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

**Lakra LP and S Patel**DOI: <https://doi.org/10.22271/chemi.2021.v9.i1b.11220>**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/m<sup>3</sup>, 1218.32 to 1130.50 kg/m<sup>3</sup>. The surface area by equivalent diameter, surface area by axial dimension and porosity was found to be 55.85 to 67.75 mm<sup>2</sup>, 50.83 to 62.27 mm<sup>2</sup> 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 *dhal* 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  $\beta$ -ODAP ( $\beta$ -Oxalyl diaminopropionic 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  $\pm$  1 °C) for 7 days for to perform the uniformly moisture distribution.

## Determination of physical properties

### Equivalent diameter ( $D_e$ )

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%, 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].

$$D_e = (LWT)^{1/3}$$

### Sphericity ( $\phi$ )

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].

$$\phi = \frac{(LWT)^{1/3}}{L}$$

## Gravimetric properties

### Thousand seed mass ( $M_t$ )

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 ( $M_t$ ) was calculated by the following formula (Chouhan, 2018).

$$M_t = \frac{1000 \times W_p}{n_s}$$

### Bulk density ( $\rho_b$ )

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.

$$\text{Bulk density } (\rho_b) = \frac{W}{V}$$

### 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:

$$\text{True density, } (\rho_t) = \frac{W}{V}$$

Where,

$\rho_t$  = True density of seeds, Kg/m<sup>3</sup>

W = Weight of seed, Kg

V = Volume of seed, m<sup>3</sup>

### 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.

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

### Where

$\rho_b$  = Bulk density, Kg/m<sup>3</sup>

$\rho_t$  = True or particle grain density, Kg/m<sup>3</sup>

## 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 Zewdu *et al.*, (2008) [44] the following formula using calculating the angle of repose.

$$\theta = \tan^{-1} \frac{2H}{B}$$

### Where

H = Height of heap

B = Diameter of wooden plate

### Coefficient of friction ( $\mu$ )

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 ( $\mu$ ).

$$\mu = F/R$$

### Where

$\mu$  = 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 varied 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<sup>3</sup>, 1218.32 to 1130.50 kg/m<sup>3</sup>

**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<sup>2</sup> and the surface area by axial dimension was found to be 50.83 to 62.27mm<sup>2</sup>.

**Porosity**

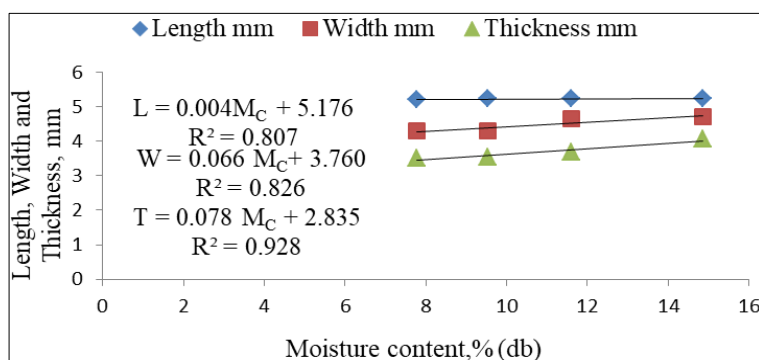
The porosity of *Lathyrus* seeds was varied in the range of 30.84 to 31.46 percent.

**Angle of repose**

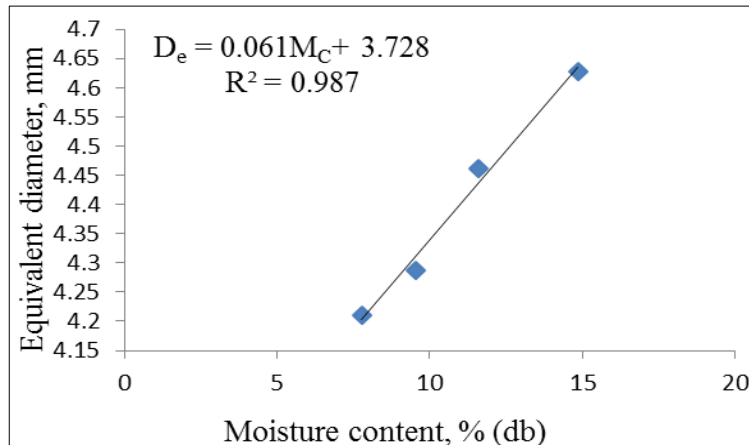
The angle of repose of *Lathyrus* seed were varied in the range of 22.41 to 29.02 ° with respect to moisture content range of 7.78 to 14.86 percent (db).

