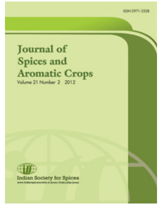
Journal of Spices and Aromatic Crops
Vol. 21 (2) : 161–163 (2012)
www.indianspicesociety.in/josac/index.php/josac

Indian Society for Spices



Physical properties of cinnamon bark

S Balasubramanian, K K Singh[1], Ashish M Mohite & T John Zachariah[2]

Central Institute of Post Harvest Engineering and Technology,
Ludhiana–141 004, Punjab, India.
E-mail: balaciphet@yahoo.com

Received 20 September 2011; Revised 01 February 2012; Accepted 14 February 2012

Abstract

Physical properties of cinnamon (*Cinnamomum verum* J.Pres) bark (*var. Nityashree*) were determined by dividing into three grades (I, II & III) according to their size at 10.15% (db) moisture content. The values of length, breadth and thickness for grade I were 48.38 mm, 7.34 mm and 1.37 mm; for grade II were 71.81 mm, 8.45 mm and 1.00 mm; for grade III were 104.95 mm, 8.15 mm and 0.98 mm, respectively. Unit volume and surface area for grade I were 214.80 mm^3 and 159.68 mm^2; for grade II were 364.92 mm^3 and 226.33 mm^2; for grade III were 409.85 mm^3 and 242.85 mm^2, respectively. Bulk density and true density for grade I were 144.56 kg m^{-3} and 177.60 kg m^{-3} for grade II were 148.44 kg m^{-3} and 186.87 kg m^{-3} for grade III were 132.08 kg m^{-3} and 202.91 kg m^{-3}, respectively. Porosity, angle of repose for grade I was 14.20% and 40.69°; for grade II were 20.95% and 41.56°; for grade III were 37.72% and 42.30°, respectively. The coefficient of static friction with respect to different surfaces *viz.*, plywood, galvanized iron and aluminum sheet for grade I were 0.86, 0.94 and 0.80; for grade II were 0.84, 0.89 and 0.79; for grade III were 0.80, 0.81 and 0.70, respectively.

Keywords: bulk density, cinnamon, physical properties, porosity, true density

Cinnamon (*Cinnamomum verum* J. Pres) is one of the important spices and bark is a economic part. The knowledge of morphology and size distribution of bark is essential for design of equipments for cleaning, grading, separation and also storage. The finest quality of bark is obtained from shoots with uniform brown colour and thin bark of 1.0–1.25 m length and 1.25 cm diameter. The ideal time for cutting the stem is when the red flush of the young leaves turn to green, indicating the free flow of sap between bark and wood. Shoots ready for peeling are removed from the stumps and the terminal ends of shoots are also removed. Published literature on the physical properties of the cinnamon bark is scanty. Hence, this study was undertaken to establish a data base on physical properties of cinnamon bark, which may be helpful in designing processing equipments.

Cinnamon bark (*var. Nityashree*) was procured from Indian Institute of Spice Research (IISR), Calicut, India. The bark was subjected to

[1]Krishi Anusandhan Bhawan–II, New Delhi–110 012, India.
[2]Indian Institute of Spices Research, Kozhikode–673 012, Kerala, India.

manual cleaning and broken, foreign matter removed, split and immature barks were separated from the sample. Moisture content was determined (10.15%, db) using standard hot air oven method at an air temperature of 80±5°C. The axial dimensions were measured using digital vernier caliper (± 0.01 mm, LC) of selected 100 samples. Variations in size (length) were found more among the barks and to minimize the error, barks were divided into three different grades namely 30–60 mm, 60–90 mm, and 90–120 mm. Bulk density was determined by the method described by Balasubramanian & Viswanathan (2010). Mean of three replications are reported. True density is the ratio of bark mass to its pure volume as determined using nitrogen gas replacement in pycnometer (model 2: *Hymipyc*; make IQI, USA). After calibration, the duplicate samples were weighed and placed in the sample chamber for determination of volume and true density. Porosity is represented as the ratio of difference between true density and bulk density to the true density i.e. percentage of volume of voids (Mohsenin 1986).

