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Comparative Physical Characteristics of Linseed (*Linum Usitatissimum*) Kernels

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Abstract

Physical properties of seeds and grains play vital role in quality characterization, selection and for the design of equipment storage, conveying, processing, handling and transportation. Kernels of twelve linseed varieties, LC-2023, LC-2063, LC-54, Padmini, Sheela, Shekhar, Sweta, Chambal, Suyog, Himani, Neelam, Surbhi were investigated for physical and optical properties. The physical properties of linseed have been compared for varietal variations. The dimensional parameters such as length, width, thickness, geometric mean diameter, surface area and aspect ratio varied from 4.35 to 5.58 mm, 2.10 to 2.86 mm, 0.74 to 1.03 mm, 2.33 to 5.45 mm, 17.08 to 93.43 mm^2 and 46.36 to 51.85, respectively. While, bulk density, true density, porosity and thousand kernel weight found to vary in the range of 1006.37 to 1198.33 kg/m^3, 571.32 to 761.59 kg/m^3, 29.29 to 47.99% and 5.421 to 10.967 g, respectively. The static coefficient of friction found to vary from 0.30 to 0.43 and angle of repose from 10.06 to 24.45°. The kernel of linseed variety Surbhi was found to be smallest and Neelam as the largest. Chambal variety of linseed was found the darkest as per colour difference data with the Shekhar variety as the lightest among the dark coloured linseed kernels. At the same time the Surbhi variety of linseed kernel found to have the highest colour difference due to its off white to cream coloured appearance.

Keywords: Linseed; Linum usitatissimum; physical property, frictional property; optical property.

1. Introduction

Linseed (*Linum usitatissimum* L.) is a member of Linaceae family and commonly known as *alsi*, *chikna* or flaxseed in India. Linseed plant is considered to be native to India and eastern Mediterranean. It is grown throughout the world including Canada, Indial, China, United States, Ethiopia and all over Europe (FAOSTAT, 2013). India contributes almost 20 percent of the total world production of linseed and also governs the linseed production among Asian countries (Fig. 1, Fig. 2). Linseed is grown mainly for fibre, oil, pharmaceutical and ornamental plants (Coskuner and Karababa, 2007). Apart from food use linseed oil is used in allied industries also due to its polymerization property (Rebole et al, 2002). The plant produces spherical fruit capsules containing around 10 kernels per compartment (Freeman, 1995). The kernels have a crisp and chewy texture and a pleasant, nutty taste (Carter, 1993). Linseed is the richest source of omega-3 fatty acids. It contains 50-60% linolenic acid which offers several health benefits such as lowering serum cholesterol, reduces blood pressure and thus maintaining the health in cardiovascular diseases, diabetes, asthma and arthritis.

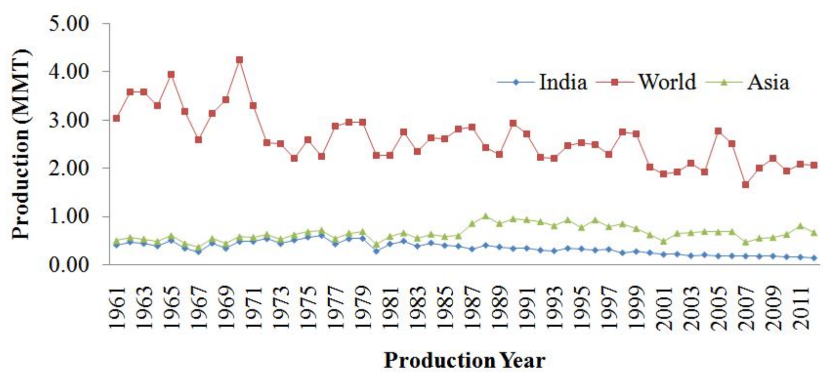

Figure 1: Linseed production.

