VERSITA

INTERNATIONAL
Agrophysics
www.international-agrophysics.org

Int. Agrophys., 2012, 26, 225-228
doi: 10.2478/v10247-012-0033-7

Oil point pressure of Indian almond kernels

O.A. Aregbesola, G.A. Olatunde, S.S. Esuola, and O.K. Owolarafe*

Department of Agricultural Engineering, Obafemi Awolowo University, Ile-Ife, Nigeria

Received March 31, 2011; accepted April 13, 2011

A b s t r a c t. The effect of preprocessing conditions such as moisture content, heating temperature, heating time and particle size on oil point pressure of Indian almond kernel was investigated. Results showed that oil point pressure was significantly ($P < 0.05$) affected by above mentioned parameters. It was also observed that oil point pressure reduced with increase in heating temperature and heating time for both coarse and fine particles. Furthermore, an increase in moisture content resulted in increased oil point pressure for coarse particles while there was a reduction in oil point pressure with increase in moisture content for fine particles.

K e y w o r d s: Indian almond kernels, oil point pressure, oil expression, preprocessing

INTRODUCTION

The almond (*Terminalia catappa*) tree like many other rosaceaus fruit trees is native of the warmer part of Western Asia and North Africa. The almond fruit consist of edible fleshy mesocarp and a stony nut which houses a dicotyledonous kernel enclosed in a hard shell. In Nigeria, the almond tree is majorly planted to serve as shed at homes and car-parks with little or no use for either commercial or subsistence processing of the fruits. There are two principal varieties of almonds, the bitter almond (*Prunus dulcis var. amara*) and the sweet almond (*Prunus dulcis var. dulcis*). (Agunbiade and Olanlokun, 2006).

Sweet almond kernels are delicious and wholesome without processing; they also yield nearly half their mass in a bland fixed oil when expressed (Morton, 1985). This oil has been reported to contain about 7.5% palmitic acid, 1.8% stearic acid, 66.4% olenic acid and 23.5% linoleic acid (Thompson and Evans, 2006). Oil extracted from sweet as well as bitter kernels of almond is used for pharmaceutical and cosmetic preparation (Agunbiade and Olanlokun, 2006).

Oil is usually expressed from oilseeds by mechanical expression or solvent extraction (Ademola and Adekoya, 2003; Enveremadu, 2010) or by a combination of both processes. Mechanical oil expression involves the application of pressure (using hydraulic or screw presses) to force oil out of the oil bearing material. The applied pressure at the point that oil comes out of the inter-particle voids is regarded as the oil point pressure. The oil point pressure, therefore, is the minimum pressure that must be applied before oil expression commences. The effective applied pressure for oil expression is considered to correspond to some value above the oil point pressure, while applied pressures below this point are regarded as effort required for mobilizing oil from the seed cells to the surface (Ogunsina *et al*., 2008). Identification of the oil point pressure in mechanical oil expression is an important step in mechanical oil expression. Oil point pressure is usually influenced by certain prepressing operations such as cleaning and dehulling, particle size reduction, moisture content adjustment and heat treatment (Ajibola *et al*., 2000; Ogunsina *et al*., 2008; Oyinlola and Adekoya, 2004).

The aim of study is to investigate the effect of some preprocessing conditions on oil point pressure of Indian almond kernel.

MATERIAL AND METHODS

About 100 kg of almond fruits was collected from Obafemi Awolowo University, Nigeria. The fleshy part (exocarp) of the fruit were removed and cracking of the nuts was done manually to obtain the needed kernels. Removal of foreign and extraneous material was done manually. The initial moisture content of the sample was 26%, w.b. and samples were then sun dried to a safe moisture content of about 5%, w.b. Moisture content determination was carried out by oven method at a temperature of 130°C for 6 h (AOAC, 1990).

*Corresponding author's e-mail: soaregbs@oauife.edu.ng

Based on preliminary laboratory investigations and literature review, preprocessing conditions important for almond oil expression were found to be particle size and moisture content of the almond kernels. Particle size reduction was carried out by milling almond samples using a mortar and pestle and sieving to obtain two granular sizes: coarse – 5.6-2.36 mm in dia, fine – less then 2.36 mm in dia (Ogunsina *et al*., 2008). Three moisture levels (5, 7 and 8%, w.b.) were also selected for the almond oil expression experiment by subdividing fine and coarse samples into three parts. Two parts of the samples had their moisture adjusted to moisture levels of about 7 and 8%, w.b. by spraying calculated amount of water on almond samples. These samples whose moisture had been adjusted were placed in plastic bags and stored in a freezer for a minimum of 7 days until used for oil expression studies. The safe moisture content of 5% (earlier on obtained after sun drying fresh samples), was used as the third moisture level.

