ARID ZONE JOURNAL OF ENGINEERING, TECHNOLOGY & ENVIRONMENT
AZOJETE March 2020. Vol. 16(1):211-221
Published by the Faculty of Engineering, University of Maiduguri, Maiduguri, Nigeria.
Print ISSN: 1596-2490, Electronic ISSN: 2545-5818
www.azojete.com.ng

ORIGINAL RESEARCH ARTICLE

DEVELOPMENT OF A MOTORIZED HYDRAULIC PRESS FOR SESAME *(Sesamum indicum L.)* OIL EXPRESSION

T. A. Ishola[1*], A. N. Efomah[1], and A. Gbabo[2]
([1]Department of Agricultural and Biosystems Engineering, University of Ilorin, Ilorin, Kwara State, Nigeria
[2]Department of Agricultural and Bioresources Engineering, Federal University of Technology, Minna,
Niger State, Nigeria)
**Corresponding author's email address: istab@unilorin.edu.ng*

ARTICLE INFORMATION

Submitted 15 February, 2019
Revised 28 August, 2019
Accepted 05 September, 2019

Keywords:
Sesame
Oil
Roasted
unroasted and
Expression

ABSTRACT

Sesame oil is edible and of high economic and medicinal potentials. However, its expression from the seeds is still largely done manually which is tedious and inefficient. The few imported mechanical oil presses are prone to incessant breakdown and costly. A motorized hydraulic press for sesame oil expression was designed, fabricated and tested. The major components of the machine include a hydraulic cylinder, hydraulic pump, two-way control valves, heater band with temperature controller, stopper plate, electric motor and the frame. Paste of ground sesame seeds wrapped in a cheese cloth was forced against a stopper end plate on the expression barrel whose temperature is controlled in order to get the oil expressed out. The machine performance was evaluated using two levels of seed conditions (roasted (RS) and unroasted (URS)) at three levels of moisture contents (6, 9 and 12% wet basis) and four levels of temperature (70, 80, 90 and 100°C). The performance indicators investigated included: throughput capacity, percentage oil yield, percentage expression efficiency and cake recovery efficiency. Results of tests showed that the highest percentage oil yield of 33.3% was recorded when sesame seed was roasted, milled and pressed at a moisture content of 6% and expression temperature of 90°C. Also the highest expression efficiency was recorded as 69.4% when the seed was roasted, milled and pressed at a moisture content of 6% and temperature of 90°C. The highest cake recovery was recorded as 74% when the sesame seed was milled without roasting at a moisture content of 12% and temperature of 70°C. The oil press would assist in the growth of indigenous edible oil production industry.

1.0 Introduction

Sesame (Sesamum indicum L.) otherwise known as beniseed is one of the major oil crops that contain approximately 50% oil and 25% protein (Elleuch et al., 2007). It is an important crop for international trading with a production capacity of 2.6 million tonnes (MT) per year, 70% of which comes from India, China, Myanmar and Sudan (Lee, 1995). The oil contains oleic acid (35.9 - 47.0%), linoleic acid (35.6 - 47.6%), palmitic acid (8.7 - 13.8%), stearic acid (2.1 - 6.4%), as well as arachidic acids (0.1 - 0.7%) (Borchani et al., 2010).

Corresponding author's e-mail address: istab@unilorin.edu.ng

The oil from the seed is renowned for its stability because it strongly resists oxidative rancidity even after long exposure to air (Global AgriSystems, 2010). The oil has some phyto-nutrients such as omega-6 fatty acids, flavonoid phenolic anti-oxidants, vitamins and dietary fiber with potent anti-cancer as well as health promoting properties (Global AgriSystems, 2010). After the extraction of oil, the cake is mostly used for livestock feed or manure.

In Nigeria, local methods are still used in extracting oil from sesame seeds. These local methods are usually slow, laborious and results in low oil yield. The local methods used include the plate press, ram press, mortar and pestle method etc. There are some imported screw presses which are usually quite expensive and prone to barrel clogging, wormshaft breakage, gear box malfunction, unavailable spare parts. With the increasing demand and economic values of sesame and its oil, these local extraction methods would not be able to meet up with the scale of production required. In order to enhance the hygienic, efficient and inexpensive extraction of sesame oil, a motorized hydraulic sesame oil press which would be adaptable to our local conditions was conceptualized. Therefore, the objectives of this study were to design, construct and carry out performance evaluation of a motorized hydraulic press for sesame oil expression. This was expected to be more efficient and convenient than the local methods of extraction in terms of time consumption and the quantity and quality of oil obtained.

