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Some Quality Characteristics and Carbohydrate Fractions of Bambara Groundnut (*Vigna subterranea L.*) Seed Flour.

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Abstract: *A study was carried out to determine the physicochemical and functional properties of bambara groundnut (Vigna subterranean L) seed using standard methods of analyses. The proximate compositions (%) were as follow; moisture (9.82±0.02), ash (3.10±0.10), crude protein (22.46±0.02), crude fat (5.80±0.02), crude fibre (4.50±0.01), carbohydrate (55.00±0.50) and energy content (362.04Kcal/100g). The mineral composition (mg/100g) of bambara groundnut showed potassium with 1702.10±0.50 to be the highest followed by phosphorus (738.04±0.15), magnesium (347.15±0.01), calcium (256.56±0.05), sodium (135.30±0.05), iron (18.51±0.10) and manganese (10.46±0.05). The antinutrient composition in mg/100g revealed tannin to be (7.15±0.50), phytic acid (6.94±0.02) and trypsin inhibitor (1.56±0.10). The functional properties of the seed also showed foam capacity to be 28.62±0.02%, foam stability at 30 and 60 min to be 21.00±0.02 and 13.00±0.10% respectively while foaming height was 40.32±0.01cm^3. The carbohydrate fractions of the seed (g/mg) showed the following pattern: reducing sugar 3.61±0.05, raffinose 0.35±0.01, stachyose 1.57±0.10 and starch 48.12±0.20. The results of this research work revealed that the seed has a potential for dietary improvement as functional agent in food industry.*

Keywords: *Bambara groundnut, proximate, mineral, antinutrient, functional, carbohydrate.*

I. Introduction

Edible seeds are important part of a raw food diet mainly for nutrients and essential fatty acids (EFAs) they contain [1]. EFAs are polysaturated fats that human body cannot produce but which must be obtained from diets. Seeds are useful in reproduction as in spread of flowering plants and the forms of nutrients derived from them varies depending on the kind of plant [2]. Seed productions in natural plant productions vary widely from year-to-year in response to weather variables, insects and diseases and internal cycles within the plant themselves [3]. Seeds are very diverse in size; plants that produce smaller seeds can generate many more seeds per flower while plants with larger seeds invest more resources into those seeds and normally produce fewer seeds [4]. Bambaba groundnut (*Vigna substerranea*) is of the family *Fabaceae*. The plant originated from West Africa. Much like peanut, it ripens its pods underground.

Bambara groundnut is called Gurjiya or Kwaruru in Hausa, Kwam in Geom, part of Plateau state, Okpa in Ibo and Epa-kuta in Yoruba part of Nigeria. Bambara groundnut represents the third most important legume in semi-arid Africa and is suitable for soil where other leguminous crops cannot be grown because it makes little demand on the soil and is drought resistant. It has a high nutritive value with 65% carbohydrate and around 18% protein values which make it an important crop for people who cannot afford expensive animal protein [5]. *Leguminosae* have been given great attention for utilization in a variety of food systems having advantages for their wide distribution throughout the world and their potentially high of protein content [6]. The seeds are useful for food and beverages while the entire plant is known for soil improvement because of its nitrogen fixing ability [7]. Bambara groundnut seed can be consumed in different forms either at immature green state or matured. At maturity however, the seeds become very hard and therefore require boiling before any specific preparation can be carried out on it [8]. Bambara groundnut can contribute positively to food security and help to alleviate nutritional problems though; it has been classified as an underutilized crop and is only receiving more attention in the recent past.

All animals derive the major portion of their food calories from the different types of carbohydrates in their diets. Most of the energy for the metabolic activities of the cell in all organisms is derived from oxidation of carbohydrate. Sucrose, Raffinose and stachyose have been found together in leguminosae. Raffinose and stachyose can be derived from sucrose by successive condensations of α-D-galactopyranose units. Raffinose and stachyose are common sugars found in high concentrations in beans, cabbage and asparagus. Raffinose consists of three simple sugars; glucose, fructose and galactose while stachyose contains the same three sugars plus a second molecule of galactose. Breakdown of raffinose and stachyose by bacteria in the colon leads to gas production which may cause discomfort to the person.

