Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.6177

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **6 (1):** 573-579 (2018)

International Journal of Pure & Applied Bioscience

Research Article

OPEN ACCESS

Some Physical Properties of Green Pea

Khilendra Kumar Sonboier[1], Kipoo Kiran Singh Mahilang[2*], Pankaj Minj[1], Pallavi Porte[3] and Tapti Taran[4]

[1]Department of APFE, SHIATS, Allahabad, UP, India

[2]Department of FMP, SVCAET&RS, IGKV, Raipur, CG, India

[3]Department of WRE, SHIATS, Allahabad, UP, India

[4]Department of FPT, Bilaspur University, Bilaspur, CG, India

*Corresponding Author E-mail: mahilang19vishu91@gmail.com

Received: 18.01.2018 | Revised: 20.02.2018 | Accepted: 23.02.2018

ABSTRACT

The study was undertaken to determine the physical properties of green pea. The variety of pea taken for the study was Arkel and the seeds tend to be round or wrinkled in shape. The research work was carried out in the laboratory at the Department of Food Process Engineering, SHAITS, Allahabad. Test parameters taken for the study were geometric dimensions of pea seeds i.e. Average length (L), width (W) and thickness (T), Geometric mean diameter (Dp), Sphericity (ϕ), Mass, Moisture Content, Bulk density, True density, angle of repose and coefficient of friction. The results showed that the average length, width and thickness of pea seeds vary from 8.50 to 10.20 mm, 6.50 to 8.50 mm and 4.00 to 5.10 mm respectively. The Geometric mean diameter (Dp) by Mohsenin method and Sphericity by Sahay and Singh method for pea was 6.94 and 0.74 respectively. The moisture content of green pea was found to be 63.5 (% wb). The Bulk density and True density by Mohsenin method for pea varies from 563.99 to 571.55 kg/m^3 and 985.66 to 991.88 kg/m^3 respectively. Angle of repose and Coefficient of friction of green pea varies from 27.31° to 28.86° and 0.57 to 0.72 respectively.

Key words: *Pea, Moisture content, Sphericity, Shelling machines, Geometric mean diameter.*

INTRODUCTION

Pea (*Pisum Sativum* L.) a member of the family Fabaceae, is an important cool-season and nutritious leguminous vegetables. It is high yielding, relatively stable crop and is extensively grown in temperate zone. These vegetables not only increase the taste but also provide us protein, salt, mineral, calcium iron, carbohydrate and vitamins[1].

India is one of the largest producers of pea in the world and stands at the 5th place in the list of major pea producers next to France. The Indian production contributes to around 7 % in the world's total produce with the production figures of 7.8 lakh tonnes. In India peas are mainly grown in Uttar Pradesh, Madhya Pradesh, Himachal Pradesh, Jharkhand, Punjab, Haryana, and Uttarakhand[2].

Cite this article: Sonboier, K.K., Mahilang, K.K.S., Minj, P., Porte, P. and Taran, T., Some Physical Properties of Green Pea, *Int. J. Pure App. Biosci.* **6(1):** 573-579 (2018). doi: http://dx.doi.org/10.18782/2320-7051.6177

To design any agricultural processing equipment for any seeds there is a need to know about its physical properties and then these properties must be determined at laboratory conditions. Like the geometric properties such as size and shape are one of most important physical properties considered during the separation and cleaning of peas. Similarly, other properties are also helpful in other operations. Although the recent scientific developments have improved but though, little is known about the basic physical characteristics of these materials. This basic information will be important not only to engineers, but also to food scientists, researchers and other scientists who may find new uses[3].

The objective of this study was to determine some physical properties of green pea to develop appropriate technologies in design and adjustment of machines used during harvesting, separating, cleaning, handling and storing of agricultural materials and to give final shape in form of food, feed and fodder[4].

MATERIAL AND METHODS

2.1Physical Properties of Green Pea

2.1.1 Average Length (L), Width (W) and Thickness (T)

To determine the size and **s**hape of the pea, a sample of 10 seeds were randomly picked.

