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Physical Profiling of *Mimusops elengi* Fruit for Post-Harvest Applications

Srashti Sharma[1], Haritima[2], Shubham[3], Vijay Kumar Singh[4], Aneesh Kunnapillil Surendran[5], Sweta Subhashree Jena[6] and Ruchi Verma[7]*

[1,2,3,7]Department of Food Processing and Technology, Gautam Buddha University, Greater Noida-201312 (U.P), India.
[4]Department of Processing and Food Engineering, Mahamaya College of Agricultural Engineering & Technology, Ambedkar Nagar-224122 (U.P), India.
[5]Department of Forest Resource Management, College of Forestry, Kerala Agricultural University, Vellanikkara Thrissur, Kerala-680656
[6]Department of Floriculture and Landscaping, College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar-751003, Odisha, India.

***Corresponding authors:** ruchiverma0715@gmail.com

Abstract
An evaluation was conducted the engineering properties of *Mimusopselengi* in its fresh, dried, and rehydrated forms. To determine the physical characteristics of the bakul fruit in several states: fresh, dried, and rehydrated. The assessment included measurements of average length, breadth, thickness, geometric mean diameter, sphericity index, surface area, bulk density, true density, and porosity. These measurements were taken at different moisture levels, specifically 63.39 % (fresh), 9.65 % (dried), and 53 % (rehydrate). The main outcomes of this study can be briefly described as follows: The length of T1, T2, and T3 ranged from 22.95 mm to 21.30 mm, the width ranged from 11.51 mm to 10.18 mm, and the thickness ranged from 14.15 mm to 13.28 mm. The values for the arithmetic mean, sphericity, aspect ratio, surface area, frontal surface area, and projected area are also determined. These findings will be utilized as a reference for designing and developing postharvest machinery, namely extraction equipment for bakul fruit.

Keywords: Bakul, Moisture, Shape, Porosity, Density

1. INTRODUCTION

Mimusops elengi L. is a beautiful, aromatic evergreen ornamental tree in the *Sapotaceae* family and is also referred to as "Bakul fruit". It goes by many names, in different languages like Bakula (Hindi and Bengali), Braamarananda, Stri-mukhamadhu (Sanskrit), Spanish cherry, West Indian Medlar, or Bullet wood tree (English), and Bakul, Anankantha and Madhuparijara (Hindi), Bakula (Bengali), Maulseri, Molchari, Maulsiri, and Bakul (Gujarathi), among others. It is a member of the Plantae Kingdom, *Mimusops* Genus, and *M. elengi L.* species. The tree's bark, blossoms, and fruits which are acidic, astringent, cooling, and anthelmintic all have therapeutic qualities. Given that all parts of *M. elengi* can be utilized in different ways to treat a wide range of human ailments, it is considered to be one of the best medicinal plants. The unripe fruit aids in tooth repair by acting as a masticatory. The fruit is one portion of the plant that can be utilized. When someone is constipated, especially a child, seeds are used to make suppositories, and ripe fruit pulp helps treat persistent diarrhea (Joshi, 2000; Chopra et al. 2000). It is distributed in the western and Eastern Ghats, peninsular region, and cultivated in the plains. Mostly the plant is grown for ornamental appearance and shade for fragrant flowers (Gami et al. 2010). The tiny, star-shaped, hairy, yellowish-white flowers can be found in little clusters or alone. The fruits are oval and 2 to 2.5 cm long, and the fruiting period takes eight to ten weeks. As seen in Figure 1 the fruit turns yellow when raw, golden orange when fully mature, and bright red-orange when fully ripe. When fully ripe, fruits have one or two seeds and can be found throughout the rainy season. The ripe fruits are pleasant and tasty, the unripe ones are astringent. The fruits are ovoid, glossy, compressed, and have a greyish-brown tint with one to two seeds (Jerline et al. 2009). Being one of the crops high in antioxidants, it may serve as a natural source of scavengers for free radicals. Anthraquinones, alkaloids, steroids or triterpenoids (saponins), and polyphenolic compounds (phenolic acids and flavonoids) are a few substances that can function as antioxidants (Bai et al. 2013 and Ponou et al. 2010). Chaovanamethakul et al. (2008) has been reported that the *Mimusopselengi L.* fruit contains flavonoid compounds and is considered a bioactive compound.

