To study the Physico-chemical properties of *Lathyrus sativus*

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**Abstract**

The physical and mechanical properties are important for developing primary processing machinery. The geometric properties such as size and shape, equivalent diameter, sphericity, surface area, volume are the important physical properties used in developing machineries for separation and cleaning. The present study was undertaken to the axial dimension of *Lathyrus sativus* (Var. *Mahateora*). The four levels of moisture content were taken at 7.78, 9.54, 11.61 and 14.86 percent (dry basis). The average value of length, width and thickness were varied from 5.20 to 5.24 mm, 4.29 to 4.70 mm and 3.51 to 4.05 mm respectively. While the bulk density and true density was decreased from 848.84 to 794.44 kg/m³, 1218.32 to 1130.50 kg/m³. The surface area by equivalent diameter, surface area by axial dimension and porosity was found to be 55.85 to 67.75 mm², 50.83 to 62.73 m² and 30.84 to 31.46 percent. The angle of repose and coefficient of friction was varied in the range of 22.41 to 29.02 ° and plywood plate, galvanized iron plate and rubber plate surface were found to be varied 0.41 to 0.55, 0.45 to 0.58, 0.63 to 0.72 respectively. The proximate composition of *Lathyrus sativus* split *dhul* was observed the protein, fat, total ash, carbohydrate and fiber content as 22 percent, 2.3 percent, 2.90 percent, 60.00 percent, 3.94 percent respectively.

**Keywords:** *Lathyrus sativus*, physico-chemical properties, axial dimension, (Var. *Mahateora*)

**Introduction**

Pulses are the most prominent and economic source of vegetative protein and cheap source of body-building protein as well. The *Lathyrus sativus* are one of the most commonly using pulses all over the world. *Lathyrus* (*Lathyrus sativus* L.) belong to the Fabaceae family. From the morphological point of view of *Lathyrus sativus* is much-branched, herbaceous annual crop with a well –developed taproot system. In India the *Lathyrus sativus* is known as *Lakhori*, *Teora* and *Khesari*, and in Ethiopia it is also known as grass pea and chickling pea and chickling vetch. It contributes in overcoming the illnesses from many chronic diseases. Pulses are the low glycemic index foods having high fiber content. *Lathyrus* is a good source of polyphenol and antioxidant protein. India is the largest producer of this very important crop and rightly has highest consumer. In India the highest production of pulses was estimated to the tune of 23 million tonnes in the year 2016-2017. In addition to this it is one of the essential protein sources for nearly 80 percentage people of all age groups in their daily diet. *Lathyrus* seed contains the anti - nutritional properties such as phytic acid, tannins, and β-ODAP (β-Oxayl dianimopropionic acid). It has been seen from the literature survey, that excess consumption of *Lathyrus* causes the paralysis of the limb and arises many other health issues.

**Materials and Methods**

**Sample preparation**

The *Lathyrus sativus* used in the study was obtained from the local market of Raipur (C.G.). All the Foreign matters, impurities are cleaned and removed manually using sieves, bamboo winnowing basket and tray. In order to attain the desired moisture (7%, 9%, 11%, 14%) levels for the study, taken the (260g) *Lathyrus* seeds and adding a calculated amount of distilled water. The *Lathyrus* sample was well mixed and conditioned after that the sample were tightly packed in the plastic. The conditioned samples were kept in a refrigerator set at (5 ± 1 °C) for 7 days for to perform the uniformly moisture distribution.
Determination of physical properties

Equivalent diameter (Dₑ)

To determine the average size of seeds, for measuring equivalent diameter of *Lathyrus* seeds, four samples measuring 260 gm each were taken from the conditioned sample at different level of moisture content viz. 7%, 9%, 11%, and 14% respectively. From each sample, 50 randomly selected *Lathyrus* seeds were measured in the three mutually perpendicular directions the length, width, and thickness. The following formula was used to calculate the equivalent diameter Dhake et al. (2017); Ghamari et al. (2014); Kenghe et al. (2011) [9, 12, 20].

\[ Dₑ = (LWT)^{1/3} \]

Sphericity (⌀)

Sphericity denotes the roundness of the object. Initially 4 samples measuring 260 gm each were taken from the conditioned sample at different level of moisture content viz. 7%, 9%, 11%, and 14% respectively. Then 50 *Lathyrus* seeds were selected randomly and linear measurement was made in three mutually perpendicular directions. The sphericity was calculated by the formula. (Zewdu et al. 2008) [44].

\[ \varnothing = \frac{(LWT)^{1/3}}{L} \]

Gravimetric properties

Thousand seed mass (Mₜ)

For the thousand seeds mass, Randomly 100 *Lathyrus* seeds were taken from the (260 g) of *Lathyrus* seeds sample and weight measurement was done using the weighing balance. This way 10 lots of each 100 *Lathyrus* seeds were prepared. Thousand seed mass (Mₜ) was calculated by the following formula (Chouhan, 2018).

\[ Mₜ = \frac{1000 \times W_p}{nₜ} \]

Bulk density (ρₒ)

The bulk density of *Lathyrus* seeds was determined using the standard test weight procedure (Baryeh, 2001). The bulk density was calculated from the mass of *Lathyrus* seeds divided by the volume of the container. *Lathyrus* seeds were freely filled up to the top level in the beaker of 250 ml volume. No additional compaction was given during the process. The Following formula was used for calculating the bulk density of *Lathyrus* seeds.

