



TIGER NUT (*CYPERUS ESCULENTUS*): COMPOSITION, PRODUCTS, USES AND HEALTH BENEFITS – A REVIEW

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ABSTRACT

This paper is a review on little history and the composition of Tigernut ranging from proximate, mineral and amino acid content. The paper further explains the kind of phytochemicals and antinutrients that can be found in tigernut. The kind of microorganisms which could be found on tigernut was also explained based on the previous works of researchers. Tigernut can also be eaten raw, processed in to flour and be used for different purposes such as bread and substitute in animal feed manufacture. Oil can also be obtained from tigernut, which is highly unsaturated and good for the health of humans. Tigernut can be used to produce drink/milk, which can serve as substitute of traditional cow milk, different types of tigernut milk are also produced, it can also be used to produce a local snack "Dakuwa". Tigernut also contributes to the reduction of cholesterol, it reduces the risk of coronary heart disease, arteriosclerosis and is recommended for those who have heavy digestion, flatulence and dysentery.

Keywords: Tigernut, Composition, Milk, Flour, Oil

INTRODUCTION

Tiger nut "*Cyperus esculentus lativum*" is an underutilized tuber of family Cyperaceae, which produces rhizomes from the base of the tuber that is somewhat spherical (Devries and Feuke, 1999). It is a tuber that grow freely and is consumed widely in Nigeria, other parts of west Africa, east Africa, parts of Europe particularly Spain as well as in the Arabian Peninsula (Abaejoh *et al.*, 2006). In many thousand years ago, tiger nut, in Spanish called chufa, was cultivated in region of chufa between Sudan and Egypt on the borders of the Nile River. There are documents that certify this product over 400 years ago. Proof of this is that on many occasion archeologists found earthen jars containing tiger nut in graves of pharaohs. (Obadina *et al.*, 2008) previously, it was cultivated in the ancient Mesopotamia between the rivers Tigris and Euphrates. At the same time historical Persian and Arab documents mentioned the nutritive, digestive and disinfective value of tiger nut. During the era the tiger nut milk was classified as medicinal drink due to its been highly energetic and diuretic, rich in mineral, predominantly phosphorus and potassium and also vitamins C and E (Abaejoh *et al.*, 2006). It was in the 8th century that Arab traders introduced the cultivation of tiger nut in the Mediterranean region of Valencia (Spain), for elaboration of tiger nut milk (leche de chufa), to know the tiger nut cultivation as it arrived to our days. It has been reported that grainy

sandy group and mild temperatures are special for the cultivation growth of earth tuber (Abaejoh *et al.*, 2006). Tiger nuts tubers appear somewhat long or round in shape with a dimension of 8mm to 16mm, smaller size however, are not used for human consumption. When hydrated, it is slightly harder (nut texture), but with a rather more intense and concentrated taste. The cultivation time is April to November (Osagie *et al.*, 1986). Being cultivated through continuance irrigation, tiger nut has to be properly dried before storage. The drying process is completely natural, (i.e. sun drying) and the process can take up to one month. The dehydrating process ensures longer shelf life, preventing rot or any other bacterial infection securing their quality and nutritional level. Unfortunately, the dehydration process make the tiger nut skin wrinkled, a situation that limits its acceptability to some people (Belewu and Abodunrin, 2006). It is known in Nigeria as "Aya" in Hausa, "Ofio" in Yoruba and "Akiausa" in Igbo where these varieties (black, brown and yellow) are cultivated (Umerie *et al.*, 1997). Among these, the yellow variety is preferred over others because of its inherent properties such as large size, attractive color and fleshier nature. It also yield more milk upon extraction, contains lower fat and higher protein and less anti nutritional factors especially polyphenol (Okafor *et al.*, 2003). Recently, there is awareness for increased utilization of tigernut (Belewu and Abodunrin, 2006; Belewu and Belewu, 2007).