Figure 1. The bakul tree with flowers and ripe fruit

It is indigenous to the regions of Indo-China, Myanmar, Sri Lanka, and India (including the Andaman Islands). Nonetheless, it is commonly planted in tropical regions, such as Ghana, Tanzania, Mozambique, and Mauritius, as an ornamental tree. Numerous commercial fruits' engineering qualities and their technical uses for particular equipment design and processing have been documented. Jahromi et al. (2008) examined some of the physical characteristics of date fruit and found that understanding the fruit's length, width, and thickness can help with the design of fruit-sorting screens. Shahnawaz and Sheikh (2011) investigated the physicochemical qualities of jamun fruits and found that these features are crucial for developing machinery that would handle and process them. KeramatJahromi et al. (2007) calculated the size and projected regions of the date (Barhi variety) using an image processing method. Numerous studies on the physical characteristics of crops have also been published. When designing equipment for decortication, drying, cleaning, grading, storing, and oil extraction, the physical characteristics of bakul fruit are crucial. Work efficiency is decreased as a result, and product loss rises. As a result, choosing and considering these parameters is crucial when developing this apparatus. The amount of published research on the physical characteristics of oranges is insufficient. In order to create a database that will be helpful in the design and development of machinery used in postharvest processes like fruit depulper and seed decorticator, this research aims to determine some physical properties of fresh, dried, and rehydrated bakul fruit, such as the dimensions (major, medium, and minor axis), volume, aspect ratio, geometric mean diameter, sphericity, surface area, and projected areas.

2. MATERIALS AND METHODS

After observing the fresh and mature, bakul fruits were collected from the campus of the Gautam Buddha University (Greater Noida). Diseased, damaged, and unusually large or small fruits were removed, and the selected fruits were almost identical in form, size, and color. The fruits were cleaned manually from tap water to remove all foreign material and defective fruits and drained to remove the excess water from the unbalanced sample. Then 100 healthy fruits were stored at room temperature until the experiments were carried out.

2.1. Physical Properties of Bakul Fruit

The engineering properties of berries play a crucial role in various aspects of the food industry, influencing product development, processing, quality control, and consumer satisfaction and the methods adopted for estimating these engineering parameters are detailed below.

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2.2. Axial Dimension

The sample's mass was measured in kilograms, and the average mass was determined from a sample of 100 fruits. The balance has a weight range of 0.00 to 10.00 kg and has a sensitivity of 100 g. A total of 100 fruit samples were collected to measure their length (major diameter), width (intermediate diameter), and thickness (minor diameter) using a digital Vernier calliper (skadioo) with a precision of ± 0.01mm as shown in Figure 2. This resulted in 100 replications in the measurements.

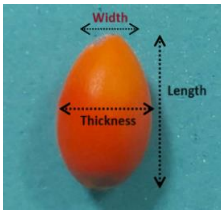

Figure 2. Dimensions of Bakul Fruits

2.3. Arithmetic mean diameter (AMD)

The Arithmetic mean diameter is obtained by dividing the sum of the Length, Width, and Thickness by the total number of linear dimensions. The arithmetic mean of the diameter of the bakul fruits was determined by measuring their length (X), breadth (Y), and thickness (Z), as reported by Sharifi et al. 2007

$$A_{MD} = \left\{\frac{X+Y+Z}{3}\right\} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where, AMD is arithmetic mean diameter in mm, X is length in mm,
Y is width in mm and Z is thickness in mm.

2.4. Geometric mean diameter (GMD)

The geometric mean diameter of bakul fruits was estimated by calculating the average of their length (X), breadth (Y), and thickness (Z) using equation (2) proposed by Nde et al. 2013.

$$G_{MD} = (XYZ)^{1/3} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where, GMD is geometric mean diameter in mm, X is length in mm,
Y is width in mm and Z is thickness in mm.

2.5. Equivalent mean diameter (EMD)

The diameter of T1, T2, and T3 was estimated by calculating the equivalent means using the length (X), width (Y), and thickness (Z) according to the equation provided by Gholami et al. 2012.

$$E_D = \left\{\frac{X(Y+Z)}{4}\right\} 1/2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where, ED is equivalent diameter in mm, X is length in mm, Y is width in mm and Z is thickness in mm.

