MOISTURE-DEPENDENT PHYSICAL PROPERTIES OF TWO VARIETIES OF AFRICAN PEAR (*DACRYODES EDULIS*) SEEDS

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Aremu, A. K., Oke, P. O. and Oyefeso, B. O.*
Department of Agricultural and Environmental Engineering, University of Ibadan, Nigeria
*Corresponding Author's Email: oyefesobabatunde@gmail.com

ABSTRACT
This study examined the physical characteristics of African pear (Dacryodes edulis) seeds that are essential for designing appropriate handling equipment. The analyzed properties include gravimetric, frictional, and geometric attributes within a moisture content range of 10.45–48.90% (wet basis). An increase in moisture content led to a rise in average length, width, thickness, arithmetic and geometric mean diameters, surface area, volume, and angle of repose for both seed varieties. Additionally, bulk density increased from 749.45 to 1306.99 kg/m³ for the cultivated variety and from 550 to 710 kg/m³ for the wild variety. True density varied between 637.57 and 922.47 kg/m³ for the cultivated type and between 749.45 and 1306.99 kg/m³ for the wild type. Porosity ranged from 0.35 to 0.57 for the cultivated variety and 0.45 to 0.69 for the wild variety. The coefficient of static friction also increased on all tested surfaces (plywood, stainless steel, and glass) with rising moisture content, where plywood exhibited the highest values, while glass had the lowest for both varieties. Furthermore, predictive regression models were developed to establish relationships between moisture content and the examined physical properties of the seeds.

Keywords: African pear, moisture content, physical properties, angle of repose, porosity, coefficient of friction.

1. INTRODUCTION

African pear (*Dacryodes edulis* (G. Don) H. J. Lam), a member of the *Burseraceae* family (Chunduff, 1984), is widely cultivated in southern Nigeria for its highly nutritious, oil-rich fruit. It is commonly known as *safou* in French, *ube* in Igbo, *elemi* in Yoruba, *eben* in Efik, and *orumu* in other local dialects (Kengue et al., 2002; Nwokeji et al., 2005). The trees are commonly grown in south-east Nigeria around homesteads. The African pear fruits helps to ameliorate the food scarcity during the food because it is eaten either raw as desert, boiled, grilled in oven or roasted in ash. The mesocarp softens to form a butter which is eaten with boiled or roasted corn. The mesocarp contains 43.99% fat and 4.47% protein (Ajiwe et al., 1997), contributing to its increased production and commercialization.

The plant flowers between February and March and the flower clusters at the end of the branches. It fruits mostly between May to August. Nigeria primarily cultivates two varieties: *D. edulis* var. *edulis* (cultivated) and *D. edulis* var. *parvicarpa* (wild). The cultivated variety typically has cylindrical fruits exceeding 5 × 2.5 cm in size, while the wild variety produces smaller, conical fruits (Okafor, 1983). The seed is often discarded and constitutes big waste and environmental pollution in towns and villages. (Busari et al., 2016) Each fruit contains a single seed (Figures 1 and 2).

Figure 1. *D. edulis* var. *edulis* seeds

Figure 2. *D. edulis* var. *parvicarpa* seeds

Guston et al. (1982) highlighted the seed's high oil content (18–70%), making it comparable to other oil-bearing seeds such as palm kernel (40%) and cottonseed (30%). Additionally, its physicochemical composition includes protein (18.03%), carbohydrates (39.10%), crude fiber (3.17%), and ash (3.45%), similar to other nuts and oil seeds (Onuegbu et al., 2016).

2. MATERIALS AND METHODS

A bulk of fresh African pear was purchased at Agbowo market, Ibadan, Nigeria. The fruits were pre-cleaned to remove all foreign materials. The nuts were obtained by soaking the fresh fruits in hot water for 10 minutes which allowed for easy removal of the fleshy mesocarps manually. The nuts were then spread in the laboratory under ambient condition to remove the surface water.

