International Journal of Environment, Agriculture and Biotechnology
Vol-9, Issue-3; May-Jun, 2024
Peer-Reviewed International Journal
Journal Home Page Available: https://ijeab.com/
Journal DOI: 10.22161/ijeab

Several imperious physical characteristics of the *Trachyspermum ammi L.* (ajwain seed)

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Received: 28 Mar 2024; Received in revised form: 03 May 2024; Accepted: 12 May 2024; Available online: 23 May 2024

Abstract— *In this study, ajwain seeds measured 2.64 ± 0.45 mm in length, 1.65 ± 0.34 mm in width, and 0.92 ± 0.15 mm in thickness at a moisture content of 6.45% (wet basis). The mean geometric diameter and sphericity were 2.16 ±0.10 mm and 0.635 ± 0, respectively. The ajwain seed has an oval shape and a ridged appearance. Its surface area and bulk density are 11.43 ±0.52 mm2 and 466.22 ±9.18 kg/m3, respectively. The angle of repose obtained was 39.90 degrees. The coefficient of friction between the ajwain seed and galvanized steel was 0.53.*

Keywords— ***Ajwain seeds, Geometric diameter, Bulk density, Angle of repose, Coefficient of friction***

I. INTRODUCTION

The physical attributes of spices pertain to their qualities, which are important for industrial procedures such as processing, handling, packaging, and storage. Ajwain, scientifically known as *Trachyspermum ammi L.*, is a member of the Apiaceae family and originated in Egypt and India. This herb is grown in dry and semiarid regions worldwide, including Iran, Pakistan, and Afghanistan. The seeds of Ajwain are extensively utilized in India and other parts of eastern Asia, both for culinary purposes and in traditional medicine. Due to its essential oil, Ajwain is considered a valuable commercial plant, particularly in the flavor and food industries. Spices play a crucial role in agriculture, serving as essential ingredients in culinary practices by enhancing the taste, aroma, and overall appeal of various dishes. (Pruthi, 1974). (Bairwa et al., 2012). Properties are essential for optimizing manufacturing processes and ensuring the quality and consistency of spice-based products in the food industry.

Ajwain seeds have distinct flavors and are utilized for a variety of culinary and therapeutic purposes due to their physical characteristics. Attributes may differ considerably among various varieties. The level of moisture in seeds plays a crucial role in the design of machinery and equipment used for planting, transporting, handling, storing, processing, and extracting seed oil (Kumar et al., 2016). Ajwain seeds are composed of a yellowish-brown essential oil (2-4%), which is utilized in numerous ayurvedic medications as well as in various food industries. Ajwain seeds have been traditionally utilized in ayurvedic and unani medicines for treating various ailments. The extracts derived from this spice are occasionally used as carminatives to alleviate flatulence and indigestion. Thymol, known for its germicidal and antiseptic properties, can be utilized in the formulation of remedies for cold and cough. In India, a decoction of ajwain seeds is frequently used to relieve asthma (Yadav, et al., 2011).

Singh, H., and Meghwal, M. (2020) described characteristics concerning seed quality, acceptability to consumers, and the behavior of ajwain before, during, and after manufacturing, storage, and consumption. The features that assist in designing handling, drying, and separation systems include size, shape, volume, surface area, density, and porosity. The grading and sizing equipment will be determined by the size and shape of the ajwain seeds. Additionally, the density and porosity of the seeds aid in sizing the hoppers and storage containers. In regard to separating seeds based on density or specific gravities, the density of the seeds will also play a crucial role. Furthermore, the design of storage bins, chutes,

hoppers, screw conveyors, threshers, and fodder harvesters can be facilitated by considering frictional qualities such as the coefficient of friction and angle of repose.

The objective of the present research was to determine the impact of the physical characteristics of the ajwain seed *Trachyspermum ammi L.*

II. MATERIALS AND METHODS

Ajwain seed

The Nathwani group of companies, situated in Jamnagar, Gujarat, India, furnished a large quantity of uniform ajwain seeds (*var. Gujarat Ajwain 1*). The ajwain seeds were stored at ambient temperature after being placed in aluminum laminates.

