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Engineering Properties of Safflower Oilseeds

A.D. Khobragade[1]
M.Tech. Scholar, Department of PFE, PGI, Dr. PDKV, Akola (M.H). India
Dr. P.A. Borkar[2]
Research Engineer, AICRP on PHET, Dr. PDKV, Akola (M.H). India
U.H. Khobragade[3]
Senior Research Assistant, AICRP on PHET, Dr. PDKV, Akola (M.H). India

Abstract
Engineering properties are useful and necessary in the design and operation of various equipments employed in the field of agricultural processing. Engineering properties of safflower such as size, sphericity, bulk density, true density, porosity, angle of repose, coefficient of static friction and 1000 seed weight were studied in order to optimize machine process parameters of modified mini oil mill. Safflower seeds of variety AKS 2007 were used for the experimentation. Safflower is a multiple purpose crop generally grown for oil production. The results obtained for size, sphericity, bulk density, true density, porosity, angle of repose, coefficient of static friction and 1000 seed weight were, 3.55-4.97 mm, 41.11-56.09 %, 0.44-0.49 g/cc, 0.76-1 g/cc, 41.96-54.54%, 28-33°, 52.6-54.1g respectively.

Keywords: *safflower oil seeds, engineering properties, mini oil mill, size, sphericiy.*

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I. INTRODUCTION

Oilseeds play an important role in providing a nutritionally balanced diet. These are the principal source of edible oil and protein in Indian diets. Oilseeds are booting edible oil processing industry, which are the most important industries of agriculture sector in India. India is a leading player in edible oil, with the World's largest importer from Indonesia and Malaysia and third largest consumer. India is the fourth largest oilseeds producing country in the world after Brazil 100 MT, followed by Argentina 66 MT, China 59.6 MT and India 34.6 MT during 2014-15. Oilseeds are the second main sources of protein after cereals in Indian diet (Kizil, 2014).

Oilseeds have been the backbone of agricultural economy of India since long. The major oilseeds cultivated in our country are Groundnut, Rapeseed and Mustard, Castor seed, Sesamum, Nigerseed, Linseed, Safflower, Sunflower and Soybean. However, Groundnut, Rapeseed/Mustard, Soybean and Sunflower account for a major chunk of the output. The oil content ranges from 19% to 68 % depending upon various oil seed crops. At present, more than 27 million hectares of land is under oilseeds cultivation (Narayana,2011).

Carthamus tinctorius L., widely accepted as Safflower or false saffron, belongs to the Compositae or Asteraceae family. This thistle-like species typically thrives in an arid climate, namely Southern Asia, China, India, Iran, and Egypt (Shirwaikar,2010). India occupies premier position in safflower in the world as it was cultivated over an area of 364 thousand hectares (50% of world area) and had a production of 229 thousand tons (27% of world production) during 2005-06. State of Maharashtra where NARI is located accounts for about 72% area and 69% of production of safflower in India. Safflower is the most important rabi oilseed crop in the Maharashtra state and occupying a pride of place in oilseeds production. In Maharashtra, it is grown in 5.89 lakh hectares with production of 3.30 lakh tonnes in 2007-08 (Anonymous, 2007). The Area covered under Safflower Oilseeds in India in 2017-18 is 81000 ha and yield was 557 kg/ha. In Maharashtra the area under safflower oil seed production was 18000ha, production was 6250 tonnes and yield was about 347kg/ha (Anonymous,2020)

The objective of this study was to study the engineering properties of the safflower oil seeds so as to optimize the machine process parameters. The mini oil mill will be used to extract the oil from the safflower oil seeds.

II. MATERIAL AND METHODS

2.1 Raw material

The safflower oil seeds of variety AKS 207 were procured from CDF, Wani Rambhapur, Akola (Maharashtra) and were used for the purpose of experimentation.

2.2 Physical properties of safflower oilseed

Some physical properties of safflower seeds before actual experimentation for optimizing machine process parameters and performance evaluation were studied.

