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The Proximate Analysis and Functional Properties of Fermented Tiger Nut *(Cyprus esculentus lativum)*

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Abstract
The tiger nut belongs to the family cyperaceous and to the order cyperales. It is worldwide in distribution. The proximate values and functional properties of fermented Tiger nut (*Cyperus esculents lativum)* were determined. The mean values obtained were significantly different ($P < 0.05$) in the range of protein (8.66 – 10.65), moisture content (19.0 – 33.6%) dry matter (81 – 66.4%) ash content (2.39 – 18.4%), fibre (14.67 – 10.48%), and crude fat (25.94 – 20.26%). Also, the value of hose bulk density, packed bulk diversity, gelation capacity, oil absorption capacity and water absorption capacity were 59.08 – 53.72 g /ml and 18 - 22g /ml respectively. The result for sensory parameters ranged from 6.96±0.00 to 7.63±0.29. All the parameters were scored higher than five, which is the minimum sort acceptable in a 9-point hedonic scale. The production of bread from fermented Tiger nut enables diversity of use, and provides affordable and nutritious food.

Key words: Tiger nut, fermentation, proximate, functional, composition, properties.

Introduction

Cyperus esculentus is a tuber which has been traditionally cultivated in the area around Valencia (spain). It is a weed of tropical and Mediterranean regions (Sanchez – Zapata et al. 2012) *C. esculenta* had been reported to be a "health" food, since its consumptions can help prevent heart disease and thrombosis and is said to activate blood circulation (Chukwuma et al. 2010). It was also found to assist in reducing the risk of colon cancer (Adejuyitan et al. 2009). This tuber is rich in energy content (starch, fat, sugar and protein), minerals (mainly phosphorus, potassium), magnesium) and vitamin E and C (Belewu and Belewu 2007; Adejuyitan 2011; Bamishaiye and Bamishaiye 2011; Sanchez – Zapata et al. 2012).

Tiger nut contains enough protein and carbohydrates and a good quantity of vitamin B1 which assists in balancing the central nervous systems and helps to encourage the body to adapt to stress (David 2010). In china, tiger nut juice is used as a liver tonic, heart stimulant to heal serious stomach pain, to promote normal menstruation, to heal mouth and gum ulcers (Bamishaiye and Bamishaiye 2011).

Tiger nut has been demonstrated to contain higher essential amino acids than those proposed in a protein standard by FAO/WHO whistling adults needs (BOSCH et al. 2005; Bamishaiye and Bamishaiye 2011, Sanchez – Zapata et al. 2012) Tiger nut is also known as earth almond, earthnut, chifa nut, "chew fa" (USA); "IMUMU, "Ofio" (yoruba); "Ayaya (Hausa) "Akiausa" (Igbo) (Omode et al. 1995; Bamishaiye and Bamishaiye 2011; Adejuyitan 2011)

Tiger nut is also useful for making oil, soap, starch and flour (Eteshola and Oraedu 1996; Adejuyitan et al. 2009). The oil was found to contain 18% saturated (palmitic acid and stearic acid) and 82% unsaturated (Oleic acid and linoleic acid) fatty acid (Mason 2005; David 2005; Tiger nut trader 2009). Therefore, tiger nut, with its inherent nutritional and therapeutic advantage, could serve as a good alternative to cassava in the baking industry (Ade-Omowaye et al. 2008).

The aim of this work was to determine the proximate values and functional properties of

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T. nut. Also production and sensory evaluation of bread from fermented T. nut.

Materials and Methods

Collection and Presentation of Samples

Black variety of tigernut used was obtained from Ipata Market in Ilorin; Kwara State Nigeria. The nuts were cleaned, sorted, washed and soaked in water. They were left in water for 48 hours for fermentation to take place and sampled every 24 hours. The samples were taken to the Nigerian Stored Products Research Institute Ilorin, Kwara State for analysis. The samples were analysed for proximate composition and some functional properties. The nuts were oven dried milled sieved for bread production.

Determination of Functional Properties

(i) Bulky Density

This was determined using a method described by Oladele and Aina, (2007). Fifty gramme (50g) of the sample was measured into a 100ml measuring cylinder and tapped to a constant volume and the bulk density (g/cm^{-3}) was calculated using the formula.

Bulky density = weight of flour (g)/flour volume (cm^3)

(ii) Water Absorption Capacity

To detect water absorption capacity of the sample, the method used by Adejuyitan et al (2009) was modified. One gramme of the sample was mixed with 10ml of distilled water in a pre-weighed 20ml centrifuge tube. The slurry was agitated for 2 minutes, allowed to start at 28^0C for 30 mins and then centrifuged at 500rpm for 20 mins. The clear supernatant was decanted and discarded. The adhering drops of water in the centrifuge tube were removed with cotton wool and the tube was weighed, the weight of water absorbed by 1g of flour or protein was calculated and expressed as water absorption capacity.

