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Research Article

PHYSICAL PROPERTIES OF ARECANUT SHEATH

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Abstract- Arecanut or Betelnut is the kernel obtained from the fruit of arecanut palm. It has some beneficial parts, such as husk, leaves and sheath, which can be used for different purpose. Among those parts arecanut sheath is extensively used for commercial plate making purpose and alternative animal fodder for cattle. But there was no study found which indicates physical properties of arecanut sheath. Hence, made an attempt to find out its physical properties such as size (L × W × T), shape, bulk density, sphericity, surface area, arithmetic mean diameter, geometric mean diameter and moisture content of dry and wet arecanut sheath and their mean values obtained were (812.24 × 280.21 × 3.92) mm, oblong, 0.76 g cc^{-1}, 0.0124, 148795 mm^2, 365.46 mm, 10.03 mm and moisture content of dry and wet sheath were 11.5 and 55.61 per cent respectively.

Keywords- Physical property, Arecanut palm, Arecanut sheath, Animal fodder, Arecanut.

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Introduction

Arecanut plant is a tall tree with slender erect, unarmed and solitary stem living for 60-100 years. It is a single trunked palm that can grow up to 30 m height with a trunk of 250 -400 mm diameter. It is grown in high rainfall area of 1500- 5000 mm and it has been estimated to produce 2.5-8 kg of arecanut per palm annually. It has been frequently grown together with long and short term crop. It requires the optimum temperature range of 15.5-38 °C. It has some beneficial parts, such as husk, leave and sheath which can be used for different purpose. In this, arecanut leaf sheath considered as one of the main part of the arecanut palm. Leaf sheath obtained from the farm are highly heterogeneous having variations in structure, shape and thickness. Sheath of arecanut tree is a hard material (good tensile strength), slow in bio-degradation and has low calorific value. Quality of areca leaf sheath varies with locations and seasons (Kalita *et al.,* 2008) [4]. Leaf sheath completely encircles the stem forming a protective covering for the developing inflorescence. The constituents of the leaf sheaths are cellulose - 43 per cent, crude fibre - 33 per cent and ash – 5 per cent. From the manorial part of view, it contain N_2 - 0.7 per cent, P_2O_5 - 0.3per cent and K_2O - 1 per cent (Biddappa, 1960) [2]. In certain regions of Kerala and Karnataka, leaf sheath is used as alternative animal fodder for cattle and also used for commercial plate making purpose but none of them found its physical properties. Considering the above factors in view, a study has been carried out to determine its physical properties such as size, shape, sphericity, surface area, bulk density, arithmetic and geometric mean diameter and moisture content.

Materials and methods

The research was conducted in order to check the physical properties of arecanut sheath. Before checking the physical properties of arecanut sheath, the survey of arecanut growing farmers was conducted and provided in [Table-1] and samples were collected in Sirsi taluk, Karnataka.

Size of Sheath

The size of sheath such as length, width and thickness was measured by using tape, scale and digital vernier calipers (Kharidwar *et al.*, 2013) [5].

Shape of sheath

The shape of arecanut sheath was identified based on appearance of sheath (Mohsenin, 1970) [6].

Bulk density

Bulk density of arecanut sheath was determined by using water displacement method. This method was used to measure the volume of individual arecanut sheath. The sheaths were coated with paraffin wax, in order to prevent any water absorption during merging process. Each sheath was weighed and then coated with paraffin wax. The wax-coated sheath were weighed and then submerged into water in suspension position and weight of displaced water was measured and recorded as the volume of the wax coated sheath. The volume of each sheath was calculated by subtracting the volume of coating wax from the volume of wax coated sheath. The volume of coating wax was obtained by dividing its weight of the wax obtained by subtracting original weight of sheath from the weight of wax coated sheath by its volume (Kharidwar *et al.*, 2013) [5].
Volume of sample = Volume of waxed sample – Volume of wax

$$\text{Bulk density} = \frac{\text{Weight of arecanut sheath}}{\text{Volume of arecanut sheath}} \text{ g cc}^{-3}$$

Sphericity

Spherecity of arecanut sheath was determined by using following equations (Mohsenin, 1970) [6].