**Coefficient of friction**

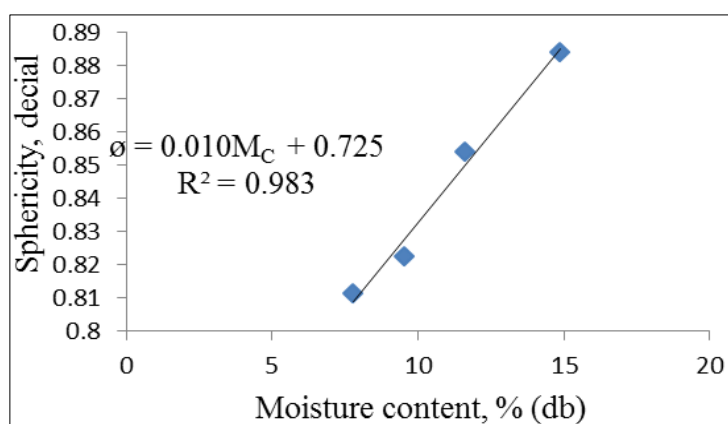
The coefficient of friction of *Lathyrus* seeds for plywood plate, galvanized iron plate and rubber plate surface were found to be varied in the range of 0.41 to 0.55, 0.45 to 0.58, 0.63 to 0.72.



