Some Physical Properties of Moringa *oleifera* Seeds

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ABSTRACT

Some physical properties of Moringa oleifera seeds were investigated in this study. Properties such as length, width, thickness, geometric and arithmetic mean diameter dimensions, sphericity ,surface area, mass, volume, solid and bulk density, specific gravity and porosity. At moisture content of 8.33% wet basis., the average length, width, thickness and mass were: 9.223mm, 8.423mm, 7.424mm and 0.258g respectively. The geometric and arithmetic mean diameters are respectively 9.144mm and 8.320mm. The surface area, volume, sphericity and aspect ratio are 0.297mm^2, 1.39cm^3, 90.37% and 0.914% respectively. The solid density, bulk density, porosity and specific gravity were: 4.77g/cm^3, 8.42g/cm^3, 7.420% and 0.28 respectively. These properties are necessary for the design of equipment for harvesting, processing, transporting, separating, packaging and storage processes.

Keywords : Moringa olifera, Physical properties, Sphericity, Dehulling, Aspect ratio

INTRODUCTION

Moringa oleifera seeds just like other parts ofthe three is found to be medicinal with numerous uses. Mature pods of the tree are edible and they form a part of the traditional diets in many countries and subtropics of the world (Anhwanye *et al.*, 2004). The leaves and seeds of M. oleifera are good source of protein, vitamin A, B, C and minerals such as calcium and iron (Dahot, 1988). The seeds of the plant can be processed into powdered state which can be traditionally used as coagulating agent in water purification (Folkard *et al.*, 2002, Anwar *et al.*, 2007). Moringa oleifera, kernels also contains a significant amount of oil which is commonly known as Ben

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oil or Behen oil. This was erroneously reported to be resistant to rancidity and used extensively in the effleurage process (Nolabigengeser and Narasaih, 1998).

Due to the facts that M. oleifera are harvested and collected traditionally which is done by handpicking, there is always unwanted materials in all the harvested seeds which necessitate the need for the cleaning of the harvested seeds. For further processing of the harvested materials there is need for the determination of some engineering properties, such as physical and mechanical properties among others. The knowledge of the physical properties are highly relevant to agricultural engineers due to the increasing economic importance of food materials, together with the complexity of modern technology for their production, handling, storage, processing, preservation, quality evaluation, distribution and marking and utilization. There is a demand of comprehensive information on its properties which are of prime importance. These properties influence the design and evaluation of the processing of the seed. In this present study, some physical properties of Moringa olifera seeds were investigated.

Experimental Procedure

Moringa oleifera seeds were locally sourced for at J.V.O Ventures in Ibadan Oyo State Nigeria. Each of the seeds were carefully broken form the pods in order to liberate and obtain them. The seeds were manually cleaned from foreign materials. A grain each was selected carefully and put in a labeled envelope for the purpose of identification and repeatability of the experiment..

The moisture content determination was carried out using an electrically powered oven which is accurate, direct and précised method according to ASAE 1993. The moisture content of the seed was determined by weighing in air with the aid of an electronic weighing balance and transferred into an electrically operated oven at 105^{o}C. The seeds were removed after one hour, weighed and placed back into the oven until a constant weight is obtained. The value of the moisture content was then computed with the equation below.

$$\% M.C_{wb} = \frac{Ww}{Ww + Wd} \times \frac{100}{1}$$

Where Ww = Weight of water (g), Wd = Weight of dry (g)

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The dimensional axes were measured using a vernier caliper with an accuracy of 0.01mm.With the data obtained from the axial dimensions the arithmetic and geometric mean diameter were calculated using the expression below (Moshsenin, 1986).

$$Da = \frac{L + W + T}{3} \text{ and } Dg = (LWT)^{1/3}$$

Sphericity (ϕ)This was obtained using the equation below Mohsenin, (1986).

$$\phi = \frac{(LWT)^{1/3}}{L}$$

The volume of the seed was determined using the equation below.

Volume = Mass/Density :

The surface area was determined by using graphical method of determination of the area of irregular seeds, as reported by Mohsenin, (1986).

The aspect ratio of the seed will be determined by the equation given by (Varnamekhasti *et al*, 2007).

$$Ra = \frac{W}{L}$$

Solid density was determined using a specific gravity bottle. The solid density of the material was determined using the equation as described by Okeke and Anyakhoha (1987)

$$Solid\ Density = \frac{M_2 - M_1}{M_4 - M_1 - M_3 - M_2}$$

Where:

M_1 ---- weight of the empty density bottle (g), M_2 --- weight of the empty density bottle filled with seed sample (25 seeds),

M_3 ---weight of the density bottle filled with water and seeds (g), M_4 --- weight of density bottle containing water only (g)

The bulk density was determined by filling an empty plastic container or predetermined volume and take weight with the seeds by pouring from a constant height, striking off the top level then weighing.