2.1 Moisture Content Determination

The moisture content of *D. edulis* seeds was determined following ASAE Standard S358.2 (1983). Samples were oven-dried at 103 ± 2°C for 24 hours at the Department of Agricultural and Environmental Engineering, University of Ibadan. A digital weighing balance (A&D SK-2000, USA) was used to record the mass and the seeds moisture content was varied at five levels. Moisture content was calculated using Equation 1.

$$M_S = \frac{100(Wi - Wf)}{Wi} \quad (1)$$

where,

M_S is the seeds moisture content (%, wet basis)
W_i is the initial mass (g)
W_f is the final mass after oven drying (g)

The desired moisture levels for the study were attained by drying the grains at a temperature of 80˚C to give a sample mass B as calculated in Equation 2, while higher Moisture levels of the sample were attained by adding the calculated amount of distilled water, Q, from Equation 3 (Aremu et al., 2022).

$$B = \frac{A(100-a)}{100-b} \quad (2)$$

$$Q = \frac{A(b-a)}{100-b} \quad (3)$$

where,

A is the initial mass of the sample (g)
B is the final mass of the sample after drying (g)
a is the initial moisture content of the sample (% wet basis)
b is the final (desired) moisture content of the sample (%, wet basis)
Q is the mass of water required for moisture content adjustment (g)

2.2 Size and Shape

Fifty randomly selected African pear seeds were labeled for identification. Length, width, and thickness were measured using a digital Vernier caliper (Carrera Precision, 0.01 mm resolution).

2.3 Mean Diameters

The Arithmetic Mean Diameter (D_a) and Geometric Mean Diameter (D_m) were calculated using Equations 4 and 5 (Oyefeso and Raji, 2018; Oyefeso et al., 2025).

$$D_a = \frac{L+W+T}{3} \quad (4)$$

$$D_m = \sqrt[3]{LWT} \quad (5)$$

2.4 Sphericity

Sphericity (φ), expressed as decimal, was determined using Equation 6 (Oyefeso and Raji, 2024).

$$\varphi = \frac{\sqrt[3]{LWT}}{L} = \frac{D_m}{L} \quad (6)$$

2.5 Surface Area and Volume

Surface area (S) was calculated using Equation 7 (Asoiro and Anthony, 2011; Oyefeso, 2021).

$$S = \pi(D_m)^2 \quad (7)$$

where,

D_m = geometric mean diameter (mm)
S = seed surface area (mm^2).

2.6 Densities

Seed mass was measured using a digital weighing balance (AND EK-6100i, 0.01 g accuracy). Volume was determined using the water displacement method (Aremu and Fadele, 2011). True density (ρ_T) was obtained as the ratio of mass to the volume of the seeds, while the bulk density was obtained according to Equation 8 (Raji and Oyefeso, 2021; Oyefeso, 2021).

$$\rho_B = \frac{M_s}{V_s} \quad (8)$$

where,

ρ_B is the bulk density (gcm^{-3})

M_S is mass of the seeds in the graduated cylinder (g)
V_S is the volume occupied by the seeds (cm^3)

2.7 Porosity

Porosity was estimated from bulk density and true density according to Equation 9 (Mohsenin, 1986; Aremu et al., 2022).

$$\varepsilon = \left(1 - \frac{\rho b}{\rho t}\right) \times 100 \quad (9)$$

Where,
ρ_b = bulk density (kgm^{-3})
ρ_t = true density (kgm^{-3})

2.8 Angle of Repose

The filling angle of repose (θ_f) was determined using a topless, bottomless cylinder (15 cm diameter, 25 cm height) placed on a 35cm diameter circular plate (Obi *et al.,* 2014). The cylinder was lifted slowly, forming a cone, and the angle of repose was calculated using Equation 10.

$$\theta_f = \tan^{-1} \frac{2H}{D} \quad (10)$$

Where,
θ_f is the angle of repose (degrees)
H is the height of the cone formed by the seeds
D is the diameter of the cone.