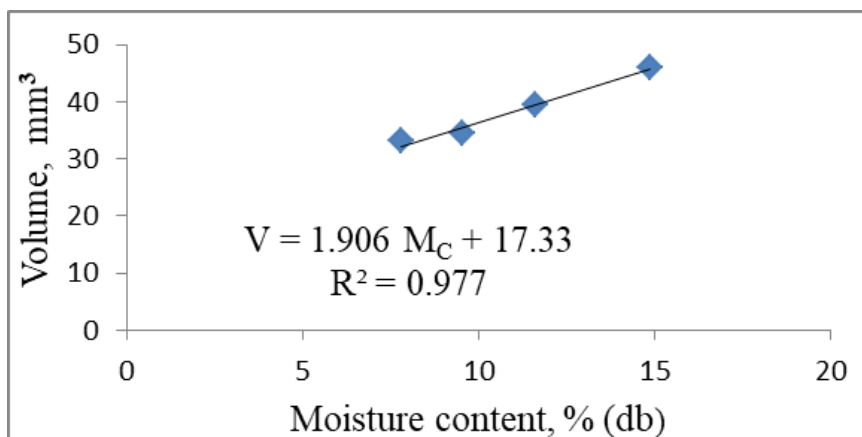
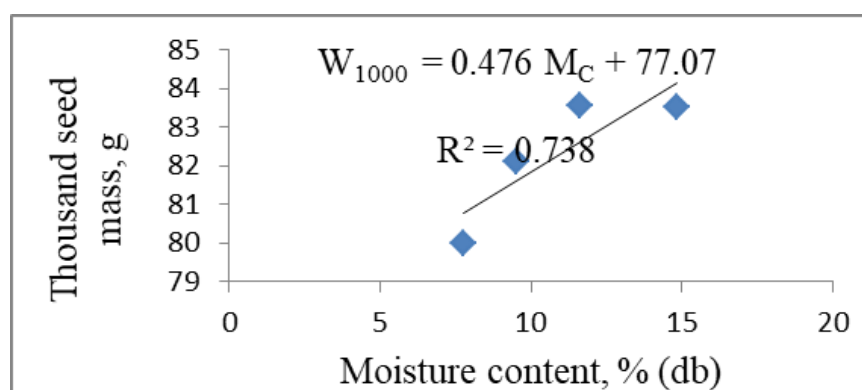
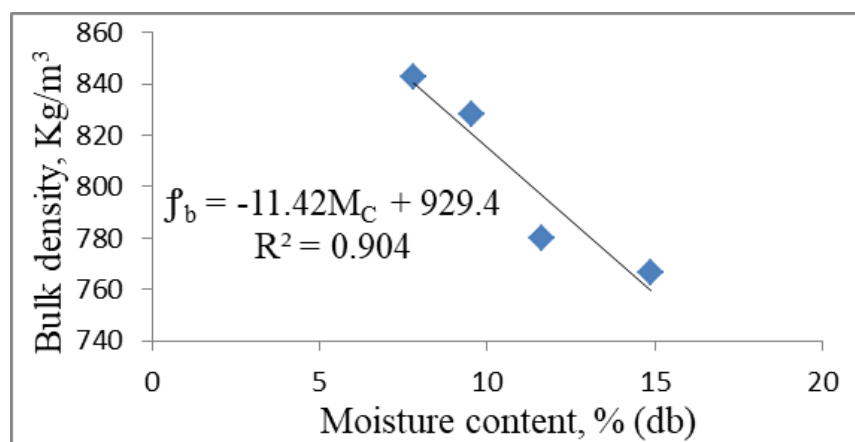
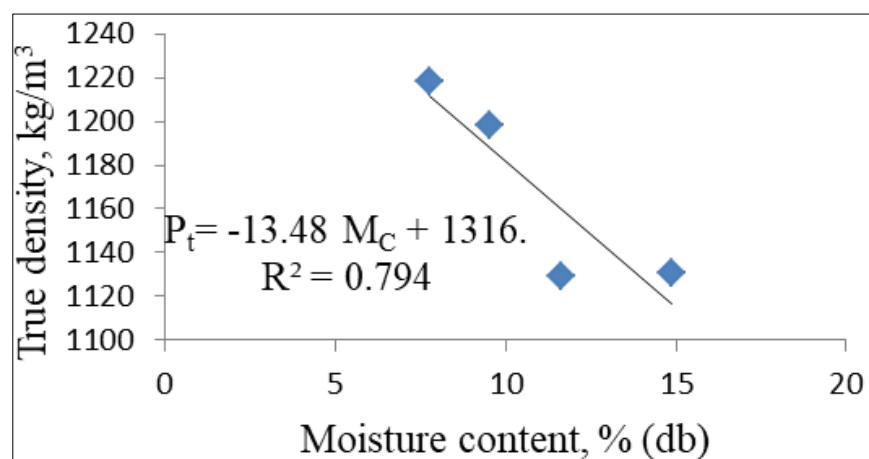
**Fig 1:** Effect of moisture content on axial dimension of *Lathyrus* seeds



**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* seedsFig 5: Effect of moisture content on thousand seeds weight of *Lathyrus* seedsFig 6: Effect of moisture content on bulk density of *Lathyrus* seedsFig 7: Effect of moisture content on true density of *Lathyrus* seeds

