

Physical Properties Of Soursop (Annona Muricata) Seeds.

¹Okoro C. K. and ²Prof. Osunde Z. D.

Department of Agricultural and Bioresources Engineering, Federal University of Technology, P.M.B 65, Minna, Niger State, Nigeria.

Abstract

Soursop is a peculiar fruit with a green bark covered with soft spines, a white or creamy pulp interspaced with seeds. In Nigeria it is called 'shawa shawa' or 'shawa shop'. A good knowledge of the physical properties of these seeds will help in design of processing and storage equipments for effective use of the seeds. Some physical properties of Soursop seeds were studied. The result shows that the average number of seeds per fruit was 81 and at 4.20 % moisture content (wb), the average weight of the seed, surface area, sphericity, bulk density, true density and porosity were 0.54gms^{-2} , $(1.48 \times 0.88 \times 0.52)$ mm, 22.13cm^2 , 0.59, 0.05g/ml, 0.54g/ml and 91% respectively. The angle of repose for wooden, steel and glass surfaces were 16.8° , 18.3° and 13.3° respectively. They are ovate shaped, with a black-brown colour when freshly removed, but gradually turns brown with time, until it attains a light brown colour.

1. Introduction

Soursop (*Annona muricata*) is a peculiar fruit with an inedible skin covered with many soft spines. The unripe fruit is green, hard both on the inside and outside and the pulp is white. When ripe, the skin becomes soft with a yellow green colour and the pulp becomes creamy, juicy and soft. Soursop has a number of black-brown seeds and fibrous membrane around pockets of flesh. Its flavour is described as a combination of strawberry and pineapple with sour citrus flavour notes, contrasting with an underlying creamy flavour reminiscent of coconut and banana ^[1]. It also has a smell similar to the guava fruit.

Soursop is native to Central America, the Caribbean and Northern South America, Columbia and Brazil, Mexico, Peru and Venezuela and some sub-Saharan African countries that lie within the tropics ^[2]. In Nigeria it grows in every part of the country commonly known as *shawa shawa* or *shawa shop*.

Soursop has a lot of medical benefits. From research the skin, leaves and seeds are used in preparing a traditional medicine for treating cancer, used by locals living in areas where it is grown.

In some parts of South and North America, the fruit is used for a native 'cancer tea' production. In Mexico and Colombia, it is a common fruit, often used for dessert as the only ingredient, or as an 'agua fresca' beverage; in Colombia, it is a fruit for juices, mixed with milk. Ice cream and fruit bars made of Soursop are also very popular. The seeds are normally left in the preparation and removed while consuming ^[3].

Research has shown that soursop is rich in vitamins B1, B2, and C. In Hawaii a research done reported that the optimum stage of eating is 5-6 days after harvest, at the peak of ethylene production.

In Nigeria it is harvested when ripe, sliced into parts and eaten directly from the inside and the seeds thrown away. It is usually eaten fresh after harvest, as it cannot be transported in large quantities to the markets for commercial purposes, owing to the soft and irregular nature of the skin when ripe. It is susceptible to damage when heaped and also because of the sticky nature of the flesh, a crushed Soursop can be very messy.

Knowledge of the physical properties of seed is of paramount importance in designing equipments for handling, storing and processing ^[4].

Jayan and Kumar (2004) reported that seed flow through a planter is dependent on size, shape, sphericity, true density, and angle of repose.

Knowing the grains bulk density, true density and porosity can be useful in sizing grain hoppers and storage facilities: they can affect the rate of heat and mass transfer of moisture, during the aeration and drying processes ^[6].

In this work, some physical properties of Soursop seeds such as number of seeds, moisture content, size, shape, weight, colour, bulk density, true density, porosity, angle of repose, surface area and sphericity were determined, to aid with design

of equipments and processes for the proper utilization of soursop seeds.

2. Materials and Methods

2.1. Material sampling

The seeds from Five (5) Soursop fruits harvested in Bwari local government area of Niger state, Nigeria, were removed, washed and allowed to dry at room temperature. Five samples (A, B, C, D and E) of 20 seeds each were randomly selected and used in determining the physical properties; this was done so as to take average values for optimum results. All the experiments were carried out in the department of Agricultural and Bioresources Engineering, Federal University of Technology, Minna, Niger State, Nigeria.