$$\varepsilon = \frac{\rho_t - \rho_b}{\rho_t} \times 100$$

where, e is the porosity (%), r_t is the true density (kg m^{-3}) & r_b is the bulk density (kg m^{-3}). For determining the angle of repose, bark was discharged through a horizontal hopper opening and a conical shaped heap is formed. The samples were fed in a tapering iron hopper having a dimension of 250 × 250 mm from top and bottom hole 20 x 20 mm was allowed to fall freely on a circular disc of 100 mm diameter. A horizontal sliding gate was provided right below the hopper to regulate the opening during the test (Sahoo & Srivastava 2002).

$$\theta = \tan^{-1}\left(\frac{2H}{D}\right)$$

where, H is the height of the cone and D is the diameter of the circular base of the cone. Coefficient of friction with respect to different surfaces namely, plywood, aluminum and mild steel sheet was determined (Ozturk & Esen 2008).

$$\mu_s = \frac{F}{N_f}$$

where, μ_s is the coefficient of friction, *F* is the measured force (N) and N_f is the normal force of the samples (N).

The length of three grades was 48.38, 71.81 and 104.95 mm, respectively. However, breadth was 7.34, 9.45, and 8.15 mm and thickness was 1.37,

Table 1. Some physical properties of cinnamon

	Grade I	Grade II	Grade III
Length (mm)	48.38 (8.21)	71.81 (8.85)	104.95 (9.17)
Breath (mm)	7.34 (0.78)	9.45 (0.56)	8.15 (0.85)
Thickness (mm)	1.37 (0.39)	1.00 (0.44)	0.99 (0.11)
Bulk density (kg m^{-3})	144.56 (12.75)	148.44 (12.13)	132.08 (8.09)
True density (kg m^{-3})	177.60 (3.30)	186.87 (4.30)	202.91 (6.10)
Porosity (%)	14.20 (0.55)	20.95 (1.12)	37.72 (1.13)
Angle of repose (^{o})	40.69 (1.05)	41.66 (0.86)	42.30 (0.70)
Coefficient of friction			
GI sheet	0.94 (0.04)	0.89 (0.05)	0.84 (0.03)
Plywood	0.86 (0.02)	0.84 (0.04)	0.80 (0.04)
Aluminum	0.81 (0.03)	0.79 (0.04)	0.69 (0.03)

Values in parenthesis indicate standard deviation

1.00 and 0.98 mm, respectively. The unit volume increased linearly from 214 to 409 mm^3. Surface area increased linearly from 159 to 242 mm^2. Bulk density of bark decreased with grade size and ranged between 148 and 132 kg m^{-3}. However, true density was found to increase (177–202 kg m^{-3}). The porosity and angle of repose showed an increasing trend with bark grades i.e. 0.15 to 0.09 and 40.69 to 42.30 respectively. The coefficient of friction for cinnamon bark of three different grades on different structural surface were found be, plywood (0.86, 0.84, 0.80), GI sheet (0.94, 0.89, 0.84), and aluminum (0.81, 0.79, 0.69). The value of static coefficients of friction was lowest against aluminum sheet surface. This may be due to the smoother and more polished surface of aluminum sheet compared to other test surfaces. These results indicated that there existed a large variation in the physical properties of cinnamon with different grades sizes. Hence, proper grading provides data for the design of equipment for processing of cinnamon.

Acknowledgment

The National Director and National Coordinator of N*ational Agricultural Innovation Project (NAIP)*, Indian Council of Agricultural Research, New Delhi.

References

Balasubramanian S & Viswanathan R 2010 Influence of moisture content on physical properties of minor millets. J. Food Sci. Technol. 47: 275–280.

Mohsenin N N 1986 Physical properties of plant and animal materials. IInd Edn. Gordon and Breach Science Publishers, New York.

Ozturk T & Esen B 2008 Physical and mechanical properties of barley. Agric. Tropica subtropica 41: 117–121.

Sahoo P K & Srivastava A P 2002 Physical properties of okra seed. Biosys. Eng. 83: 441–448.