2.9 Coefficient of Friction

The static coefficient of friction (μ) was evaluated on plywood, stainless steel, and glass using a tilting table method (Ajav *et al.,* 2014). The *D. edulis* seeds were placed parallel to the direction of motion and the table was gradually tilted using a screw device. The angle (θ) at which seeds began sliding was recorded, and friction was determined using Equation 11(Aremu et al., 2022).

$$\mu = \tan \theta \quad (11)$$

where,
μ = static coefficient of friction (decimal)
θ = angle of Inclination (degrees)

2.10 Statistical Analysis

Descriptive statistics was performed using Microsoft Excel (Version 2010). Regression analysis was used to model relationship between the physical properties determined and the moisture content. Duncan Analysis of Variance (ANOVA) was conducted to assess the significance of moisture content effects.

3. RESULTS AND DISCUSSION

This study examined various physical properties of two African pear seed varieties (*Dacryodes edulis)*, including arithmetic and geometric mean diameters, axial dimensions, surface area, sphericity, volume, porosity, densities, and angles of repose, across five moisture content levels: 10.45, 20.38, 30.65, 40.03, and 48.90% (wet basis). The average values and standard deviations of these properties are presented in Tables 1a and 1b, while Table 1c details the static friction coefficients of the seeds on three different surface materials. A general trend observed was an increase in the measured physical properties as moisture content rose from 10.45 to 48.90% (wb).

3.1 Seed Dimensions

The principal dimensions of the seeds, including length, width, and thickness, increased with moisture absorption. The mean values of these dimensions at varying moisture levels are shown in Table 1a.

Between 10.45% and 48.90% (wb), the average length of cultivated (A) variety increased from 50.89 ± 4.35 mm to 58.95 ± 4.05 mm (a 16% increase), whereas the wild (B) variety length increased from 40.34 ± 3.23 mm to 43.81 ± 3.74 mm (a 9% increase). The width increased from 20.06 ± 1.48 mm to 22.64 ± 1.65 mm (13% increase) for cultivated seeds, and from 18.04 ± 2.03 mm to 21.63 ± 2.19 mm (20% increase) for wild seeds. Similarly, the thickness increased from 17.02 ± 1.70 mm to 19.39 ± 2.02 mm (14% increase) for cultivated seeds, and from 15.09 ± 2.23 mm to 19.02 ± 2.17 mm (26% increase) for wild seeds. These findings are in agreement with those reported by Altuntas and Erkol (2010) for shelled kernel walnuts. The relationship between moisture content (MC) and axial dimensions for both varieties were defined in Equations 12–17.

$$L = 18.558MC + 48.173 \quad (R^2 = 0.8171) \quad \text{Cultivated variety} \quad (12)$$
$$W = 6.15MC + 19.015 \quad (R^2 = 0.7867) \quad (13)$$
$$T = 5.5719MC + 16.174 \quad (R^2 = 0.8273) \quad (14)$$
$$L = 8.0741MC + 39.374 \quad (R^2 = 0.8963) \quad \text{Wild variety} \quad (15)$$
$$W = 9.4208MC + 16.574 \quad (R^2 = 0.8720) \quad (16)$$
$$T = 9.4208MC + 16.574 \quad (R^2 = 0.8720) \quad (17)$$

