi, 2008). Tiger-nut has been cultivated since early times (chiefly in South Europe and West Africa) for its small tuberous rhizomes, which can be eaten raw, roasted, dried, baked or made into a refreshing beverage (tiger-nut milk) called “kunun aya”. The plant is taxonomically classified under division Magnoliophyta; class Liliopsida; order Cyperales; family Cyperaceae; genus Cyperus and specie Cyperus esculentus.
The plant grows to a height of 1-3ft and pollination occurs by wind. It grows mainly in the tropical and warm temperature regions of the world. Main areas of

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cultivation include; Spain, Nigeria, Senegal, Guinea and Cameroun (Oladele and Aina, 2007)

In West Africa, the plant is gathered from the wild while it is a troublesome weed in planted field in United States (Belewu and Adedunmi, 2008). In Egypt, it is used as a source of food, medicine and perfumes. Some varieties (black, brown and yellow) are cultivated in Nigeria and among these, only two varieties; (yellow and brown) are readily available in the markets. There is a notable preference for the yellow variety to all other varieties possibly because of its properties like its bigger size and attractive colour. The variety with yellow colour also yields more milk upon extraction, contains lower fat and more protein and possesses less anti-nutritional factors especially polyphenols (Okafor and Nwachukwu, 2003). Chufa as it is usually called is nondrying oil equally obtained from the rhizome.

The milk obtained from Tiger-nut popularly known in the Northern part of Nigeria as 'Kunun aya' is one of the indigenous, locally fermented, non-alcoholic beverage drinks that is widely consumed for its thirst-quenching and nutritive properties. Even though it is being consumed throughout the year, its extensive consumption is known to be during the dry season (Okafor and Nwachukwu, 2003). Significant variations exist in the procedures depending on the desired taste and cultural habits that leads to differences in quality and stability. It is usually packaged and sold in plastic bottles. Tiger-nut milk or 'Kunun aya' must be consumed within 2 - 24 hours at 4 – 100C due to its poor shelf life (Akoma *et al*., 2006; Musa and Hamza, 2014). This drink is very cheap because the tiger-nuts and additives used in its production are easily and locally sourced.

It is believed that tiger nut help to prevent heart attacks, thrombosis and cancers, especially of the colon (Bibek, 2001; Gambo and Da'u, 2014). They are thought to be beneficial to diabetic patients (if sugar-free) and those seeking to reduce cholesterol or lose weight (Oladele and Aina, 2007). It was reported that tiger-nut is high in dietary fiber content, which could be effective in the treatment and prevention of many diseases including colon cancer, coronary heart diseases, obesity, diabetics and gastro intestinal disorders. Its tubers are also use as an aphrodisiac, carminative, diuretic and stimulant (Aletor et. al., 1995). Tiger-nuts have been reported to be used in the treatment of flatulence, indigestion, diarrhea and dysentery.

Food insecurity continues to threaten large proportions of households in low income countries. There is a need to harness the full potentials of locally consumed but underutilized crops in order to create a positive ratio between the ever growing population and food availability, especially in the countries where food security is a major challenge. Tiger nut has been for many years one of the underutilized food crops in Nigeria. There is little documentation on the nutritional quality and versatility of tiger nuts in food preparation despite its availability; as such tiger nut remains one of the least popular tubers in Nigeria. This research is aimed at evaluating the nutritive value of tiger nuts which could aid in solving major nutritional problems through exploitation of its nutritional and economic potentials.

2.0 MATERIALS AND METHODS

Sample collection

Fresh raw samples of tiger nuts were purchased from kabala Doki bus stop market, Kaduna, Nigeria.

Sample preparations

The tiger nut samples were soaked in two changes of clean water for 12 hours. The soaked tiger nuts were sorted and washed in two changes of water, blended into paste in electric blender and filtered. Small

amount of distilled water was added during the blending and filtering process. It was filtered with a clean damp muslin cloth and the filtrate obtained was transferred into wash dried plastic bottles, and kept under ice throughout the experiment.

Vitamins Determination

The vitamin content of the tiger nuts were determined using different standard methods;

Vitamin C Content was determined according to the Folin-Ciocalteu reagent (FCR) method by Mgaya *et al*. (2014).