Φιγυρε 1. Σουρσοπ φρουιτ (Αννονα μυριχάτα).



Φιγυρε 2. Σλιχέδ σουρσοπ φρουιτ, σηοωινγ τηε πυλπ ανδ τηε ιντ ερσ-παχέδ σεεδσ.



Φιγυρε 3. Ωασηέδ σουρσοπ σεεδσ.

2.2. Methodology

2.2.1. Number of seeds. The seeds from each fruit were manually counted and the average value was calculated. The average number (n_{ave}) of seeds in each fruit was calculated as

$$n_{ave} = \frac{n_1 + n_2 + n_3 + n_4 + n_5}{5}$$

Where, n_1, n_2, n_3, n_4 and n_5 are number of seeds in the first, second, third fourth and fifth fruit respectively.

2.2.2. Moisture content. The moisture content was calculated using the oven drying method [7]. The samples were put in separate tin containers with a known weight. The weight of the seeds and the container was then taken and the tins containing each sample placed in an air tight oven at 105 °C. The weight of each sample was taken at an interval of 1 hour until a constant weight was achieved. For accuracy, the readings were taken three times and average values were used to calculate the moisture content on wet basis using the following formular,

$$M_c = \frac{WW - DW}{WW} \times 100$$

Where

M_c = Moisture content

WW = weight of sample and container before oven drying

DW = weight of sample and container after oven drying. [7]

2.2.3. Weight. The mass (m) of each sample was measured, using an electronic balance (SFE 300). The average of each sample was calculated. The weight (W) was then calculated using the relationship;

$$W = mg$$

Where g = acceleration due to gravity. The mean value of the five samples was then recorded as the weight of seed.

2.2.4. Size. Major, minor and intermediate diameter (L , W and T respectively) of each seed in the five samples was taken using vernier callipers (Tricle brand) to the nearest 0.02mm and 0.001 inch.

2.2.5. Sphericity. Jouki and Khazaei (2012), reported that sphericity, can be calculated using the formula;

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

Where L is the grain length, W is the grain width and T is the grain thickness.

$$D_g = (LWT)^{1/3}$$

Where D_g is the geometric mean diameter (GMD) of the grain,

$$\varphi = \frac{D_g}{L}$$

2.2.6. Surface area. The surface area S , of each seed contained in the samples was determined using graphical representation method. Each seed was wrapped completely with a foil paper, and the outline of the outstretched foil paper was traced on a graph. The number of cubes in each traced outline was counted and multiplied by 0.04cm^2 , being the area of each small graph cube.

2.2.7. Bulk density. The bulk density (ρ_b) was calculated using the toluene displacement method. The weight of each sample (m) and the volume of the cylinder (v_c), were used to calculate the bulk density, using the equation;

$$\rho_b = \frac{m}{v_c}$$

The average bulk density was then calculated for the five samples.

2.2.8. True density. The toluene displacement method was also used to determine this property. The sample was weighed and then immersed in toluene solution in a calibrated measuring jar; the change in the level of solution was then measured as the volume of seeds immersed in the toluene solution. Average mass of each sample measured was taken as the mass of seed (m_s), since a single seed showed no significant change in the level of the solution and the average volume of seeds was taken as the seed volume (v).

$$\rho_t = \frac{m_s}{v}$$

Where ρ_t is the true density.

2.2.9. Porosity. The bulk density and true density were used to obtain the porosity using the equation given by;

$$\varepsilon = \left[1 - \frac{\rho_b}{\rho_t}\right] \times 100$$

Where ε = porosity.

2.2.10. Shape. Mohsenin, 1986, defined the shape of the seeds using the chartered standard. This standard was used to determine the shape of the seeds.

2.2.11. Angle of repose. This was determined on three surfaces: wood, stainless steel and glass, with an apparatus of fixed and adjustable boards and a hollow wooden box of size $(9 \times 7.5 \times 1)$ cm.

The box was filled with the seeds and placed at the top end of the adjustable board parallel to the pointer. The adjustable board was gradually tilted upwards until the box just moves. The angle the board makes with the horizontal that is the angle of tilt was then read from the protractor. This was repeated three times for all surfaces.