Preconditioned almond samples (stored in the freezer) were removed 24 h before experimentation to allow gradual thawing and moisture equilibration. The moisture content of samples was checked by oven drying method to ensure that the required moisture content is used. After this, 30 g of each of the samples was thinly spread in a pan and heated in an oven at different heating temperatures of 70, 85, 100, and 115°C and heating times of 15, 20, 25 and 30 min, respectively. After heating, the samples were transferred into the cylinder in which strips of white blot papers were inserted in each hole around the lower perimeter of the test cylinder (perforated metal base). The strips were allowed to project well inside the cylinder so as to spot oil when the oil point was attained. The pressure applied to each sample through the point load was varied by moving the cylinder and contents across the lever (Ajibola *et al*., 2002; Ogunsina *et al*., 2008).

RESULTS AND DISCUSSION

A summary of the average oil point pressure for coarse and fine aggregates at different expression conditions (heating temperatures, heating times and moisture content) is presented in Table 1. Statistical analysis (ANOVA) of these results is presented in Tables 2 and 3, respectively. The mean values of oil point pressure for Indian almond kernels lie between 1.00 and 2.33 MPa. This value is higher than values obtained for oil point pressure of cashew nut (Ogunsina *et al*., 2008), but lower than values for melon seed (Tunde-Akintunde, 2010), soy seed (Ajibola *et al*., 2002), locust seed (Owolarafe *et al*., 2003) and rape seed (Sukumaran and Singh, 1989).

T a b l e 1. Oil point pressure (MPa) of almond kernel at different preprocessing conditions

Heating temperature (°C)	Heating time (min)	Moisture content (%, w.b.)					
		5		7		8	
		Fine	Coarse	Fine	Coarse	Fine	Coarse
70	15	2.15	1.44	2.06	2.20	2.06	2.33
	20	2.03	1.39	1.84	1.68	1.78	2.26
	25	1.97	1.34	1.73	1.42	1.56	2.21
	30	1.88	1.29	1.66	1.32	1.47	2.13
85	15	1.79	1.25	1.58	1.31	1.38	2.07
	20	1.67	1.23	1.48	1.29	1.48	1.97
	25	1.64	1.20	1.44	1.26	1.37	1.88
	30	1.57	1.18	1.39	1.20	1.32	1.80
100	15	1.52	1.14	1.35	1.14	1.26	1.69
	20	1.50	1.12	1.29	1.13	1.28	1.69
	25	1.46	1.10	1.26	1.11	1.22	1.60
	30	1.43	1.08	1.21	1.07	1.20	1.52
115	15	1.42	1.07	1.16	1.07	1.15	1.51
	20	1.38	1.03	1.13	1.05	1.11	1.46
	25	1.35	1.01	1.12	1.01	1.07	1.48
	30	1.33	1.00	1.12	1.01	1.03	1.37

T a b l e 2. ANOVA table showing the effect of preprocessing conditions on oil point pressure of almond kernels

Source	DF	Sum of squares	Mean square	F value	Pr > F	at P<0.05
Particle size (PS)	1	0.11	0.11	16.12	0.00	s
Temperature (Temp)	3	10.40	3.47	531.42	<.00	s
Time (T)	3	0.91	0.30	46.45	<.00	s
Moisture content (MC)	2	1.93	0.96	147.72	<.00	s
PS × Temp	3	0.04	0.02	2.29	0.08	ns
PS × Time	3	0.00	0.00	0.03	0.99	ns
PS × MC	2	6.83	3.42	523.42	<0.00	s
Temp × T	9	0.53	0.06	9.01	<0.00	s
Temp × MC	6	0.22	0.04	5.73	<0.00	s
T × MC	6	0.08	0.01	2.10	0.06	ns
PS × T × Temp	9	0.01	0.00	0.09	1.00	ns
Temp × T × MC	18	0.17	0.01	1.48	0.11	ns
Model	66	21.43	0.32	49.75	<0.00	

T a b l e 3. Statistical analysis showing the effect of preprocessing conditions on oil point pressure of fine and coarse aggregates of almond kernel

Source	DF	Fine aggregates					Coarse aggregates		
		Sum of squares	Mean square	F value	Pr > F	at P<0.05	Sum of squares	Mean square	F value
Temperature (Temp)	3	5.82	1.94	930.26	<0	s	4.63	1.54	1 076.23*
Time (T)	3	0.44	0.15	70.47	<0	s	0.47	0.16	109.08*
Moisture content (MC)	2	1.30	0.65	310.52	<0	s	7.46	3.73	2 604.46*
Replicate	1	0.10	0.10	45.69	<0	s	0.09	0.09	65.46*
Temp × T	9	0.28	0.03	15.13	<0	s	0.25	0.03	19.40*
Temp × MC	6	0.02	0	1.92	0.10	ns	0.55	0.09	63.49*
T × MC	6	0.02	0	1.28	0.28	ns	0.09	0.02	10.96*
Temp × T × MC	18	0.09	0	2.32	0.01	ss	0.36	0.02	14.10*
Model	48	8.07	0.17	80.54	<0		13.91	0.29	202.21
Error	47	0.10	0.00				0.07	0	

*Means significant at 5 % level.

