

Full Length Research Paper

Studies on the fungi and phytochemical and proximate composition of dry and fresh tiger nuts (*Cyperus Esculentus. L*)

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Phytochemical and proximate composition of fresh and dry nuts of *Cyperus esculentus* (tiger nuts) was investigated. Investigated also was the fungi associated within these dry and fresh nuts. *Aspergillus niger*, *A. flavus*, *A. terreus* associated with both dry and fresh nuts, while *Penicillium citrinum* and *Aspergillus fumigatus* associated with the dry nuts. Values of minerals of the fresh and dry nuts fell within the range of 41.75 ± 1.004 - 158.49 ± 0.124 for iron (Fe), 54.77 ± 0.0877 - 22.763 ± 0.727 for zinc (Zn), 41.05 ± 0.112 - 52.35 ± 0.112 for Copper (Cu), 0.36 ± 0.0895 - 2.05 ± 0.112 for Lead (Pb), 189.05 ± 0.112 - 34.55 ± 0.112 for phosphate (PO₄), and 3343.0 ± 6.211 - 6349.45 ± 0.00 for Nitrate (NO₃), and they are in mg/100g. The nutrient values of the fresh and dry nuts fell within the range of 13.06 ± 0.0895 - 9.327 ± 0.112 for moisture 3.82 ± 1.589 - 9.69 ± 0.124 for Ash, 4.76 ± 6.12 - 3.57 ± 0.124 , for Protein, 3.287 ± 4.401 - 2.147 ± 0.112 for Lipid, 59.53 ± 5.667 - 65.05 ± 0.112 for carbohydrate, 25.23 ± 6.961 - 10.847 ± 0.334 for fiber and 75.67 ± 5.411 - 45.78 ± 0.476 for vitamin C. The comparative analysis of the proximate composition of the nutrients in the samples of the plant, showed that with the exception of Fe, Cu, Pb, NO₃, Ash, Carbohydrate in fresh nuts, the values of Zinc (Zn), Phosphate (PO₄), moisture, protein, lipid, fibre and vitamin C were higher in the fresh nuts than that of the dry nuts.

Keywords: Composition, fungi, Phytochemical, Proximate, Tiger Nuts.

INTRODUCTION

The tiger nut is not really a nut but a small tuber first discovered some 4000 years ago. It has many other names like zulu nut, yellow nut grass, ground almond, edible rush and rush nut (Mason, 1985). They have excellent nutritional qualities with a flat composition similar to olives, phosphorus and potassium. They are gluten and cholesterol free and have very low sodium content. The oil of the tuber was found to contain 18% saturated (palmitic acid and stearic acid) and 82% unsaturated oleic and linoleic acid fatty acids (Choudhury, 1961). Since the tubers contain 20-36% oil, *C. esculentus* has been suggested as potential oil crop for the production of biodiesel (Mason, 1985). The tubers

are rich both in starch and oil, the dry matter of fresh tubers is from about 70% to about 90%.

Tiger nuts are regarded as a digestive tonic, having a heating and drying effect on the digestive system and alleviating flatulence and also promote urine production and menstruation (Wills, 1962). The tubers are said to be aphrodisiac, carminative, diuretic, stimulant and tonic, and in ayurvedic medicine are used in the treatment of flatulence, indigestion, colic, diarrhea, dysentery, debility and excessive thirst. (Pengium, 1984). They have a heating and drying effect on digestion too and so this is incredibly important in their effectiveness (carp cellular and digestive enzymes work more actively as a result and fish have more energy available to be active). (Schwartz, 1984). Tiger nuts have long been recognized for the health benefits as they are high in fiber, proteins, and natural sugars. They have a high content of soluble glucose and oleic acid. Along with a high-energy content

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(starch, fats, sugars and proteins), they are rich in mineral such as phosphorous and potassium and in vitamins E and C. It is believed that they help to prevent heart attacks thrombosis and cancer especially of the colon. They are thought to be beneficial to diseases and those seeking to reduce cholesterol or lose weight. The very high fiber content combined with a delicious taste, make them ideal for healthy eating. (Mason, 1985). Typically, 100g tiger nuts contains 386kcal (1635kj) as 7% proteins, 26% fats (oils), 31% starch, 21% glucose. They contain 26% fiber of which 14% is non-soluble and 12% soluble. Mineral content of tiger nuts, Sodium 34.0mg/100g, Calcium 92.0mg/100g Potassium, 424.0mg/100g, Magnesium, 93.0mg/100g, Iron, 4.0mg/100g, Copper 0.97 mg/100g, Manganese 0.25 mg/100g, Phosphorus 211.0mg/100g (Mason, 1985).