Table 1a. Selected physical properties of African pear seeds

Moisture Content (%, wet basis)	Variety	L (mm)	W (mm)	T (mm)	AMD (mm)	GMD (mm)	Sphericity
10.45	A	50.89	20.06	17.02	29.32	25.87	0.51
		(4.35)	(1.48)	(1.70)	(2.18)	(1.90)	(0.02)
	B	40.34	18.04	15.09	24.49	22.19	0.55
		(3.23)	(2.03)	(2.23)	(2.10)	(2.15)	(0.40)
20.38	A	52.15	20.12	17.21	29.83	26.21	0.50
		(4.33)	(1.46)	(1.95)	(2.23)	(2.01)	(0.02)
	B	41.26	18.38	15.23	24.96	22.53	0.54
		(3.17)	1.53)	(2.24)	(1.53)	(1.42)	(0.03)
30.65	A	52.59	20.49	17.70	30.26	26.67	0.51
		(5.37)	(1.74)	(1.86)	(2.34)	(1.98)	(0.03)
	B	41.39	18.59	15.71	25.23	22.88	0.55
		(2.33)	(1.82)	(1.96)	(1.26)	(1.22)	(0.02)
40.0	A	54.18	21.00	17.91	31.03	27.25	0.50
		(3.44)	(1.40)	(1.95)	(1.54)	(1.36)	(0.02)
	B	42.18	20.37	17.87	26.81	24.78	0.58
		(2.21)	(2.39)	(3.26)	(2.31)	(2.74)	(0.06)
48.90	A	58.95	22.64	19.39	33.66	29.54	0.50
		(4.05)	(1.65)	(2.02)	(2.00)	(1.88)	(0.02)
	B	43.81	21.63	19.02	28.16	26.16	0.59
		(3.74)	(2.19)	(2.17)	(1.90)	(1.94)	(0.05)

Note: Variety A = Cultivated variety, Variety B = Wild variety, Standard deviation values are in parentheses

Table 1b. Other physical properties of African pear seeds investigated

Moisture Content (%, wet basis)	Variety	Surface Area (mm²)	Volume (mm³)	True Density (kg/m³)	Bulk Density (kg/m³)	Porosity	Angle of Repose (°)
10.45	A	2115.19 (315.70)	2934.66 (667.28)	637.57 (142.29)	390	0.35 (0.15)	32.69
	B	1562.03 (311.73)	1873.87 (575.73)	749.45 (157.05)	550	0.45 (0.10)	35.25
20.38	A	2171.73 (340.38)	3055.58 (730.37)	761.94 (79.99)	430	0.48 (0.05)	34.17
	B	1601.74 (205.92)	1929.83 (378.69)	942.89 (190.59)	600	0.57 (0.08)	37.31
30.65	A	2247.90 (338.81)	3215.74 (734.01)	816.36 (115.79)	450	0.51 (0.07)	36.88
	B	1650.03 (178.29)	2014.29 (330.43)	1306.99 (214.04)	650	0.69 (0.05)	39.16
40.03	A	2339.88 (234.38)	3399.60 (510.12)	922.47 (120.36)	500	0.57 (0.05)	39.36
	B	1953.79 (450.52)	2633.14 (949.32)	981.53 (197.55)	680	0.58 (0.07)	42.59
48.90	A	2753.29 (349.38)	4348.95 (822.73)	915.31 (178.00)	560	0.55 (0.08)	47.79
	B	2163.19 (313.67)	3034.39 (643.91)	983.39 (149.04)	710	0.59 (0.05)	49.17

Note: Variety A = Cultivated variety, Variety B = Wild variety, Standard deviation values are in parentheses

Statistical analysis (Duncan's Multiple Range Test) presented in Table 2 revealed significant differences ($p < 0.05$) in mean values for length, width, thickness, arithmetic and geometric mean diameters, and sphericity across different moisture levels. However, no significant difference ($p < 0.05$) was found in the width and thickness of both varieties at 40.03% and 48.90% (wb), likely due to the small variation in moisture content, which resulted in minimal swelling.

Table 1c. Coefficient of friction of African pear seeds at five moisture contents

Moisture Content (%, wet basis)	Variety	Glass	Stainless Steel	Wood
10.45	A	0.288 (0.027)	0.300 (0.043)	0.320 (0.040)
	B	0.289 (0.044)	0.290 (0.059)	0.326 (0.070)
20.38	A	0.316 (0.042)	0.357 (0.063)	0.362 (0.056)
	B	0.328 (0.044)	0.340 (0.052)	0.359 (0.041)
30.65	A	0.387 (0.050)	0.398 (0.053)	0.415 (0.046)
	B	0.346 (0.044)	0.372 (0.054)	0.407 (0.066)
40.03	A	0.398 (0.050)	0.413 (0.056)	0.425 (0.063)
	B	0.382 (0.045)	0.412 (0.045)	0.424 (0.042)
48.90	A	0.431 (0.058)	0.441 (0.045)	0.466 (0.054)
	B	0.392 (0.034)	0.432 (0.047)	0.453 (0.054)