2.6. Sphericity

Fruit structure is commonly described in terms of its sphericity. It is an important parameter to know the fluid, heat, and mass transfer calculations. The sphericity (ɸ) was calculated using the following formula.

$$\text{Sphericity } (\Phi) = \{(X \times Y \times Z)/L\}1/3 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

2.7. Shape and size

A total number of 100 fruits were sampled to quantify the dimensions of length (X), breadth (Y), and thickness (Z) for each fruit. The collected data were utilized to quantify the shape index (Lsh) of each sample, as described by Buyanov and Voronyuk (1985).

$$Lsh = \left\{\frac{X}{Y}\right\} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Where, Lsh is Shape index, X is Length of fruit, and Y is width of the fruit.

2.8. Surface, Volume and Projected area

According to Olajide and Ade-Omowaye (1999), the surface area of the sample was determined by analogy with a sphere of the same geometric mean diameter.

$$S = (Dg)^2 \ldots\ldots (6)$$

$$V = \pi (G_{MD})^3 \ldots\ldots (7)$$

$$PA = (Y \times X) \ldots\ldots (8)$$

Where, S is surface area, Dg is geometric diameter, GMD is geometric mean diameter,
X is Length and Y is Width.

2.9. Frontal surface area (FSA)

A solid object's frontal surface area is how it would appear if it were cut by an intersecting plane. The equation described by Mohsenin (1980) was used to calculate the frontal surface area (FSA) of the samples.

$$F_{SA} = \pi \frac{\pi}{4} XY \ldots\ldots (9)$$

Where, FSA is frontal surface area in mm^2, X is length and Y is width of the samples in mm.

2.10. Cross-Sectional Area (CSA)

The cross-sectional area refers to the measurement of the area formed by a plane that intersects an object perpendicular to its longest axis. The cross-sectional area of the samples was calculated using the equation referenced by Mohsenin (1980).

$$C_{SA} = \frac{\pi}{4 \times 9} (X+Y+Z)^2 \ldots\ldots (10)$$

Where, CSA is cross sectional area (mm^2), X is length, Y is width and Z is thickness in mm

2.11. Shape Index (SI)

The shape index is determined by the ratio of the width to the square root of the product of the length and thickness. The shape index was calculated using the equation provided by Mohsenin (1980).

$$SI = Y\sqrt{XZ} \ldots\ldots (11)$$

Where, SI is shape index in mm^2, X is length, Y is width and Z is thickness in mm.

2.12. Aspect Ratio

The aspect ratio (R) of the jackfruit seeds were calculated as equation given by Maduako and Faborode (1990).

$$A_R = \left\{\frac{Y}{X}\right\} \ldots\ldots (12)$$

Where, AR is aspect ratio (%), X is length (mm), and Y is width (mm).

2.13. Bulk Density

According to Eleazu et al. (2014), the bulk density was determined by adding 50 g of material to a graduated cylinder and measuring the volume.

$$\text{Loose bulk density (g/mL)} = \frac{\text{Bulk mass of sample}}{\text{Bulk volume}}$$

2.14. True Density

In accordance with Solanki et al. 2017, the true density of the samples was determined by repeating the 20 trials and calculating the average value.

$$T_D = \frac{X}{Y} \ldots\ldots (13)$$

Where, TD = true density (kg.m-3), X = mass of fruit in kg
y = volume of water displaced by the sample (m3).

2.15. Tapped Density

The samples were gently filled into 10 mL graduated plastic cylinders. The cylinder's bottom was lightly tapped against a laboratory bench that was covered with foam, repeatedly, there was no further diminution of the sample level. The weight of the sample was determined and the bulk density was calculated as the ratio of the weight of the sample to the volume of the sample (Kaur et al. 2005).

2.16. Porosity

By using bulk density and true density values, the porosity of the samples was calculated as specified by Nde et al. 2013

$$P_o = (1 - \frac{BD}{TD}) \times 100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (14)$$

Where, PO is porosity in %, BD is bulk density in kg m-3 and TD is true density (kg/m-3).

3. RESULT AND DISCUSSION

The engineering properties are represented in Table 1, which showed a noticeable difference in fresh, dried, and rehydrated bakul. The physical characteristics are crucial for transportation, processing, sorting, and separation. It helps with the examination of the product's behaviour when handling materials and the design of machines. Size and form are crucial factors for both material conveyance and issues pertaining to the distribution of stress in the material under pressure. To optimize and better design tools, equipment, machines, and systems for processing fruit, the physical qualities of the fruit were characterized.