1. Size
2. Sphericity
3. Bulk density
4. True density
5. Porosity
6. Angle of repose
7. Coefficient of static friction
8. Thousand seed weight
9. Moisture content

2.1.1 Size

The size of the safflower seeds were specified by length, width and thickness.It was measured by digital vernier calliper (Mityutoyo) with least count 0.01 mm.The dimensions of randomly selected fifteen safflower oil seeds were measured and average value was calculated.

2.1.2 Sphericity

The sphericity is a measure of shape character compared to a sphere. Assuming that volume of solid is equal to the volume of tri-axial ellipsoid with intercepts a, b, c and that the diameter of circumscribed sphere is largest intercept of the ellipsoid. The sphericity was calculated using the following equation (Mohsenin, 1970). Average of replications was considered as a sphericity value.

$$\text{Sphericity } (\Phi) = \frac{(a \times b \times c)^{\left(\frac{1}{3}\right)}}{a} \tag{1}$$

Where, a = Longest intercept, mm
b = Longest intercept normal to a, mm
c = Longest intercept normal to a and b, mm

2.1.3 Bulk density

The bulk density of safflower seeds was determined using the mass/volume relationship. An empty measuring jar of known volume was filled with safflower seeds separately and the mass of filled amount was weighed using an electronic balance (Mohsenin, 1970). The bulk densities of the samples were calculated using the following equation. Average of replications were considered as a bulk density value of the safflower seed.

$$\rho_b = \frac{M}{V} \tag{2}$$

Where, ρ_b = Bulk density, kg/m^3
M = Mass of fruit, kg
V = Container volume, m^3

2.1.4 True density

The ratio of mass of sample to the true volume is termed as true density of the sample. The true density of the safflower seeds was measured by using liquid displacement method. Toluene was used instead of water because it was absorbed by the sample to a lesser extent. Toluene was taken in a measuring jar of known volume. Sample of 10 gram safflower oilseeds were weighed and poured into the jar. The change in the level of toluene in the jar was recorded. The true densities of the samples were calculated using the formula (Mohsenin, 1970). Average of replications were considered as a true density value of the safflower oil seeds.

$$\text{True volume of sample} = \left\{\begin{matrix}\text{Final toluene level} \\ \text{in measuring jar}\end{matrix}\right\} - \left\{\begin{matrix}\text{Initial toluene level} \\ \text{in measuring jar}\end{matrix}\right\} \tag{3}$$

$$\text{True density kg/m}^3 = \frac{\text{Weight of sample}}{\text{True volume of sample}} \quad (4)$$

2.1.5 Porosity

The porosity is also known as the packing factor and it was determined from bulk density and true density of sample. The porosity was calculated by using the following expression (Mohsenin, 1970). Average of five replications was considered as a porosity of safflower oil seeds.

$$\text{Porosity (\%)} = \frac{\text{True density-Bulk density}}{\text{True density}} \times 100 \quad (5)$$

2.1.6 Angle of repose

The angle of repose of safflower oil seeds was determined by allowing the material to fall freely to form a heap cone. The diameter of the base circle and height of the heap were measured. The angle of repose was calculated by using the following expression. Average of five replications was considered as anangle of repose of safflower oil seeds.

$$\theta = \tan^{-1} \frac{2h}{D} \quad (6)$$

Where, θ = angle of repose, degrees
h = height of the pile, m
D = diameter of the pile, m

2.1.7 Coefficient of static friction

The coefficient of static friction on mild steel surface was measured for safflower oil seed by using inclined plane method. The material was kept on horizontally placed surface and slope was increased gradually. The angle at impending slip was recorded. The coefficient of static friction was computed by using following formula. The experiment was repeated five times and means value of 'θ' for safflower oil seed was calculated.

$$\text{Coefficient of static friction} = \tan\theta \quad (7)$$

Where, θ = angle of static friction, degrees.