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The bulk porosity was determined using density (bulk and solid) parameters as described by Mohsenin 1980

$$Porosity = \frac{1 - Bulk\ density}{Solid\ density} \times 100$$

RESULTS AND DISCUSSION

The moisture content of the seed was determined to be 8.33% wet basis. The summary of the basic geometric parameters is presented in Table 1.

Table 1: Basic geometric characteristics of Moringa oleifera seeds

Physical Properties	N	Minimum	Maximum	Mean
Length (mm)	100	7.72	11.64	9.2227 (±0.7584)
Width (mm)	100	6.78	11.20	8.4229 (±0.5926)
Thickness (mm)	100	3.56	8.80	7.4244 (±0.8453)
Arithmetic Mean Diameter (mm)	100	4.48	10.09	8.3203 (±0.6267)
Geometric Mean Diameter (mm)	100	6.99	89.49	9.1435 (±8.1321)
Unit Mass (g)	100	0.15	0.41	0.2582 (±0.0404)
Surface Area (mm^2)	100	0.18	0.48	0.2970 (±0.0519)
Sphericity (%)	100	65.00	98.00	90.3700 (±5.6865)

Aspect Ratio	100	0.74	0.99	0.9140 (±0.0593)

Note: Figures in parenthesis represents the standard deviation.

The length, width and thickness ranges from 7.72mm – 11.64mm, 6.78mm – 11.20mm and 3.56mm – 8.80mm respectively. The importance of these and the other characteristics are useful in determining aperture sizes and other parameters in machine design has reported by Mohsenin (1986) and highlighted lately by Omobuwajo *et al*. (1999). The arithmetic mean diameter, geometric mean diameter, surface area, aspect ratio, sphericity and unit mass ranges from 4.48mm – 10.09mm,6.99mm – 9.49mm,0.18cm^2 – 0.48cm^2,0.74 – 0.99,65% - 98% and 0.15g – 0.41g respectively . The aspect ratio is an indicator of a tendency toward a particular shape. (Reddy and Chakraverty, 2004). The geometric mean of the axial dimension is useful in the estimation of the projected area of a particle moving in the turbulent or near turbulent region of an air stream. This projected area of the particle is generally indicative of its pattern of behaviour in a flowing fluid such as air, as well as the ease of separating extraneous materials from the particle during cleaning by pneumatic means. The value of sphericity (90.37%) shows that their shape approaches that of a sphere (Tabil *et al.*, 1999; Gorial and O'Callaghan, 1990). The summary of the determined gravimetric properties are presented in Table 2.

Table 2. Gravimetric result of the physical properties

	N	Minimum value	Max.value	Mean
Solid Density (g/cm^3)	4	3.93	6.38	4.77 (±1.08)
Bulk Density (g/cm^3)	4	6.78	11.2	8.42 (±0.59)
Porosity (%)	4	3.56	8.8	7.42 (±0.85)
Specific Gravity	4	0.15	0.41	0.28 (±0.04)
Volume (cm^3)	4	1.113	1.57	1.39 (±0.20)

Note: Figures in parenthesis represents the standard deviation.

The solid density, bulk density, volume, specific gravity and porosity ranges from 3.933g/cm^3 – 6.380 g/cm^3,0.9765 g/cm^3 – 0.9843 g/cm^3 ,1.113cm^3 – 1.570 cm^3,0.0039 – 0.0064 and 75 – 85 % respectively. These characteristics can be used to design separation or cleaning devices for the seeds.

CONCLUSION

Size of the seeds in terms of its geometric characteristics were established .The parameters were obtained and determined at the moisture content of the seed immediately after dehulling. The moisture content of the seed is 8.33%wb.The sphericity of the seed can also be concluded to be 90.37% which shows that the seed is spherical as stated by Kachru *et. al*., (1994)

The average values of the physical properties analyzed for this seed such as length, width, thickness, arithmetic and geometric mean diameter, surface area, unit mass, aspect ratio, solid density, bulk density, porosity specific gravity and volume were determined as 9.22mm, 8.42mm,7.42mm,8.32mm,9.14mm,0.2970mm^2,0.2582g,0.91,4.77g/cm^3,8.42g/cm^3,7.42%,0.28,1.39cm^3 respectively

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