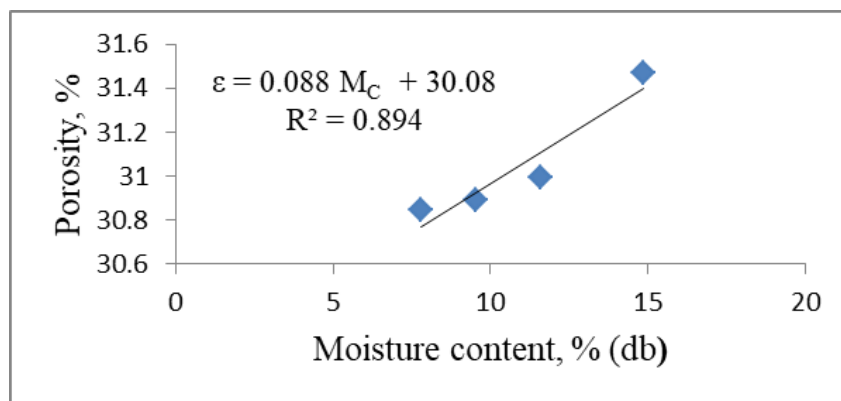


Fig 8: Effect of moisture content on porosity of *Lathyrus* seed

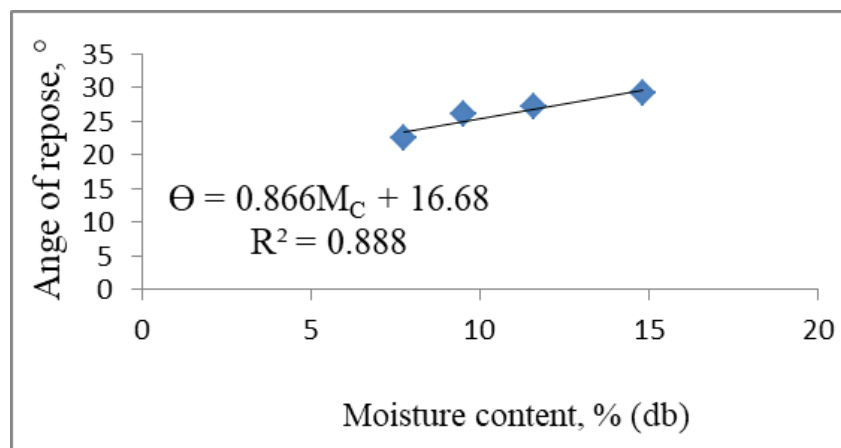


Fig 9: Effect of moisture content on angle of repose of *Lathyrus* seeds

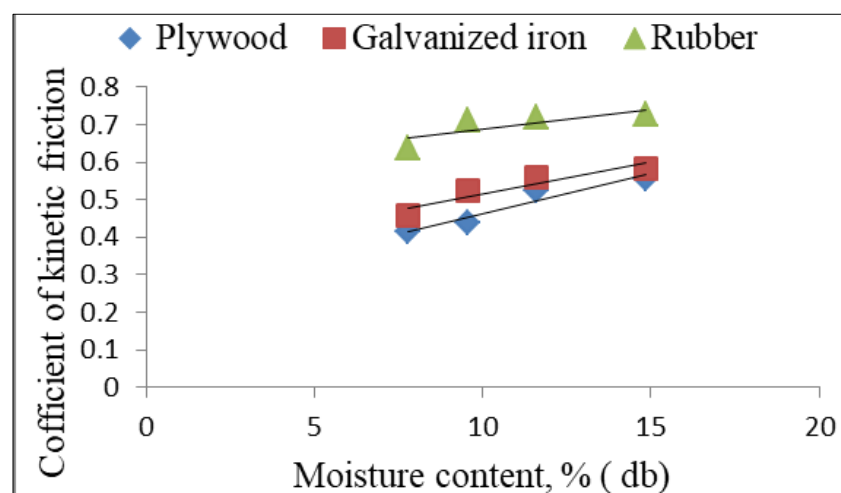


Fig 10: Effect of moisture content on coefficient of kinetic friction of *Lathyrus* seeds