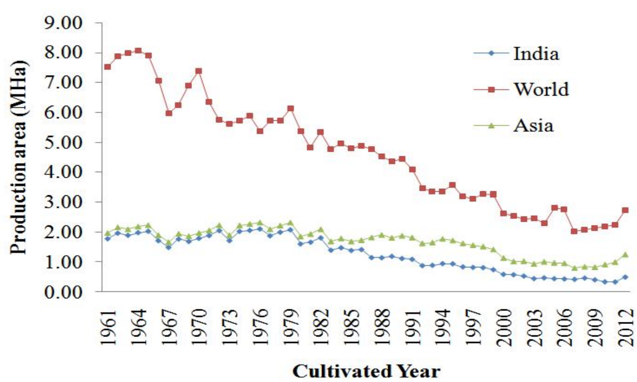

Figure 2: Cultivated area under linseed.

The physical properties of linseeds and like those of other grains and seeds are essential for the design of equipments, especially for handling, processing and storing the grains. The physical properties consisting of geometrical, gravimetrical and frictional properties with optical properties of various varieties of linseed have been studied under present investigation.

2. Materials and Methods

2.1 Sample Preparation

Twelve major varieties of linseed grown in India, viz. LC-2023 (1), LC-2063 (2), LC-54 (3), Padmini (4), Sheela (5), Shekhar (6), Sweta (7), Chambal (8), Suyog (9), Himani (10), Neelam (11) and Surbhi (12) were procured from CSAUA&T, Kanpur and PAU, Ludhiana (Table 1). Kernels of all varieties were subjected to air classifier to remove the dirt, dist, chaffs, lighter particles as well as damaged kernels. The cleaned kernels presented in Fig. 3 were evaluated for physical and optical properties.

Table 1: Physical and optical characteristics of linseed kernels.

Variety	**L**	**B**	**T**	**AR**	**SA**	**GMD**	**BD**	**TD**	**POR**	**TKW**	**CFPV**	**CFPP**	**CFGI**	**CFG**	**AOR**	**l**	**a**	**b**
LC-2023	4.61	2.32	0.81	50.47	25.95	2.87	711.98	1056.15	32.58	6.097	0.34	0.32	0.32	0.38	18.39	49.36	9.73	11.99
LC-2063	4.68	2.30	0.74	49.14	22.52	2.66	670.53	1103.36	39.20	6.523	0.32	0.30	0.34	0.35	21.75	49.29	6.71	11.70
LC-54	4.77	2.21	0.88	46.36	30.50	3.10	738.37	1111.61	33.56	6.903	0.33	0.30	0.30	0.37	24.45	49.53	10.03	12.26
Padmini	4.93	2.49	0.86	50.50	39.25	3.53	660.04	1098.39	39.90	8.020	0.34	0.32	0.34	0.36	18.41	48.85	10.64	12.65
Sheela	4.96	2.36	0.84	47.68	33.98	3.29	571.32	1099.16	47.99	7.503	0.35	0.37	0.37	0.40	22.31	49.23	9.96	11.64
Shekhar	4.95	2.51	0.94	50.66	48.17	3.91	761.59	1077.53	29.29	8.557	0.39	0.35	0.35	0.41	20.60	50.24	10.12	11.94
Sweta	4.94	2.50	0.84	50.82	38.06	3.48	652.91	1054.69	38.04	8.023	0.34	0.33	0.33	0.43	19.56	47.81	9.66	10.55

Chambal	4.89	2.53	0.76	51.85	31.64	3.14	680.54	1198.33	43.19	7.080	0.34	0.33	0.33	0.41	20.09	47.36	9.01	10.65
Suyog	5.37	2.49	0.93	46.43	54.44	4.16	676.93	1091.38	37.94	8.997	0.34	0.31	0.34	0.41	18.41	49.94	9.73	12.09
Himani	4.65	2.27	0.88	48.84	30.31	3.10	654.29	1067.51	38.70	6.503	0.34	0.33	0.32	0.39	21.73	48.40	9.51	10.75
Neelam	5.58	2.86	1.03	51.17	93.43	5.45	659.61	1006.37	34.39	10.967	0.34	0.32	0.33	0.34	24.40	48.47	9.51	10.93
Surbhi	4.35	2.10	0.77	48.22	17.08	2.33	624.11	1155.83	46.01	5.421	0.37	0.33	0.32	0.34	10.06	63.91	10.73	24.77