3. Discussion of Results

Ταβλε 1. Πηψισιχαλ προπερτιες οφ σουρσοπ (αννονα μυριχατ α) σεεδ

| Property | Mean | Max. | Min. | STD | CV (%) |
|-------------------------------|--------|--------|--------|-------|--------|
| Moisture cont. (%) | 4.20 | 4.849 | 3.530 | 0.665 | 15.8 |
| Size(mm): L | 1.482 | 1.740 | 1.220 | 0.129 | 8.7 |
| W | 0.883 | 1.200 | 0.255 | 0.119 | 13.5 |
| T | 0.522 | 0.895 | 0.430 | 0.070 | 13.4 |
| GMD(mm) | 0.881 | 0.909 | 0.832 | 0.042 | 4.8 |
| Sphericity | 0.594 | 0.614 | 0.582 | 0.017 | 2.9 |
| Surface Area(cm^2) | 22.130 | 32.800 | 15.400 | 4.485 | 20.3 |
| Weight(gms^{-2}) | 3.463 | 3.692 | 3.220 | 0.237 | 6.8 |
| True density(g/ml) | 0.544 | 0.656 | 0.473 | 0.099 | 18.2 |
| Bulk density(g/ml) | 0.047 | 0.050 | 0.043 | 0.003 | 6.4 |
| Porosity (%) | 91.111 | 93.333 | 90.000 | 1.925 | 2.1 |
| Angle of repose: | | | | | |
| Wood (degrees) | 16.800 | 17.500 | 16.000 | 0.764 | 4.5 |
| Stainless steel (degrees) | 18.300 | 19.000 | 18.000 | 0.577 | 3.2 |
| Glass (degrees) | 13.300 | 14.000 | 13.000 | 0.577 | 4.3 |

Morton (1987) reported that a large soursop fruit may contain from a few dozen to 200 or more seeds. The average number of seeds calculated is approximately 81, which is in agreement with Morton's report.

Table 1 gives a summary of the mean values, standard deviation from the mean (STD) and the coefficient of variation (CV) of the physical properties of soursop (*Annona muricata*) seeds determined at 4.20 % (wb) moisture content.

The shape of the seed could be described as ovate; egg shaped and broad at stern end. The observed colour of the seeds when freshly removed from the pulp is shiny black-brown. The seeds gradually turn brown after some time, until they attain a light brown colour.

4. Conclusion

In conclusion physical properties of soursop as shown in table 1 were determined at 4.20 % (wb) moisture content. The angle of repose is greatest using the stainless steel surface at 18.3⁰ followed by wood at 16.8⁰ and glass at 13.3⁰. Soursop seeds are ovate shaped with black-brown colour, which later turns brown with storage. These results will aid with design and processes for proper utilization of soursop seeds.

5. Acknowledgement

The authors would like to appreciate Mallam Zegi and Mr Peter (laboratory technicians) in the department of Agricultural and Bioresources Engineering, for their technical support.

6. References

- [1] Guanabana, retrieved from <http://en.wikipedia.org/wiki/Soursop>
- [2] Morton, Julia F. "Soursop (*Annona muricata*)". Fruits of warm climates. Purdue University". pp. 75–80, 1987. Retrieved from <http://www.hort.purdue.edu/newcrop/morton/soursop.html>, on 21st January, 2013.
- [3] Soursop, retrieved from <http://en.wikipedia.org/wiki/Soursop>, 21st January, 2013.
- [4] Abdi D. Zewdu. "Moisture-dependent physical properties of Ajwain (*Trachyspermum ammi* L.) seeds". Pillip Agric scientist, vol. 94 No. 3, 278-284, 2011.
- [5] P.R. Jayan and V.J.F Kumar. "Planter design in relation to physical properties of seeds". Journal of Tropical Agriculture 42(1-2): 69-71, 2004.
- [6] M. Jouki and N. Khazaei. "Some physical properties of rice seed (*Oryza sativa*)", Research Journal of Applied Sciences, Engineering and Technology, 4(13): 1846-1849, 2012.
- [7] Yaning Zhang, A.E. Ghali and Bingxi Li. "Physical properties of corn residues", American Journal of Biochemistry and Biotechnology, 8(2), 44-53, 2012.
- [8] Nuri N. Mohsenin. "Physical properties of plants and animal materials, Gordon and Breach science publishers, Cooper station, New York, New York 10267 USA, 1986.