The dimensions along three perpendiculars mutually axes of the pea was measured with a Vernier caliper to an accuracy of 0.01mm. The Average length (L), width (W) and thickness (T) was calculated by using the following relationship 2.1, 2.2, and 2.3

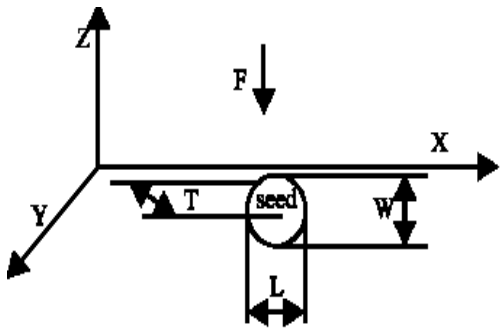

Fig. 2.1 shows the measurement of length, width and thickness of green pea pods

$$\mathbf{L} = \frac{\sum_{i=1}^{n} \mathbf{L}}{n} \quad \ldots (2.1)$$

$$\mathbf{W} = \frac{\sum_{i=1}^{n} \mathbf{W}}{n} \ldots (2.2)$$

$$\mathbf{T} = \frac{\sum_{i=1}^{n} \mathbf{T}}{n} \quad \ldots (2.3)$$

Where,

L = Major diameter (length), mm;

W= Intermediate diameter (width), mm; and

T = Minor diameter (Thickness), mm.

2.1.2 Geometric Mean Diameter (Dp)

The geometric mean diameter (Dp) was calculated by using the following relationship 2.4. $\mathbf{D_P} = (\mathbf{LWT})^{\frac{1}{3}} \quad \ldots (\mathbf{2.4})$

Where,

L = Major diameter (length), mm;

W= Intermediate diameter (width), mm; and

T = Minor diameter (Thickness), mm.

Fig 2.2 Measurement of Dimensions of Green Pea Using Vernier Caliper

2.1.3 Sphericity (ϕ)

Sphericity is defined as the ratio of the diameter of a sphere of the same volume as that of the particle and the diameter of the smallest circumscribing sphere or generally the largest diameter of the particle [8].This parameter shows the shape character of green pea relative to the sphere having the same volume and the sphericity was calculated by relationship 2.5.

Sphericity

$$= \sqrt{\frac{\text{Volume of particles}}{\text{Volume of circumdsribed Sphere}}}$$

$$= \frac{(\mathbf{LWT})^{1/3}}{\mathbf{L}} \quad \ldots (2.5)$$

Where,

L = Major diameter (length), mm;

W= Intermediate diameter (width), mm; and

T = Minor diameter (Thickness), mm.

2.1.4 Mass of Green Pea

Thousand seed weight (TSW) was measured by counting 100 seeds and weighing them in an electronic balance to an accuracy of 0.001 g

and then multiplied by 10 to give mass of 1000 seeds.

2.1.5 Determination of Moisture Content

The fresh green pea was purchased from local market in Allahabad city. The sample was manually shelled. Moisture content of the sample was determined by standard air oven method.

Test sample of 100 gm was kept for 24 hours in hot air electric oven maintained at 100 °C. After 24 hr the sample was drawn from the oven and placed in a dessicator for cooling to ambient temperature conditions. After cooling the weight of the sample was taken precisely. The loss in weight was determined and moisture content was calculated by relationship 2.6.

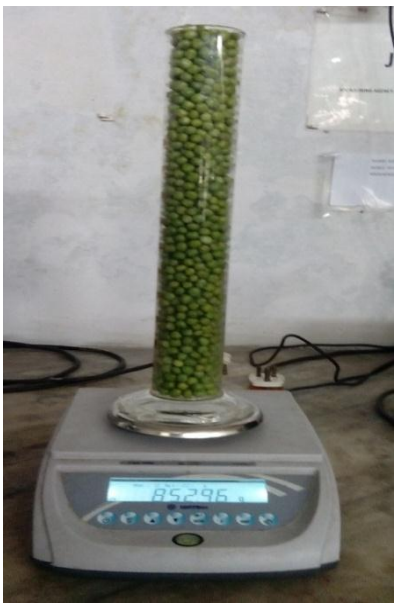

Fig 2.3 Measurement of Bulk Density of Green Pea

2.1.7 True Density

True density was determined using the toluene (C_7H_8) displacement method. 250 ml toluene was used in place of water, because it is not absorbed by peas. The volume of toluene displaced was found by immersing pea of know mass in the toluene.