Composition

Table 1: Proximate composition of dried tigernut

CONSTITUENTS	YELLOW VARIETY (%)	BROWN VARIETY (%)
Moisture	3.50	3.78
Crude Protein	7.15	9.70
Lipid	32.13	35.43
Crude Fibre	6.26	5.62
Carbohydrates	46.99	41.22
Ash	3.97	4.25
ENERGY (KJ)	1343	1511

Source: : Oladele and Aina, (2007)

It was reported that Chufa tubers contain almost twice the quantity of starch as potato or sweet potato tubers (Kuner *et al.*, 2002). Regarding total sugar content, reducing sugar and sucrose, in general tubers have high contents of sugar. When the sugar contents of Chufa tubers were compared with those of other

tubers and nuts, the sugar level of Chufa was relatively low (Shaker *et al.*, 2009). However, the taste of Chufa depends on the sugar content to give a very characteristic flavor. Because of its pleasant nutty flavor, Chufa is consumed as a kind of snack food and could be useful in food technology.

Table 2: Mineral Composition of Tigernut Flour

Mineral Element (mg/100g)	YELLOW VARIETY	BROWN VARIETY
Calcium	155	140
Sodium	245	235
Potassium	216	255
Magnesium	51.2	56.3
Manganese	33.2	38.41
Phosphorous	121	121
Iron	0.65	0.80
Zinc	0.01	0.01
Copper	0.02	0.01

Source: Oladele and Aina, (2007)

Shaker *et al.*, (2009) study revealed that Chufa tubers have high calcium, sodium and phosphorus and low magnesium, manganese, iron, zinc and copper mineral contents. The high values of calcium found in the Chufa, are adequate for bone and teeth development

in infants. The presence of other minerals such as iron is highly important because of its requirement for blood formation. Therefore, Chufa nut flour could be used as supplementation for cereal flour to improve its content of Ca (Oladele and Aina, 2007).

Table 3: Amino acid Profile of Tigernut

Amino acid	mg/16g N
Histidine	4.43±1.10
Isoleucine	4.84±0.90
Leucine	8.03±0.83
Lysine	6.50±0.67
Methionine	11.83±2.50
Phenylalanine	4.27±1.00
Threonine	3.59±0.50
Valine	5.93±0.81
Serine	4.96±0.91
Tyrosine	3.31±0.49
Alanine	9.24±1.90
Arginine	5.79±1.23
Aspartic acid	14.79±3.00
Cysteine	0.69±0.15
Glutamic acid	12.14±2.38
Glycine	6.35±0.80
Proline	4.00± 1.00

Source: Shaker *et al.*, (2009)

The amino acids profile was dominated by Asp, which resulted from the conversion of asparagine (Borges *et al.*, 2008). Other important amino acids were Glu, which resulted from glutamine, followed by Leu, Ala and Arg. These results are in accordance with that of Oladele and Aina, (2007). In general, Chufa tubers are good source of these compounds, however, amino acids profiles are not well balanced, with certain essential amino acids occurring in limiting concentration when compared to FAO recommended levels. Tiger nut milk without sugar can be drunk for diabetes for its content in carbohydrate which is a base of sucrose and starch (without glucose) and due to its content of arginine which liberates the hormone insulin.

Chukwuma *et al.*, (2010) analysed tigernut tuber for the presence of phytochemicals, it was observed that alkaloids, cyanogenic glycosides, resins, tannins, sterols and saponins were present in the raw tuber,

however only alkaloids, sterols and resins were present in the roasted sample. Analysis of the antinutrient composition yielded oxalates (0.25±0.65g/100g), tannins (9.50±0.46mg/100g), phytates (1.97±0.81mg/100g), saponins (0.88±0.02g/100g), and cyanogenic glycosides (1.80±0.69mg/100g). It was also observed that roasting numerically decreased the levels of the anti-nutritive factors analysed. Food contains various compositions of nutrients and antinutrients and could have important or deleterious effects in the body when consumed. The composition of the nutrients and antinutrients usually leads to side effects found in most plants which may lead to toxicity, hyperlipidaemia, excessive weight gain, hyperglycaemia carotenemia, constipation, kidney stones body odour, bad breath, allergies, diarrhea, frequent urination and acne (Anonymous, 2009).

