Physical And Chemical Properties Of Pumpkin In ADO-EKITI

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***Abstract*— The study was undertaken to determine the physical and chemical properties of pumpkin. Two varieties of pumpkin (Cucurbita moschata and Winter crookneck squasch) were used for the study and termed variety A and B respectively. Moisture content of the two varieties varying from 12.6% to 28.6% (dry basis), the thickness, major diameter, intermediate diameter and minor diameter, sphericity and mass of Cucurbita moschata which is variety A increased linearly from 5.88 to 7.10mm, 16.02mm; to 24.72mm; 10.68mm to 18.18mm; 11.02mm to 19.24mm; 0; 0.75 to 0.80; 1.68kg to 2.78kg while thickness, major, intermediate and minor diameter, sphericity and mass of winter crookneck squash which is variety B increased linearly from 5.92mm to 7.22mm, 16.06mm to 24.41mm; 11.00mm to 18.28mm, 11.48mm to 19.40mm; 0.77 to 0.81; 1.70kg to 2.80kg. The coefficient of friction on plywood increased from 28.6° to 42.8° respectively. The nutritional values of pumpkin determined show that the crop has high percentage of protein (24.4%) while both fat and ash content has the lowest nutritional value of 0.5% each**

***Index Terms*— Physical properties, chemical properties, Moisture content; Pumpkin.**

I. INTRODUCTION

The engineering properties of biomaterials constitute an important and essential data for design of machines, structures, processes and controls. They are also useful in analysis and determination of the efficiency of a machine or an operation, development of new products and equipment and the final quality of products (Mohsenin, 1986). Size and shape are important in determining the method of separation and cleaning especially by pneumatic method, density and specific gravity are needed in calculating thermal diffusivity in heat transfer and Reynolds's number in pneumatic and hydraulic handling separation, and determination of terminal velocity (Mijinyawa and Omoikhoje, 2005). Sieve types are based on size and shape of materials to be separated. Mechanical properties such as compressive strength is relevant in the choice of stack height to avoid produce damage in storage. Coefficient of friction of materials on various structural surfaces is important in predicting the movement of the materials in handling and harvesting equipment and the pressure exerted on the walls of storage structures (Mijinyawa and Omoikhoje, 2005).

The basic engineering properties exhibited by agricultural material include the physical, mechanical, thermal, optical, and electrical properties (Mohsenin, 1970). These basic properties including chemical properties are widely applicable to the storage, packaging, handling, and transportation and processing of agricultural material (Oloko et al; 2009).

Pumpkins are members of the cucurbit family – cucurbitaceae. Other vegetables in this family include gourds, water melons, squash, cucumbers and cantaloupes (William et al; 2014).

The origins of the pumpkin can be traced to the Southern regions of North America and the Northern regions of South America. Mature and immature fruit of the pumpkin are generally edible. However, a large portion of the commercially produced pumpkins are used for decorative purposes. The use of the pumpkin as a jack O' lantern during Halloween has a long history in the United States (William et al; 2014).

One of the major differences in pumpkin varieties is fruit size. There are five general categories based on this characteristic. Table 1 below lists selected varieties in each category.

Table 1: Common Pumpkin Varieties

Variety	Days to Maturity	Comments
Giant (>20 lb)		
Prizewinner	120	Good color and shape
Bix Max	120	Bright orange
Big Moon	120	Very large
Atlantic Giant	120	Medium orange, large
Jack – o'lantern	105	Med orange, good handle
(7-20 lb)	95	Round to fall, good handle,
Howden	90	good color
AC 510	90	Semi-vine, good handle
Applachian	100	Medium orange, good
Aspen	105	handle
Alladin	90	PM tolerant, dark orange
Autumn King	100	Good handle, dark orange
Autumn Gold	120	Early coloring
Big Autumn	90	Large-Autumn Gold, early
Gold Rush	95	coloring
Jack of All	115	Large handle, deep orange
Trades	90	Deep orange, semi-vine
Frosty	100	Compact vine, weaker
Sorcerer	100	handles
School Time		Semi-vine, deep orange,
Magic Lantern	90	good handle
Merlin	85	Bright orange, compact vine
Small or Pie	100	PM tolerant, dark orange
Pumpkins	100	PM tolerant, dark orange
(4-7 lb)	70	
Hybrid Pam		Compact vine, dark orange
Trickster	100	Dark orange, good handle,
Mystic Plus	100	3-4 lb