Fig 1. Ajwain seed

Characteristics

The characteristics that are important for size reduction include shape, size, sphericity, bulk density, surface area, etc. The physical properties of the ajwan seeds were determined using the methods described below.

Size and shape

After random selection from the bulk sample, the major (longest intercept), intermediate, and minor diameters of the Ajwain seeds were measured using a digital micrometer digital screw gauge (Figure). The digital screw gauge had a minimum length of 0.01 mm.

Fig.2. Digital micrometer screw gauge

The form was recognized by sketching the longitudinal and lateral cross sections on a cardboard, matching it with the shapes on the standard chart, and subsequently describing it with a phrase. The geometric mean diameter and sphericity of each seed were calculated using the formula provided. (Mohsenin, 1986).

$$Geometric\ Mean\ Diameter, Dg = (L * B * T)^{\frac{1}{3}} \ldots (3.1)$$

$$Sphericity, (\varphi) = \frac{(L*B*T)^{1/3}}{L} \ldots\ldots (3.2)$$

where

L = Longest intercept, (Length) in mm;

B = Longest intercept normal to 'L' (Breadth) in mm;

T= Longest intercept normal to 'L' and 'B' (Thickness) in mm.

Surface area

The surface area of the seed was determined using the following equation (Altuntas, et al., 2005):

$$Surface\ area,\ (Sa) = \Pi * (Dg)^2 \ldots\ldots (3.3)$$

where

Dg = Geometric mean diameter (mm)

Bulk density

To calculate the bulk density, seeds were added to a stainless steel cylinder until it was full. Any remaining seeds were then gently rolled over the container's rim with a cylindrical glass rod without applying any pressure (Carmen 1996). The bulk density was calculated by dividing the mass of the seeds that were placed inside the cylinder by its volume. The bulk density was computed using the method described in equation 3.4.

$$\rho_b = \frac{Mx}{Vc} \ldots\ldots (3.4)$$

where

ρ_b =Bulk density (kg/m^3)

Mx=Weight of sample, (kg)

Vc=Volume of the container, (m^3)

Angle of repose

A vertical cylinder constructed from a sheet that was open at both ends (Figure) was used to measure the angle of repose of the ajwain seeds. The cylinder was then filled with the seed and gently raised (Dutta, et al., 1988). Equation 3.5 was used to determine the angle of repose.

$$Angle\ of\ repose, \emptyset = tan^{-1}\frac{2h}{d} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.5)$$

where

h = height of the cone (mm)

d = diameter of the cone (mm)

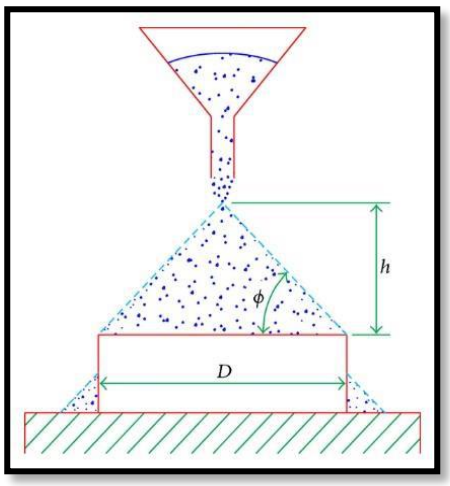
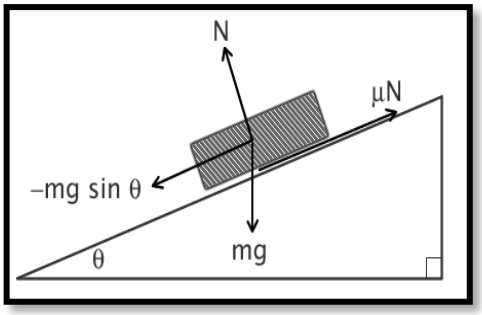