3.1. Shape and size of bakul fruit

The bakul fruit typically has an oval or ellipsoidal shape, resembling a small, rounded drupe. It is not perfectly spherical but rather slightly elongated, with a tapering end. The fruit's shape can vary slightly depending on factors such as the variety of the bakul tree and the stage of ripeness. However, generally, it is characterized by its small, rounded, and slightly elongated form.

Table1. Engineering Properties of *Mimusopselengi* (Bakul) Fruit

S. No.	Parameters	Samples		
		T_1	T_2	T_3
1.	Length(mm)	22.95±0.03^{c}	21.13±0.02^{a}	21.30±0.02^{b}
2.	Width(mm)	11.51±0.03^{c}	10.08±0.02^{a}	10.18±0.03^{b}
3.	Thickness(mm)	14.15±0.03^{c}	13.15±0.03^{a}	13.28±0.02^{b}
4.	AMD (mm)	16.20±0.015	14.79±0.01	14.92±0.02
5.	GMD (mm)	15.09± 0.02	13.72± 0.01	13.85±0.02
6.	EMD (mm)	73.62±0.09^{c}	61.38±0.11^{a}	62.5±0.15^{b}
7.	Sphericity (%)	0.66 ±0.0	0.65±0.0	0.65±0.0
8.	Aspect Ratio (%)	50.18±0.19^{b}	47.68±0.15^{a}	47.78±0.16^{a}
9.	Surface Area (mm^2)	715.63±1.97^{c}	591.64±0.99^{a}	602.61±1.81^{b}
10.	Volume (mm^3)	10803.8±44.71	8121.3±20.50	8348.23±37.60
11.	FSA (mm^2)	650.19±1.78	524.12± 0.42	533.57± 1.53
12.	CSA (mm^2)	30.79±002^{c}	26.59±0.08^{a}	27.04±0.06^{b}
13.	S.I (mm^2)	29.53±0.04^{c}	26.75±0.02^{a}	27.00±0.04^{b}
14.	Projected Area	247.13 ± 29.38	214.05 ± 1.86	221.91 ± 8.07

Values expressed are means ± SD (n = 3).
Means in the rows with different superscripts are significantly different ($p \le 0.05$).
Where, T1= Fresh bakul fruit, T2= Dried bakul fruit, T3= Rehydrated bakul fruit

3.2. Axial Dimension

The axial dimensions for T1 ranged 22.95 mm, 21.13 mm, and 21.30 mm, T2 ranged 11.51 mm, 10.08 mm, and 10.18 mm and in T3 ranged 14.15 mm, 13.15 mm, and 13.28 mm respectively. The axial dimensions of bakul fruits observed in this study were higher when compared to Jetropa seeds (Garvnayak et al. 2008), wild pistachios (Heidarbeigie et al. 2008), and African nutmeg (Burubai et al. 2007). These values are higher as compared to the present findings. Present investigation observed that the moisture content is directly proportional to the axial dimensions. The length and diameter were found to be high in T1 (22.95 mm, 21.13 mm, and 21.30 mm), while the lowest values were found in T2 (11.51 mm, 10.08 mm, and 10.18 mm). These measures could be useful in figuring out the size of machine parts, such how many fruits should be engaged at once, how far between the slicing discs should be, and how many slices an average fruit should yield. The major axis is useful when applying compressive force to create mechanical rupture because it displays the material's natural rest condition. This dimension will help apply shearing force when slicing berries and fruits. These dimensional characteristics are used in the design of sieve apertures for cleaning and sorting processes, as well as in the construction of chutes and hoppers. Axial dimensions of bakul fruits can also be influenced by a variety of factors, including post-harvest handling, cultivation practices, genetic variability, and environmental conditions.

3.3. Arithmetic mean diameter

The arithmetic mean diameter values for T1, T2, and T3ranged 16.20 mm, 14.79 mm, and 14.92 mm respectively. The present study was comparable for fresh neem fruit which shown the higher value ranged 11.02 mm, 10.60 mm and 14.90 mm at different moisture content as reported by Nde et al. (2013) and Adedeji and Owolarafe, (2015). AMD reached a maximum value of T1 and a minimum value of T2. Having a comprehensive understanding of the precise details of the AMD values is highly beneficial for constructing sorting and packaging machinery, especially for objects that possess asymmetrical geometric designs.

3.4. Geometric mean diameter

The geometric mean diameter, determined by the dimensions of length, width, and thickness. The current investigation recorded the measurements for T1, T2, and T3 were 15.09 mm, 13.72 mm, and 13.85 mm respectively. This study's geometric mean diameter value is higher than that of the other study. The importance of these measurements in determining aperture diameters and other aspects of machine design was mentioned by Omobuwajo et al. (1999) and Mohsenin (1980).

