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Proximate and Phytochemical Analysis of Tiger Nuts (*Cyperus esculentus*) Oil

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Abstract

The major purpose of this study was to analyse proximate and phytochemical composition of tiger nut (Cyperus esculentus) oil. The study adopted experimental research design. Dehydrated tiger nut was purchased from Nigerian market and processed into oil using fermentation method. The oil was subjected to proximate and phytochmical analysis using standard methods. Result obtained showed that the crude protein (0.40%), ash (0.00%), crude fibre (0.00%), fat (98.94%), moisture content (0.49%), carbohydrate (0.47%) and metabolizable energy (8114.01kca./kg). These proximate compositions show that tiger nut oil is high in metabolizable energy. Phytochemical analysis showed that tiger nut oil is rich in bio-active components; tannin (20.00mg/100g), phytate (24.19mg/100g), flavonoids (9.22mg/100g), glycoside (7.81mg/100g) and alkaloids (18.68mg/100g). These results confirmed the fact that tiger nut oil can be utilized medicinally and therapeutically for improving health of Nigerians. Recommendations include among others that the state and federal government in Nigeria should synergize to establish tiger nut research institute who will work out modalities on how tiger nut can be cultivated in large quantities processed into various useful and healthful products

Keywords*:* Proximate, Phytochemical, Tiger Nut, Oil, Quantitative Tests, , Analysis

Introduction

Tiger nut **(***Cyperus esculentus***)** also known as chufa, yellow nut sedge, earth almond, or ground almond are not actually nuts, but rather tubers because its edible part usually sits beneath the surface of the soil. The tuber has characteristic sweet, almond-like flavor and taste. Tiger nut is one of the unexploited rich food sources with inherent nutritional and medicinal values. Bando, Tutuwa, Ogu, Nuhu, and Mbaragbog, (2020) described tiger nut as an edible perennial grass-like plant of the sedge family. Tiger nuts according to Bazine & Arslanoglu (2020) originated from Africa and tropical Asia. The plant produces rhizomes and spherical tubers which are rich in variety of nutrients and have been linked to several health benefits ranging from better digestion to a reduced risk of heart diseases (Bamishaiye and Bamishaiye, 2011). Tiger nut plant is usually a fast-growing plant which can grow up to 20 to 70 cm tall. It lives in a moderate climate with a temperature between 20 °C and 30 °C and can thrive well in all types of soil types except saline soil (Bazine & Arslanoglu .2020).

Tiger Nuts can be utilized for food in varieties of ways. According to Alina

(2022) and Berlinda (2021) tiger nuts can be eaten as snacks in fresh, dried, baked or roasted forms. In dried form, they are better enjoyed when soaked in water especially overnight to soften the outer part. The flour of roasted tiger nuts is good addition in biscuits and other bakery products. The flour has also been utilized in the production of meal (tiger nut fufu) which is eaten and enjoyed with different soup of choice. The tubers can be processed into a milk-like product called Tiger nuts milk. Tiger nuts milk with or without the addition of cow milk have been utilized in the production of Yoghurt drink. In the Northern part of Nigeria, tiger nuts have been utilized in the production of a popular non-alcoholic drink (beverage) called "*Kunu Aya*" Tiger nuts is commonly called and recognised by different names in different parts of the world. In Nigeria, it is called "*aya*" (Hausa), "*aki-Hausa*" (Igbo) and "*ofio*" (Yoruba). Tiger nut is popularly known as "*atadwe*" (Ghana), "*chufa*" (Spain), "*mandorla*" (Italy), "*souchet*" (France), "*junca*" (Portugal) etc.

Tiger nut is said to be very good for its nutritional, therapeutic and medicinal values. Berlinda (2021); Rida (2022) and Alina (2022) argued that regular consumption of tiger nuts can help to boost libido and sperm production and erectile dysfunction as the high amount of Arginine and Omega 3 in tiger nuts help in better flow of blood from the heart through the arteries down to the penis. Berlinda (2021) also maintained that the high content of Vitamin E in tiger nut helps prevent against skin wrinkles and premature aging which helps in keeping the skin healthy and strong. Chukwuma, *et. al* (2010) asserts that consuming tiger nut can help to improve cardiovascular health by lowering the bad cholesterol in the blood stream. Its good content of potassium and other related minerals allows better flow of blood which reduces the risk of blockage that can lead to heart attack. It has antioxidant effect over fat which are responsible for coronary heart disease.

