RESEARCH PAPER | International Journal of Agricultural Engineering | Volume 13 | Issue 1 | April, 2020 | 96-99
ISSN–0974–2662 ■ Visit us : *www.researchjournal.co.in* ■ **DOI: 10.15740/HAS/IJAE/13.1/96-99**

Jackfruit seeds and its physical properties

■ **Ankur M. Arya, B.R. Singh, Samsher, Suresh Chandra, Neelesh Chauhan, Vaishali and Sweta Singh**

Received : 07.01.2020; **Revised :** 27.02.2020; **Accepted :** 12.03.2020

See end of the Paper for authors' affiliation

Correspondence to :

Ankur M. Arya
Department of Agricultural Engineering,
SardarVallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.) India
Email: arya.ankur76@ gmail.com

■ **ABSTRACT :** The physical properties of jack fruit seed are essential for the design and facilities for the harvesting handling conveying, separation, drying, aeration, storing, and processing. Various types of cleaning, grading and separation equipments are designed on the basis of their physical properties. The length came between 22.06 mm to 35.68 mm. whereas the width was ranged between 10.66 mm to 21.78 mm. The thickness was in between 8.72 mm to 16.50 mm. The arithmetic mean diameter of jackfruit seed were ranging from 15.02 mm to 23.80 mm. The geometric mean diameter was 13.30 mm to 22.61 mm and the sphericity was found between 0.53 to 0.73. The jackfruit seed showed bulk density as 0.49 g/ml^3. Whereas the true density was lying between 1.02 g/ ml^3 to 1.59 g/ml^3, while porosity came as 50.27 to 69.17 per cent.

■ **KEY WORDS :** Jack fruit seed, Physical properties, Length, width, Thickness, Arithmetic mean diameter, Geometric mean diameter, Sphericity, Bulk density, True density, Porosity

■ **HOW TO CITE THIS PAPER :** Arya, Ankur M., Singh, B.R., Samsher, Chandra, Suresh, Chauhan, Neelesh, Vaishali and Singh, Sweta (2020). Jackfruit seeds and its physical properties. *Internat. J. Agric. Engg.*, **13**(1) : 96-99, **DOI: 10.15740/HAS/IJAE/13.1/96-99.**

Jackfruit (*Artocarpus heterophyllus* Lam.) is one of the most significant and widely grown fruit trees in tropical region. It belongs to the family Moraceae. It is native to India and is also found in many parts of South East Asia. Jackfruit consist about 29 per cent pulps, 12 per cent seeds and 54 per cent rind (Berry and Kalra, 1988). Jackfruit is a nutritious fruit, rich in vitamins A, B and C, potassium, calcium, iron, proteins and carbohydrates. Jackfruit seeds are from 2 to 4 cm long, and a fruit can contain from 100 to 500 seeds, which represent 8–15 per cent of the total fruit weight (Chowdhury *et al*., 2012). Jackfruit seeds are good sources of protein and starch. Jackfruit seed also contain lignans, isoflavones, saponins, that are called phytonutrients and they have numerous health benefits such as anti-cancer, anti-ageing and antioxidant. Seeds make-up around 10 to 15 per cent of the total fruit weight and have high carbohydrate and protein contents (Tulyathan *et al.,* 2002). The jackfruit seed contains moisture content 61.8 per cent (w.b.), protein (11.85 %), fibre (3.19 %) and carbohydrate (26.20 %). The calorific value is 382.79 kcal/100g. It contains ash and fat content (dry matter basis) is 0.15 % and 1.006 %, respectively (Gupta *et al.*, 2011). The Jackfruit seed flour contains an appreciable value of calcium (3087 mg/kg), iron (130.74 mg/kg), potassium (14781 mg/kg), sodium (60.66 mg/kg), copper (10.45 mg/kg) and manganese (1.12 mg/kg). The seed is 2-4 cm in length and 1.5- 2.5 cm in diameter. Upto 500 seeds can be found in a single fruit (Islam *et al.*, 2015). Jackfruit seed contains (54mg/100g) magnesium elements. It is a nutrient important in the absorption of calcium and works with calcium to help strengthen the bone and prevents bone-related disorders such as osteoporosis. Jackfruit seeds are a good source

of starch (22%) and fibre (3.19%). Jackfruit seed starch is to be useful in relieving biliousness. Extract from jackfruit seed helps indigestion (Swami *et al.*, 2012).