## 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.

## References

1. Akalu G, Johansson G, Nair BM. Effect of processing on the content of  $\beta$ -N-oxalyl- $\alpha$ ,  $\beta$ -diamino propionic acid ( $\beta$ -ODAP) in grass pea (*Lathyrus sativus*) seeds 1998.
2. Amin MN, Hossain MA, Roy KC. Effects of moisture content on some physical properties of lentil seeds. Journal of Food Engineering 2004;65(1):83-87.
3. Aruna T, Devindra S. Nutritional and anti-nutritional characteristics of two varieties of red gram (*Cajanus Cajan*) seeds 2016;6(9):2250-3153.
4. AOAC. Official methods of analysis, 17th Edition. Association of Official Analytical Chemists, Arlington, Virginia 2000;6:2250-3153.
5. Bakhtiari MR, Ahmad D, Othman J, Ismail N. Physical and mechanical properties of kenaf seed applied engineering in agriculture 2011;27(2):263-268.
6. Bamgbaye IA, Adebayo SE. Seed moisture dependent on physical and mechanical properties of *Jatropha curcas* 2012.
7. Baran MF, Durgut MR, Aktaş T, Ülger P, Kayışoğlu B. Determination of some physical properties of rapeseed 2016.



8. Chowdhury MMI, Sarker RI, Bala BK, Hossain MA. Physical properties of gram as a function of moisture content. *International Journal of Food Properties* 2001;4(2):297-310.
9. Dhake KP, Gajabe MH, Burbade RG. Moisture dependent physical properties of Bengal gram seeds (*Cicer arietinum* L.) 2017.
10. Dutta SK, Nema VK, Bhardwaj RK. Physical properties of gram. *Journal of Agricultural Engineering Research* 1988;39(4):259-268.
11. Ganjloo A, Bimakr M, Zarringhalami S, Safaryan JM, Ghorbani M. Moisture-dependent physical properties of green peas (*Pisum sativum* L.). *International Food Research Journal* 2018;25(3):1246-1252.s
12. Ghamari S, Mohammadi K, Khanahmadzadeh A, Goli H. Evaluation the some physical properties of chickpea seeds in Kurdistan region of Iran. *International Journal of Agriculture and Forestry* 2014;4(3A):4-7.
13. Ghodki BM, Goswami TK. Effect of moisture on physical and mechanical properties of cassia. *Cogent Food & Agriculture* 2016;2(1).
14. Habibullah AM, Shah HU. Proximate and mineral composition of mung bean. *Sarhad J Agric* 2007;23(2):463-466.
15. Hailu D, Abera S, Tekla TA, Box PO, Jimma E. Effects of Processing on Nutritional Composition and Anti-Nutritional Factors of Grass pea (*Lathyrus Sativus* L): A review 2015;36:61-71.
16. Jain RK, Bal S. Properties of pearl millet. *Journal of agricultural engineering research* 1997;66(2):85-91.
17. Jouki M, Khazaei N. Some physical properties of rice seed (*Oryza sativa*). *Research journal of applied sciences, engineering and technology* 2012;4(13):1846-1849.
18. Jukanti AK, Gaur PM, Gowda CLL, Chibbar RN. Nutritional quality and health benefits of chickpea (*Cicer arietinum* L.): a review. *British Journal of Nutrition* 2012.
19. Karababa E, Coşkun Y. Moisture dependent physical properties of dry sweet corn kernels. *International Journal of Food Properties* 2007;10(3).
20. Kenghe RN, Nimkar PM, Shirkole SS. Moisture dependent physical properties of *Lathyrus*. *Journal of food science and technology* 2013;50(5):856-867.
21. Nimesh A, Sharanagat VS. Effect of moisture content on engineering properties of chickpea seed. *Agricultural Engineering Today* 2016;40(1).
22. Poomsa-ad N, Wiset L, Duangkhamchan W. Effect of moisture content on physical and aerodynamic properties of sorghum. *Journal of Medical and Bioengineering* 2014;3(3).
23. Ramakrishna V, Rani PJ, Rao PR. Anti-nutritional factors during germination in Indian bean (*Dolichos lablab* L.) seeds. *World Journal of Dairy & Food Sciences* 2006;1(1):06-11.