Fig.3. Measurement of the angle of repose

Coefficient of friction

The coefficient of static friction for the ajwain seeds was measured on galvanized steel using a box without a top or bottom. The surface was gradually elevated until the filled cube began to slide down, and the angle at this point was noted. The coefficient of static friction was then calculated using the provided formula. (Orhevba, et al., 2013).

$$\mu = \tan\theta \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.6)$$



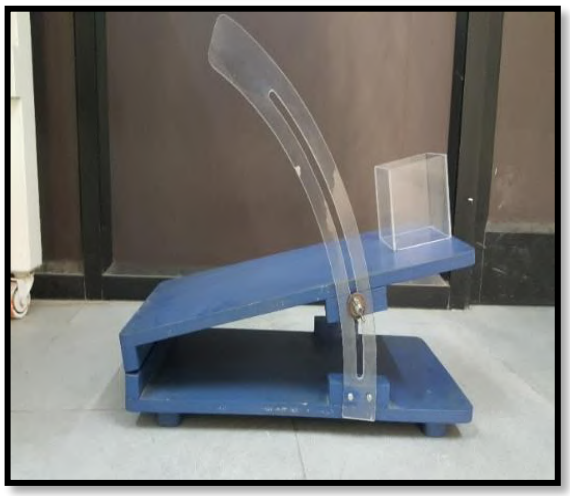


Fig.4. Measurement of the coefficient of friction

III. RESULTS AND DISCUSSION

Physical characteristics

The present analysis focused on the engineering properties of ajwain seeds, specifically their characteristics, such as size, shape, surface area, sphericity, coefficient of friction and angle of repose, which were determined according to the procedure described in the previous section. The data obtained are presented in Table.1

The average dimensions of the ajwain seeds, including length, width, and thickness, were 2.64 ± 0.45 mm, 1.65 ± 0.34 mm, and 0.92 ± 0.15 mm, respectively, with a moisture content of 6.45% (wet basis). These measurements play a crucial role in determining sieve apertures and various parameters in machine design (Mohsenin, 1986). Additionally, the average geometric mean diameter was 2.16 ± 0.10 mm, with a sphericity of 0.635 ± 0. The shape of the ajwain seeds was identified as oval with a ridged appearance, highlighting the importance of roundness and sphericity in predicting the drying behavior of agricultural grains (Orhevba, *et al*., 2013).

The average bulk density and surface area were found to be 466.22 ±9.18 kg/m3 and 11.43 ±0.52 mm2, respectively. When designing a storage system for ajwain seeds prior to processing, the surface area and bulk density are important factors to consider. The measured angle of repose was

39.90°. It was discovered that there was a 0.53 coefficient of friction between the galvanized steel and the ajwain seed. The design of hoppers, which are critical to the processing of agricultural products, depends on these discoveries. The physical characteristics that were noted are consistent with those that Zewdu (2011) reported; the few differences might be ascribed to variations in cultivars and environmental circumstances.

Table 1: Characteristics of ajwain seeds

Parameter	Mean values ± SDs
Size	Length: 2.64±0.45 mm
	Width: 1.65 ± 0.34 mm
	Thickness : 0.92 ± 0.15 mm
	Geometric mean diameter: 2.16±0.10 mm
Shape	Oval in shape with a ridged appearance.
Sphericity	0.635 ± 0.05
Surface area	11.43 ± 0.52 mm^2
Bulk density	466.22 ±9.18 kg/m^3
Coefficient of friction	0.53
Angle of repose	39.90°

IV. CONCLUSION

An investigation was conducted to examine the physical attributes of the ajwain seeds. Under conditions of constant moisture content, the measurements included dimensions, shape, sphericity, surface area, bulk density, coefficient of friction, and angle of repose, these several imperious physical characteristics are related to their qualities, which are significant for industrial processes like handling, processing, packing, and storing.

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