Vitamin B1, B2, B3 and B6 were analysed using methods described by (AOAC, 2012).

Vitamin E (Tocopherol) was analyzed using chromatographic separation and quantitative determination at 325nm. 5gm of the samples were weighed and placed in 100ml volumetric flasks and homogenized. The samples were saponified with ethanoic KOH (antioxidant added) for 30minutes. These samples were transferred to the separating funnel using H_2O/ETOH and repeatedly extracted with hexane. Extracts and Evaporates were combined to dryness under low pressure. Residue was dissolved in mobile phases. The samples were separated and determined by High Performance Liquid Chromatography (HPLC) using MEOH/H_2O, 95/5 (v/v) as the mobile phase. A UV detector set at 325nm was used to detect the amount of tocopherol content of the samples and recorded.

Amino Acids Determination

The amino acid content of the Tiger nuts where determined using an amino acid analyzer, following the method of Moore and stein (1985)

Proximate analysis

The recommended methods of the association of official analytical chemists (AOAC) (1990) were used for the determination of moisture, ash crude lipid, crude fiber and nitrogen content. Percentage of carbohydrate was determined by difference.

Phytochemical Screening

The procedure described by Harbone (1984) were used for analyzing the presence of saponins, tannins, alkaloids, flavonoids, cyanogenic glycosides, phytates and oxalates were carried out using.

Mineral Analysis

Samples for mineral analysis were prepared by weighing by weighing one gram of sample into a beaker followed by addition of 20ml Nitric acid. The beaker was heated until a clear digest was obtained which was filtered. The digest was transferred into a 100ml volumetric flask and diluted with deionised water to the mark.

Mineral elements were analysed from the acid digested samples using an Atomic Absorption Spectrophotometer (AAS) (Solar969 unicam) (Isaac and Johnson, 1975) for some elements except Sodium which was analyzed using flame photometer.

3.0 RESULT AND DISCUSSION

Result of vitamin analysis of tiger nut (Table 1) shows that tiger nut has considerable content of vitamins, with high concentrations of vitamin B1 and vitamin C, while vitamin E is also present at a concentration of 120.5ug/g .Vitamin B2, B3 and B6 are also present in moderate quantity (Table 1). Analysis of amino acid composition of tiger nut (Table 2) revealed that tiger nut is rich in essential amino acid such as lysine (3.81±0.09), threonine (2.42±0.02), leucine (2.74±0.07), phenylalanine (1.80±0.04) and cysteine (1.97±0.10). Lysine is shown to be the highest amino acid present. Result of chemical analysis of tiger nut showed that tiger nut is rich in carbohydrate and lipid. It

is also a good source of fiber and has a substantial amount of protein (Table 3). Elemental analysis of tiger nut reveals it to be a good source of Iron, Magnesium, Calcium, Sodium and Zinc as shown in (Table 4). Also, qualitative phytochemical analysis showed the presence of phytochemicals such as Saponins, Tannins, Alkaloids, Flavonoids, Cyanogenic glycoside, Phytates, and Oxalates, (Table 5).

The results for vitamins content (Table 1) showed vitamin E to be higher than the rest of the vitamins present. Adequate vitamins such as vitamin C and E also present are considered as protective nutrients. Supposing 100 g of tiger nuts is eaten per day by children between 4 – 9 years old, the vitamin C content could be adequate, providing about 88 – 100 % of their recommended dietary intake (FAO / WHO / UNU, 2002). Vitamin C is important in hormone and neurotransmitter synthesis. 100 g of tiger nuts could also meet about 77 % daily vitamin C needs of adolescents, 69 % for adults and 52 % for pregnant mothers. Besides, high vitamin C concentration in tiger nuts may help to render soluble the iron content and make it more available (Bender, 1973; Lake and Water worth 1983; MAFF, 1981).Vitamin C and E are antioxidants which are important in the prevention of coronary diseases and cancer. This 100 g of tiger nuts could also meet about 75 – 88 % daily

Table 1: Vitamin composition of tiger nut

Vitamins	Concentration
Vitamin E	120.5
Vitamin B1	31.50
Vitamin B2	22.49
Vitamin B3	15.67
Vitamin B6	12.33
Vitamin C	30.90