In Nigeria, they are mainly grown in the Northern part of the country. They are eaten by humans raw, or soaked in water and are often mixed with roasted peanuts. Tiger nuts are instant carp baits, but it is relatively recently that tiger nut meals, extracts and flours have become popularly utilized with baits like boiles and pellets. Tiger nut milks are popular as health or low protein rich tonic drinks, but such milks are not necessarily the best product to soak into tiger nuts. They are used in the manufacturing soap, body cream, etc. , and tubers are used as a foodstuff, particularly in the northern part of the country where they are an important food crop with certain tribes. They may be eaten raw, baked as a vegetable, roasted like ground nuts or grated and used to make ice cream,. (Danguguwa, 1963).

Much of the work done has been on the fresh nuts, but, this work is aimed at comparative study of the fresh and dry nuts with a view to determining which of them that has more stable nutrients, as well as isolation and identification of fungi associated with the dry and fresh tiger nut.

MATERIALS AND METHOD

Sample collection

Fresh and dry Tiger nut sample materials were bought from one of the popular markets known as Abakpa market located in Abakaliki which is the state capital of Ebonyi State.

Methods

Isolation of fungi

Fresh and dry tiger nuts were sterilized in 10% sodium hypochlorite for five minutes to remove surface saprophytes and rinsed with several changes of sterile distilled water, and left to dry in a sterile tray. Five seeds

of both dry and sterile nuts were put in potato dextrose agar in sterile Petri-dishes. Twenty Petri-dishes were used for each treatment of the dry and fresh nuts. They were incubated for 48 hours in the dark, after which the fungal isolated were made into pure cultures. The manual by Barnnet and Hunter (2000) was used to assist in fungal identification.

Sample treatment

The sample materials were carried in sterile nylon bags to the laboratory where they were analyzed. At first they were washed and then allowed to dry, after which they were ground (these sample includes both the fresh and dry), after which they were packaged in a foil getting them ready for proximate analysis.

Analysis of Proximate and mineral composition of fresh and dry tiger nuts

Proximate mineral analyses were carried out using AOAC (1990) methods which included protein determination using Kjeldahl method, fat extraction via Soxhlet method, crude fiber determination using digestion with sulphuric acid, moisture determination by drying: the samples for 16-18 hours at 100-102°C in an oven; and the ash by ashing the sample at 550°C for 9 hours in a furnace oven.

RESULT AND DISCUSSION

Aspergillus niger, *A. flavus*, *A. terreus* associated with both dry and fresh nuts, while *Penicillium citrinum* and *Aspergillus fumigates*. Many of these moulds are capable of producing mycotoxin such as aflatoxins, ochratoxins and fumonisins. Mycotoxins, particularly aflatoxins (AFTs) and ochratoxin A (OTA) pose a significant threat to human health. Aflatoxins are potent carcinogens and, in association with hepatitis B virus, are responsible for many thousands of human deaths per annum, mostly in nonindustrialized tropical countries (Shephard 2006). Ochratoxin A is a probable human carcinogen and it was reported to cause urinary tract cancer and kidney damage in people from Eastern Europe; exposure to OTA seems to be the biggest hazard correlated to microscopic fungi for the European consumers of cereals (EC 2006). These toxic substances are known to be either carcinogenic (aflatoxin B₁, ochratoxin and fumonisin B₁); oestrogenic (zearalenone), neurotoxic (fumonisin B₁) nephrotoxic (ochratoxin) demartotoxic (trichothecenes); immunosuppressive (aflatoxin B₁, ochratoxin A, T-2 toxin) (Bankole and Adebajo, 2003; Jestoi *et al.*, 2004; Coronel *et al.*, 2010). The consumption of mycotoxin contaminated commodities is related to several acute and chronic diseases in human and animals (Bhat and Miller 2010) and the diseases or physiological abnormalities resulting from exposure to

Table 1. The phytochemical nutrients/mineral composition of the fresh and dry nuts of *Cyperus esculentus*: (Tiger nut). Concentration mg/100g /mean $\pm$ S.D