The limited number of available nutritive and oil seed crops with concurrent variability in their chemical composition has spurned interest to look for other seeds unexploited which can be optimized for various applications. The intention of this work is to critically identify and provide answers to the knowledge gaps in terms of chemical composition existing between bambara groundnut and other commercial seeds in order to reduce the over-dependence on the already existing well-known ones.

II. Materials and Methods

2.1 MATERIALS

Dried, matured seeds of bambara groundnut (*Vigna subterranean L.*) seeds were bought from Apata market, Ibadan, Oyo State Nigeria. The seeds were dehulled, grinded using a laboratory blender (Philips Harris model), passed through a 2mm sieve and later oven dried at 70^0C to constant weight prior to further analysis.

2.2 METHODS

The proximate compositions of the seed were determined using the methods of AOAC, [9]. The mineral element composition for sodium and potassium was determined using flame emission spectrometer (FES) while magnesium, phosphorus, iron and manganese were determined using atomic absorption spectrometer (AAS). The anti nutritional factors for tannin, trypsin inhibitor and phytic acid were determined by the methods described by Mubarak, [10]. Functional properties of the seed were done by the methods reported by Appiah *et al.*, [11]. The carbohydrate fractions of the seed were done by the methods outlined by Mubarak, [10].

III. Results and Discussion

3.1 RESULTS

Table 1: Chemical composition of bambara groundnut seed (%)

Parameter	Mean ± S.D
Moisture	9.82±0.02
Ash	3.10±0.10
Crude Protein	22.46±0.02
Crude fat	5.80±0.02
Crude fibre	4.50±0.01
Carbohydrate	55.00±0.50
Energy (Kcal/100g)	362.04

n=2

Table 2: Mineral composition of the bambara groundnut (mg/100g)

Parameter	Mean ±S.D
K	1702.10±0.50
Na	135.30±0.05
Mg	347.15±0.01
P	738.04±0.15
Fe	18.51±0.10
Ca	256.56±0.05
Mn	10.46±0.05

n=2

Table 3: Toxicant level of bambara groundnut (mg/100g)

Parameter	Mean± S.D
Tannin	7.15±0.50
Phytic acid	6.94±0.02
Trypsin inhibitor	1.56±0.10

n=2

Table 4: Functional Properties of bambara groundnut

Parameter	Mean ± S.D
Foam capacity (%)	28.62±0.02
Foaming stability (30 min) (%)	21.00±0.02
Foam stability (60 min) (%)	13.00±0.10
Foaming height (vol. in cm^3)	40.32±0.01

n=2

Table 5: Carbohydrate fractions of bambara groundnut (g/mg)

Parameter	Mean ± S.D
Reducing sugar	3.61±0.05
Raffinose	0.35±0.01
Stachyose	1.57±0.10
Starch	48.12±0.20

n=2

3.2 DISCUSSION

The results of proximate composition of bambara groundnut are presented in table 1. The moisture content was found to be 9.82±0.02%. This value compared favourably with 9.75% reported for mung bean seed (Mubarak, 2000). The low value obtained would be an advantage as it would increase the shelf life of the seed. The ash content of 3.10± 0.10% was found to be lower than 3.607% reported for the seed by Mahala and Mohammed, [6]. The ash content suggests that the seed would not be useful for animal feed since 1.5- 2.5% ash content has been suggested by other researchers elsewhere as suitable range for plant materials to be useful as livestock feed.