METHODOLOGY

This study was conducted at the Food Analysis Laboratory in the Department of Agriculture Engineering, SVPUA&T Meerut, Uttar Pradesh, India, during 2019. The shape of the jackfruit seeds was determined with the help of geometric mean diameter. To determine the geometric mean diameter of the jackfruit seed spatial dimensions like length (L), breadth (W), thickness (T) was measured with the help of digital vernier calipers. Mass of jackfruit seeds were determined using high accuracy electronic balance. The volume of seed samples was determined individually by water displacement method using a cylinder of 1 liter capacity. Arithmetic mean diameters (AMD), geometric mean diameter (GMD), surface area and sphericity were calculated by using the following equations as suggested by Mohsenin (1986):

$$\text{AMD} = \frac{L + W + T}{3}$$

$$\text{GMD} = \sqrt[3]{LBT}$$

$$\text{Surface area} = \pi (\text{GMD})^2$$

$$\text{Sphericity} = \frac{\text{GMD}}{L}$$

where,

L= Length; W= Width; T= Thickness

Determination of bulk density:

It is the ratio of mass per unit volume. Bulk density is important parameter in designing of different processing machineries. The process of bulk density determination is to first of all measure the empty weight of the known volume 5 lit. of measuring container (W_1). After that jackfruit seed sample was poured into the measuring cylinder and weighing it (W_2). The original weight of sample by subtracting above two weights (W_3). Then find out the bulk density by dividing original weight of sample to the volume of cylinder. It was determined by the formula given by Kachru *et al.* (1994).

$$\rho b = \frac{\text{Mass of sample}}{\text{Volume}}$$

Determination of true density:

The true volume was determined using the liquid displacement method. Toluene (C_7H_8) was used instead of water because it is absorbed by acorns to a lesser extent. In addition, its surface tension is low, so that it fills even shallow dips in an acorn, and its dissolution power is low (Mohsenin, 1978). The process of bulk density determination is to first of all measure the unit mass of jackfruit seed. Then sample is submerged in a known volume (V) of toluene in a beaker. Then measure the volume displaced by sample (V") and find out the true value of volume displaced by sample. Finally true density (kg/m^3) of samples was calculated by dividing the unit mass of each sample by its true volume. True density of jackfruit seed was determined by the formula.

$$\text{True density} = \frac{\text{Unit mass of jack fruit seed}}{\text{Displaced volume}}$$

Determination of porosity:

The porosity ($\in$) of jackfruit seed was computed from the values of bulk density and true density using the relationship given by Sahay and Singh (1994).

$$\text{Porosity} = \frac{\text{True density - Bulk density}}{\text{True density}} \times 100$$

RESULTS AND DISCUSSION

The results obtained from the physical property analysis of jackfruit seeds are given in Table 1. Total 50 numbers of seed samples were taken for this experiment. The length of jackfruit seed were ranging from 22.06 mm to 35.68 mm. The width of jackfruit seed were ranging from 10.66 mm to 21.78 mm and the thickness of jackfruit seed were ranging from 8.72 mm to 16.50 mm. The arithmetic mean diameter (AMD) of jackfruit seed were ranging from 15.02 mm to 23.80 mm. The geometric mean diameter (GMD) of jackfruit seed were ranging from 13.30 mm to 22.61 mm. The sphericity of jackfruit seed were ranging from 0.53 - 0.73. The jackfruit seed showed bulk density as 0.49 g/ml^3. Whereas the true density was lying between 1.02 g/ ml^3 to 1.59 g/ml^3, while porosity came as 50.27 – 69.17 %. The surface area of jackfruit seed were ranging from 555.54 mm to 1605.41 mm.

Conclusion:

The linear dimensions length (L), width (W) and thickness (T) for the jackfruit seed increases with increase in moisture content. Bulk density and true density increases while porosity decreases with increase