$$\textbf{True Density}\left(\frac{\textbf{g}}{\textbf{cm}^3}\right) = \frac{\textbf{Weight of sample (g)}}{\textbf{Volume displaced (cm}^3\textbf{)}} \ldots (2.8)$$

$$\textbf{Moisture}\ \% = \frac{W1-W2}{W1-W}\textbf{X}\ 100 \ldots (2.6)$$

Where,

W = Weight of petridish (g)

W_1 = Weight of petridish + sample (g); and

W2 = Weight of petridish + dried sample (g).

2.1.6 Bulk Density

Bulk density of green pea was calculated by placing the sample of green pea in a measuring cylinder which has 5.4 cm of diameter and 36.7 cm of length. The sample was taken in the cylinder was weighed using an electronic balance with least count of 1g.

$$\textbf{Bulk Density} = \frac{\textbf{Mass of sample (g)}}{\textbf{Volumeof flask occupied by sample (cm}^3\textbf{)}} \ldots (2.7)$$

Fig 2.4 Measurement of True Density of Green Pea

2.1.8 Determination of Angle of Repose

The angle of repose is the angle between the base and the slope of the cone formed by vertical fall of the granular material on a horizontal plane. The size, shape, moisture content and orientation of pods affects the angle of repose.

Angle of repose was calculated by making the regular heap by dropping the green pea through over smooth surface. The height and diameter of the heap were measured by measuring tape. Angle of repose was measured by using relationship 2.9.

$$\textbf{Angle of Repose(degree)} = \tan^{-1}\frac{\textbf{h}}{\textbf{r}} \ldots (2.9)$$

Where,

h = Height of heap (cm); and

r = Radius of heap (cm).

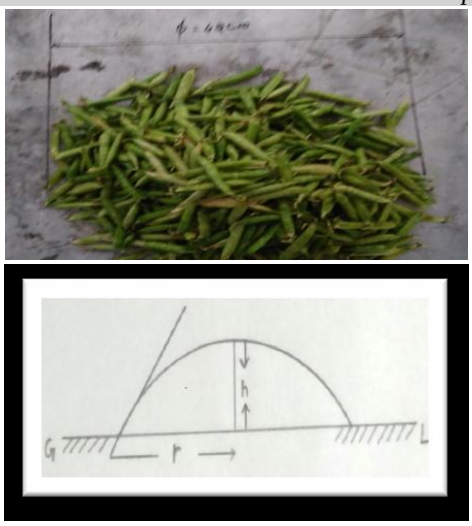

Fig 2.5 Measurement of Angle of Repose of Green Pea

2.1.9 Coefficient of Friction

Coefficient of friction between granular materials is equal to the angle of internal friction for the material. The frictional coefficient depends on the shape, surface characteristics and moisture content of green pea[8]. The coefficient of friction measured by using relationship 3.11 and the Fig.3.5 shows measurement of coefficient of friction of green pea.

$$\mu = \tan\theta \quad \ldots (2.10)$$

Where,

μ = Coefficient of friction; and

Θ = Angle of friction.

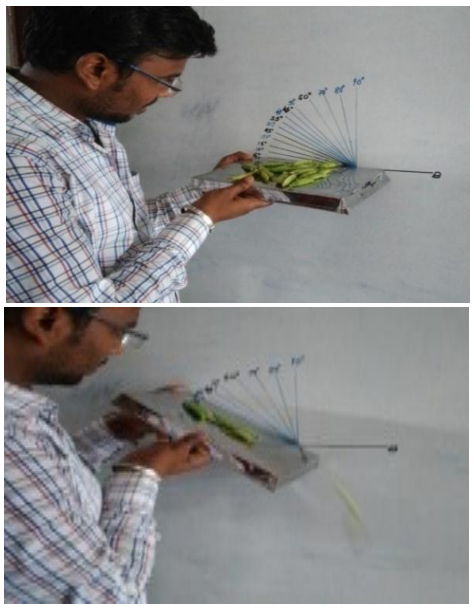

Fig 2.6 Measurement of Coefficient of friction of Green Pea

RESULTS AND DISCUSSIONS

3.1 Physical Properties of Green Pea

3.1.1 Size and Unit Mass of Green Pea

'Arkel' Variety of green pea was taken for study. 10 green pea seeds sample were selected for the determination of unit mass and physical dimensions (viz. length, width and thickness).