(iii) Least Gelation Concentration

This was determined by using the modified method of Igbabul et al. (2013). Appropriate sample suspension of 2,4,6,8,10,12,14 and 16% W/V were prepared in 5ml distilled water. The test tubes containing these suspensions were heated for 3hours. The least gelation concentration was determined when the sample from the inverted test tube did not fall down the lip.

Determination of Proximate Analysis

In this analysis, the following parameters were determined—crude protein, ash content, moisture content, fat and crude fibre. Carbohydrate content was determined by differential method.

(i) The micro kjeldahl described by Association of Official Analytical chemist (A.O.A.C) (1995); Oladele and Aina, (2007); Moses et al. (2012) was used for the determination of crude protein.
(ii) Method of Eteshola and Oradu (1996) was employed to determine fat content of the sample.
(iii) Ash Content Determination: The methods described by Pearson (1973), Akubor and Baditu (2004) were directly employed.
(iv) In determining moisture content, the method of Cantalejo (1997) was used.
(v) The method of Oladele and Aina (2007) was employed in the determination of crude fibre.
(vi) Carbohydrate Content: Carbohydrate Content of the sample was determined as described by Kirk and Sawyer (1991).

Foam Capacity and Foam Stability of the Flour

The method of Narayana and Narasinga Rao (1982) described by Adejuyitan et al. (2009) was used to determine foam capacity and foam stability.

Swelling Power

The method of Adejuyitan et al. (2009) was directly employed using small quantity of the sample (1g) to measure the swelling power of the flour produced from black tigernut.

Sensory Evaluation

Bread samples produced from tiger nut flour were presented to a ten member panel of judges for sensory evaluation. The panelists scored the aroma, taste, texture, flavour and overall acceptability using a nine point hedomic scale, where 9 indicated extremely like and 1 extremely dislike (Igbabul et al. 2013).

Baking of Tigernut Bread

The method used by Ade-Omowaye et al. (2008) was modified to produce tigernut bread. The nuts were sorted (500g) fermented for 24 hours and sun dried. The fermented dried sample was ground and sieved. Ingredients such as salt (2g), sugar (5g), butter (75g), yeast (5g), and four drops of groundnut oil were added and mixed together thoroughly, left for 30 minutes to rise up. It was then poured into a tin that is used for baking bread and placed in a hot oven for 40 minutes.

Statistical Analysis

The values obtained were subjected to descriptive statistics using Mean and Standard Error of mean. Duncan Multiple Range Test (DMRT) was used to test for the means that are significantly different from each other, which are presented by alphabets in superscripts in the Tables.

Results

Table 1 showed proximate analysis of fermented T. nut and this indicated that the fermented T. nut contained high content of dry matter, carbohydrate, crude fat, and crude fibre at 0 hour which decreases with time. Their mean values were statistically different from each other throughout the length of fermentation ($P<0.05$). Meanwhile, crude protein and moisture content increased with increase in time. Mean value of all functional properties of fermented T. nut increased with the length of fermentation except loose bulk density that decreased with time. All the values were statistically different with time ($P<0.05$), as shown in Table 2.

The result of sensory evaluation of bread made from fermented T. nut is presented in Table 3. The result ranged from 6.96± 0.00 to 7.63 ± 0.29. All the parameters were scored higher than five which is the minimum score acceptable on a 9 point hedonic scale.

Table 1: Proximate Analysis of fermented T. nut

Sample (Hours)	Moisture Content	Dry Matter	Ash Content	Crude Fibre (%)	Crude Fat (%)	Crude Protein (%)	Carbohydrate
0	19.0 ± 2.02^{c}	81.0 ± 3.51^{a}	2.39 ± 0.07^{a}	14.67 ± 1.41^{a}	25.94 ± 1.82	8.66 ± 1.45^{c}	29.34 ± 0.05^{a}
24	21.7 ± 1.05^{b}	78.3 ± 2.03^{b}	2.25 ± 0.01^{b}	12.80 ± 0.74^{b}	24.56 ± 1.00^{b}	9.85 ± 0.08^{b}	28.84 ± 0.03^{b}
48	33.6 ± 1.76^{a}	66.4 ± 1.28^{C}	1.84 ± 0.00^{c}	10.48 ± 1.11^{c}	20.26 ± 0.00^{c}	10.65 ± 1.32^{a}	24.82 ± 0.12^{c}

Values are presented as mean SEM ± (n=3). All groups are compared to each other at $P < 0.05$. Values with the same superscript along the same column are not statically different from each other.

