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COMPARATIVE STUDY OF THE PHYSICO-CHEMICAL, STRUCTURAL AND PROXIMATE ANALYSIS OF YELLOW AND BROWN TIGERNUT(Cyperus Esculentus)

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***Abstract*—This study was conducted to determine and compare the physio-chemical, structural and proximate properties of yellow and brown Tiger nut samples which are essential for designing engineering processes. The methodology was based on the methods described in Association of Official Analytical Chemists and the Chemical analysis of foods. The mean bulk density, true density, porosity, geometric diameter and sphericity for samples A and B are 0.67 and 0.67g/cm^3, 1.17 and 1.20g/cm^3, 43.4 and 31.67%, 8.82 and 7.94, 92.6 and 90.35% respectively. The analysis of the proximate compositions indicates a moisture content in the range of 6.9– 8.0 % and 49 – 54% for brown and yellow varieties respectively. Also, the crude protein, ash, crude fibre, crude fat, and carbohydrates contents indicates a relatively higher percentage for the brown as compared to the yellow variety. Energy values ranged from 190- 270 Kcal and 430 – 550 kcal for both samples. Both samples also contain significant amounts of Mg (95.32 -140.96 mg), K (106.44 – 427.92 mg), P (121.78 – 195.95 mg), and low Na (15.77 – 18.27 mg) content. . Comparisons of both tigernut samples have shown that the brown varieties are more suited to handling and processing**

Keywords—Tigernut, proximate, physiochemical, Structural, Analysis

INTRODUCTION

Tigernut (*cyperus esculentus*) is an edible perennial grass-like plant with spherical tubers belonging to the sedge family. It is widely distributed in temperate zones and is frequently found inhabiting wet marshes, edges of water bodies such as ponds and streams where it grows into coarse tufts [1]. Despite its name, tigernut is a tuber crop, and it has been called by a wide variety of names including: yellow nutsedge, Chufa, earth almond and in Nigeria by the Hausas as 'Aya', Igbos as 'Akiausa' and Yorubas as 'Imumu'.[2].

Tigernut has been cultivated for thousands of years and since ancient times has been regarded and used mostly as a foodstuff; it was first cultivated along the Nile in ancient Egypt and also in Spain where it is still regarded as a very important economic crop. Tigernut is considered to have its origins in the Mediterranean area and western Asia but has spread (mainly as a weed) to many parts of the world during the Arabian expansion in the Middle Ages [3]. It is a crop which is very rich in energy contents (starch, fat, sugar, protein), minerals (mainly phosphorus and potassium) and oil. It is also well noted for its various medicinal and health benefits.

In Nigeria, tigernut is cultivated on a small scale by local farmers mostly in the northern part of the country. It is available in fresh, semi-dried and dried varieties in the market where it is sold locally and consumed mostly uncooked. It can be eaten wholly in different forms as raw, roasted, grated and baked and it is sometimes used in addition to other food ingredients in making beverages[4].

Tigernut has found a lot of uses over the years locally and even in industries. It tubers can be used for a wide varieties of applications and products which includes oil, flour, milk, starch etc. Tigernut milk is a sweet, non-diary, nutritious, energetic and diuretic drink. It contains reasonable quantity of minerals predominantly phosphorus and potassium. Tigernut milk also contains vitamins C and E with a reasonable quantity of carbohydrate, fats and proteins required to meet daily human nutrition needs [4].

Also, Tigernut flour is a good replacement of wheat flour in the confectionery industry because of its natural sugar content which is reasonably higher and which makes the quantity of sugar that need to be added to the product to be reduced. This has made tigernut flour appropriate to be used in flavoring ice creams and biscuits as well as used as an additive in the bakery industry[5].

Tigernut tubers is also said to contain about 20 – 30% oil and has been found to be a healthier alternative to oil obtain from olive and peanut. It has also been suggested as a potential oil crop for the production of biodiesel [6].

Tigernut, although not entirely new and despite it being recognized for both its nutritional and medicinal characteristics still remains relatively unknown and largely unexploited in major parts of the world even in regions where it is cultivated. In Nigeria for example, tigernut is basically a neglected crop. This probably may be due to inadequate knowledge on its

production, utilization, medicinal properties, health benefits and nutritional value. Tigernut oil despite its high nutritional value is hardly used in food industries compared to other vegetable oils such as olive, groundnut and peanut oil. Therefore, further research is required to emphasize its benefits in food industries, its economic importance and to enhance it production and utilization. Therefore, this paper is aimed at determining some key physiochemical and structural properties of two varieties of tigernut (yellow and brown) .

MATERIALS AND METHODS

Sample collection and preparation

The yellow and brown Tiger nut (Cyperus *esculentus*) varieties used in this research were obtained from choba market, Rivers State, Nigeria. The samples were selected and cleaned to remove foreign materials such as dust, dirt, broken and immature nuts. The samples were then labeled accordingly as

Sample A = Yellow tiger nut

Sample B= Brown Tiger nut

The methods used in the analysis of the physio-chemical and structural properties are based on the methods described in Association of Official Analytical Chemists [7]. The proximate components were determined by the methods described in [8].