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07	100	PM tolerant, 5-7 lb.
Neon	105	Smooth, 3-5 lb., early coloring
Baby Pumpkins (1-3 lb)	85	Early, early coloring, semi vine, PM tolerant
Baby Pam	95	
Lil Ironsides	100	2 lb., uniform
Lil Goblin	100	1-2 lb., smooth, very hard
Baby Bear		3.4-lb., smooth, very hard
Spooktacular	115	1 lb., good handle
Miniature Pumpkins (> 1 lb)	90	2-3 lb., good shape and uniformity
Jack Be Little	100	
Munckin		½ ib., medium vine.
Sweetie Pie		½ lb., very uniform, bright orange
Baby Boo		Bright orange
Other Novelty Pumpkins		White miniature
Buckskin		Buff colored, acorn shaped, great for pies
Casper		Bright white, smooth, 10-12 lb.
Lumina		Flat to globe white pumpkin, 10-15 lb. (stress causes a blue tint)

Note: PM – Powdery mildew tolerant

Source: Charles et al: (2014)

The engineering properties of a biomaterials are dependent on a number of factors such as spices or variety and the climatic environment where it is cultivated. This makes it desirable that the engineering properties of locally cultivated varieties be determined. The engineering properties determined and reported in this paper are size, sphericity, density, porosity, and compressive strength, angle of repose, moisture content and proximate analyses.

II. Materials and Methods

The two major pumpkins varieties used in this study (Cucurbita moshata and Winter crookneck squash) were bought at Ministry of Agriculture and Natural Resources, Akure, Ondo State and planted at the Demonstration Farm, Department of Agricultural and Bio-Environmental Engineering, the Federal Polytechnic, Ado-Ekiti, Ekiti State. The two varieties were chosen because they were readily available in this environment.

Electronic sensitivity weighing machine and vernier caliper were used to take some measurements such as weight, diameters of the varieties while universal testing machine was used to test for the compressive strength of the material, and inclined plane for angle of repose. The bulk density was determined using water displacement method. The colour was determined using visual observation. Sphericity is defined as the ratio of an equivalent diameter of the solid to the diameter of a sphere of equal volume according to Mohsenin (1980):

$$Sphericity\ (S_p) = \frac{(abc)^{1/3}}{a} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (1)$$

Where: a = major diameter; b = intermediate diameter and c = minor diameter.

The Arithmetic Mean Diameter (AMD), Geometric Mean Diameter (GMD), and Harmonic Mean Diameter (HMD) were obtained using the relationships as shown in equations 2, 3 and 4 respectively:

$$Arithemetic\ Mean\ Diameter\ (AMD) = \frac{(abc)}{3} \quad \ldots..2\ (Mohsenin, 1980)$$

$$Geometric\ Mean\ Diameter\ (GMD) = (a+b+c)^{\frac{1}{3}} \quad \ldots\ldots.3\ (Mohsenin, 1980)$$

$$Harmonic\ Mean\ Diameter\ (HMD) = \frac{1}{a}+\frac{1}{b}+\frac{1}{c} \quad \ldots\ldots\ldots\ldots.4\ (Mohsenin, 1980)$$

The proximate analysis to determine the nutritional value of the crop was carried out in the following areas: ash content, moisture content; protein, fat, crude fibre, and carbohydrate. The physical properties of the two varieties were determined in five (5) replications. Student T – test statistical tool was used.