Table 2: Functional Properties of Fermented T. nut

Sample (Hours)	loose bulk Density (mg/ml)	Packed bulk Capacity (mg/ml)	Gelation Capacity (%)	Oil Absorption Capacity (g/100g)	Water absorption (g/100g)
0	59.08 ± 1.03^{a}	$72.12 \quad \pm 0.11^{b}$	18 ± 1.33^{c}	95.50 ± 2.03^{c}	129.06 ± 3.43^{b}
24	54.53 ± 0.08^{b}	70.51 ± 0.42^{c}	20 ± 0.00^{b}	107.41 ± 2.86^{b}	136.41 ± 2.57^{b}
48	53.72 ± 1.00^{c}	73.25 ± 0.81^{a}	22 ± 0.10^{a}	125.80 ± 1.62^{a}	159.16 ± 1.38^{a}

Value are presented as mean ± SEM (n=3). All groups are compared to each other at $P < 0.05$. Values with the same superscripts along the same column are not statistically different from each other.

Table 3: Mean Sensory Scored of Bread Produced from Fermented T. Nut

Samples Parameter	Bread
Taste	7.63 ± 0.29
Flavour	7.56 ± 0.08
Aroma	6.96 ± 0.00
Texture	7.21 ± 1.06
General acceptability	7.50 ± 0.07

Discussion

The results of the proximate analysis and functional properties are shown in Table 1 and 2 respectively. From the Tables, there were changes in some constituents of the fermented tigernut sample. There was decrease in crude fat from zero hour down to 48hours. There was also reduction in ash content, crude fibre and carbohydrate content. This could be attributed to metabolic activities of the micro organisms during fermentation. The decrease in carbohydrate content might be due to the presence of amylase enzyme containing microbes in the fermented wort. The presence of this enzyme enables the use of tigernut in production of bread, biscuit and generally in food formulation. This observation agrees with Oladele and Aina (2007).

There was an increase protein and moisture content (Table 1). The increase occurred with fermentation period. This result was similar to the observation of Okafor et al. (2003); Akubor and Baditu (2004) and Adejuyitan et al. (2009). The fat content decreased with fermentation period. This was contrary to the report of Adejuyitan et al. (2009) but could be compared favourably with the values reported by Oladele and Aina (2005). The ash content is an indication of the presence of mineral elements in tigernut sample. The reduction in the ash content may be as a result of usage of these minerals by inherent microorganisms for metabolic activities which resulted in reduction of the carbohydrate content. Various researchers, have reported the presence of high percentage of mineral contents in tigernut samples. Umerie and Enebeli (1997); Sowonola et al. (2005); Oladele and Aina (2007); Tigernut Trader (2009) reported the presence of high amounts of calcium, sodium, copper, potassium, magnesium, manganese and iron in tigernut products such as milk, flour, “kunnu”: to mention a few.

The water absorption capacity increased with the length of fermentation (Table 1). This was similar to the report of Adejuyitan et al. (2009). It is also favourably compared with the observation of Rita (2009) during the production of yoghurt from tigernut. The oil absorption capacity increased from zero hour to 48 hours of fermentation. The values obtained in this study agreed with Etesola and Oraedu (1996) but it was dissimilar to the report of Narayama and Narasinga (1982). The value of oil absorption in this study was higher than the value obtained by some researchers on tiger nut products.

Bulk density increased with the length of fermentation. Bulk density is a measure of heaviness of a sample. The highest bulk density was obtained at 48 hours of fermentation as shown in Table 2. This was encouraging compared with the results of bulk density of other researchers.

The percentage gelation capacity increased with the highest peak at 48hours of fermentation. This was in line with the findings of the Tigernuts Traders (2009) and also compared favourably with the study of the Spectators (2010). This result suggests that tigernuts flour may find application in the production of some baked product. The foam capacity and swelling power of black tiger nut flour was encouraging although the percentage was not up to that of flour produced from barley. Result of this was not shown on the Table. The bread produced have greater aroma, the texture was soft and it tasted like a baked cake. This was collaborated with Ade-Omowaye et al. (2008).

Conclusion

In conclusion, the diverse usage of the black tiger nut cannot be over-emphasized. Its usage in the production of milk, yoghurt and oil and baking products couple with its medicinal health benefit could serve as good alternative to cassava in baking industry.

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