$$\phi = \frac{(L \times W \times T)^{1/3}}{L}$$

Where,

ϕ = Spherecity

L = Length of sheath, mm

W = Width of sheath, mm

T = Thickness of sheath, mm

Table-1 *Survey of arecanut growing farmers in Sirsi taluk, Karnataka*

Sl.. No	Name of the farmer	Area of arecanut plantation (acre)	Village	Variety	Yield (q acre^{-1})	Number of sheath per plant	Uses of arecanut sheath	Used as a cattle fodder or not	Any Implement or Machine used for chopping
1	Vinayaka	0.75	Bakkal	Kanaka	11	7	Wet sheath used as a cattle fodder and dry sheath used as a fuel for water heating	yes	Sickle and machets
2	Shrinivasa	2	Balanahalli	Thirthahalli	12	8	dry sheath used as a manure for farm	No	Sickle and machets
3	Vivek	5	Bakkal	Kanaka	15	6	Wet sheath used as a cattle fodder and dry sheath used as a fuel for water heating and as a manure for farm	yes	Sickle and machets
4	Prasad	1	Bakkal	Srimangala	13	7	dry sheath used as a fuel for water heating and cooking	No	Sickle
5	Madesha	3	Audala	Thirthahalli	15	8	dry sheath used as a fuel for water heating and cooking	No	Sickle
6	Madayya	10	Dasanagadde	Kanaka	14	7	Wet sheath used as a cattle fodder and dry sheath used as a fuel for water heating and as a manure for farm	yes	Sickle and machets
7	Vijay	7	Balanahalli	Kanaka	15	6	Wet sheath used as a cattle fodder and dry sheath used as a fuel for water heating and as a manure for farm	yes	Sickle
8	Devayya	4	Balavalli	Srimangala	13.5	9	Wet sheath used as a cattle fodder and dry sheath used as a fuel for water heating	yes	Sickle and machets
9	Shivalinga	5	Balanahalli	Kanaka	12.5	8	Wet and dry sheath used as a cattle fodder and dry sheath fuel for water heating and as a manure for farm	yes	Sickle and machets
10	Prakash	2	Bankanal	Thirthahalli	14	9	dry sheath used as a fuel for water heating and cooking	No	Sickle
11	Shivanna	3	Balavalli	Kanaka	13	7	dry sheath used as a fuel for water heating and cooking	No	Sickle and machets
12	Machayya	2	Bankanal	Thirthahalli	16	8	dry sheath used as a fuel for water heating and cooking	No	Sickle
13	Muralidhar	1	Bankanal	Kanaka	14	6	Wet sheath used as a cattle fodder and dry sheath used as a fuel for water heating	yes	Sickle
14	Amresha	0.5	Bakkal	Thirthahalli	7	8	dry sheath used as a fuel for water heating and cooking	No	Sickle
15	Dasanna	4	Dasanagadde	Kanaka	14	9	Wet sheath used as a cattle fodder and dry sheath used as a fuel for water heating and as a manure for farm	yes	Sickle and machets
16	Kumara	2	Balanahalli	Mohithnagar	16	8	dry sheath used as a fuel for water heating and cooking	No	Sickle
17	Mahesha	3	Bankanal	Kanaka	15	7	Wet sheath used as a cattle fodder and dry sheath fuel for water heating and as a manure for farm	yes	Sickle and machets
18	Raghuveer	2	Bankanal	Thirthahalli	18	6	dry sheath used as a fuel for water heating and cooking	No	Sickle
19	Mahadeva	5	Bakkal	Kanaka	14	5	Wet and dry sheath used as a cattle fodder and fuel for water heating	yes	Sickle &machets

Surface area

The surface area is one of the important physical properties of biological materials. For determining surface area, arecanut sheath was cut into small segments with a knife. The cut segments were placed on the drawing sheet and the outer shape of segments was traced using pencil. Initial point was marked on the traced line of segments of the sheet and the planimeter was moved along the traced line in clockwise direction till it reached the initial point. The surface area of the arecanut sheath was displayed by the planimeter and it was recorded (Mohsenin, 1970) [6].