Tiger nuts oil has a characteristic nutty taste and flavour. It is golden brown in colour and has high content of oleic acid with low acidity that makes it useful to maintain skin health. The oil is loaded with important nutrients essential for the body. Tiger nut oil has a number of applications ranging from culinary purposes, cosmetics, pharmaceuticals, bio-fuel, traditional medicine, food preservation, skin care, hair care etc. For instance, Kumar *et al.* (2017) assert that due to its high smoke point, tiger nut oil is suitable for frying and sautéing while according to Ijaritimi *et al.* (2018) tiger nut oil has been studied for its potential use in the treatment of various diseases, including cancer, diabetes, and cardiovascular disease. Some of the health benefits of tiger nut oils as reported by Rida (2022) are that it lowers bad cholesterol level and increases level of good cholesterol, it lowers the chances of formation of blood clots and prevents arteriosclerosis, it stimulates the calcium absorption in bones and produces new bony materials, it provides relief from fatigue and soothes the nervous system as well as eliminates free radicals. Kurek (2019) and Tong *et al*. (2021) have established that the presence of phytochemicals (bio-active components) such as tannin, phytate, flavonoids, glycoside. alkaloids etc, in some plants like tiger nuts are added medicinal advantage of utilizing such plants.

Processing of tiger nuts into edible oil is not entirely a new practice, however, its

utilization for culinary and health purposes still largely remained unexploited especially in Nigeria, Hence, this study tends to close this gap by generating research results that could contribute to popularizing tiger nuts oil among individuals and families as alternative oil for improving healthy living.

Purpose of the Study

The major purpose of the study was to analyse proximate and phytochemical composition of tiger nut **(***Cyperus esculentus***)** oil. Specifically, the study determined:

1. proximate composition of tiger nut oil
2. phytochemical composition of tiger nut oil as a measure of its bio-activeness

Materials and Methods (For production of Tiger nut oil)

***Design of the Study*:** Experimental design was adopted for the research.

Materials and Methods

***Procurement of Material*:** Dehydrated tiger nut was purchased from Mile 12 Market, Lagos, attrition mill (grinding machine) for wet-milling, muslin cloth, non-stick cookware and packaging plastic bottles. Materials for proximate analysis include; analytical balance, oven (105^0C), desiccators, Soxhlet apparatus, fat extraction solvent (hexane), Kjeldahl apparatus, protein analysis reagents (sodium hydroxide), ash crucibles, Muffle furnace and tiger nut oil sample while for phytochemical analysis are; tiger nut oil sample, solvents (hexane, ethanol, methanol), phytochemical standards High performance liquid chromatography (HPLC)

Sample Preparation: Dried tiger nuts were sorted (removal of bad tubers) and soaked in clean water for 24 hours to soften the nuts for better recovery during milling. Soaked nuts were later washed with detergent to remove adhering plant materials. They were then washed thoroughly with clean water to remove traces of detergent and wet-milled using attrition mill. The slurry obtained after milling was sieved with the aid of muslin cloth to separate the milk from the shaft. The milk was then allowed to stand for 5 hours during which the oily cream floats at the top while the starch settle at the bottom. The oily cream was later carefully removed into another container where it was allowed to ferment for three days. Fermented cream was placed in a non-sticky pot and allowed to burn out gradually over a low heat. When the cream was completely burnt out, oil with a nutty flavor was then recovered. Recovered oil was doubled- filtered and allowed to cool before packaged in a plastic bottle

Proximate Analysis: For the proximate analysis, sample was analyzed for crude protein, ash, crude fibre, fat, moisture content, carbohydrate (CHO) and metabolizable energy (ME) according to the official methods of analysis described by the Association of Official Analytical Chemist (A.O.A.C., 18th Edition, 2005).