Vitamin E & C were measured in µg/g
Vitamin B was measured in mg/ml

Table 2: Amino acid content of tiger nut

AMINO ACIDS	CONTENTS
Arginine	17.78±0.51
Aspartic	5.01±0.09
Cystine	1.97±0.10
Glutamic	5.29±0.18
Glycine	2.40±0.10
Histidine	2.02±0.11
Isoleucine	0.78±0.03
Leucine	2.74±0.07
Crude protein	7.82
Carbohydrate	47.05

Table 4: Mineral content of Tiger nut

Element	Concentration (mg/100g)
Mg	94.98
Na	37.95
Zn	3.70
Ca	100.00
Cu	0.96
Fe	4.75

Table 5: Result of phytochemical analysis of Tiger nut

Phytochemicals	Presence
Saponins	+
Tannins	+
Alkaloids	+
Flavonoids	+
Cyanogenic glycosides	+
Phytates	+
Oxalates	+

Lysine	3.81±0.09
Methione	0.77±0.01
Phenylalanine	1.80±0.04
Proline	1.50±0.00
Serine	2.14±0.08
Threonine	2.42±0.02
Tyrosine	0.80±0.04
Valine	1.65±0.07

Values are means of triplicate ± standard deviation

Table 3: Proximate composition of Tiger nut

Parameter	Percentage composition (%)
Moisture	7.20
Ash	1.75
Crude lipid	24.50
Crude fiber	26.76

requirement needs for vitamin E for children (4-9 years) and 33 – 35 % for adults. Vitamin E has also been associated to delay in the aging process (Wardlaw and Kessel, 2002). Vitamin C content in plain tiger nut milk is significantly higher than that of other vegetable milks and non-vegetable milk (Obizoba, 1998). Addy and Eteshola (1984) showed that baobab milk contained0.04 mg / 100 ml and the reports of Moore (2004) showed that soya bean milk contained 0.01 mg / 100 ml of vitamin C. A major function of vitamin C is to promote the formation of collagen, an important protein found in connective tissue. Collagen is an integral component of bone, skin and blood vessels. Thus, high intake of vitamin C will improve wound healing and prevent scurvy (whose symptoms include bleeding gums and pinpoint hemorrhages on the skin). Tiger nut milk beverages may play an important role in the treatment of iron deficiency anemia because of its high vitamin C content. Vitamin C enhances iron absorption in the gastrointestinal tract. Vitamin C increases absorption of non-heme protein by donating an electron to the ferric form of iron to create the ferrous form of iron which is absorbed better, and chelating as well. Vitamin C being an antioxidant will help to deter certain forms of cancer assist carnitine production and synthesis of neurotransmitter. Vitamin C and vitamin E as antioxidants work together against free radicals. Vitamin C also helps to maintain or reactivate vitamin E levels so that it can continue its indispensable function in immunological system (vitamin C is essential for lymphatic activity within the immune system) and tissue preservation. Hence, vitamin E is thought to have a preventive effect against ageing, cardiovascular diseases and cancer. Vitamin B1 is crucial for carbohydrate and amino acid metabolism. It is essential for nerve function. Vitamin B2 takes part in the metabolism of all energy yielding nutrients; numerous oxidation – reduction reactions. Tiger nut milk has low amounts of vitamin B12, a cofactor for enzymes controlling folate metabolism and homocysteine metabolism is essential for the normal maturation of the blood cells and in prevention of pernicious anaemia. Tiger nut beverages could provide vitamin B12 for vegetarians or vegans and low income earners or countries that cannot easily afford meat and dairy products as a source of vitamin B12. Notably, vitamin B12 is found mainly in animal foods and not commonly found in plants. Its chemical structure has cobalt integrated in it. Cobalt plays its only role in human nutrition integrated in vitamin B12 (Wardlaw and Kessel, 2002; Moore, 2004).

