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Effect of Germination on the Nutrient and Antioxidant Properties of Tigernut (*Cyperus esculentus*).

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Abstract

This study aims to add value to tigernut tuber by revealing its health benefits and food value on germination. In this study, tigernut tubers were germinated and the proximate composition, mineral constituents and the anti-oxidant properties were analyzed to evaluate the effect of germination on these nutritive properties.The total phenolic content of raw and germinated seeds was measured by the Folin-Ciocalteu method, and the antioxidant activity determined by the 2,2-diphenyl-1-picrylhydrazyl and 2,2-azino-bis-3-ethylbenzothiazoline-6-sulphonic acid assay. The results of the evaluation shows that the protein content increases from 10.50-13.24 %, crude fiber from 4.73-5.39 % on germination and the fat content from 25.40-25.70 %. The mineral analysis showed an increase in the parameter analyzed and that tiger-nut is rich in macro elements. Sodium increases from 32.10-65.50 (ppm); calcium from 158.00-206.00 (ppm); potassium from 541-597.00 (ppm); there is no detection of heavy elements, and germination were observed to have significant effect on the tiger-nut mineral composition ($P \leq 0.05$). The functional properties equally reveal the potentials of tiger-nut. The water absorption capacity reduces on germination from 1.89-1.78 g/g; the bulk density from 27.50-25.20 g/ml. The DPPH inhibition activity of the germinated tigernut was significantly higher than the DPPH inhibition activity of fresh tigernut. The various parameters investigated shows that germinated tiger-nut could be useful in food formulations as well as in weaning and in baking.

Key words: Germination, proximate composition, antioxidant properties, functional properties, tiger-nut.

1. Introduction.

Tiger-nut (*Cyperus esculentus*)is an underutilized crop of the family Cyperaceae which produces rhizomes from the base and tubers that are somewhat spherical. It is commonly known as 'Ofio', in Igbos, 'Aya', in Hausa. It can be eaten raw, dried, roasted or grated and can be further subjected to further processing. Its uses in cooking and as fuel, baking flour, fish bats, milk in lieu of cow's milk and in fermentation are outlined (Adejuyitan *et, al*. 2008). Tiger-nut was reported to have positive effect on cholesterol level due to high content of vitamin E (Belewu and Belewu, 2007). The nuts were found to be rich in myristic acid, oleic acid, linoleic acid with oleic being abundant (Ezebor *et al*., 2005); rich in energy content, minerals (phosphorus and potassium) and found to be ideal for children, older persons and sportsmen (Martinez, 2003).

Germination is a natural process that occurred during growth period of seeds in which they meet the minimum condition for growth and development (Sagronis *et al*., 2006). During this period, reserves materials are degraded, commonly used for respiration and synthesis of new cells prior to developing embryo (Vidal-valverde *et al.,* 2002). The process starts with the uptake of water by the quiescent dry seed and terminates with the emergence of the embryonic axis, usually the radical (Bewley and Black, 1994). Several studies on the effect of germination on legumes found that germination can increase protein content, dietary fiber, reduce tannin and phytic content and increase mineral bio availability (Ghavidel and Prakash, 2006). Germination also was reported to be associated with increase of vitamin concentration and bioavailability of trace elements and minerals (El-Adaw*ay*, 2002). Kaushik *et al*., (2010) found that germination improved calcium, copper, manganese, zinc, riboflavin, and niacin and ascorbic acid contents.
Out of the three varieties (black, brown and yellow), the yellow varieties is preferred to all other varieties because of its inherent properties like its bigger size, attractive color and fleshier body. Tiger-nut was reported as very healthy as it helps in the prevention of heart attack, thrombosis, and activates blood circulation, it also

helps to prevent cancer especially of the colon due to high content of soluble glucose (David, 2005), the potential of its utilization is still very limited in Nigeria suggesting the need for more studies to aid its acceptability and applications in food formulation in the country.

This work therefore aimed at determining the effect of germination on the nutrient and antioxidant properties of tiger-nut flour in order to be able to explore its potential in food formulation.

2. Materials and Methods

2.1 Sample collection and preparation.

The yellow varieties of tiger-nut used were obtained from the kings market in Ado-Ekiti, Ekiti State Nigeria. The nuts were cleaned, sorted, washed and dried in a hot air oven at 105^{o}C for 3 hrs. The nuts were milled into flour and sieved. The germinated sample were steeped in water overnight, drained and spread under wet muslin cloth and left to germinate for 48hrs at room temperature (28^{o}C) without direct contact with the sun light (Yasmin *et al.,* 2008). It was dried and milled, sieved into 40mm mesh size flour and packaged.