Microbiology

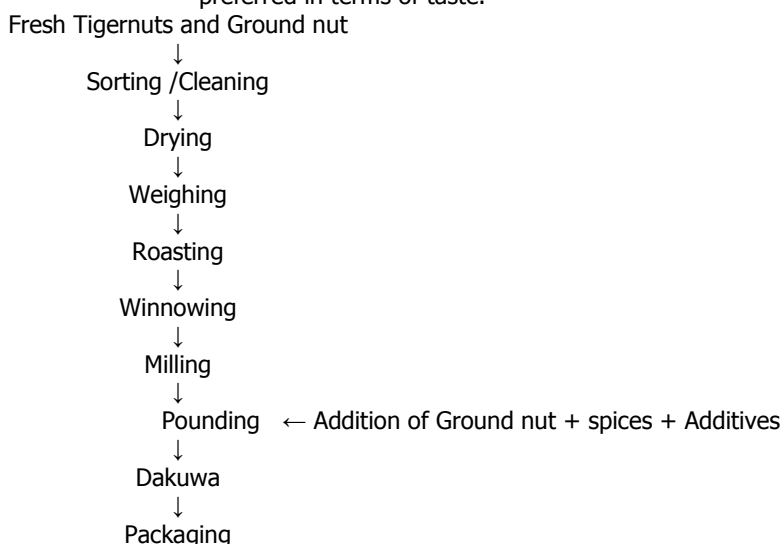
A study revealed that the lack of effective antimicrobial treatments at any step from planting to consumption suggested that pathogens introduced at any point may be present on the final food product (Sagoo *et al.*, 2001). A mixture of microorganisms that have been isolated from exposed tiger nuts included *Bacillus subtilis*, *Staphylococcus aureus*, *Aspergillus flavus*, *A. niger*, *Fusarium solani*, *Saccharomyces cerevisiae*, *S. fubiligera* and *Candida pseudotropicalis*, with varied percentage frequencies of occurrence, which rendered the tiger nuts unwholesome, except for the unexposed samples, which recorded relatively lower microbial loads (Onovo and Ogaraku, 2007). The presence of pathogenic *E. coli*, *S. faecalis*, and *S. aureus* usually constitutes a direct proof of faecal contamination of irrigation water (Cheesbrough, 2006). Hubert *et al.* (2011) conducted an assessment of microbiological safety of tigernut in the cape coast metropolis of Ghana and found out that the most predominantly encountered species were *E.coli* and *Bacillus spp* which had 18.9% each. Others include *Enterococcus spp* (16.2%), *S. aureus* and *P.aeruginosa* (13.5% each) and *Streptococcus spp* (10.8%) *Enterobacter cloacae* was the least frequent isolate (8.1%). A study conducted by Chukwu *et al.* (2013) indicated the following fungus to be associated with both fresh and dry nuts *Aspergillus niger*, *A. flavus* and *A. terreus* while *Penicillium citrinum* and *Aspergillus fumigates* were associated with the dry nuts.

Uses and Products

As food, tiger nut can be eaten as snack which can be prepared by soaking in water for few minutes. It can also be eaten roasted, dried, baked and can be made into a refreshing beverage called "Horchata De Chufas" or tigernut milk. It also finds uses as a

flavouring agent for ice cream and biscuits (Cantalejo, 1997), as well as in making oil, soap, starch and flour. Tiger nut has a unique sweet that is found to be ideal for use in the baking industry. It can be used to make delicious cakes and biscuits and also as component of fruit flavors. Through various analysis, there is a strong belief in the benefits of flour for health reasons as it has been found to be an alternative for dietetics and it is gluten free which in any case, is a positive alternative within the use of any type of flour (www.tigernuts.com). It is a good alternative to wheat flour, as it is gluten free and good for people who cannot take gluten in their diet. It is considered a good flour or additive for the baking industry, as its natural sugar (good option for diabetics). The high fiber content of its raw material (tiger nut) makes the product very healthy. Tiger nut flour does not loose any of its nutritional properties in the milling process (Salau *et al.*, 2012).

Dakuwa is a snack produced majorly in northern Nigeria though consumed in other parts of the country. It is made of maize, groundnut, sugar and spices. The maize is sometimes replaced in full or in part with tigernut. During *dakuwa* processing the maize, tigernut and groundnut are usually roasted to achieve the desired quality. Oladele *et al.* (2009) reported that acceptability of *dakuwa* is dependent on the flavor, colour and taste of the product which are achieved through roasting. Ocheme *et al.* (2001) reported that *dakuwa* processing is an art rather than a science. *Dakuwa* is processed locally with no standardized processing procedure especially the roasting of the ingredients during its processing. Oladele *et al.*, (2013) evaluated the effects of roasting temperature of tigernut on the acceptability of *dakuwa* where temperature of 150, 160 and 170°C was used; *Dakuwa* produced with tigernut roasted at 150°C was most preferred in terms of colour, texture and flavor and the one produced at 160°C was the most preferred in terms of taste.