L (Length, mm); B (Breadth, mm); T (Thickness, mm); AR (Aspect ratio); SA (Surface area, mm^2); GMD (Geometric mean diameter, mm); BD (Bulk density, kg/m^3); TD (True density, kg/m^3); POR (Porosity, %); TKW (Thousand kernel weight, g); CFPV (Coefficient of friction plywood perpendicular); CFPP (Coefficient of friction plywood parallel); CFGI (Coefficient of friction galvanized sheet); CFG (Coefficient of friction glass); AOR (Angle of repose, degree); l (Luminance); a (redness to greenness index); b (yellowness to blueness index).

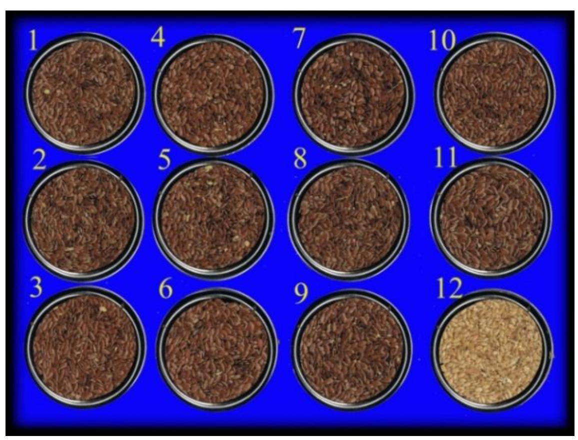

Figure 3: Linseed kernels of different varieties.

2.2 Physical and Optical Characterization

The particle size analysis of cleaned linseed kernels was determined through the developed image analysis technique (Prasad et al, 2012). The procedure for the determination of dimensional properties (Length, L; Breadth, B; Thickness, T; Aspect ratio, AR; Surface area, SA; Geometric mean diameter, GMD), gravimetric properties (Bulk density, BD; True density, TD; Porosity, POR; Thousand kernel weight, TKW), the frictional properties (Angle of repose, AOR; Coefficient of friction on glass surface, CFG; Coefficient of friction on galvanized iron surface, CFGI; Coefficient of friction on plywood parallel surface, CFPP; Coefficient of friction on plywood perpendicular surface, CFPV) and optical properties (L; a; b and colour difference, ΔE) was adopted as described elsewhere (Prasad et al, 2010, Singh and Prasad, 2013). The moisture content was determined using standard method (AOAC, 2000). The statistical analysis for the data obtained in triplicate was evaluated and reported as mean.

3. Results and Discussion

The data related to dimensional parameters, gravimetric properties, frictional characteristics with optical properties for linseed kernels varieties wise as cooperative study for twelve varieties grown in India as LC-2023, LC-2063, LC-54, Padmini, Sheela, Shekhar, Sweta, Chambal, Suyog, Himani, Neelam, Surbhi are presented (Table 1).

3.1 Dimensional Properties

The length of linseed kernels for different varieties under investigation varied from 4.35 mm (Surbhi) to 5.58 mm (Neelam). The breadth of linseed kernels varied from 2.10 mm (Surbhi) to 2.86 mm (Neelam) and 0.74 mm (LC-2063) to 1.03 mm (Neelam) as thickness (Table 1). Geometrical mean diameter, surface area and aspect ratio of linseed kernels ranged from 2.33 mm (Surbhi) to 5.45 mm (Neelam), 17.08 mm^2 (Surbhi) to 93.43 mm^2 (Neelam) and 46.36 (LC-54) to 51.85 (Chambal), respectively. The obtained results are very well in agreement with earlier studies.

