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Analysis of Some Physio-Chemical Properties of Milk Bush (*Thevetia peruviana*) Seeds

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Abstract: The proximate and some technological properties of milk bush (*Thevetia peruviana*) seeds were investigated. The results obtained showed the following chemical compositions: Moisture content (2.94%), protein (7.44%), oil (57.05%), crude fibre (22.37%), ash (2:24) and carbohydrate by difference (7.76%). In the same vain, mineralogical analysis using an inductively coupled plasma atomic emission spectrometer was conducted. The results obtained showed that magnesium, potassium and sodium were the predominant elements in the seeds. The technological properties studied were unit mass, unit volume, geometric mean, diameter, sphericity, bulk density, true density and porosity with average values of 4.14 g, 4.403.57 mm^3, 20.34 mm, 0.67, 657.73 kg/m^3, 942.05 kg/m^3 and 31%, respectively. Information of these properties could be useful in process machine design. On the other hand, knowledge of the proximate properties is important for nutritional and dietary information.

Key words: Chemical properties, elemental composition, milk bush, physical properties

INTRODUCTION

One of the basic post harvest requirements of crop processing is the quality assurance for food products. The quality assurance programme as reflected in the chemical composition of foods is often determined to establish the acceptability or nutritive value of the food product. These chemical properties include moisture content, crude protein, crude fact crude fibre, ash content and carbohydrate. An accurate and precise quantitative analysis of other chemical properties of foods is important for nutritional labeling and to determine whether the food meets the standard (Nielson, 2002).

Mohsenin (1970) indicated that the physical properties of agricultural materials are necessary in the design and development of process machine. These physical properties include mass, sphericity, bulk density, projected area, geometric mean diameter, surface area, and radius of curvature. *Thevetia peruviana* commonly known as milk bush is an evergreen, dicotyledonous shrub which is believed to have originated from the forest of tropical America, Precisely from Central America, but has naturalized in the tropical and subtropical regions of the world. It is abundantly available in Nigeria, where it is mainly grown as an ornamental plant. The seed of the plant contains about 60% oil and the defatted seed cake is about 37% protein (Olatunji, 2010). Despite extensive literature search, no published information was found on properties of milk bush useful for the designing of equipment for its handling, processing and storage. These properties therefore need to be investigated for process machine design as well as dietary information. Therefore the objectives of this work is to establish milk bush chemical composition and its physical properties such as volume, geometric mean diameter, bulk density, sphericity, porosity and projected area.

MATERIALS AND METHODS

Fresh milk bush fruits were obtained from Federal Government College, SNAPs compound, Port Harcourt Nigeria on 15th January, 2010. The fruits were transported in polythene bags to the process centre and manually separated to remove dirts and immature seeds. The clean seeds were then held at room temperature for three days to soften the mesocap and for easy removal of the kernel.

Chemical properties: Determination of moisture content, crude protein, crude fibre, ash content, fat content and carbohydrate and elemental composition were carried out in accordance with Association of Official Analytical Chemist (AOAC, 1990) Methods. One (1) g of dried and grounded milk bush was put into a Pyrex crucible and 10 mL of pure HNO_3 was added. This was incinerated in Gallenkamp microwave oven at 250ºC for 18 h, and it was then diluted to the volume of 25 mL with water.

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Samples were filtered through a filter paper. The mineral contents were then determined with an inductively coupled plasma Atomic Emission Spectroscopy (ICP-AES) at the University of Ado Ekiti Chemistry Lab in Ekiti State, Nigeria.

Physical properties: All the physical properties were determined at moisture content 9.21% d.b. For 100 seeds, (a) major (b) intermediate, and (c) minor diameters were measured using a vernier caliper model CD (5cp - Mitutoyo England), having a resolution of 0.01 mm. The geometric mean diameter (GMD) was calculated as

$$GMD = (abc)^{1/3} \quad (1)$$

Subsequently, sphericity, f, was calculated using the equation prescribed by Mohsenin (1970) as:

$$f = \frac{(abc)^{1/3}}{a} \quad (2)$$

The unit volume of 100 individual seeds was determined form values of a, b, and c using the formula proposed by Miller (1987):

$$V = \frac{\pi\, abc}{6} \quad (3)$$

The projected area was calculated using the equation proposed by Li *et al*. (1998) as shown in Eq. (4):

$$A_p = KV^{2/3} \quad (4)$$

Where,
A_P = average projected area (mm^2)
K = constant, 1.21
V = projected volume (mm^3)

In the same vein, the surface area was evaluated using the equation as proposed by Li *et al*. (1998) as show in Eq. (5):

$$A_s = (36p)^{1/3}\, V^{2/3} \quad (5)$$

where, A_s = Average surface area (mm^2)

The unit mass of 100 individual seed was evaluated using a top-loading electronic balance (Model 6330, 01PPL, India), having an accuracy of p0.01G. Also bulk density of seed was determined using a cylindrical container (volume = 250 x $10^{-6}m^3$). The container was filled with seeds and seeds having half of their lengths projected above the top edge were removed and the entire container weighed. The bulk density was calculated as (Li *et al*., 1998):

$$L_d = \frac{W_b}{V_b} \quad (6)$$

where,
L_d = bulk density (kg/m^3)
W_b = mass of seeds (kg)
V_b = volume of container (m^3)

