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Physical Properties of Tamarind (Tamarindus indica L.) Fruit

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ABSTRACT

Tamarind (Tamarindus indica L) is a multipurpose tropical fruit tree used primarily for its fruits, which are eaten fresh or processed, used as a seasoning or spice, or the fruits and seeds are processed for non-food uses. fruit Conventional method of tamarind seed separation was laborious and time consuming. In traditional practice for removal of seed from 1 Kg of fruit 0.67 man-hr was required. After recognizing the importance of mechanization of tamarind processing, various tamarind physical properties need to be studied to design a machine to remove shell and seed. The average length, width, thickness, geometric mean diameter, sphericity index, surface area, bulk density and true density of tamarind fruit at moisture content of 25% on dry basis were determined. The angle of repose during filling and emptying were in an average of 32.43° and 48.62° respectively. The average length, width, thickness, geometric mean diameter, sphericity index, surface area, bulk density and true density of tamarind fruit were observed as 93.94mm, 15.37mm, 11.73mm, 25.57mm, 0.2734, 206.63mm^2, 616.39kg/m^3 and 1042.25kg/m^3 respectively.

Key words: *Angle of repose, Bulk density, Physical properties, Sphericity index, Surface area.*

Tamarind(*Tamarindus indica* L.) is a multipurpose tropical fruit tree used primarily for its fruits, which are eaten fresh or processed, used as a seasoning or spice, or the fruits and seeds are processed for non-food uses. Tamarind belongs to the dicotyledonous family which is the third largest family of flowering plants with a total of 727 genera recognised and the number of species is estimated at 19,327 (Gunasena *et al.*, 2000). Tamarind is widely grown as a subsistence crop for meeting local demands. It is also grown commercially. Numerous national programmes have recognised tamarind as an underutilised crop with wider potential since demand for products is substantial and the species can be incorporated into agro forestry systems.

In India, Andhra Pradesh, Kerala, Tamil Nadu, Karnataka, Madhya Pradesh, Bihar, West Bengal and Chhattisgarh are tamarind producing states. In Andhra Pradesh, Anantapur is the majorly producer of tamarind. Anantapur District is in the arid agro-ecological zone and is marked by hot arid bioclimatic condition with dry summers and mild winters. The district is in the rain scarce area and the normal rainfall is 553 mm.

Tamarind tree has a acid climatic adaptability and can be grown in humid to dry hot regions. It is very sensitive to frost. The optimum rainfall requirement is 750-1900mm, but can thrive in region with low annual rainfall of 500-750mm.

In general the traditional method for separating of the tamarind seed by the hand beating with wooden piece which is laborious and time consuming practice. In villages all family members including children involve in tamarind seed removing activity as it is time consuming activity, which results in loss of education of children. In traditional practice for removal of seed from 1 Kg of fruits 0.67 man-hours is required. Due to beating of fruits with a wooden piece at times there is chance of getting finger biting, hence safety is also at risk. In traditional method person has to remain in sitting posture for long time which results in fatigue. Hence there is very much need to develop suitable machine to remove shell and separate seed. For designing machine, there is a need to consider some physical properties of tamarind fruit such as length, width, thickness, geometric mean diameter, sphericity index, surface area, bulk density and true density. With the above view, the present study was conducted to analyse various physical properties of tamarind fruit.

MATERIAL AND METHODOLOGY

Physical Properties of Tamarind

Local variety of tamarind fruit from the tamarind farmers in Madakasira, Anantapuram District was purchased to determine the engineering properties. The physical properties such as moisture content, size, shape, bulk density, true density, geometric mean diameter, sphericity index , surface area and angle of repose were determined. The methods adopted for determining various physical properties are detailed below.

Moisture Content

Moisture content was determined using hot air oven method. Shell of the samples were removed manually, seeds of the samples were not removed for determining moisture content. Three samples of each 15g kept in an oven for 3 days at 105°C. Moisture content of tamarind fruit was determined by using following formula. Moisture Content was expressed in terms of % dry basis.

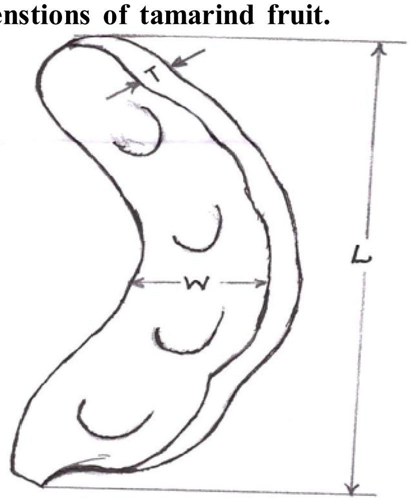
$$\text{Moisture Content of Tamarind fruit, \%} = \frac{W_2 - W_3}{W_2 - W_1} \times 100$$

Weight of the Empty crucible, W_1
Weight of the Empty crucible + Sample, W_2
Weight of the Empty crucible + Sample after drying, W_3

Dimensions of Tamarind

Tamarinds were randomly chosen for measuring dimensions. Length, width and thickness of each tamarind fruit were measured using vernier caliper (least count 0.01 cm). Fifty observations were made to get average values of length, width and thickness of the tamarind fruits, dimensions of tamarind fruit was shown in fig.1.