Arithmetic mean diameter and geometric mean diameter

For each arecanut sheath, the length, width and thickness of arecanut sheath were measured on randomly selected arecanut sheath. The length, width and thickness of sheath were measured using a metal tape and digital calliper with an accuracy of 0.01 mm. The arithmetic mean diameter (D_a) and geometric mean diameter (D_g) of the sheath were found by using the below given equations

(Mohsenin, 1970) [6].

$$Da = \frac{L + W + T}{3}$$

$$Dg = (L + W + T)^{1/3}, mm$$

Moisture content

The moisture content of arecanut sheath is defined as the quantity of water per unit mass of the wet sheath. Moisture content of arecanut sheath at the time of freshly fallen varies drastically (Biddappa, 1960) [2]. The moisture content of arecanut sheath was measured by oven dry method. Initially the sample with the known weight (25 g) was kept in oven at 105°C for 24 hours. The oven dry sample is then weighed. The moisture content of sample was calculated by the following formula (Khardiwar *et al.*, 2013) [5].

$$M.C = \frac{(W_1 - W_2)}{W_1} \times 100$$

Where,

M.C = Moisture content of sheath, per cent

W_1= weight of sample before drying, g

W_2= weight of sample after drying, g

Result and Discussion

The randomly selected 25 arecanut sheath was used for determining physical properties of arecanut sheath. The results obtained after checking of physical properties of arecanut sheath was presented in [Table-2]. According to the [Table-2] the size of arecanut sheath such as length, width and thickness of arecanut sheath was determined. The maximum length, width at the centre, width at the both the end of arecanut sheath was observed to be 1110 mm, 339.20 mm, 360.80 mm & 240.50 mm, while minimum length, wide at the centre, wide at the both the end of arecanut sheath was observed to be 650 mm, 230 mm, 210 &130 mm and then maximum and minimum thickness of sheath observed to be 5.25 mm and 2.55 mm respectively. The shape of arecanut sheath was found to be oblong shape, because the vertical diameter of the sheath is greater than horizontal diameter respectively. The maximum bulk density was found to be 0.8 gcc^{-1} and the minimum bulk density was recorded to be 0.71 gcc^{-1}. The mean bulk density of arecanut sheath was found to be 0.76 gcc^{-1} at 9–14.5 per cent of moisture content (w.b).The maximum sphericity of arecanut sheath was 0.0146, while it was minimum of 0.0099 with a mean value of 0.0124 respectively at 9–14.5 per cent of moisture content (w.b). The maximum surface area of arecanut sheath was 2, 30,035 mm^2 while it was a minimum of 80,640 mm^2 with a mean value of 1, 48,795 mm^2 respectively at 9–14.5 per cent of moisture content (w.b). The arithmetic mean diameter of the arecanut sheath was found to be in the range of 291.31 to 482.89 mm with a mean value of 365.46 mm respectively at 9–14.5 per cent of moisture content (w.b). The geometric mean diameter of arecanut sheath was in the range of 9.34 to 11.04 mm with mean value of 10.03 mm respectively at 9– 14.5 per cent of moisture content (w.b). The maximum moisture content of freshly fallen arecanut sheath was found to be 59.75 per cent while it was a minimum of 50 per cent with a mean value of 55.61 per cent respectively. The maximum moisture content of dry arecanut sheath was found to be 14.5 per cent while it was a minimum of 9 per cent with a mean value of 11.50 per cent respectively. These results are in close agreement with the findings of Bavappa *et al.* (1982) [1], Biddappa (1960) [2], Gaikwad and Bhargav (2012) [3].

Table-2 *Different physical properties of arecanut sheath*

Sl. No	Physical properties of arecanut sheath				
	Particulars		Mean	SD	C.V
1	Length, mm		812.24	152.77	18.80
2	Width, mm		280.21	2.76	0.983
3	Thickness, mm		3.92	1.03	26.36
4	Bulk density, g cc^{-1}		0.76	0.03	3.94
5	Spherecity		0.0124	0.00	13.73
6	Surface area, mm^2		148795	523020	35.15
7	Arithmetic mean diameter, mm		365.46	64.92	17.76
8	Geometric mean diameter, mm		10.03	0.59	5.85
9	Moisture content, (per cent)	Wet	55.61	3.65	6.56
		Dry	11.50	1.61	14.02

Conclusion

The physical properties of arecanut sheath such as length, width, thickness, shape, bulk density, sphericity, surface area, arithmetic mean diameter, geometric mean diameter and moisture content of dry and wet arecanut sheath have been studied clearly and their mean values obtained were 812.24 mm, 280.21 mm, 3.92 mm, oblong, 0.76 g cc^{-1}, 0.0124, 148795 mm^2, 365.46 mm, 10.03 mm and moisture content of dry and wet sheath were 11.5 and 55.61 per cent respectively.

Conflict of Interest: None declared

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