24. Ramezani PN. Induction of mutation inL grasspea *Lathyrus sativus* Linn through gamma radiation and ethyl methanesulphonate 2015.
25. Razavi SMA, Yeganehzad S, Sadeghi A. Moisture dependent physical properties of canola seeds. *J. Agric. Sci. Technol* 2009;11(3):309-322.
26. Sangani VP, Davara PR. Moisture dependent physical properties of pigeon pea grains. *International Journal of Postharvest Technology and Innovation* 2013;3(1).
27. Seifi MR, Alimardani R. Comparison of moisture-dependent physical and mechanical properties of two varieties of corn (Sc 704 and Dc 370). *Australian Journal of Agricultural Engineering* 2010;1(5).
28. Sharon MEM, Abirami CK, Alagusundaram K, RPS, JA. Moisture Dependent Physical Properties of Black gram. *Agricultural Engineering International: CIGR Journal* 2015;17(1).
29. Singh U, Voraputhaporn W, Rao PV, Jambunathan R. Physico-chemical characteristics of pigeon pea and mung bean starches and their noodle quality. *Journal of Food Science* 1989;4(5):1293-1297.
30. Singh KK, Goswami TK. Physical properties of cumin seed. *Journal of Agricultural Engineering Research* 1996;64(2):93-98.
31. Sonawane AV, Rajwade YA, Singh D, Desai S, Rajurkar GB. Moisture dependent physical properties of horse gram. *International Agricultural Engineering Journal* 2014;23(2):7-14.
32. Srivastava S, Khokhar S. Effects of processing on the Reduction of  $\beta$ -ODAP ( $\beta$ -N-Oxalyl-L-2, 3-diaminopropionic acid) and Anti-Nutrients of Khesari Dhal, *Lathyrus sativus*. *Journal of the Science of Food and Agriculture* 1996;71(1):50-58.
33. Taghi Gharibzahedi SM, Mousavi SM, Ghahderijani M., A survey on moisture-dependent physical properties of castor seed (*Ricinus communis* L.). *Australian Journal of Crop Science* 2011;5(1):1.
34. Tavakoli M, Tavakoli H, Rajabipour A, Ahmadi H, Gharib-Zahedi SMT. Moisture-dependent physical properties of barley grains. *International Journal of Agricultural and Biological Engineering* 2010;2(4):84-9
35. Tunde-Akintunde TY, Akintunde BO. Some physical properties of sesame seed. *Biosystems Engineering* 2004;88(1):127-129.
36. Urga K, Fite A, Kebede B. Nutritional and antinutritional factors of grass pea (*Lathyrus sativus*) germplasms. *Bulletin of the Chemical Society of Ethiopia* 1995;9(1).
37. Urga K, Fite A, Kebede B. Nutritional and antinutritional factors of grass pea (*Lathyrus sativus*) germplasms. *Bulletin of the Chemical Society of Ethiopia* 1995;9(1).
38. Urga K, Fufa H, Biratu E, Husain A. Evaluation of *Lathyrus sativus* cultivated in Ethiopia for proximate composition, minerals,  $\beta$ -ODAP and anti-nutritional components. *African Journal of Food, Agriculture, Nutrition and Development* 2005;5(1).
39. Woldemedhin AF. Improving the nutritional quality of *Lathyrus sativus* L. (grass pea) for safer consumption 2008.
40. Yalçın İ, Özarslan C. Physical properties of vetch seed. *Biosystems Engineering* 2004;88(4):507-512
41. Yan ZY, Spencer PS, Li ZX, Liang YM, Wang YF, Wang CY *et al.* *Lathyrus sativus* (grass pea) and its neurotoxin ODAP. *Phytochemistry* 2006;67(2):107-121.
42. Yerra S, Putta S, Kilari EK. The role of Food Processing Techniques in the detoxification of ODAP IN *Lathyrus sativus*. *International Journal of Information Research and Review* 2016;3(8).
43. Zareiforoush H, Komarizadeh MH, Alizadeh MR. Effect of moisture content on some physical properties of paddy grains. *Research Journal of Applied Sciences, Engineering and Technology* 2009;1(3).
44. Zewdu AD, Solomon WK. Moisture-dependent physical properties of grass pea (*Lathyrus sativus* L.) seeds. *Agricultural Engineering International: CIGR Journal* 2008.