Generally, with the exception of oil expression at 8% moisture content, oil point pressure for fine aggregates of Indian almond kernels was greater than oil point for coarse aggregates. This is in agreement with findings of Ogunsina *et al*. (2008). Statistical analysis revealed that the effects of particle size and moisture content were significant ($P < 0.05$) on oil point determination for the kernels (Table 2). Further analysis of results showed that oil point pressure increased with increase in moisture content (from 5 to 8%) for coarse samples while on the contrary, a decrease in oil point pressure with increase in moisture content was observed for the fine aggregates of kernels (Table 3). This could be attributed to the fact that as surface area increases, more moisture is available for heat distribution thereby reduction in oil viscosity which in turn leads to ready flow of oil. Hence, it is not surprising that the interaction of the effects of particle size and moisture content was also significant on oil point pressure of the kernels (Table 2). Also, according to Ogunsina *et al*. (2008), the reduction of oil point pressure with increase in moisture content for finely ground particles could be attributed to availability of adequate moisture to transfer oil from oil bearing cells which suggests that moisture contents of finely ground particles were too low for oil to flow out readily.

Results from Tables 2 and 3 showed that oil point pressure significantly ($P < 0.05$) reduced with increase in heating temperature from 70 to 115°C for all moisture content used. It was also observed that as heating time was increased from 15 to 30 min, the oil point pressure significantly reduced. Heat treatment during oil extraction is very important as it leads to moisture loss due to temperature rise which facilitates the rupturing of oil bearing cells, creating a void which serves as a migratory space for the contents of oil bearing cells as heating continues. This in turn leads to moisture adjustment, protein coagulation and reduced viscosity which causes oil to flow readily from the oil bearing cells (Ogunsina *et al*., 2008). This, therefore, explains the reduction in oil point pressure with increase in heating time and temperature; and significant interactions between temperature and time and also between temperature and moisture content (Table 2). Similar results were also obtained by Ajibola *et al*. (2002), Ogunsina *et al*. (2008), and Owolarafe *et al*. (2003) for the oil point pressure of cashew, soybeans, and locust beans, respectively.

CONCLUSIONS

1. The effect of preprocessing conditions (moisture content and particle size of kernels; heating temperature and time) were significant ($P < 0.05$) on oil point determination of Indian almond kernels.

2. Coarsely ground Indian almond kernel aggregates had lower oil point pressure than those finely ground.

3. Oil point pressure increased with increase in moisture content for coarse samples while it reduced with increase in moisture content for fine samples of Indian almond kernel.

4. Increase in heating time and temperature decreased oil point pressure for both fine and coarse samples of Indian almond kernels. This shows that adequate or effective heat treatment hastens break down of oil cells and increased viscosity of oil from oil bearing cells of the kernel.

5. Heating almond kernels before oil expression at a temperature of 70°C for 15 min produced the highest oil point pressure for both finely (2.15 MPa) and coarsely ground samples (2.33 MPa) at moisture contents of 5 and 8% for fine and coarse samples, respectively.

6. The lowest oil point pressure (1.00 and 1.03 MPa for coarse and fine samples, respectively) was obtained for coarse samples at a moisture content of 5%, and fine samples at 8% moisture when both samples were preheated at a temperature of 115°C for 30 min before oil expression.

REFERENCES

Ademola O. and Adekoya L., 2003. Development of a laboratory model screw press for peanut oil expression. J. Food Eng., 221-227.

Agunbiade S.O. and Olanlokun J.O., 2006. Evaluation of some nutritional characteristics of Indian almond (*Prunus amygdalus*) Nut J. Nutrition, 5(4), 316-318.

Ajibola O., Adetunji S., and Owolarafe O., 2000. Oil point pressure of sesame seed. Ife J. Technol., 9(1-2), 57-62.

Ajibola O., Okunade D., and Owolarafe O., 2002. Oil point pressure of soybean. J. Food Process Eng., 25, 407-416.

AOAC, **1990.** Official Methods of Analysis. Washington, DC, USA.

Enweremadu C.C. and Alamu O.J., 2010. Development and characterization of biodiesel from shea nut butter. Int. Agrophysics, 24, 29-34.

Morton J.F., 1985. Indian almond (*Terminalia catappa*) a salt-tolerant, useful, tropical tree with nut worthy of improvement. Economic Botany, 39(2), 101-112.

Ogunsina B., Owolarafe O., and Olatunde G., 2008. Oil point pressure of cashew (*Anacardium occidentale*) kernels. Int. Agrophysics, 22, 53-59.

Owolarafe O., Adegunloye A., and Ajibola O., 2003. Effects of processing condition on oil point pressure of locust bean seed. J. Food Proc. Eng., 26(51), 489-497.

Oyinlola A. and Adekoya L., 2004. Development of a laboratory model screw press for peanut oil expression. J. Food Eng., 64, 221-227.

Sukumaran C.R. and Singh B.P.N., 1989. Compression of a bed of rape seeds: the oil point. J. Agric. Eng. Res., 42(2), 77- 84.

Thompson L.A. and Evans B., 2006. *Terminalia catappa* (Tropical almond). In: Species profiles for Pacific Island agroforestry, Version 2.2, www.traditional.tree.org.

Tunde-Akintunde T.Y., 2010. Determination of oil point pressure for melon seed. J. Food Process Eng., 33(1), 179-189.