Crude Protein: 5g of tiger nut oil was weighed into a Kjeldahl flask and protein analysis reagents were added. This was digested, distilled and titrated with sodium hydroxide. The crude protein was calculated as percentage (%)

Ash Content: Tiger nut oil was weighed into an ash crucible and later heated in muffle furnace at 550^0C for about 2 hours. This was cooled and weighed to calculate ash content as percentage (%)

Fibre: Tiger nut was weighed into a crucible. Sulphuric acid and sodium hydroxide were then added. This was later digested and filtered so that the

residue was calculated as percentage (%) of crude fibre

Crude Fat: For crude fat, tiger nut oil was weighed into Soxhlet apparatus and extracted with hexane for 6 hours. The solvent was evaporated and the residue weighed as percentage (%) of crude fat

***Moisture Content*:** Tiger nut oil was measured into a crucible. This was dried in the oven at 105^0C for 2 hours. It was then cooled in desiccators and calculated as percent moisture content.

Carbohydrate: This was determined by subtracting the sum of moisture, crude protein, crude fat, crude fibre, and ash from 100%.

Phytochemical analysis: Quantitative tests were conducted for tannin, phytate, flavonoids, glycoside and alkaloids using the quantitative methods for phytochemical analysis described by Bando et al (2020). All analysis was carried out in duplicate. Flavonoids, tannin, alkaloids, phytate and glycoside were analyzed using HPLC to detect and for quantification. The quantitative methods for phytochemical analysis described by Bando et al (2020) were used.

Result

Table 1: Proximate Composition of Tiger nut Oil

	Composition of Tiger nut Oil/100g		
Proximate Parameters	**Test A***	**Test B***	**Average ****
Crude Protein	0.39	0.41	0.40
Ash	0.00	0.00	0.00
Crude Fibre	0.00	0.00	0.00
Fat	98.95	98.92	98.94
Moisture Content	0.50	0.49	0.49
Carbohydrate (CHO)	0.16	0.18	0.17
Metabolizable Energy ME (Kcal/Kg.)	8114.22	8113.80	8114.01

** *Results calculated in Duplicates Test A is first test, Test B is second test*

Table 1 shows result of proximate composition of tiger nut. It shows that metabolizable energy (8114.01 kcal/kg). Metabolizable energy is the energy available to cells in the body for metabolism which enable the cells of the body to stay alive and to function effectively. The result also showed that the percentage of ash content in 100g of oil sample is zero. This implies that the level of the pureness of the oil is very high. The presence of high ash content could signify the presence of toxic materials such as mercury. Other composition as obtained from the table are; crude protein (0.40%), crude fibre (0.00%), fat (98.94%), moisture content (0.49%), carbohydrate (0.47%). The high fat content (98.94%) indicates that tiger nut oil is a rich source of lipids, making it suitable for culinary and industrial applications.

Table 2: Phytochemical Composition of Tiger nut Oil

	Composition of Tiger nut Oil (mg/100g)		
Pytochemical Parameters	**Test A***	**Test B***	**Average ****
Tannin (mg/100g)	20.05	19.96	20.00
Phytate (mg/100g)	24.21	24.18	24.19

Table 2 contd.

Flavonoids (mg/100g)	9.19	9.24	9.22
Glycoside (mg/100g)	7.83	7.78	7.81
Alkaloids (mg/100g)	18.40	18.96	18.68

** *Results calculated in Duplicates*

Table 2 shows that tiger nut oil is rich in bio-active components, tannin (20mg), phytate (24.19mg), flavonoids (9.22mg), glycoside (7.81mg), and alkaloids (18.69mg). This confirmed the fact that tiger nut oil can be utilized medicinally and therapeutically for improving health of Nigerians.