Minerals	Iron (Fe)	Zinc (Zn)	Copper (Cu)	Lead (Pb)	Phosphate PO ₄	Nitrate (NO ₃)
Fresh nuts	41.75 $\pm$ 1.104	34.77 $\pm$ 0.0877	41.05 $\pm$ 0.112	0.36 $\pm$ 0.0895	189.05 $\pm$ 0.112	3343.0 $\pm$ 6.211
Dry nuts	158.49 $\pm$ 0.124	22.763 $\pm$ 0.727	52.35 $\pm$ 0.112	2.05 $\pm$ 0.112	34.55 $\pm$ 0.112	6349.45 $\pm$ 0.00

Concentration %

Nutrients	Moisture	Ash	Protein	Lipid	Carbohydrate	Fibre	Vitamin c
Fresh nuts	13.06 $\pm$ 0.0895	3.82 $\pm$ 1.589	4.76 $\pm$ 6.12	3.287 $\pm$ 4.40	59.53 $\pm$ 5.667	25.23 $\pm$ 6.961	75.67 $\pm$ 5.411
Dry nuts	9.327 $\pm$ 0.112	9.69 $\pm$ 0.124	3.57 $\pm$ 0.124	2.147 $\pm$ 0.112	65.05 $\pm$ 0.112	10.847 $\pm$ 0.334	45.76 $\pm$ 0.476

mycotoxins are known as "Mycotoxicosis".

Negedu *et al* (2011), reported that commodities such as groundnuts, maize, sorghum, rice, yam, cassava, tiger nut, soyabeans, cotton seeds, fruits, vegetables spices can be contaminated with toxins of fungal origin such as aflatoxins, ochratoxins, fumonisins, patulin, sterigmatocystin, deoxynivalenol, zearalenone and other mycotoxins which pose serious economic and health risks. These findings indicate that there may be a risk of human exposure to mycotoxins through the consumption of tiger nuts, as they contain some of the fungi that secrete these toxins.

The result of comparative proximate analysis of the phytochemical and nutrient composition of the fresh and dry nuts of *Cyperus esculentus* (Tiger nut) showed that the mineral micro nutrients; zinc (Zn), iron (Fe), copper (Cu) and Lead (Pb) and mineral macro nutrients phosphate (PO₄) and nitrate (NO₃), food nutrients ash, protein, moisture, lipid, carbohydrate, fiber and vitamin C were obtained. Some of the micro nutrients such iron (Fe), copper (Cu), lead (Pb), were higher in the dry nuts than in the fresh nuts, whereas the values of food nutrients such as moisture, protein, lipid, fiber and vitamin C were higher in the fresh nuts than those from the dry nuts of *Cyperus esculentus* L as shown in Table 1.

The result of the ash content of the fresh nuts (3.23%), fell within the range of ash content of most nut-like plant (0.7 – 35%) as reported by Alonso (1965), and the crude protein content of fresh nuts (2.19%) within the range of protein content of nut-like plants as reported by Wills (1962). These macro and micro nutrients are of great importance to plants themselves and humans; zinc (Zn) play a major role in photosynthesis in plants. Iron (Fe) is an important component of the blood as reported by USDA (2003). Protein which is useful for the maintenance of good health and vitality; of importance in the promotion of growth and development of all the body tissues and the major source of building materials for muscles, blood, skin, hair, nails and internal organs including the heart and brain as reported by Primo

(1975); could be extracted in large quantity during the preparation of "horchata" (Tiger nut milk).

Carbohydrate is the chief primary source of energy to the body, and is composed of carbon, hydrogen and oxygen. Usually, with the last two elements in the portion in water, it is very high in this plant (Tiger nut) and its of great importance in both plants, animals and humans as reported by Mason (1985). Lipids are found in all known living organisms, including the tiger nut and play an essential role in the maintenance of life as reported by Dolev (1970) and serve as another important source of energy. Fiber is another constituent of the plant (Tiger nut), substances which is part of the food that is not digested by human body Dolev (1970). The crude fiber is probably different from the dietary fiber and consists of lignin and cellulose and materials in food remaining after a vigorous standardized treatment with acid and alkali, while dietary fiber is the most significant substance for man's digestive tract; hence the normal functional of the intestinal tract depends upon the presence of adequate fiber in the diet as by reported Barko (1978).

CONCLUSION

From the literature, the tiger nuts have long been recognized for their health benefits as they are high in fiber, proteins and natural sugars and high content of soluble glucose and oleic acid; they are also rich in minerals such as phosphorous, and nitrate. However, people should be discouraged from eating plenty of it as it contains lead (Pb) which inhibits haemoglobin synthesis and fungi which secrete mycotoxins that are injurious to health.

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