2.1.8 Thousand seed weight

One thousand randomly selected safflower oil seeds were collected and weighed on electronic balance (Contech) with least count 0.01 g. This magnitude was termed as the thousand seed weight. Average of replications have been considered and reported as thousand seed weight.

2.1.9 Moisture content

The moisture content of the safflower seeds was determined by using hot air oven method. A known weight of safflower seed samples was taken and kept in an oven at 130°C for 3 hours. After constant weight, sample was removed from the oven and cooled. After cooling, final weight of the sample was taken and the moisture content on wet basis was determined by using the following formula and expressed in percentage (Sahay and Singh, 1994).

$$\text{Moisture content ,\%} = \frac{\text{Initial weight-Final weight}}{\text{Initial weight}} \times 100 \quad (8)$$

III. RESULT AND DISCUSSION

The engineering properties of safflower are presented and discussed here. Co-efficient of friction, angle of repose, geometric mean diameter, sphericity, moisture content, true density, bulk density, porosity of safflower oil seeds of variety AKS 207 were measured..

All the observations were replicated thrice and average was calculated which are given in Table 1.

Table I Physical properties of safflower seeds

Safflower Oilseeds

Particular	**Range**	**Average($\pm$ S.D)**
Length, mm	7.13-7.79	7.47$\pm$1.34
Width, mm	3.0-3.9	3.49$\pm$0.51
Thickness, mm	2.1-3.5	2.8$\pm$0.33
Geometric mean diameter, mm	3.55-4.97	4.21$\pm$0.63
Sphericity, %	41.11-56.09	47.14$\pm$0.003
Bulk density, g/cc	0.44-0.49	0.46$\pm$0.02
True density, g/cc	0.76-1	0.89$\pm$0.11
Porosity, %	41.96-54.54	47.52$\pm$6.41
Angle of repose, degree	28-33	30.84$\pm$1.96
Thousand seed weight, g	52.6-54.1	53.6$\pm$0.04
Moisture content, % (w.b)	3.9-5.3	4.634$\pm$0.66

IV. CONCLUSION

Safflower is a multiple purpose crop generally grown for oil production. An added advantage of safflower oil is lower cost of production thus can become an alternate option for those who cannot afford to buy olive and other functional oils (Khalid, *et al.*,2017). The various engineering properties i.e size, sphericity, bulk density, true density, porosity, angle of repose, coefficient of static friction and 1000 seed weight calculated i.e. for safflower oilseeds were useful for optimizing the machine parameters for mini oil mill.

REFERENCES

[1]. Sahay and Singh, *Unit operation of Agricultural Processing* (Vikas publication house pvt.ltd, New Delhi.2004)

[2]. Khalid, N., Khan R.S., Hussain, I., Farroq, M., Ahmad, A., Ahmed. A comprehensive characterisation of safflower oil for its potential applications as a bioactive food ingredient - A review, *Trends in Food Science & Technology,* 66 , 2017, 176-186

[3]. Kizil S., Çakmak O, Kirici S. and Inan M. A Comprehensive Study on Safflower (*CarthamusTinctorius*L.) in Semi-Arid Conditions, *Biotechnology & Biotechnological Equipment*, 22(4), 2014, 947-953.

[4]. Narayan, P. Chauhan, M. S. and Chauhan, S. Oilseeds Scenario in India. Agriculture Today. 2011, 40-43.

[5]. Shirwaikar A, Khan S. Medicinal plants for the management of post menopausal osteoporosis: A review. *Open Bone J*. 2, 2010, 1-13.

[6]. Anonymous. Project Directors' Report. *Annual Research Workers' Group Meeting of Safflower*. Aug. 23-25. Maharana Pratap Univ. of Agriculture & Technology, Udaipur. Directorate of Oilseeds Research, Rajendranagar, Hyderabad-500030,2007.

[7]. Anonymous. https://www.nfsm.gov.in/StatusPaper/NMOOP2019.pdf. 2020.

[8]. Mohsenin N.N, *(Physical properties of plant and animal materials,* 2nd ed.; Gordon and Breach publishers,*1970)*