2.2 Proximate Analysis.

The proximate composition (moisture, crude protein, crude fibre, ash and fat) were determined using the methods described by AOAC, (2005). The protein content was determined using micro-kjeldahl method (N x 6.25) and the carbohydrate was calculated by difference. The gross food energy was estimated by multiplying the crude protein, crude fat and total carbohydrate by At water factors 4, 9 and 4 respectively (Okwu, 2006; Osborne and Vooget, 1998).

2.3 Mineral composition

Using the method described by AOAC (2000). The ash of each sample was digested with 5ml of 2M HNO_3 and heated to dryness on a heating mantle. 5mL of 2M HNO_3 was added again, heated to boil and filtered through a Whatman No 1 filter paper into a 100ml volumetric flask. The filtrate was made up with distilled water. Calcium, Potassium and Sodium was determined using Jenway Digital Flame Photometer (PFP7 model) while other minerals apart from phosphorus were determined using Buck Scientific Atomic Absorption Spectrophotometer (AAS, Buck Model 210VGP model). The phosphorus in the sample filtrate was determined by using Vanadomolybdate reagent at 400nm using colorimetric method (Colorimeter SP 20, Bausch and Lamb).

2.4 Functional Properties.

The following functional properties were determined; water and oil absorption capacity according to (Eke and Akobundu 1993), the foaming capacity and stability by Fagbemi and Oshodi (1991). And bulk density according to Sosulski et al., 1976.

2.5 Antioxidant activity by DPPH method

The antioxidant activity of tiger nut extract were measured with 1, 1, diphenyl-2-picrylhydrazyl (DPPH) radicals according to the method of Xia *et al*., (2012). Aliquots of the extracted sample (1g/L) were mixed 1: 1 (v/v) with 0.1 X 10^{-3} M DPPH in anhydrous ethanol for 30min in the dark. The absorbance of the samples was recorded spectrophotometrically on a UV mini-1240 model (Shimadzu Kyoto, Japan) at 516nm and the antioxidant activity of the sample expressed based on equation (1).

$$\text{DPPH AA (\%)} = [1 = (\frac{As}{Ac})] \text{ X } 100$$

Where A_s is the absorbance of sample; A_c is absorbance values of the solution without sample.

Statistical analysis

All data obtained in triplicates, were subjected to analysis of variance (ANOVA) using the SPSS statistical package while means were separated with Duncan Multiple Range test (DMRT), significance was accepted at 5% level of probability.

3. Results and Discussion

Chemical composition

The result of the proximate compositions of the raw and germinated tiger-nut was presented on table 1. The result shows that there were significant differences ($P \leq 0.05$) among the samples. The fat content (25.40-25.70 %) compared favorably with the result of (Ogunlakin *et al.,* 2008) who obtained 27.29% fat from tiger-nut. The edible and stable oil obtained is said to be superior oil that compares favorably with olive oil. The oil is golden brown with a rich nutty taste and remains liquid at room temperature. This could make the oil suitable for salad making and could serves as a substitute for cotton seed oil, olive in times of scarcity (Shaker *et al.,* 2009). Therefore germination has improve the protein content of tiger-nut from 10.50-13.24% this could make tiger nut on germination suitable for formulation of protein rich diet; the protein content was higher than (7-8 %) as reported by Oderinde and Tairu (2009). The ash content increases from 5.64-6.32% higher than the value of (Oladele and Aina 2007) who obtained (3.97-4.25%) for tiger nut. Therefore, germination of the tiger nut tuber for 48hrs has improved the proximate composition of tiger-nut and the food value greatly improved.

Table 1: Proximate composition of raw and germinated tiger-nut (% dry weight).

Parameters	Raw Tiger nuts	Germinated Tigernut
Moisture content	9.60^{b}	9.78^{a}
Protein	10.50^{b}	13.24^{a}
Crude fibre	5.30^{a}	4.73^{b}
Crude fat	25.70^{a}	25.40^{b}
Ash	5.64^{b}	6.32^{a}
Carbohydrate	43.26^{a}	40.53^{b}
Metabolizable energy	446.34	443.68

Values with different superscripts on the same row are significant ($P \leq 0.05$).