3.2 Gravimetric and Frictional Properties

The gravimetric properties for bulk, true density, porosity and TKW of variety wise linseed kernels is represented in Table 1 and found to fall in the range of 571.32 kg/m^3 (Sheela) to 761.59 kg/m^3 (Shekhar); 1006.37 kg/m^3 (Neelam) to 1,198.33 kg/m^3 (Chambal); 29.29% (Shekhar) to 47.99% (Sheela) and 5.421 g (Surbhi) to 10.967 g (Neelam). The data reflects the dependency of porosity and density as decreased porosity value was observed on increase of densities. The found gravimetric parameters especially the TKW values are in agreement with the dimensional parameters length. Higher the length as well as GMD more was the TKW.

The static coefficient of friction was studied on four different surfaces and reported in table 1. It ranged from 0.30 to 0.43 for linseed kernels. LC-2063 and LC-54 varieties shows least coefficient of friction on ply parallel and steel surface and whereas the linseed variety Sweta showed highest coefficient friction on glass surface. The static coefficient of friction was found least for galvanized iron, followed by plywood and glass. The angle of repose of the studied raw linseed varieties ranged from 10.06 to

24.45° (Table 1). Surbhi linseed variety showed least value of AOR and highest value for LC-54. The obtained data may thus be used in the development of storage, conveying, processing, handling and transportation equipments.

3.3 Optical properties

The lowest and highest values for lightness (L) were found as 49.94 (Suyog) to 63.916 (Surbhi). L shows degree of lightness to darkness in which Surbhi variety showed highest value of lightness and Suyog showed lowest lightness value. Similarly 'a' shows degree of redness to greenness in which var. LC-2063 (6.717) reflected lowest value of redness and var. Surbhi (10.738) had highest value of redness and degree of yellowness to greenness shows by 'b' value in which var. Sweta had found the lowest value 10.557 and variety Surbhi was observed to have the highest b value 24.772. Chambal variety of linseed was found the darkest as per colour difference data with the Shekhar as the lightest among the dark coloured linseed kernels. At the same time the Surbhi variety of linseed kernel found to have the highest colour difference (69.385) due to its off white to cream coloured appearance. Therefore, the optical parameters thus may be considered to identify the variety on optical method, even online process could also be applied in sort of seeds.

4. Conclusion

The variations found in the observed physical and optical properties of linseed may thus play vital role in the development of various equipments used for storage, conveying, processing, handling and transportation. Moreover, the optical properties may thus be applied in order to make the automated process.

References

[1] A Rebole, M L Rodrıguez, L T Ortiz, C Alzueta, C Centeno, and C Trevino (2002), Mucilage in linseed: effects on the intestinal viscosity and nutrient digestion in broiler chicks, *Journal of the Science Food and Agriculture,* **82**, 10, pp. 1171–1176.

[2] AOAC (2000), *Approved methods of analysis*, The Association of Official Analytical Chemists, Washington DC.

[3] FAOSTAT (2013), http://www.faostat.org.

[4] J F Carter (1993), Potential of flaxseed and flaxseed oil in baked goods and other products in human nutrition, *Cereal Foods World*, **38,** 10, pp. 753-759.

[5] K Prasad, P R Vairagar and M B Bera (2010), Temperature dependent hydration kinetics of *Cicer arietinum* splits, *Food Research International*, **43,** 2, pp. 483-488.

[6] K Prasad, Y Singh, and A Anil (2012), Effects of grinding methods on the characteristics of Pusa 1121 rice flour, *Journal of Tropical Agriculture and Food Science*, **40**, 2, pp. 193-201.

[7] T P Freeman (1995), *Structure of flaxseed*, In: Flaxseed in human nutrition, Champaign, AOCS Press, pp. 11-21.
[8] Y Coskuner and E Karababa (2007), Some Physical Properties of Flaxseed (*Linum Usitatissimum L.*), *Journal of Food Engineering*, **78,** pp. 1067-1073.
[9] Y Singh and K Prasad (2013), Physical characteristics of some of the paddy varieties as affected by shelling and milling, *Oryza* (In Press).