Note: Variety A = Cultivated variety, Variety B = Wild variety, Standard deviation values are in parentheses

Table 2. Duncan's Multiple Range Test results of the axial dimensions of African pear

Moisture Content (%, wet basis)	Variety	Length (mm)	Width (mm)	Thickness (mm)	AMD (mm)	GMD (mm)	Sphericity
10.45	A	50.90_a	20.07_a	17.02_a	29.33_a	25.88_a	0.51_a
	B	40.35_b	18.04_b	15.10_b	24.50_b	22.19_b	0.55_b
20.38	A	52.15_a	20.13_a	17.22_a	29.83_a	26.21_a	0.50_a
	B	41.27_b	18.39_b	15.24_b	24.96_b	22.53_b	0.55_b
30.65	A	52.59_a	20.50_a	17.70_a	30.27_a	26.68_a	0.51_a
	B	41.40_b	18.59_b	15.71_b	25.23_b	22.88_b	0.55_b
40.03	A	54.18_a	21.00_a	17.91_a	31.03_a	27.26_a	0.50_a
	B	42.19_b	20.38_a	17.87_a	26.81_b	24.79_b	0.59_b
48.90	A	58.96_a	22.64_a	19.40_a	33.67_a	29.54_a	0.50_a
	B	43.82_b	21.64_a	19.02_a	28.16_b	26.17_b	0.60_b

*Note: Variety A = Cultivated variety, Variety B = Wild variety. *Means with same letter(s) across columns are not significantly different at $p<0.05$.*

3.2 Mean Diameters

The arithmetic and geometric mean diameters, shown in Table 1a, also exhibited an increasing trend with moisture content.

As moisture content rose from 10.45% to 48.90% (wb), the arithmetic mean diameter increased from 29.33 mm to 33.67 mm (cultivated) and from 24.50 mm to 28.16 mm (wild). Also the geometric mean diameter increased from 25.88 mm to 29.54 mm (cultivated) and from 22.19 mm to 26.17 mm (wild). The percentage increase in arithmetic mean diameter was 14.79% and 14.94% for cultivated and wild varieties, respectively, while the geometric mean diameter increased by 14.14% and 17.94%, respectively.

There exists a linear relationship between the Arithmetic (D_a) and Geometric (D_g) Mean Diameters with the Moisture Content (Mc) as shown in Equations 18 to 21.

$Da = 0.101MC + 27.787$	($R^2 = 0.8164$)	Cultivated variety	(18)
$Dg = 0.0856MC + 24.538$	($R^2 = 0.8091$)		(19)
$Da = 0.0942MC + 23.099$	($R^2 = 0.897$)	Wild variety	(20)
$Dg = 0.1047MC + 20.565$	($R^2 = 0.8842$)		(21)

3.3 Sphericity

The average sphericity values at different moisture levels are listed in Table 1a. The sphericity of the cultivated variety increased from 0.50 to 0.51, while the wild variety increased from 0.55 to 0.59. A linear relationship exists between sphericity and moisture content, as described in Equations 22 and 23. These results are consistent with findings reported for shelled and kernel walnuts by Altuntas et al. (2010).

$$Ø = -0.0001MC + 0.51 \quad (R^2 = 0.3879) \quad (22)$$

$$Ø = 0.0014MC + 0.525 \quad (R^2 = 0.8083) \quad (23)$$

where,

Ø = Sphericity

MC = Moisture Content

Aydin *et al.* (2010) reported the same for Turkish mahaleb,

3.4 Surface Area and Volume

As moisture content increased, both surface area and volume of the seeds expanded (Table 1b). The surface area of cultivated seeds increased from 2115.19 mm² to 2753.29 mm² (10.45% to 48.90% wb). For wild seeds, it expanded from 1562.03 mm² to 2163.19 mm² over the same moisture range. A similar trend was observed in unshelled Moringa oleifera seeds (Adejumo et al., 2012). The surface area plays a crucial role in moisture loss during drying, affecting the drying rate of seeds, grains, and other particulates.