The true density was also evaluated as follows:

$$l_{Tr} = \frac{M}{V} \quad (7)$$

where,
l_{Tr} = true density (kg/m^3)
M = mass of individual seeds (kg)
V = product volume (m^3)

The porosity of the bulk seed was computed from the values of the true density and bulk density of the seeds by using the relationship given by Mohsenin (1970).

$$Pf = \left(1 - \frac{l_d}{l_{Tr}}\right) \times 100 \quad (8)$$

where,
P_f = Porosity in %
l_d = Bulk density, kg/m^3
l_{Tr} = True density, kg/m^3

All the data obtained were analyzed using a SAS software package (2004).

RESULTS AND DISCUSSION

Chemical properties: Proximate analysis was carried out on milk bush kernel and the summary of results of moisture content, crude protein, and crude fibre, ash content, fat content and carbohydrate are presented in Table 1.

The result obtained shows that Milk bush seeds contained 2.94% moisture content, 7.44% crude protein, 57.05% fat content, 7.76% carbohydrate 22.37% crude fibre and 2.24% ash content. Adequate consumption of dietary fibre is important for optimal health. Therefore, seeds containing 22.37 of crude fibre could help prevent constipation and diverticular diseases (gastrointestinal disorders). Similarly, ash content represents the total mineral content in food; hence seeds with ash content of 2.24% are an indication of the abundance of minerals in Milk bush.

Elemental composition: The elemental composition of milk bush *(Thevetia peruviana*) kernels are shown in Table 2.

Table 1: Proximate composition of milk bush (*Thevetia peruviana*)

Properties	Mean	S.D.
Moisture content (%)	2.94	0.03
Crude protein (%)	7.44	0.23
Crude fibre (%)	22.37	0.10
Ash content (%)	2.24	0.06
Fat content	57.05	0.07
Carbohydrate	7.76	0.27

Table 2: Elemental composition of milk bush (*Thevetia peruviana*)

Minerals	Average values (PPm)	S.D.
Mg	213.71	0.02
K	91.34	0.03
Na	29.18	0.03
Mn	0.99	0.06
Fe	3.77	0.01
Cu	4.79	0.02
Zn	0.16	9.75
Pb	0.50	18.71

Table 3: Physical properties of milk bush at 2.94Mc.d.b

Properties	Mean	S.D.
Major diameter, a, (mm)	30.27	0.01
Intermediate diameter, b(mm)	15.10	0.06
Minor diameter, c(mm)	18.4	0.02
GMD (mm)	20.34	0.13
Sphericity, f (mm)	0.67	0.01
Volume (mm^3)	4,403.57	0.08
Mass (g)	4.15	0.08
Projected area (mm^2)	334.30	0.08
Surface area (mm^2)	1,336.09	0.02
True density (kg/m^3)	942.05	0.02
Bulk density (kg/m^3)	657.73	0.01
Porosity (%)	31	0.20

From Table 2, the predominant elements in milk bush seeds are magnesium, potassium and sodium with average values of 213.7, 91.34 and 29.18 ppm respectively. These three elements constitute the macro elements that are essential for plant growth. Similarly manganese, iron copper and zinc with average values of 0.99, 3.77, 4.79 and 0.16 ppm constitute the micro elements which are also essential for plant growth. The milk bush cake with the presence of these macro and micro elements can be used for fertilizer or applied directly to correct contaminated soils (Falusi and Adeleye,1988).

Technological properties: The dimensional and processing properties of Milk bush seed is presented in Table 3.

As shown in the Table 3, the average major, intermediate and minor diameters of milk bush seeds are 30.27, 15.10 and 18.4 mm, respectively. The geometric mean diameter was found to be 20.34 mm. These values are relevant to the design of sorters, screens and containers. An evaluation of average sphericity was found to be 0.67. This value is close to the values reported by Musa and Haydar (2004) for sumac fruits (0.76). The high sphericity value of milk bush obtained is important in the selection of handling principles such as conveying and grading.

Bulk density, true density, volume, unit mass and porosity were observed to be 657.73 kg/m^3, 942.05 kg/m^3, 4,403.57 mm^3, 4.15 g and 31%, respectively. These properties can be equally utilized in the containerization of this crop. Thus, information herein provided is essential for the design of equipment, for handling, transport; process and storage of the seeds.

CONCLUSION

The analysis of some technological properties of milk bush which includes the physical and chemical properties show that milk bush at 2.94% moisture content (db) has crude protein 7.44%, crude fibre 22.37%, Ash content 2.24%, fat content 57.05% and carbohydrate 7.76% respectively.

The major diameter, minor diameter, geometric mean diameter, sphericity and bulk density were observed to be 30.27 mm, 15.10 mm, 18.40 mm, 20.34 mm, 0.67 mm and 657.73 kg/m^3, respectively. These properties are also important for process machine design.

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