The moisture content of green pea was found to be 63.5 (% wb). Table 3.1 represents the geometric properties of green pea.

Length of fresh green pea varies from 8.50 to 10.20 mm with the average length of 9.38 mm. The SD and coefficient of variance was calculated to be 0.518 mm and 5.522 per cent respectively. Similarly width range varies from 6.50 to 8.50 mm with average of 7.87 mm. The SD and coefficient of variance was calculated to be 0.566 mm and 7.191 per cent respectively. The thickness varies from 4.00 to 5.10 mm with average thickness of 4.53 mm. The SD and coefficient of variance was calculated to be 0.371 cm and 1.189 per cent respectively.

The geometric mean diameter and sphericity of green pea seeds were found to be 6.94 and 0.74 on average of 10 green pea seeds. The SD of geometric mean diameter and sphericity was found to be 0.439 cm and 0.016 percent respectively. The coefficient of Variance for geometric mean diameter and sphericity was observed to be 6.325 and 2.162 percent respectively.

3.1.2 Bulk Density of Green Pea

A measuring cylinder of 500 ml capacity was used to measure the bulk density of green pea. Four replicated trials were conducted using a measuring cylindrical having diameter 5.4 cm and length of 36.7 cm.

Average weight of sample is found to be 476.13 g and the bulk density obtained 566.77 kg/m^3. The range of bulk density varies from 563.99 to 571.55 kg/m^3.The bulk density of green pea is shown in Table 3.2.

3.1.3 True Density of Green Pea

A measuring cylinder of 500 ml capacity was used to measure true density of green pea. A 250 ml of toluene was used to fill the void between the seeds.

Average weight of sample was found 110.00 g and the average volume of and toluene was found 361.20 ml. the average volume of true density was calculated of 988.10 kg/m^3 whereas, the range of true density was found to vary from 985.66 to 991.88 kg/m^3. The true density of green pea is shown in Table 3.3.

3.14 Angle of Repose of Green Pea

It is evident from the data that angle of repose for green pea over SS sheet ranges between 27.31° to28.86° with an average of 28.37°. The average angle of repose of green pea is shown in Table 3.4.

3.1.5 Coefficient of Friction of Green Pea

Coefficient of friction was measured by using inclined plane apparatus. The average value of coefficient of friction for green pea to stainless steel sheet ranges from 0.57 to 0.72 with an average of 0.67. The average Coefficient of friction of green pea is shown in Table 3.5.

Table: 3.1 Geometric Properties of Selected Green Pea

S.N.	Length (mm)	Width (mm)	Thickness (mm)	Geometric Mean Diameter (mm)	Sphericity
1	9.50	8.00	4.20	6.83	0.72
2	9.10	7.90	4.00	6.60	0.73
3	9.00	7.40	4.20	6.54	0.73
4	10.20	8.50	5.10	7.62	0.75
5	9.40	8.00	4.50	6.97	0.74
6	9.70	8.20	4.90	7.30	0.75
7	8.50	6.50	4.30	6.19	0.73
8	9.20	8.10	4.80	7.10	0.77
9	10.10	8.30	4.90	7.43	0.74
10	9.10	7.80	4.40	6.78	0.75
Average	**9.38**	**7.87**	**4.53**	**6.94**	**0.74**
Range	**8.50-10.20**	**6.50-8.50**	**4.00-5.10**	**6.54-7.62**	**0.72-0.77**
SD	0.518	0.566	0.371	0.439	0.016
CV	5.522	7.191	8.189	6.325	2.162