The mineral composition analysis results showed that germination has significantly improved the elements determined as shown on Table 2, except for manganese and zinc content. The sodium content increases from 32.10 to 65.50 (ppm); the calcium content from 158.00 to 206 (ppm) higher than the value of Ekeanyanwu and Ononogbu, (2010) for Nigeria tigernut; Potassium from 541.00 to 597.00 (ppm) and phosphorus from 596.00 to 601.00 (ppm) respectively. This increase in the mineral composition could make tiger-nut to have more nutritional benefit when incorporated into the diet of children and pre-school students who requires calcium. Potassium which is an important component of cell and body fluids that help regulate heart rate and blood pressure was greatly increased on germination of the sample, this could make germinated tiger nut flour more beneficial when added to the diet of people with high blood pressure. Phosphorus for teething and strong bone development recorded a higher value in the processed sample. The increase in the calcium, magnesium, copper are equally in agreement with the Kaushik *et al*., (2010); who found out that germination improve the mineral contents of legumes. These factors could make the germinated tigernut flour useful in biscuit production for school children and the extract incorporated into weaning foods. As a gluten free diet, it could be added into diets of people who cannot take gluten and an advantage in the bakery industry. The iron content is low which ranged from 0.86 to 1.16 (ppm). The non detection of lead, chromium, cobalt, nickel from the sample is an indication that tiger-nut used for the analysis are free from heavy metal contamination and its implications in diets.

Table 2. Mineral compositions of raw and germinated tiger-nut.

Mineral Compositions	Raw Tigernut (ppm)	Germinated Tiger nut (ppm)
Sodium	32.10^{b}	65.50^{a}
Calcium	158.0^{b}	206.00^{a}
Potassium	541.0^{b}	597.00^{a}
Manganese	0.31^{a}	0.34^{a}
Iron	0.86^{a}	1.16^{a}
Magnesium	5.77^{b}	7.80^{a}
Copper	0.24^{b}	0.39^{a}
Phosphorus	596.00^{b}	601.00^{a}
Lead	ND	ND
Colbalt	ND	ND
Nickel	ND	ND
Cadmium	ND	ND
Chromium	ND	ND

Values with different superscripts on the same row are significant ($P \leq 0.05$), ND= not detected

The result of the functional properties of the tiger-nut as presented in Table 3 shows that the water absorption capacity ranged 1.78-1.89 g/g which show the ability of the flour to bind water, compare with dried albumen powder (0.54 g/g) (Massoura *et al*., 1996). The reduction in the bulk density of the germinated flour could be an advantage in the preparation of supplementary foods (Akubor and Obiegbunna, 1999). The foaming capacity increases from 22.10-30.40%; this shows that the germinated tiger-nut could be useful in the baking industry where foaming is desirable.

It has been recognized that Phenolic compounds are a class of antioxidant agents which act as free radical terminators (Shahidi and Wansundara, 1992). Table 4. Show the content of total polyphenols that were measured by Folin Ciocalten reagent method. The total phenol varied from 3.98-4.01 (mg/100g), this shows that germination does not increase the polyphenol content of tiger nut flour produced this is in accordance with the work of Megat *et al.,* 2012, on germinated soybean and peanut respectively. The antioxidant activity increased on germination from 33.22-45.00 % this shows that germination has enhanced the antioxidant activity of the tiger nut flour produced. This could make the tiger nut flour a useful product in delaying the progression of HIV infection to AIDS (David, 2005).

Table 3: The functional Properties of raw and germinated tiger-nut.

Functional properties	Raw tiger-nut	Germinated
Water absorption capacity	1.89^a g/g	1.78^b g/g
Oil absorption capacity	1.30^b g/g	2.50^a g/g
Foaming capacity	22.10^b (%)	30.40^a (%)
Foaming stability	15.40^b (%)	17.20^a (%)
Bulk density	27.50^a (g/ml)	25.20^b (g/ml)

Values with different superscripts on the same row are significant (P≤ 0.05).

Table 4: Content of total Phenolics and antioxidant activity of raw and germinated tiger nut.

Plant species	Phenol (mg/100g of seed flour)	IC $_{50}$ value ($\mu g/ml$)
Raw tiger-nut	4.01 ± 0.04^b	33.22 ± 0.27^b
Germinated tiger nut	3.98 ± 0.02^b	45.00 ± 0.43^a

Values with different superscripts on the same row are significant (P≤ 0.05).

4. Conclusion.

From the observation made, it can be concluded that germination has positive significant effect on the physicochemical and nutritive properties of tiger-nut. The use of tiger-nut in the formulation of foods and baking purposes is encouraged.

References.

Adejuyitan, J.A, Otunola, E.T, Akande E.A & Oladokun, F.M 2008. Effect of fermentation on the proximate composition of flour produced from Tiger-nut. In the proceedings of 32nd annual Nigerian Institute of food Science and Technology (NIFST) conference. 13-17 October, 2008. Pp. 62-63.

AOAC, 2000. *Official Methods of analysis*. 17th edition. Association of Official Analytical Chemists, Washington DC, USA.