The Volume increased from 2934.66 mm³ to 4348.95 mm³ (cultivated) and from 1873.87 mm³ to 3034.39 mm³ (wild) as moisture content rose from 10.45% to 48.90% wb. The observed volumetric expansion resulted from moisture absorption. Equations 23–26 define the relationship between moisture content, surface area, and volume.

$SA = 14.759Mc + 1881.6$	($R^2 = 0.7905$)	Cultivated variety	(24)
$V = 32.398Mc + 2416.3$	($R^2 = 0.7716$)		(25)
$SA = 15.944Mc + 1306.5$	($R^2 = 0.8686$)	Wild variety	(26)
$V = 31.008Mc + 1364.3$	($R^2 = 0.8539$)		(27)

3.5 True and Bulk Density

The true density of cultivated seeds increased from 637.57 kg/m³ to 922.47 kg/m³ (10.45% – 40.03% wb) before slightly decreasing to 915.31 kg/m³ (48.90% wb). For wild seeds, true density first increased from 749.45 kg/m³ to 1306.99 kg/m³ (10.45% – 30.65% wb) before decreasing to 983.39 kg/m³ (48.90% wb). The decrease was due to increased seed volume outweighing mass gain. A similar trend was observed in melon (Citrullus colocynthis) seeds (Bande et al., 2012).

The bulk density also increased with moisture content from 390 kg/m³ to 560 kg/m³ (cultivated) and from 550 kg/m³ to 710 kg/m for wild varieties.

$T.D = 7.4556Mc + 586.46$	($R^2 = 0.929$)	Cultivated variety	(28)
$T.D = 5.5212Mc + 826.77$	($R^2 = 0.177$)	Wild variety	(29)
$B.D = 4.2225Mc + 338.98$	($R^2 = 0.9604$)	Cultivated variety	(30)
$B.D = 3.9527Mc + 517.1$	($R^2 = 0.9769$)	Wild variety	(31)

3.6 Porosity

The porosity of the seeds increased from (0.35±0.15) to (0.57±0.05) as the moisture content rose from 10.45% to 40.03% (wb) in the cultivated (A) variety. However, as the moisture content further increased from 40.03% to 48.90% (wb), the porosity slightly declined from (0.57±0.05) to (0.55±0.08). In the case of the wild (B) variety, porosity rose from (0.45±0.10) to (0.69±0.05) as moisture levels increased from 10.45% to 30.65% (wb). However, beyond this point, porosity dropped from (0.69±0.05) to (0.59±0.05) when moisture content increased from 30.65% to 48.90% (wb). The decline in porosity at higher moisture levels can be attributed to the expansion of the seed dimensions, which reduces the amount of air space, leading to a denser arrangement of the seeds. A similar pattern was observed by Altuntas (2010) in studies on shelled and kernel walnuts.

Additionally, equations 32 and 33 define the correlation between porosity (P) and moisture content (MC) of African pear seeds on a wet basis.

$P = 0.0051MC + 0.3428$	($R^2 = 0.8419$)	Cultivated variety	(32)
$P = 0.0031MC + 0.4869$	($R^2 = 0.325$)	Wild variety	(33)

3.7 Angle of Repose

The filling angle of repose exhibited an increasing trend with rising moisture content in both varieties of African pear seeds. In the cultivated (A) variety, the mean angle of repose increased from 32.69˚ to 47.79˚ as the moisture content rose from 10.45% to 48.9% (wb) (Table 1b). Similarly, in the wild (B) variety, the mean angle of repose increased from 35.25˚ to 49.17˚ with higher moisture levels. This increase can be attributed to the surface tension created by the moisture layer surrounding the seeds, which enhances their cohesion and stability. A similar trend was observed by Mollazade et al. (2009) in studies on fennel seeds (*Foeniculum vulgare*).