Source: Sulaiman, (2008)

Tigernut oil is high quality oil extracted by a cold, virgin process in order to ensure that it retains all the unique nutritional quality of the tiger nut itself. Tiger nut oil has composition similar to olives and a rich

mineral content, especially phosphorus and potassium. Tiger nuts oil is also cholesterol free and has very low sodium content.

The oil was found to contain 18% saturated (palmitic acid and stearic acid) and 82% unsaturated (Oleic acid and Linoleic acid) (Zhang *et al.*, 1996). Tiger nut oil was first used by the Egyptians 4000 years ago in preference to olive oil which is considered a generally healthier alternative. The oil is golden brown in color and has a rich, nutty taste. Tiger nut oil as also a fantastic component of beauty products having high oleic acid content and low acidity hence excellent for the skin (www.tigernuts.com). In addition, tiger- nut is used for making oil, soap and starch (Adejuyitan *et al.*, 2009).

The tiger nut milk is a refreshing vegetable drink which is prepared mainly with tiger nut, sugar and water. It can serve as a superb substitute of traditional cow milk with a natural sweet taste. There are different ways you can find this product presented: Natural: is the one prepared with the right amount of tigernut, water and sugar for the product to have a minimum of 12% soluble solids, 2.2% starch, 2.5% of fats, 6.3 P^H and less of the 10% of sugar in form of sucrose (www.tigernuts.com).

Pasteurized natural milk: is the milk that is subjected to a treatment of pasteurization below 72°C without adding additives its composition is the same as the first one (www.tigernuts.com).

Sterilized tiger nut milk is one obtained after subjecting the milk to a technological process which transform or eliminates totally or partially its content of starch and processed after its packaging with a thermal treatment which ensures destruction of microorganisms and in activity of its forms resistance (www.tigernuts.com)

UHT Tiger nut milk: Is the milk subjected to process for eliminating the starch and processed by a thermal treatment ultrahigh temperature (UHT) which ensures, after its aseptic packaging, the destruction of microorganisms and its form of resistance (www.tigernuts.com).

Natural Tigernut Milk: This is the one prepared with the right amount of tiger nut, water and sugar. Other ways of presenting milk are concentrated tiger nut milk and condensed milk (www.tigernuts.com).

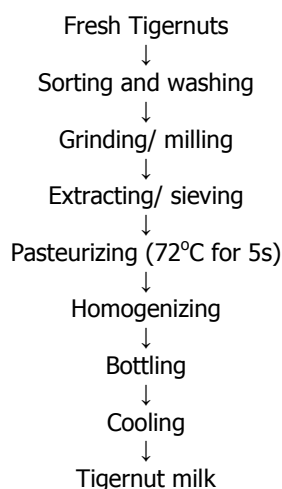


Figure 1: Flow chart for Tigernut milk drink production

Source: Udeozor, (2012)

Udeozor (2012) evaluated the proximate and sensory quality potentials of Tiger nut-Soy milk drink, Significant difference ($p < 0.05$) existed in sensory scores of mouth feel, colour and aroma, but there was no significant ($p > 0.05$) difference in taste and overall acceptability; although all the samples were generally accepted in terms of sensory quality. It was concluded that milk from tiger-nut and soybean be encouraged due to the high nutrient contents (protein, fat, etc) so as to solve the problem of protein- calorie malnutrition. In a previous study by Adgidzi (2010), efforts led to the production of acceptable beverages and yoghurt-like products from tiger nuts. The beverage products were found to contain a proximate composition of 1.89 and 2.67% protein, 0.92 and 1.33% fat, 0.16 and 0.21% ash, 0.24 and 0.33% crude fiber, 76.86 and 80.27% moisture and 15.96 and 19.15% carbohydrates. Mineral composition Calcium (Ca), potassium (K), sodium (Na), magnesium (Mg) and phosphorus (P) per 100g ranged between 14.90 and 25.60mg, 6.40 and 8.10mg, 1.98

