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Physical properties of coriander (*Coriandrum sativum* L.) seeds

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Abstract
Coriander (*Coriandrum sativum* L.) is medicinal herb belongs to the carrot family *Umbelliferae* or *Apiaceae* and comes from the mediterranean region. The fresh seeds after drying are used as spices. Coriander has been used to treat a variety of ailments, including dyspeptic, loss of appetite, convulsions, anxiety and insomnia. In this study the physical properties of coriander seeds were studied. The physical properties of coriander seeds *i.e.* length, width, thickness, bulk density, sphericity, volume, surface area, geometric mean diameter and angle of repose were varied between 6.09-6.16 mm, 3.92-3.97 mm, 3.58-3.68 mm, 298.83-291.62 kg/m^3, 72.57-72.85%, 33.05-34.61 mm^3, 61.32-63.24 mm^2, 4.41-4.47 mm and 29.75-32.73º, respectively with the different level of moisture content (7.2-11.2% wb). The length, width, thickness, geometric mean diameter, sphericity, angle of repose, volume and surface area of coriander seed showed significant increase with increased in the coriander seed moisture level.

Keywords: Coriander seeds, physical properties, moisture content level

1. Introduction
Coriander (*Coriandrum sativum* L.) is herb belongs to the carrot family (*Umbelliferae* or *Apiaceae*) and comes from the mediterranean region. Commercially, this herb is grown in Europe, Asia, and Africa. It is cultivated for its seeds and leafs. In general fresh leaves are used for garnishing the different preparation. The fresh seeds after drying are used as spices. Coriander is an important spice crop having a prime position in flavouring food. The plant is a thin stemmed, small, bushy herb, 25 to 50 cm in height with many branches and umbels. Leaves are alternate end compound. Fruit is globular, 3 to 5 mm diameter, when pressed break into two locules each having one seed. The seeds are pale white to light brown in colour. Coriander used to treat different disease like diuretic, antipyretic, stomachic, stimulant, laxative, anathematic, and treats biliousness, bronchitis, and vomiting, as well as being a strong aromatic, antiseptic, expectorant, and antispasmodic. Hiccough, suppuration, piles, inflammation, toothache, jaundice, scabies, and gland tuberculosis are all treated with the leaves, which are hypotonic and analgesic.
In this study, the physical properties of coriander seeds were evaluated namely sphericity, angle of repose, density, surface area, volume at different moisture levels.

2. Materials and Methods
The dried coriander seeds of local variety (*Fal dhaniya*) were purchased from the Raipur local market and were used for this experiment. The procured seeds (Illustration: 1) were first properly cleaned and undesirable portions were removed manually and then the cleaned sample was used for conducting further experiment. The initial moisture content of dried coriander seed was determined by using standard hot air oven method (temperature of oven 105 ± 1 °C for 24 h). Initial moisture content of coriander seed was found to be 9.08% (w.b.). To achieve high moisture contents in the seeds, calculated amount of water was sprayed and mixed thoroughly. Samples were packed in low density polyethylene (LDPE) pouches and kept in a refrigerator at 5 °C for 48 h for uniform distribution of moisture throughout the seed (Barnwal *et al.*, 2015) [3]. Samples were allowed to reach ambient temperature for measurement of physical properties. Thus, three levels of moisture content (7.2, 9.1 and 11.2% w.b.) were selected (Balasubramanian *et al.* 2012) [2]

2.1 Physical properties of Coriander seeds
2.1.1 Initial moisture content
The initial moisture content of coriander seed was determined by using hot air oven. The

moisture content was calculated by taking the difference between the initial weight of sample before drying and final weight after drying and divided by initial weight of sample before drying (AOAC, 1984) [1].

Illustration: 1 Coriander seed

$$\text{Moisture content (\% wb)} = \frac{W_1 - W_3}{W_1 - W_2} \quad (1)$$

2.1.2 Geometric mean diameter

The axial dimensions of a randomly selected 100 coriander seeds was measured using digital vernier caliper (±0.01 mm, LC). The geometric mean diameter (GMD) was expressed as the cube root of three axes of seeds i.e. (a) major dimension(L), (b) medium(W) and (c) minor dimension(T). The average geometric mean diameter (mm) was determined by using the following equation (Mohsenin, 1986) [8]:

$$\text{GMD} = \sqrt[3]{L \times W \times T} \quad (2)$$

2.1.3 Sphericity (φ)

Sphericity is defined as the ratio of the surface area of a sphere having the same volume as the seed to the surface area of the seed. The shape of a food material is usually expressed in terms of its sphericity. Sphericity was determined using the measured geometric dimensions (Mohsenin, 1986) [8].

$$\text{Sphericity } (\varphi) = \frac{\sqrt[3]{L \times W \times T}}{L} \quad (3)$$