In other to determine the dimensions of the nuts, samples from each varieties consisting of about 20 nuts were randomly selected. Each nut out of the group of 20 nuts was then measured using a micrometer screw gauge with accuracy to 0.01mm. The length(L) were measured by holding the nuts in an upright position between the two nodes (A and B) of the measuring device. The diameter was measured by taking two readings from the broadest points near the two nodes and the average taking as the width (W). The smallest reading was divided by the biggest to get the thickness factor which was then multiplied by the averaged diameter to obtained the thickness (T)

Plate1: Brown and Yellow tigernut Samples

RESULTS AND DISCUSSION

Table 1: Summary of Physiochemical and Structural properties

	Samples A					Samples B				
Properties	Min	Max	Mean	SD	Var	Min	Max	Mean	SD	Var
Major dia. L(mm)	7.74	11.63	9.69	±1.95	3.78	7.76	9.70	8.73	±0.97	0.94
Intermediate dia W(mm)	8.51	10.20	9.35	±0.85	0.72	6.75	9.3	8.03	±1.28	1.63
Minor dia. T(mm)	6.75	8.45	7.60	±0.85	0.72	5.61	8.65	7.13	±1.52	2.31
Bulk density(g/cm^3)	0.58	0.75	0.67	±0.09	0.008	0.63	0.70	0.67	±0.04	0.001
True density(g/cm^3)	1.13	1.21	1.17	±0.04	0.002	1.15	1.20	1.18	±0.03	0.0009
Porosity(%)	48.7	38.0	43.4	±5.35	28.6	45.21	41.67	43.44	±1.77	3.13
Geometric diameter(mm)	7.63	10.00	8.82	±1.18	1.40	6.64	9.21	7.94	±1.30	1.65
Sphericity(%)	86.6	98.6	92.6	±0.7	0.49	85.70	95.0	90.35	±4.65	21.6

Key : Sample A = Yellow Tiger nut Max = Maximum

Sample B= Brown Tiger Nut %MC= Percentage moisture content,

Min=Minimum Var = variance SD = standard deviation

Table 2: Proximate composition

Properties	Sample A	Sample B
Moisture content (%)	49 – 54	6.9 – 8.0
Protein	2.5 – 4.3	5.7 – 7.0
Ash	0.8 – 1.5	1.8 – 4.0
Fat content	15.5 – 17	34 – 40
Crude fiber	8.0 – 10.0	12.1 – 14.5
Carbohydrate	11 – 25	26.5 – 40
Energy(kcal)	190 – 270	430 – 550
Ph	6.0 – 6.2	6.1 – 6.2

Table 3: Summary of the proximate composition

	SAMPLE A			SAMPLE B		
Properties (g/100g)	Mean	SD	Var	Mean	SD	Var
Moisture(%)	51.7	±2.5	6.25	7.51	±0.60	0.30
Protein	3.4	±0.9	0.81	6.75	±1.25	1.56
Ash	1.15	±0.35	0.12	8.03	±1.28	1.63
Fat	7.60	±0.85	0.72	37	±3.0	9.0
Crude fibre	9.0	±1.0	1.0	14.0	±1.5	2.25
Carbohydrate	21.75	±7.0	49	26.7	±6.75	45.6
Energy (kcal)	169	±5.35	28.6	466.8	±1.77	3.13

Table 4: Mineral content

Properties (mg/100g)	Sample A	Sample B
Magnesium	**90.6**	**105**
Potassium	**350**	**400**
Phosphorus	**140**	**175**
Calcium	**175**	**190**

The physical properties of both samples from the results can be seen to have significant differences in terms of the dimensions of the nuts with dimensions for samples A ranging from 9.69 ± 1.95, 9.35 ± 0.85 and 7.60 ± 0.65 for the length, width and thickness respectively and that for sample B ranging between 8.73±0.97, 8.03 ±1.28, and 7.13 ±1.52 respectively. The differences in size is due largely to the significant difference in moisture content, with the dimensions reducing with decreasing moisture content. The geometric mean diameter and sphericity of the samples has a sphericity value indicating that sample A are more spherical and therefore will flow with ease on a conveyer belt during processing. This is expected since one will naturally expect the yellow variety to be closer to a sphere due to it smooth body and larger sizes.

Crude Protein, Ash content, fat, fibre and carbohydrate values for the both varieties as shown in Table 2 above clearly indicates that the brown tigernuts have a higher proximate composition than the yellow variety. This is a clear indication that the brown variety is of a higher nutrition value per unit mass of the sample than the yellow varieties. . Tigernut is characterized by a good nutritional profile. It has been investigated by several authors to contain protein content ranging from 3.98-9.70%, fat content of 24.00-35.43%; while carbohydrate content ranges between 22.08 and 75.88%. [9] and [10] evaluated the energy value of tigernuts to be 1511 kJ/100g and 1754.98 kJ/100g respectively. Tigernut tubers are also rich in fiber, ranging from 6.26 to 13.00 % [9].

The beverage has also been found to contain 26.4 mg/100ml sodium, 10.5 mg/100ml calcium, 13.0 mg/100ml magnesium, 32.3 mg/100ml phosphorus, 0.16 mg/100ml iron, 0.57 mg/100ml zinc, 0.13 mg/100ml niacin and 0.02 mg/100ml thiamin/vitamin B1 [11]. Also, the energy values ranged from 190 – 270 kcal (795 – 1130 kJ) per 100 gram of sample for sample A (795 – 1130 KJ), and a value in the range of 430 – 550 kcal(1800 - 2300) for Sample B. The mineral content analysis also shows that there are more mineral contents per gram of samples in the brown varieties than the yellow variety.

CONCLUSION

The physico-chemical and structural properties of food and plant materials are very important parameters in the development and design of processing and storage equipment. The results of the analysis shows that tigernuts are rich in energy giving nutrients (carbohydrate and fats), phosphorus, potassium, magnesium and are also fairly high in protein and calcium. Comparisons of both tigernut samples have shown that the brown varieties are more suited to handling and processing. It has a much

lower moisture content than the yellow varieties which makes it to have a much higher shelf life than the yellow variety, and its smaller size courtesy of its smaller average geometric diameter and a high average sphericity index makes its easier to handle than the yellow varieties.

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