Bulk density (ρₒ) = \( \frac{W}{V} \)

True density

The ratio of mass of sample to the true volume is termed as true density of the sample. The true density was determined using the toluene displacement method. The sample of 10 g *Lathyrus* seeds were immersed in graduated measuring cylinder in which 20 ml toluene was filled and then the amount of displaced toluene was recorded. According to (Singh and Goswami, 1996) [30] the true density was calculated using following formula:

True density, (ρₚ) = \( \frac{W}{V} \)

Where,

ρₚ = True density of seeds, Kg/m³

W = Weight of seed, Kg

V = Volume of seed, m³

Porosity

It is the percentage of volume of voids in the test sample at given moisture content. It was calculated as the ratio of the difference in the true and bulk density to the true density.

\[ \varepsilon = \frac{\rho_t - \rho_o}{\rho_t} \times 100 \]

Where

ρₒ = Bulk density, Kg/m³

ρₚ = True or particle grain density, Kg/m³

Frictional properties

Angle of repose

The angle of repose is the angle between the base and the slope of the cone formed by the vertical fall of the granular material on a horizontal plane. The angle of repose of the *Lathyrus* seeds was calculated from the height and the diameter of the naturally formed heap of the seeds on a particular plate which was measured by measuring scale. According to Zendu et al., (2008) [44] the following formula using calculating the angle of repose.

\[ \theta = \tan^{-1} \left( \frac{2H}{B} \right) \]

Where

H = Height of heap

B = Diameter of wooden plate

Coefficient of friction (µ)

The coefficient of kinetic friction was determined with respect to the three different surfaces viz; sheets plywood plates, galvanized iron plate and rubber plate. The *Lathyrus* seeds were fed in a square steel container. The square steel container was connected to a hanging weight carrier by means of a rope (thin thread), which is passed over a frictionless pulley at the one end of the table. The container was placed on the surface sheet and weight (200g, 100g, 50g, 20g, 10g, 5g) were added to the hanging carrier gradually until container just started to slide on the surface. According to Zewdu et al. (2008) [44] the formula was used to determine the coefficient of friction (µ).

\[ \mu = \frac{F}{R} \]

Where

µ = Coefficient of friction

F = Force of limiting friction

R = Normal reaction

Results and Discussions

Grain dimension

The determined physical properties of the moisture content of the *Lathyrus* seeds were found to be varied from 7.78 to 14.86 percent (db) while the length, width, and thickness was varied from ranged 5.20 to 5.24 mm, 4.29 to 4.70 mm and 3.51 to 4.05 mm respectively. Similarly reported by Dhake et al. (2017); Ghamari et al. (2014); Kenghe et al. (2011) [9, 12, 20]

Sphericity

The sphericity of *Lathyrus* seeds were varied from 0.811 to 0.884 percent.
**Equivalent diameter**
Equivalent diameter of *Lathyrus* seeds were varied from 4.20 to 4.62 mm with respect to moisture content range from 7.78 to 14.86 percent.

**Thousand seed mass**
The thousand seeds weights of *Lathyrus* were increased with respect to moisture content range from 79.97g to 83.50 g.

**Bulk density**
The bulk density and true density of *Lathyrus* seeds was decreased from 848.84 to 794.44 kg/m$^3$, 1218.32 to 1130.50 kg/m$^3$.

**Surface area**
The surface area of Lathyrus seeds were calculated by two different methods. The surfaces are by equivalent diameter and surface area by axial dimension. The surface area by equivalent diameter was found to be 55.85 to 67.75 mm$^2$ and the surface area by axial dimension was found to be 50.83 to 62.27mm$^2$.

**Porosity**
The porosity of *Lathyrus* seeds was varied in the range of 30.84 to 31.46 percent.

**Angle of repose**
The angle of repose of *Lathyrus* seed were varied in the range of 22.41 to 29.02 ° with respect to moisture content range of 7.78 to 14.86 percent (db).

**Coefficient of friction**
The coefficient of friction of *Lathyrus* seeds for plywood plate, galvanized iron plate and rubber plate surface were found to be varied in the range of 0.41 to 0.55, 0.45 to 0.58, 0.63 to 0.72.

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**Fig 1:** Effect of moisture content on axial dimension of *Lathyrus* seeds

**Fig 2:** Effect of equivalent diameter of *Lathyrus* seeds with respect to moisture

**Fig 3:** Effect of moisture content on sphericity of *Lathyrus* seeds
Fig 4: Effect of moisture content on volume of *Lathyrus* seeds

\[ V = 1.906 \, M_C + 17.33 \]
\[ R^2 = 0.977 \]

Fig 5: Effect of moisture content on thousand seeds weight of *Lathyrus* seeds

\[ W_{1000} = 0.476 \, M_C + 77.07 \]
\[ R^2 = 0.738 \]

Fig 6: Effect of moisture content on bulk density of *Lathyrus* seeds

\[ \rho_b = -11.42M_C + 929.4 \]
\[ R^2 = 0.904 \]

Fig 7: Effect of moisture content on true density of *Lathyrus* seeds

\[ \rho_t = -13.48 \, M_C + 1316 \]
\[ R^2 = 0.794 \]
Conclusion
From the results of experimental studies it can be concluded that physical properties including axial dimension, equivalent diameter, sphericity, volume, thousand seed weight, surface area, porosity, angle of repose, coefficient of friction were increasing with respect to moisture.

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