Akubor, P.I & Obiegbuna, J.E 1999. Certain chemical and functional properties of ungerminated and germinated millet flour. *Journal Food Sci. Technol* 36: 241-243.

Belewu, M.A. & K.Y. Belewu, 2007. Comparative physico-chemical evaluation of tiger-nut, soybean and coconut milk sources. International Journal Agric. Biol. 9: 785-787.

Bewley, J.D & Black, M. 1994. Seeds: Physiology of development and germination. Plenum Press, New York.

David, A.B. 2005. Tigernut. A dictionary of food and Nutrition. Encyclopedia com: http://www.encyclopedia.com /doc/1039-tigernut. Html.

El- Adaway, T.A. 2002. Nutritional composition and anti-nutritional factors of chickpeas (*Cicerarietinum* L) undergoing different cooking methods and germination. *Plant Foods for Human Nutrition* 57: 83-97.

Ekeanyanwu, R.C. & Ononogbu C.I. 2010. Nutritive value of Nigerian Tiger-nut (Cyperus esculentus L). Agricultural Journal. 5: 297-302.

Eke, O.S. & Akobundu, E.N.T. 1993. Functional Properties of African Yam bean (Sphenosylis stenocarpa) seed flour as affected by Processing. Food Chem. 48: 337-340.

Ezebor, F, Igwe, C.C, Owolabi, F.A.T. & Okoh, S.O. 2005. Comparison of the physico-chemical characteristics, oxidative and hydrolytic stabilities of oil and fat of *cyperus esculentus L.* and *butyrospermum parkii* (shea nut) from Middle-Belt States of Nigeria. Nigerian Food Journal; 23: 33-39

Fagbemi, T.N. & Oshodi A.A. 1991. Chemical composition and functional properties of Full Fat Fluted Pumpkin seed flour. Nigerian Food Journal. 9: 26-32.

Ghavidel, R.A. & Prakadh, J. 2007. The impact of germination and dehulling on nutrients ,anti-nutrients, in vitro iron and calcium bioavailability and in vitro starch and protein digestibility of some legumes seeds. LWT 40:1292-1299.

Kaushik, G., Satya, S & Naik, S.N. 2010. Effect of domestic processing techniques on the nutritional quality of the soybean. Mediterranean Journal of Nutrition and Metabolism 3:39-46.

Martinez, Y. 2003. Scientific analysis of effect of tigernut on heart diseases and related aspects.

Massoura, E.J. Yereijken, M. Koister, P. & Derken J.K.P. 1996. Isolation and Functional Properties of Proteins from cramble Abyssinia oil seeds. Journal of Food Science 5: 322-327.

Megat Rusydi, M.R & Arina A. 2012. Effect of germination on total phenolic, tannin and Phytic acid contents in soybean and peanut. International Food Research Journal. 19(2): 673-677.

Oladele, A.K. & Aina, J.O. 2007. Chemical composition and functional properties of flour produced from two varieties of tiger nut (*Cyperus esculentus*). Afr. J. Biotechnol., 6: 2473-2476.

Ogunlakin, G.O. Ade-Omowaye, B.I.O & Abioye, V.F. 2008. Influence of pretreatment on some quality characteristics of tiger-nut flour. In Proceeding of 32th annual Nigerian Institute of Food Science and Technology (NIFTS) Conference 13-17 October, pp 94-95.

Okwu, D.E. 2006. The potentials of Ocimum gratissum, Pengluria exntensa and Tetrapheurea tetraptera as spice and flavouring agents. Journal Chem. Soc. Nigeria. 31(1&2): 38-42.

Osborne, O.R & Vooget, P. 1978. Calculation of Calorific in the Analysis of Nutrients in Roots. Academic Press New York. 239-244.

Shahidi, F & Wansundara, PKJPD. 1992. Phenolic antioxidants. Criticl Reviews in Food Science and Nutrition. 32: 67-103.

Sangronis, E., Rodriguez, M., Cava, R. & Torres, A. 2006. Protein quality of germinated *Phaseolus vulgaris*. European Food Research and Technology 222: 144-148.

Sosoulki , H. 1967. Determination of Functional Properties of flour Products. In AOAC 2nd Edition.

Vidal-Valverde, C., Frias, J., Sierra, I., Blazquez, I ., Lambein, F & Kuo, Y. 2002. New functional legume foods by germination : Effect on the nutritive value of beans , lentis and peas. European Food Research and Technology. 215:472-477.

Yamin, A., Zeb, A., Khalil, A.W., Paracha, G.M & Khattak, A.B. 2008. Effect of Processing on the Anti-nutritional Factors of Red Kidney Bean (*Phaseolus vulgaris*) grain. *Journal of Food* Bioprocessing Technology 1: 415-419.