Table 1 : Physical properties of jackfruit seed samples

Sample No.	L (mm)	W (mm)	T (mm)	AMD	GMD	Sphericity	Weight (g)	Vol. (ml^3)	True density (g/mm^3)	Bulk density (g/mm^3)	Porosity (%)	Surface area (S)
Sample 1	31.09	15.86	13.10	20.02	18.62	0.60	3.92	3.42	1.15		57.34	1089.08
Sample 2	30.50	16.01	12.01	19.51	18.03	0.59	3.28	3.22	1.02		51.99	1021.14
Sample 3	25.60	20.00	10.90	18.83	17.74	0.69	3.10	3.05	1.02		51.89	987.93
Sample 4	29.22	14.06	9.00	17.43	15.46	0.53	3.04	3.01	1.01		51.58	750.82
Sample 5	25.06	12.70	11.26	16.34	15.30	0.61	2.98	2.60	1.15		57.34	735.32
Sample 6	32.28	18.02	14.26	21.52	20.24	0.63	3.76	3.36	1.12		56.30	1286.67
Sample 7	28.40	16.84	12.78	19.34	18.28	0.64	3.15	3.10	1.02		51.88	1049.68
Sample 8	24.00	12.34	8.72	15.02	13.72	0.57	2.75	2.38	1.16		57.68	591.05
Sample 9	26.50	17.82	13.20	19.17	18.40	0.69	3.18	3.08	1.03		52.64	1063.53
Sample 10	28.42	15.76	12.64	18.94	17.82	0.63	3.26	3.11	1.05		53.35	997.43
Sample 11	22.06	13.26	10.56	15.29	14.56	0.66	2.05	2.00	1.03		52.29	666.00
Sample 12	23.84	10.66	9.26	14.59	13.30	0.56	3.10	3.04	1.02		52.05	555.54
Sample 13	27.80	13.16	11.34	17.43	16.07	0.58	3.12	3.06	1.02		52.04	810.72
Sample 14	24.92	18.08	13.20	18.73	18.12	0.73	2.82	2.26	1.25		60.81	1030.73
Sample 15	31.76	14.74	12.56	19.69	18.05	0.57	3.80	3.40	1.12		56.25	1022.92
Sample 16	33.70	20.98	13.48	22.72	21.20	0.63	4.01	3.58	1.12		56.34	1411.50
Sample 17	29.40	17.22	14.78	20.47	19.56	0.67	3.92	3.38	1.16		57.84	1201.25
Sample 18	30.80	18.76	12.94	20.83	19.55	0.63	3.85	3.30	1.17		58.09	1200.63
Sample 19	26.00	16.04	10.56	17.53	16.39	0.63	3.08	3.01	1.02		52.21	843.64
Sample 20	32.60	19.58	12.07	21.42	19.75	0.61	3.16	3.06	1.03		52.65	1224.86
Sample 21	34.72	20.18	16.50	23.80	22.61	0.65	3.60	3.28	1.10		55.45	1605.41
Sample 22	35.68	18.00	14.70	22.79	21.14	0.59	5.04	4.48	1.13	0.49	56.53	1402.62
Sample 23	30.60	16.01	12.06	19.56	18.08	0.59	3.78	3.38	1.12		56.27	1026.21
Sample 24	31.36	21.78	13.50	22.21	20.97	0.67	3.90	3.30	1.18		58.62	1380.73
Sample 25	29.25	17.98	15.48	20.90	20.12	0.69	3.18	3.07	1.04		52.79	1270.73
Sample 26	28.80	13.44	12.65	18.30	16.98	0.59	3.16	3.05	1.04		52.80	905.42
Sample 27	31.16	15.86	14.70	20.57	19.37	0.62	3.20	3.08	1.04		52.93	1177.81
Sample 28	35.60	18.34	15.40	23.11	21.58	0.61	3.17	3.06	1.04		52.80	1462.77
Sample 29	30.60	16.00	11.30	19.30	17.69	0.58	3.26	3.21	1.02		51.85	982.22
Sample 30	26.16	12.42	9.22	15.93	14.42	0.55	3.28	3.22	1.02		51.99	652.51
Sample 31	24.84	14.76	10.91	16.84	15.87	0.64	3.30	3.14	1.05		53.47	791.23
Sample 32	27.63	16.24	13.80	19.22	18.36	0.66	3.70	3.35	1.10		55.73	1058.83
Sample 33	32.68	20.51	14.20	22.46	21.19	0.65	3.85	3.40	1.13		56.82	1410.22
Sample 34	30.72	19.77	12.83	21.11	19.83	0.65	3.76	3.36	1.12		56.30	1234.14
Sample 35	28.00	12.24	10.38	16.87	15.27	0.55	4.20	3.62	1.16		57.85	731.74
Sample 36	24.76	16.80	13.85	18.47	17.93	0.72	3.40	3.14	1.08		54.84	1009.10
Sample 37	22.69	15.56	8.98	15.74	14.69	0.65	2.95	3.00	0.98		50.27	677.66
Sample 38	26.80	12.00	10.01	16.27	14.77	0.55	3.08	3.02	1.02		52.05	684.59
Sample 39	28.25	16.38	12.47	19.03	17.94	0.63	3.60	2.27	1.59		69.17	1010.17
Sample 40	25.21	13.22	9.00	15.81	14.42	0.57	3.52	3.24	1.09		54.99	653.07
Sample 41	30.44	19.56	14.68	21.56	20.60	0.68	3.88	3.28	1.18		58.66	1332.36
Sample 42	31.91	14.55	12.95	19.80	18.18	0.57	3.25	3.06	1.06		53.96	1038.25
Sample 43	28.60	17.27	11.42	19.10	17.80	0.62	2.85	2.26	1.26		61.22	994.98
Sample 44	26.74	13.40	10.39	16.84	15.50	0.58	3.76	3.34	1.13		56.56	754.25