3.5. Equivalent mean diameter

The highest value of EMD was shown to be higher in T1, while the lowest found in T2 respectively. The values range 73.62 mm, 61.38 mm, and 62.5 mm were obtained for equivalent mean diameters of the T1, T2, and T3. The measurements for fresh and dry neem seeds were 28.87 (27.98 to 30.89) mm and 30.07 (28.94 to 31.08) mm respectively, which are smaller than the bakul fruits.

3.6. Sphericity

The sphericity values for T1, T2, and T3 are displayed in Table 1 ranged 0.66%, 0.65%, and 0.65% accordingly. It is defined as a solid object's unique shape as compared to a spherical object of the same volume. A food material's sphericity is frequently used to describe its shape. The study conducted by Omobuwajo et al. 2000 found that Ipoli fruit have a higher sphericity as compared to the present study and the values of bakul fruit were also higher than that of sweet cherry fruit (Vursavus et al. 2006). This attribute is significant in calculations involving fluid flow, heat transmission, and mass transfer. The fruit is more likely to slide than roll on flat surfaces, according to the low sphericity values. The design of hoppers and chutes requires consideration of these variables.

3.7. Aspect Ratio

The Aspect ratio of the T1, T2, and T3 were found to be 50.18 %, 47.68 %, and 47.78 % respectively. One term used to define the shape of a food material is aspect ratio, which compares the width to the length of the fruits in a proportionate manner. The aspect ratio in the current investigation was determined to be lower than that of Ipoli fruits, measuring 0.7. (Burubai, 2014) Dabai fruits, however, were discovered to be 0.56 (Halim, 2021). Because of their high aspect ratio, fruits are more likely to slide down their flat surface, much like oil bean seeds, as opposed to rolling

3.8. Surface area and Volume

Surface area is expressed as the total area over the outside of a fruit and the surface area values for T1, T2, and T3varies 715.636 mm^2, 591.643 mm^2, and 602.614 mm^2, and the volume were found to be 10803.8 mm^3, 8121.3 mm^3 and 8348.23 mm^3 respectively. Values of the bakul fruits were higher than that of cornelian cherry fruit samples as stated by the Demir and Kalyoncu (2003). The simplest definition of a volume is the whole area that a three-dimensional solid takes up. In addition to being necessary for hopper and conveyor designs, surface area and volume are also necessary for containerization, packaging, and the computation of fruit's elastic modulus. Clayton et al. (1996) stated that when expressing the transport of heat into or out of fruits and vegetables, surface area is crucial. In light of this, it may be said that the fruit's surface area transfers energy at a far slower pace than that of the other fruit.

3.9. Frontal surface area

The portion of the fruit exposed to the front is referred to as the frontal surface area. Table 1 displays the values observed for T1 (650.197 mm^2), T2 (524.12 mm^2), and T3 (533.577 mm^2), which depict a solid object if cut by an intersecting plane. This measurement can be significant in various engineering applications, particularly in food processing, packaging, and agricultural machinery design. For instance, in the design of sorting or grading machines for berries, knowing the frontal surface area can help engineers determine how to optimize the equipment for efficient handling and processing. Similarly, in packaging design, understanding the frontal surface area can influence decisions regarding packaging size, shape, and material to ensure proper protection and presentation of the berries.

3.10. Projected Area

Projected area values are crucial to the design and development of machine vision-based grading systems. The respiration rate, maturity index, and gas permeability may all be computed using the anticipated area to predict when to harvest, how much water will be lost, and how much heat and mass will be transferred during drying and cooling. In the present study, the value for T1, T2, and T3 was found to be 247.13 mm^2, 214.05 mm^2, and 221.91 mm^2 respectively. Furthermore, the predicted discrepancy in the physical attributes could be due to the inherent variability in fruit dimensional features (Azman et al. 2020). The experimentally projected areas of bakul fruit were found to be higher than those of hackberry (Demir et al. 2002) and cornelian cherry (Demir and Kalyoncu, 2003), and lower than those of *Juniperusdrupacea* fruits (Akinci et al. 2004) and myrtle fruit (Aydin and Ozcan, 2007).