The correlation between the angle of repose (AOR) and moisture content (MC) of the seeds was described in Equations 34 and 35. A comparable linear relationship between moisture content and angle of repose was also reported by Nimkar and Chattopadhyay (2001) for green gram.

$AOR = 0.3629MC + 27.263$	($R^2 = 0.8672$)	Cultivated variety	(34)
$AOR= 0.245MC + 32.368$	($R^2 = 0.9858$)	Wild variety	(35)

3.8 Coefficients of Friction on selected Surfaces

The static coefficient of friction of African pear seeds showed an increasing trend with rising moisture content across all three tested surfaces—stainless steel, plywood, and glass. For the cultivated (A) variety, the coefficient of friction increased from 0.29 to 0.43 on glass, 0.30 to 0.44 on stainless steel, and 0.32 to 0.47 on plywood. Similarly, for the wild (B) variety, the values increased from 0.28 to 0.39 on glass, 0.29 to 0.43 on stainless steel, and 0.33 to 0.45 on plywood, as presented in Table 1c. Among the surfaces examined, plywood exhibited the highest coefficient of friction, whereas glass and stainless steel had the lowest values for both seed varieties.

The relationship between the coefficient of friction (COF) and moisture content (MC) for each of the three surfaces was mathematically expressed in Equations 36 to 41.

$COF_{wood} = 0.0037MC + 0.2875$	$R^2 = 0.974$	Cultivated variety	(36)
$COF_{steel} = 0.0035MC + 0.2762$	$R^2 = 0.9559$		(37)
$COF_{glass} = 0.0038MC + 0.2495$	$R^2 = 0.9583$		(38)
$COF_{wood} = 0.0033MC + 0.294$	$R^2 = 0.984$	Wild variety	(39)
$COF_{steel} = 0.0037MC + 0.2582$	$R^2 = 0.9878$		(40)
$COF_{glass} = 0.0027MC + 0.2666$	$R^2 = 0.9755$		(41)

4. PRACTICAL IMPLICATION OF THE RESULTS

Selected physical properties of the two varieties of African pear seeds such as the length, width, and thickness at moisture content range 10.4 to 48.90% (wet basis) investigated in this study were significantly influenced by variation in the moisture content. These dimensions are important in determining aperture size of machines for separation machines. The three major axes play an important role in the application of compressive force which will induce mechanical fracture. The geometric mean diameter and sphericity are also important in the design of hoppers for processing machines. The true and bulk density will be used in the design of handling equipment and load shafts for processing machines. Proper choice of the materials of construction for conveying systems can also be ensured by the application of the angle of repose and coefficient of friction determined in this study.

5. CONCLUSIONS

Moisture-dependence of selected physical properties of cultivated and wild varieties African pear seed were investigated in this study. An increase in the moisture content from 10.45% to 48.90% wb result in the increase of average length, width, thickness, arithmetic and geometric mean diameters, surface area, volume, and angle of repose for the two varieties. With increase in moisture content, the bulk density was found to increase from 749.45 to 1306.99 kg/m^3 for cultivated variety and from 550 to 710 kg/m^3 for wild variety. The true density values ranged from 637.57 to 922.47 kg/m^3 and 749.45 to 1306.99 kg/m^3 for cultivated and wild varieties, respectively. The porosity ranged from 0.35 to 0.57 and 0.45 to 0.69 for cultivated and wild varieties, respectively. There is an increase in the static coefficient of friction on the three material surfaces studied (plywood, stainless steel and glass) with the highest value obtained on plywood and the lowest value on glass for cultivated and wild varieties, respectively. The information provided in this study will be useful for the development and improvement of machines and facilities for the post-harvest operation of African pear seeds.

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