2.1.4 Surface area

The surface area of coriander seed was calculated based on the geometric mean diameter (GMD) in the following equations (Mohsenin, 1986) [8]:

$$\text{Surface area } (S) = \pi(\text{GMD})^2 \quad (4)$$

2.1.5 Volume

Volume of seeds was determined based on three major perpendicular dimensions of the seeds namely length, width and thickness (Coskuner, 2007) [6]. The volume of coriander seeds sample was determined by the following equation:

$$\text{Volume} = \frac{\pi B^2 L^2}{6(2L - B)} \quad (5)$$

Where B is:

$$B = (WT)^{0.5} \quad (6)$$

2.1.6 Bulk density

The bulk density was determined as the ratio between the mass of seed in a container to its volume. It was determined by filling a 1000 ml measuring cylinder with seeds from a height of about 15 cm, striking the top level and then weighing the contents (Coskuner and Karababa, 2007) [6].

$$\text{Bulk Density} = \frac{\text{Mass of the sample(kg)}}{\text{Volume of the container}(m^3)} \quad (7)$$

2.1.7 Angle of repose

The angle of repose is the angle made by seeds with the horizontal surface when heaped from a known height. 200 gm of seeds were heaped over a horizontal surface of instrument slowly from a height of 10 cm. The slant height of the heap was determined and radius of the heap was calculated from the circumference of the heap. The angle of repose was calculated using the formula (Shirsat, *et al.*, 2019)] [13]

$$\theta = \tan^{-1}\left(\frac{2h}{d}\right) \quad (8)$$

3. Result and Discussion

3.1 Physical properties of dried coriander seeds

A randomly selected coriander seeds were used to measure the dimensions such as length, width and thickness by using vernier caliper. The major, medium and minor dimensions were observed in the range of 6.09-6.16 mm, 3.92-3.97 mm and 3.58-3.68 mm, respectively (Table 1). It was observed that the geometric mean diameter increased linearly from 4.41 to 4.47 mm with the increased in moisture content, it may be due to swelling and stretching in coriander seed surface. Similar results were reported by Coskuner and Karababa (2007) [6] for coriander seed. Balasubramanian *et al.* (2012) [2] reported that the value of medium and minor dimensions and geometric mean diameter of coriander seeds increased from 3.20-3.64 mm, 2.91-3.31 mm and 3.36-3.62 mm respectively with increase in moisture content from 3.5-17.7% (w.b.).

Table 1: Effect of moisture content on physical properties of coriander seeds

S. No.	Physical Properties	Moisture content (% w.b.)		
		7.2	9.1	11.2
1	Length (mm)	6.09	6.12	6.16
2	Width (mm)	3.92	3.94	3.97
3	Thickness (mm)	3.58	3.64	3.68
4	Geometric mean diameter (mm)	4.41	4.43	4.47
5	Bulk density (kg/m^3)	298.83	296.64	291.62
6	Sphericity (%)	72.57	72.72	72.85
7	Volume (mm^3)	33.05	33.83	34.61
8	Surface area (mm^2)	61.32	62.13	63.24
9	Angle of repose (°)	29.75	30.76	32.73

The value of bulk density of the coriander seeds varied between 298.83 to 291.62 kg/m^3 with the various levels of moisture contents from 7.2 to 11.2%. The value of bulk density was decreasing with the increase in moisture content. Similar result was obtained in case of corn where the value of bulk density linearly decreased from 627.4-607.8 kg/m^3 as the moisture content increases from 10.39-19.64% (Probst *et al.* 2013) [9]. Sharanagat and Goswami (2014) [12] reported the value of bulk density of coriander seed decreased from 260 to 245.5 kg/m^3 at 8 to 15% moisture content (w.b.).

The values of sphericity of coriander seeds were varied from 72.57-72.85% for different moisture levels 7.2 to 11.2% (Table 1). It was increased linearly with increase in the moisture content. Similarly result was found by Baumler *et al.* (2006) [4] for Safflower seeds where sphericity increased

linearly from 0.58 to 0.62 with the increase in moisture content from 3.7-15.6% (d.b). The volume of the seeds of coriander varied from 33.05 mm^3 to 34.16 mm^3 as the moisture content increased from 7.2% to 11.2% (w.b.). Rathod *et al.*, (2020) [10] reported the same increasing trend of surface area from 2.38-9.45 mm^3 with the increase in moisture content for fenugreek seed. It was varied between 29.75 and 32.73º as the moisture content varied from 7.2 to 11.2% (w.b.).

4. Conclusion

The initial moisture content of fresh and dried coriander seed was 9.08% w.b. The length, width and thickness, geometric mean diameter, sphericity, angle of repose, volume and the surface area of the coriander seeds increased linearly with increase in moisture content from 7.2 to 11.2% wb. The bulk density was observed to follow decreasing trend with increase in moisture content in coriander.

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