3.11. Cross-sectional area

The size of the section created when a plane cuts an item transversely at a right angle to its longest axis is known as the cross-sectional area. T1, T2, and T3 had a cross-sectional area ranged 30.79 mm^2, 26.59 mm^2, and 27.04 mm^2 respectively as given in Table 1. It refers to the area of the berry when it is sliced perpendicular to its longitudinal axis. This measurement is essential for various engineering applications, particularly in food processing, packaging, and equipment design. Understanding the cross-sectional area of berries is crucial for designing equipment such as slicers, dicers, and sorters used in food processing operations. It helps engineers optimize the size and configuration of these machines to efficiently process berries while minimizing waste. Furthermore, in packaging design, knowledge of the cross-sectional area allows engineers to determine how berries will be arranged within containers or packaging materials. This information is vital for designing packaging that maximizes space utilization, minimizes damage during transportation, and enhances product presentation.

3.12. Shape Index

The values of the shape index ranged 29.53 mm^2, 26.75 mm^2, and 27.00 mm^2 for T1, T2, and T3. Shape and size play a major role in the design of processing equipment. When describing grains, seeds, fruits, and vegetables, they are frequently utilized. When sorting and measuring fruits and vegetables, as well as when screening solids to remove foreign elements, shape and physical dimensions play a crucial role. These characteristics determine how many fruits can fit in shipping containers or plastic bags of a specific size. When fruits and vegetables are transported hydraulically, the form and density of the design fluid velocities determine how sorting, harvesting, size, and grinding machines are designed. The sphericity and aspect ratio of the product can be used to define its form, and these factors have an impact on the products' flow properties.

3.13. Bulk Density

According to Goneli (2008), the observed variance is most likely the result of the fruit's internal space and the contraction of its dimensions as moisture is removed from the product working together in the values of bulk density for the T1, T2 ranged 0.02 kgm^{-3} and 0.0015 kgm^{-3} according to the study described by Owolarafe and Shotonde's (2004). Moreover, real density and bulk density are essential for agricultural product marketing. The miracle berry fruit goods will need to be upgraded to reduce their transportation expenses because trucks are usually employed for their transportation (Zorzenoni et al. 2019). It could be useful in the development of hoppers and storage facilities. Furthermore, pressure stresses on storage structures are influenced by the bulk density, angle of repose, and frictional coefficients of the materials used for bin walls. Several scientists have studied the mechanical and physical properties of different food and agricultural items to provide baseline data for process equipment design. The real densities of *Parkiaspeciosa* seeds and quinoa are similar to those of Ipoli fruit, per published studies. The density data shows that it is heavier than both air and water. These qualities are therefore useful when developing separation protocols.

3.14. True Density

The values of true density were found to be 0.02 and 0.02 kgm^{-3} respectively for both T1 and T2. According to Owolarafe and Shotonde (2004) the higher average value of the true density and bulk density for okra fruits at 743.6 kgm^{-3} and 450.42 kgm^{-3} respectively in their work on the physical properties of fresh okra fruit. The research findings of Douglas et al. (2014) corroborate this in their work on cranberry fruits. Both the density and volume of different agricultural goods are critical factors in many technical processes as well as the assessment of product quality.

3.15. Porosity

In present study of the porosity for T1 and T2were found to be 0.20 % and 0.02 %. The amount of airways in particle matter, or porosity, influences how difficult it is for air to pass through bulk materials. Airflow resistance consequently affects the effectiveness of systems designed for force convection drying of bulk solids and aeration systems used to control the temperature of stored bulk solids. Comparable patterns of variation in porosity grow with decreasing moisture content was reported by Nde et al. 2013.

CONCLUSION

The present study comprehensively assessed the physical and engineering properties of *Mimusops elengi* (Bakul) fruit in its fresh, dried, and rehydrated states to facilitate post-harvest handling and processing system design. The results revealed that drying significantly reduced the size, mass, surface area, and volume of the fruit, while rehydration restored some of these properties, albeit not to the levels of the fresh sample. Dimensional parameters such as length, breadth, thickness, sphericity, aspect ratio, and volume were notably altered by moisture variation. These changes directly impact handling, grading, sorting, and packaging operations. Bulk and true densities, porosity, and surface area were also influenced, which are critical parameters for designing storage bins, hoppers, dryers, and transportation systems. The study establishes a foundational data set for designing mechanized post-harvest systems tailored to the unique properties of *Mimusops elengi*. Furthermore, such profiling supports value addition and promote the utilization of this underutilized fruit in nutraceuticals and functional food applications.

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