Fig.1.Dimenstions of tamarind fruit.



Geometric Mean Diameter (GMD)

Geometric mean diameter was determined by using the following formula.

Geometric mean diameter (Dg) $Dg = (LWT)^{1/3}$

Where,

L = Length of the fruit, mm
W = Width of the fruit, mm
T = Thickness of the fruit, mm

Sphericity Index

It is a measure of how spherial(round) an object is.

Sphericity index= **Dg/L**

Where

Dg=Geometric mean diameter
L=Length of the fruit, mm

Surface Area

Surface area (S) was calculated by using the following equations **S = ð Dg^2**

Bulk Density

Bulk density was calculated as the ratio between mass and bulk volume of tamarind. As the size of tamarind was larger than grains, the following method was adopted to determine the bulk density of tamarind. For determining bulk density of tamarind fruit, the fruits were not compacted in beaker.

$$\text{Bulk Density} = \frac{\text{Weight of the Sample (Kg)}}{\text{Volume of the Sample } (m^3)}$$

True Density

Some agricultural products having irregular shape, small size and void spaces poses certain problems in measuring of volume and density. The volume of such irregular shaped material is generally determined by displacement method.

$$\text{True volume} = \frac{\text{Mass of displaced toluene (kg)}}{\text{Density of toluene} \left(\frac{kg}{m^3}\right)}$$

By knowing the mass of the tamarind and the true volume, the density of tamarind was obtained as the ratio between the mass of the tamarind to its true volume.

$$\text{True density} = \frac{Wa}{Va}$$

Table 1. Various physical Properties of Tamarind Fruits.

Property	No. of observations	Average Value
Length(mm)	50	93.94mm
Width(mm)	50	15.37mm
Thickness(mm)	50	11.37mm
Geometric Mean	50	25.57mm
Sphericity Index	50	0.2734
Surface area	50	2062.63mm^2
Bulk Density	10	616.39Kg/m^3
True Density	10	1042.25Kg/m^3
Angle of Repose(Filling)	10	32.43^o
Angle of Repose(Emptying)	10	48.62^o

Where,

W_a = mass of tamarind, kg

V_a = true volume of tamarind, m^3

Angle of Repose

The angle of repose is the angle made by the tamarind with the horizontal surface when piled from a known height. The radius of the pile was calculated from the circumference of the pile and the height of the pile was determined. The angle of repose was calculated using the formula :

$$\theta = \tan^{-1} (l/r)$$

where,

θ = angle of repose, degree

r = radius of pile, mm

l = height of pile, mm

RESULTS AND DISCUSSION

Physical properties of the tamarind fruit such as size, shape, bulk density, true density, porosity, sphericity index and surface area were determined and the properties of the tamarind fruits are given in Table 1.

All the experiments were carried out when the moisture content of the tamarind was at 25% on dry basis. The physical properties such as size and shape are very much important in designing processing equipments. Average length, width and thickness of the tamarind were found to be 93.94 mm, 15.37 mm and 11.37 mm, respectively. The average geometric mean diameter, sphericity index and surface area were 25.57 mm, 0.2734 and 2062.63 mm^2 respectively. The average values of bulk density and true density were found to be 616.39 kg/m^3 and 1042.25 kg/m^3 respectively. Filling angle of repose and emptying angle of repose were 32.43^o and 48.62^o respectively. The result showed that tamarind fruits are not a free flowing material. The results were on par with results of Karpoora et.al.,2013.

CONCLUSION

The tamarind fruits at the moisture content of 25% on dry basis possessed the average length, width and thickness of 93.94mm, 15.37mm and 11.73mm respectively. The average values of geometric mean diameter, sphericity index and surface area were 25.57mm, 0.2734 and 2062.63mm^2 respectively. The average values of bulk density and true density were found to be 616.39 kg/m^3 and 1042.25 kg/m^3 respectively. Filling angle of repose and emptying angle of repose were 32.43^o and 48.62^o respectively. The physical properties of tamarind fruit can be used for design of various machine components like hopper, shelling mechanism and deseeding mechanism.

LITERATURE CITED

Gunasena H P M and Hughes 2000 Tamarind, Tamarindus Indica L., International Centre for underutilised Crops, South ampton, UK.

Karpoora sundara pandian N,Dhananchezhiyan P and Parveen S 2013 Physical and Engineering Properties of Tamarind Fruit. *International Journal of Scientific Engineering and Technology*, 2:1083-1087

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