Analysis for amino acid composition (Table 2) revealed that tiger nut is rich in essential amino acid such as lysine, threonine, leucine, phenylalanine and cystine. Okarfor *et.al*., (2003) reported that food rich in total essential amino acid will contribute to the supply of essential amino acid in diet. These essential amino

acids are required for synthesis that occurs in the muscles, regulates blood sugar and boosts body's energy level, involves in control of body water balance, regulates mood and sleep (tryptophan), production of hormones, antibodies and enzymes. The results of proximate composition of tiger nuts as shown in Table 3 revealed that tiger nut is rich in carbohydrate, fat and fiber. They are also a good source of protein. Tiger nut could be eaten fresh or dried as snacks by young and old for its high energy and preventive or protective nutrients. These nutrients could significantly contribute to the body's metabolic process while also providing the body with nourishment and refreshment. According to a report by FAO/WHO/UNU in 2002, if 100g of tiger nut is consumed, it could significantly contribute more than 40% of carbohydrate to a child's (4-9 yrs.) daily carbohydrate requirement and more than 32% to an adult's daily carbohydrate need. The 47.05% of carbohydrate content obtained in this result agree with this report with respect to high carbohydrate content of tiger nut. When compared to other starchy roots and tubers, tiger nuts have a significantly higher amount of fat content and could contribute more than 73% of fat to a child's daily fat need and more than 49% to an adult daily fat requirement (FAO/WHO/UNU, 2002). Fat content of tiger nuts are relatively similar to that of nuts and seeds but are higher than that of cereals and compares well with that of soya beans (Achinewu, 1998). High fat content may indicate the high values of oil soluble vitamins such as vitamins A, D, E, and K. Tiger nuts fiber values from findings are in line with the reports of Umerie *et al*. (1997), Addy and Eteshola (1984) and Mohammed *et al*., (2018). In contrast, Temple *et al*. (1990) reported a lower fiber value of about 5.5%. About 100g of tiger nut if consumed contains fiber content which could play important roles in the reduction of pressure and transit time of food through the body, aiding digestion. Fiber aids in alleviation of flatulence problem, thus tiger nut fiber could be explore in formulating diets for treating indigestion, constipation and non-communicable diseases such as colon cancer, diverticulosis, coronary heart diseases and obesity (Bender, 1973; Wardlaw and Kessel, 2002; Ball, 1994). Protein content of tiger nut fell within range of values reported by Umerie *et al*., (1997), Temple *et al*., (1990) and Addy and Eteshola, (1984). Tiger nut protein content compares with that of cereals such as rice and sorghum (Osagie and Eka, 1998). Tiger nut could contribute more than 17% of protein to adult's daily protein need and more than 26% to a child's daily protein requirement (FAO/WHO/UNU, 2002). The ash value (1.75%) fell within the range (0.70-1.53%) for other starchy roots such as yam, cassava and potatoes as reported by Osagie and Eka, (1998). Tiger nut ash value was in line with the reports of Temple *et al*. (1990), while Umerie *et al*. (1997) and Addy and Eteshola (1984) reported higher values (2.48% and 6.70% respectively). From the result, magnesium is present in high concentration (94.98mg/100g). Magnesium provides bone strength, aids enzyme, help in nerve and heart functions. Tiger nuts contain protective nutrients because it could supply adequate zinc, iron, vitamin C and E. Zinc is an integral part of hormones and more than nearly 100 different enzymes (Osagie and Eka, 1998). Zinc is important in many metabolic reactions and may play an important role in immunity, alcohol metabolism, sexual development and reproduction. High iron content of tiger nut could contribute in preventing anemia (Obizoba, 1998). Iron (Fe) is functional component of hemoglobin and other key compounds used in respiration, immune function and cognitive development (Obizoba, 1998). Method of processing may affect nutritional composition and moisture

content of tiger nut.

4.0 CONCLUSION

Several other literatures have provided separate information on contents of tiger nuts. However, this research work combined and analyzed different parameters such as phytochemicals, proximate analysis contents, vitamins, elements and amino acids contents of tiger nut using the same tiger nut sample and under the same experimental condition hence, providing some level of consistency in the result. The findings from this study reveals tiger nut to be a good source of vitamins as well as minerals. It also reveals the presence of nutrients such as protein, carbohydrates and fats while also being rich in essential amino acids. Qualitative phytochemical analysis also indicates the presence of saponins, tannins, alkaloids, flavonoids, cyanogenic glycosides, phytates and oxalates. The result of this study thus shows that tiger nut is rich in nutritive contents, and therefore provides important information which will enable its enhanced utilization, increased production and help promote food security.

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