Discussion of Findings

This study explored the health potentials of tiger nut oil as prognosis for healthy consumption in Nigeria. Tiger nuts when eaten as snack (fresh, dried, baked or roasted) or processed it into edible oil have potentials for helping to improve the health status of individuals. Gambo & Da'U (2014); Elom & Ming (2017) and Mohammed & Mua 'Zu (2019) have established the fact that tiger nuts are beneficial in digestion, cardiovascular health, diabetes, central nervous system, sex and libido tonic, cancer etc. The result of proximate composition in this study shows that tiger nut oil is high in metabolizable energy (8114.01 kcal/kg). Metabolizable energy is the energy available to cells in the body for metabolism which enable the cells of the body to stay alive and to function effectively. This implies that including tiger nut oil in human diet could significantly help to boost general wellness. The result also showed that the percentage of ash content in 100g of oil sample is zero (an indication that the oil produce from tiger nut using fermentation method is very pure free from toxic materials such as mercury). The result also revealed that tiger nut oil is an excellent source of monounsaturated fats. Alina (2022) have earlier argued that the high fat profile of tiger nut oil is similar to that of heart-healthy olive oil. Hence, utilizing tiger nut oil for culinary purposes could help individuals and families maintain a healthy heart. Tiger nut oil has number of applications ranging from culinary purposes, cosmetics, pharmaceuticals, bio-fuel, traditional medicine, food preservation, skin care, hair care etc. The findings of the present study are consistent with those of Kumar *et al.* (2017) who reported that due to its high smoke point, tiger nut oil is suitable for frying and sautéing. They are also consistent with findings of Ijaritimi *et al.(*2018) who reported that tiger nut oil has the potential for use in the treatment of various diseases, including cancer, diabetes, and cardiovascular disease.

The phytochemical composition of tiger nut oil in Table 2 showed that tiger nut oil is rich in bio-active components such as tannin (20.00mg/10g), phytate (24.19mg/100g), flavonoids (9.22mg/100g). glycoside (7.81mg/100g) and alkaloids (18.69mg/100g) with tannin, phytate and alkaloids present in higher quantities. This result corroborates that of Bando et al (2020) who in a similar study confirmed that tiger nut is an excellent source of polyphenol, alkaloids and glycoside. The presence of bio-actives such as tannin, phytate, flavonoids, glycoside and alkaloids in plant materials make such plants exhibit diverse pharmacological and biochemical actions

when ingested or utilized by humans. Tong et al (2021) observed that tannin for instance help in accelerating blood clothing, reducing blood pressure and decreases the serum lipid level. Kurek (2019) asserts that alkaloids have diverse physiological effects ranging from antibacterial, anti-inflammatory, analgesic and antitumor activity while Gemede (2014) in a study of potential health benefits and adverse effects associated with phytate in foods found that phytate have beneficial health effect such as antioxidant and anticancer properties. Roy et al (2022) observed that flavonoid is a biologically active phytochemical that is very popular in the plant kingdom for its medicinal applications.

Conclusion

This study investigated the proximate and phytochemical composition of tiger nut oil. He proximate and phytochemical analysis of tiger nuts oil revealed its exceptional nutritional and bioactive profile. The findings demonstrated that tiger nuts oil is an excellent source of metabolizable energy, dietary fibre, crude protein, and healthy fats. Furthermore, the phytochemical analysis identified a rich presence of bioactive compounds, including tannins, flavonoids, glycosides, and alkaloids. These findings suggest that tiger nuts oil has immense potential a nutraceutical, providing essential nutrients and energy; functional food ingredient, enhancing dietary fibre and protein contents, and as pharmaceutical agent utilizing its bioactive compounds for therapeutic purposes. The study thus concludes that tiger nut oil is a nutritious and phytochemucally rich oil with potential health benefits, including antioxidants, anti-inflammatory and antimicrobial activities. Hence, apart from consuming tigernuts routinely as snack (fresh, dried, baked or roasted), acceptable edible oil can be extracted from its tubers which can be utilized for culinary, medicinal and therapeutic purposes by humans. The presence of bio active chemicals such as tannin, phytate, flavonoids, glycoside and alkaloids in tiger nut oil will no doubt help individuals and families in Nigerian develop and maintain all-round wellness for better productivity if allowed to be part of their daily diets

Recommendations

Based on the findings, the following recommendations are made:

1. Tiger nut research institutes should be created and funded for comprehensive biochemical analysis of tiger nut oil to foster healthy consumption.
2. Investigation of the stability and shelf-life of tiger nut oil should be conducted under different conditions
3. Inclusion of tiger nut in human diets will not only help to create varieties but also help to solve the problems of malnutrition and food insecurity in Nigeria.
4. Further investigation is needed on the effects of processing conditions on the proximate and phytochemical composition of tiger nut oil
5. Further research on the optimal extraction methods of tiger nuts oil to enhance bioactive compound recovery should be explored.

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