Table: 3.2 Determination of bulk density of Green Pea

Sample No	Sample weight(g)	Cylinder volume(cm^3)	Bulk Density(kg/m^3)
Sample 1	475.40	840.08	565.89
Sample 2	473.80	840.08	563.99
Sample 3	475.20	840.08	565.66
Sample 4	480.15	840.08	571.55
Average	**476.14**	**840.08**	**566.77**
Range	**473.80-480.15**		**563.99-571.55**

Table: 3.3 Determination of True Density of Green Pea

Sample No	Sample weight (g)	Volume of seeds + toluene (cm^3)	Volume of toluene (cm^3)	True density (kg/m^3)
Sample 1	110.00	361.60	250	985.66
Sample 2	110.00	360.90	250	991.88
Sample 3	110.00	361.60	250	985.66
Sample 4	110.00	361.20	250	989.20
Average	**110.00**	**361.20**	**250**	**988.10**

Table: 3.4 Determination of Angle of Repose of Green Pea

S.No.	Height of heap (cm)	Radius of heap (cm)	Angle of repose Ø for SS sheet
1	11.5	21	28.70°
2	11.3	20.5	28.86°
3	11	21.3	27.31
4	11.5	21.05	28.64°
Mean	**11.32**	**20.96**	**28.37°**

Table: 3.5 Determination of Coefficient of Friction of Green Pea

S.No.	Friction angle Ɵ for SS sheet	Coefficient of Friction, (tan Ɵ) for SS sheet
1	35°	0.70
2	35°	0.70
3	30°	0.57
4	36°	0.72
Mean	**34°**	**0.67**

CONCLUSIONS

The following conclusions are drawn from this investigation on physical properties of green pea. The variety of the pea taken for study was Arkel. The average length, width and thickness of pea were 9.38 mm, 7.87 mm and 4.53 mm respectively. The range of bulk density varies from 563.99 to 571.55 kg/m^3 with average of 566.77 kg/m^3. The range of true density was found to vary from 985.66 to 991.88 kg/m^3 with average of 988.10 kg/m^3. The average angle of repose of green pea was 28.37° whereas the average Coefficient of friction of green pea was 0.67 respectively. Therefore, from engineering point of view, this all information of physical properties of pea seeds are useful for designing of pea related shelling machines such as Pea Sheller using Arkel seed as a variety.

REFERENCES

1. Agropedia, Vegetable pea varieties. Website:http//agropedia.iitk.ac.in. (2015).
2. Coggins, J. W., Green pea sheller. *United State Patent*, 1704427 (1929).
3. Commodities control, District-wise production of pea in Uttar-Pradesh.Website :http//www.commoditescontrol.com/eagritrades/common/newsdetail.php?*type* (2015).
4. Cutting, L., Pea and bean sheller. United State Patent, 53956 (1866).
5. Duke, J. A., Hand book of legumes world economic important, plenum press, *New York Pp*. 199-265 (1981).
6. Husle, L. H., Nature, composition and utilization of food legumes Pp-97 In: F. L. muehlbaver and W. L. kaiser (eds.), expanding the production use of cool season food legumes. Kluwer Academic

Publisher Dordrecht, Netherlands. Board. Production, area and productivity of peas in India. Website: http// www. nnb.gov.in. pp. 173-175. (1994).

7. National Horticultural Board, State wise area, production and productivity of peas in Northern India. National Horticultural Board. Website: http//www.nnb.gov.in.*Pp*. 176 (2015).
8. Sahay, K. M. and Singh, K. K., Unit operations in agricultural processing. New Delhi: *Vikas Publishing House Pvt. Ltd.* (2010).
9. Singh, D.S., Shelling characteristics of green pea pods. *J. Agri. Engg*. **37(3):** 21-26 (2000).
10. Wikipedia, Introduction of pea (*Pisum Sativum* L.) and classification of pea in India. Website:http//en.m.wikipedia.org/ wiki/pea (2015).
11. Yalcin, I., Ozarslan, C. and Akbas, T., Physical properties of pea (*Pisum sativum L*.) seed. *Journal of Food Engineering*, 79, 731–735 (2006).