The protein content was found to be 22.46±0.02%. The value was found to be a little bit higher than 16.6% but comparable to 18-21% proteins reported for the seed [12,13]. The protein content could be utilized in the body for repairing of worn- out tissue and building up of new ones. Crude fat content of the sample was found to be 5.80±0.02%. This value was found to be lower than 27.9±1.1% obtained for Kargo seed [14]. The value was however similar to 5.65% reported for pride of barbados seed nut [15]. The seed can therefore be classified as low fat food. The low fat content could be useful in formulating low fat diet for certain category especially the obese. The crude fibre content showed a value of 4.50±0.01% in the seed. The value is a little bit lower than 6.48% reported for the whole sesame seed [16]. The low crude fibre content would aid in normal digestion of food because high value has been attributed to some form of disorder in animal such as colon cancer. The carbohydrate and energy contents of the seed were found to be 55.00±0.50% and 362.04Kcal/100g respectively. These values suggest that the seed would be a very cheap source of energy to the body.

Table 2 revealed the mineral element contents of the seed. Potassium with 1702.10±0.50mg/100g was found to be the highest, followed by phosphorus with 738.04±0.15mg/100g. Next to these two elements are magnesium (347.15±0.01mg/100g), calcium (256.56±0.05mg/100g), sodium (135.30±0.05mg/100g), iron (18.51±0.01mg/100g) and manganese (10.46±0.05mg/100g) respectively. These elements are useful in the normal functioning of the body system. Combination of calcium with other nutrients like magnesium, phosphorus, manganese, vitamin A, C, D, chlorine and protein has been linked to bone formation while others like iron is required for normal functioning of the central nervous system [15].

Table 3 showed the content of three antinutrients. Tannin, phytic acid and trypsin inhibitor in mg/100g were found to be 7.15±0.50, 6.94±0.02 and 1.56±0.10 respectively. Phytic acid affects bioavailability of composite nutrients because they have the ability to complex bivalent ions which can make them unavailable in monogastric animals [17]. The value for trypsin inhibitor was found to be very low compared to 15.8TIU^{A}/mg protein reported for mung bean seed (Mubarak, 2005). The low value is desirable because high content of trypsin inhibitor has been reported to lower digestibility of legume proteins [17].

Values of functional properties of bambara groundnut was presented on table 4 showing foam capacity (28.62±0.02%), foam stability (30 and 60 minutes) (21.00±0.02 and 13.00±0.10%) and foaming height (40.32±0.01cm^3).The value for foaming capacity was higher than the one reported for some varieties of cowpea [11,18] .The value obtained for foaming stability at 30 and 60 minutes showed that the foaming produced at 30 minutes (21.00%) is relatively more stable than those at 60 minutes (13.00%). Foaming ability of a material is related to the rate of decrease of the surface tension of air/water caused by absorption of protein molecules [14]. The foaming height of 40.32±0.01cm^3 was found to be low when compared to 53.30±0.14cm^3 and 43.00±0.11cm^3 reported by Akin-Osanaye *et al.,* [14] for dehulled Kargo seed flour and its protein isolate respectively. The high foaming capacity and stability would make the seed a useful foam enhancer in food system [11]. The seed could also be useful as aerating agent in food materials that require the production of stable foam.

Table 5 shows the carbohydrate fractions (mg/100g) of bambara groundnut with reducing sugar (3.61±0.01), raffinose (0.35±0.01), stachyose (1.57±0.10) and starch (48.12±0.20). The results revealed starch to be the highest component of the carbohydrate which is an indication of high energy content of the seed. Mubarak, [10] reported that cooking processes significantly reduced stachyose, reducing sugar and raffinose but the reduction in starch they observed after cooking treatment was not significant which is an indication that after cooking, considerable amount of the starch would still be available for utilization by the body.

IV. Conclusion

The results of this research work showed that bambara groundnut seed could have an added potential as a source of cheap and affordable source of nutrients to man and animal. The good functional properties would also make the seed useful in fortifying food materials that are low in protein. The seed is therefore a good resource for this present time as well as for the future.

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