and 3.24mg, 0.046 and 0.054mg, 0.060 and 0.083mg respectively. In a similar study conducted by Gambo (2012), it was indicated that Tigernut milk and cow milk in the same proportion can produce yoghurt that will have similar sensory attributes to soymilk yoghurt. Agbabiaka *et al.* (2012) evaluated the potential of tigernut (*Cyperus esculentus* L.) as substitute for maize in diets of African catfish (*Clarias gariepinus* Burchell) juveniles. Five isonitrogenous diets (CP=40%) were formulated such that tiger nut replaced maize at 0%, 25%, 50%, 75% and 100% respectively in a completely randomized design. The control diet contained no tiger nut. The experiment was conducted in hapa nets suspended in an outdoor concrete pond at the rate of ten fish per hapa in a triplicate, making a total of fifteen experimental units and fed at 5% biomass daily. Result of the growth performance revealed that control diet has the best weight gain and specific growth rate ($P < 0.05$) while the least was obtained from diet containing 100% tigernut.

Mean weight gain decreased as tiger nut increased in the diet; similar observation was recorded from the feed intake ($P < 0.05$). It was observed that tiger nut cannot totally replace maize in diets of *Clarias gariepinus*, but may be used at dietary level not beyond 50% for catfish production.

Nutritional Importance of Tiger nut

The tiger nut milk compared with any other soft drink is not just a refreshing drink but also very healthy. It contributes to the reduction in the in cholesterol by diminishing the 'bad' cholesterol low density Lipoprotein (LDL), and increasing the 'good' cholesterol, high density Lipoprotein (HDL) (Belewu and Abodunrin, 2006). Its content of vitamin E also collaborates against the cholesterol because it has an antioxidant effect over fats, which are ideal for coronary heart disease (Chukwuma *et al.*, 2010). *Cyperus esculentus* was reported to help in preventing heart, thrombosis and activates blood circulation, responsible for preventing and treating urinary tract and bacterial infection, assist in reducing the risk of colon cancer (Adejuyitan *et al.*, 2009). They are thought to be beneficial to diabetics and those seeking to reduce cholesterol or lose weight, the very high fibre content combined with a delicious taste make them ideal for health eating (Dianne, 1960). Tiger nut milk has been found to be good for preventing arteriosclerosis, since its consumption can help prevent heart problems and thrombosis and activate blood circulation ((Chukwuma *et al.*, 2010). Tiger nut without sugar can be used for diabetes for the carbohydrate content with best of sucrose and starch {without glucose} and due to its high content of

arginine, which liberates the hormone insulin. Tiger nut milk is also a suitable drink for celiac patients, who are not able to tolerate gluten and also for the lactose-intolerant who stay away from cow milk and many dairy foods. It could also be recommended for those who have problems with digestion, flatulence, and diarrhea because it provides some digestive enzymes like catalase, lipase, and amylase (Adejuyitan, 2011). Tiger nut milk is also said to be recommended for those who have heavy digestion, flatulence, dysentery and diarrhea because it provides a lot of digestive enzymes diuretic, stimulant and tonic in addition to being thirst quencher (Abaejoh *et al.*, 2006). Tiger nut milk is said to be rich in minerals, like phosphorus, calcium and magnesium, iron and in vitamin C and E which are essential for body growth and development. Its energetic value (100 cal/100g) makes it a very good energetic drink. A very important point is that it does not contain lactose or gluten (Belewu and Abodunrin, 2006). Tiger nuts are said to be aphrodisiac and carminative, also promote urine production and menstruation (Wills, 1962).

CONCLUSION

The utilization of tiger nut (*Cyperus esculentus*) is steadily increasing. This might be as a result of knowledge on the composition of tiger nut especially the protein and fibre, the protein content may be up to 9.70% depending on the variety which helps in body development and repair of tissues, the fibre also helps in reducing cholesterol and body weight. Different kinds of products are obtained from tigernut i.e tigernut flour, "Dakuwa", "kunu", and Tigernut oil and some of them can be eaten as snack.

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