Contd… Table 1

Table 1 contd…

Sample 45	31.18	16.72	15.55	21.15	20.09	0.64	3.70	3.32	1.11		56.12	1267.14
Sample 46	33.51	19.03	14.26	22.27	20.87	0.62	3.80	3.36	1.13		56.76	1368.00
Sample 47	26.15	13.00	10.80	16.65	15.43	0.59	3.25	3.04	1.07		54.26	747.29
Sample 48	23.30	15.64	12.40	17.11	16.53	0.71	3.18	3.07	1.04		52.79	858.23
Sample 49	22.40	14.46	8.95	15.27	14.26	0.64	2.76	2.36	1.17		58.19	638.39
Sample 50	29.46	17.30	11.00	19.25	17.76	0.60	3.20	3.02	1.06		53.85	990.93

where
L = Length
W = Width
T = Thickness
AMD = Arithmetic mean diameter
GMD = Geometric mean diameter
Vol. = Volume

in moisture content.

Authors' affiliations:

B.R. Singh, Samsher, Suresh Chandra and Neelesh Chauhan, Department of Agricultural Engineering, SardarVallabhbhai Patel University of Agriculture and Technology, **Meerut (U.P.) India**

Vaishali, Department of Agricultural Biotechnology, SardarVallabhbhai Patel University of Agriculture and Technology, **Meerut (U.P.) India**

Sweta Singh, S.K.N. Agricultural Universitty, Jobner, **Jaipur (Rajasthan) India**

REFERENCES

Berry, S.K. and Kalra, C.L. (1988). Chemistry and Technology of jackfruit (*Artocarpus heterophyllus)*. A review. *Indian food Packer,* **42** : 62-76.

Chowdhury, A.R., Bhattacharya, A.K. and Chattopudhyay, P. (2012). Study on functional properties of raw and blended jackfruit seed flour for food application. *Indian J. Nat. Products Resour*., **3**(3):94-99.

Gupta, D., Mann, S., Sood, A. and Gupta, R.K. (2011). Phytochemical, nutritional and antioxidant activity evaluation of seeds of jackfruit. *Internat. J. Pharma. & Bio Sci.*, **2**(4): 336-345.

Islam, M.S., Begum, R., Khatun, M. and Dey, K.C. (2015).A study on nutritional and functional properties analysis of jackfruit seed flour and value addition to biscuits. *Internat. J. Engg. Res. & Technol. (IJERT)*, **4** (12): 139-147.

Kachru, R.P., Gupta, R.K. and Alam, A. (1994). *Physico-chemical constituents and engineering properties of food crops*. Scientific Publishers, Jodhpur, India, ISBN: 8172330839.

Mohsenin, N.N. (1986). Physical Properties of Plant and Animal Materials. Taylor and Francis, New York.

Mohsenin, N.N. (1978). *Physical properties of plant and animal materials*, Gordon and Breach Science Publishers, New York, NY.

Sahay, K.M. and Singh, K.K. (1994). *Unit operations in Agricultural processing*. 1st Edition. Vikas PublishingHouse, Pvt. Ltd., New Delhi, India

Singh, A. (1986). *Fruit physiology and production*, Kalyani Publishers, New Delhi, India. p. 210.

Swami, S.B., Thakor, N.J., Haldankar, P.M. and Kalse, S.B. (2012). Jackfruit and its many functional components as related to human health: A review. *Compre. Rev. Food Sci. & Food Safety*, **11:** 565-576.

Tulyathan, V., Tananuwonga, K., Songjinda, P. and Jaiboonb, N. (2002). Some physico-chemical properties of jackfruit seed flour and starch. *Sci. Asia*, **28:** 37-41.