III. Results and Discussion

The mean values of some physical properties for the two varieties were calculated and the results obtained for the two varieties are shown in Table 2 and Table 3 shows the proximate analysis of the crop respectively.

Table 2: Mean Values for Physical Properties of Pumpkins

Parameters	Variety A (Cucurbita moschata)	Variety B (Winter crook-neck squash)
Moisture content (%) (Dry basis	2.16	2.8
Colour	Light green	Green with dotted white round the body
Major diameter (mm)	23.27	21.94
Intermediate diameter (mm)	15.06	14.90
Minor diameter (mm)	11.43	11.34
Thickness (mm)	6.49	6.55
Shape	Sphere	Sphere
Sphericity	0.67	0.71
Average weight (kg)	2.88	2.59
Volume (cm^3)	3.30	3.10
Density (kg/cm^3)	0.87	0.84
AMD (mm)	1335.20	1235.70
GMD (mm)	15.88	15.47
HMD (mm)	0.197	0.200

From Table 2, the average weight of variety B (Winter crooknect squash) is greater than that of variety A (Cucurbita moschata) while the arithmetic mean, geometric mean and harmonic mean diameter of variety A were greater than that of variety B. These parameters are very important in the design of planting, harvesting and processing equipment.

Table 3: Summary of the Proximate Analysis of the two verities

Parameters	Nutritional Valve (%)
Ash Content	0.5
Protein Content	24.4
Fat Content	0.5
Carbohydrate	13.6
Crude Fibre	8.4

From Table 3, the protein content of the crop is high and followed by the percentage of carbohydrate. Tables 4 and 5 show the summary of the ANOVA. The size of the sample, n is 5.

Table 4: **Summary of ANOVA of data for Diameters of Cucurbita Moschata**

Observation	ANOVA				
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	368.942	2	184.471	23.855	0
Within Groups	92.798	12	7.733		
Total	461.74	14			

Observation	**MULTIPLE COMPARISON**				
LSD					
(I) diameter	(J) diameter	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval
					Lower Bound / Upper Bound
Major	Intermediate	8.22800*	1.75877	0.001	4.396 / 12.06
	Minor	11.85400*	1.75877	0	8.022 / 15.686
Intermediate	Major	-8.22800*	1.75877	0.001	-12.06 / -4.396
	Minor	3.626	1.75877	0.062	-0.206 / 7.458
Minor	Major	-11.85400*	1.75877	0	-15.686 / -8.022
	Intermediate	-3.626	1.75877	0.062	-7.458 / 0.206

*. The mean difference is significant at the 0.05 level.

Table 5: Summary of ANOVA of Data for Diameters of Winter crooknect squash

Observation	**ANOVA**				
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	291.252	2	145.626	19.796	0
Within Groups	88.276	12	7.356		
Total	379.528	14			

Observation	**MULTIPLE COMPARISONS**				
LSD					
(I) diameter	(J) diameter	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval
					Lower Bound / Upper Bound
Major	Intermediate	7.03800*	1.71538	0.001	3.3005 / 10.7755
	Minor	10.60600*	1.71538	0	6.8685 / 14.3435
Intermediate	Major	-7.03800*	1.71538	0.001	-10.7755 / -3.3005
	Minor	3.568	1.71538	0.06	-0.1695 / 7.3055
Minor	Major	-10.60600*	1.71538	0	-14.3435 / -6.8685
	Intermediate	-3.568	1.71538	0.06	-7.3055 / 0.1695

*. The mean difference is significant at the 0.05 level.

IV. CONCLUSION

The properties such as physical and proximate analysis of the two varieties of pumpkins were studied in order to develop some machines for planting and processing pumpkins. The results shows that there was no difference on both values obtained from the two varieties; it is therefore recommended that prototype machines for planting, harvesting and processing pumpkins varieties can be embarked upon. Further work should be carried out on the mechanical properties of pumpkins to determine whether there is any significance in both physical and mechanical properties of pumpkins.

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