2. Materials and Methods

2.1 Design Considerations

In carrying out the design work in the study, much effort was directed towards obtaining a system that would develop more than the minimum pressure required to extract the oil and still be dimensionally stable afterwards. That is none of the parts of the machine would fail after extracting the oil. Physical and mechanical properties of the sesame seed were considered in order to arrive at a design concept for the machine. Convenience of use was also considered. The machine expressed oil from paste of ground sesame seeds wrapped in a cheese cloth which compressed it against a stopper end plate of an expression barrel whose temperature was controlled in order to get the oil expressed out. The compression was achieved by movement of a press plate attached to the end of a hydraulic rod. The outward and inward movement of the hydraulic rod inside a hydraulic cylinder was actuated by hydraulic fluid from an electric motor powered hydraulic pump. Various components of the oil press were designed and fabricated. All the components of the machine that were fabricated were obtained locally. The machine could be operated by one person and all the control levers are within his reach during operation.

2.2 Design Calculations

2.2.1 Determination of the pressure acting on the Expression Barrel

The expression barrel was considered as a thick hollow cylinder under pressure exerted by a rod moving inside a hydraulic cylinder. A preliminary test was carried out to determine the pressing force required to express oil completely from a 500g sample of ground sesame seed using the Universal Testing Machine [UTM] (Model No: FS300CT). A test rig which had perforations at the base and the same bore area as the expression barrel of the machine was used. To determine the pressure required to express oil completely from the sample, the formula given by Ramsdale (2006) was used:

$$\mathrm{P} = \frac{\mathrm{F}}{\mathrm{A}} \qquad (1)$$

where, F = Force from the from UTM machine = 160 kN , A = Bore area of the test rig = 0.009 m2, P = Pressure required to express oil completely was obtained to be 17.78 MPa.

Corresponding author's e-mail address: istab@unilorin.edu.ng

A press plate of diameter 100 mm travelling inside an expression barrel of internal diameter 106 mm was selected to facilitate easy movement within the expression barrel during operation. The length of the barrel was 600 mm but stroke length of the press plate inside it was 400 mm.

2.2.2 Determination of the Combined Stresses on the Expression Barrel

In order to obtain the combined stresses on the expression barrel, there was need to obtain the barrel thickness (t) which could withstand the internal pressure that it would be subjected to (Khurmi and Gupta, 2005). To calculate the thickness on the expression barrel pressure, the formula given by Khurmi and Gupta (2005) was used

$$t = r_i\left[\sqrt{\frac{\sigma_t + P}{\sigma_t - P}} - 1\right] \qquad (2)$$

where: P = Operating pressure = 17.78 (earlier determined) MPa, r_i = internal radius of barrel = 53 mm, σ_t = Allowable tensile stress for mild steel barrel materials = 250 MPa, t = barrel thickness was calculated to be 8.11 mm.

To calculate the hoop stress, longitudinal stress and radial stress, the formula given by Ryder (1985) was used. Hoop stress is given by the relation

$$\sigma_h = \frac{Pr_i}{t} \qquad (3)$$

where: P = maximum pressure applied on the barrel was 17.78 MPa, ri = internal radius of the barrel was 53 mm , t = thickness of the barrel was 8.109 mm and $\sigma_h =$ Hoop stress was calculated to be 116.209 MPa.

Longitudinal stress is given by the relation

$$\sigma_L = \frac{\sigma_h}{2} \qquad (4)$$

where: $\sigma_h = \text{Hoop stress} = 116.209\ \text{MPa}$ σ_L = longitudinal stress was calculated as 58.105 MPa.

The radial stress (σ_r) is given by

$$\sigma_r = -P \qquad (5)$$

where: $\sigma_r = -17.78\ \text{MPa (as determined earlier)}$

Failure occurs in a member of materials subjected to combined stresses when one of the principal stresses reaches the failure value such as yield stress, (σ_0) which ranges from 225 to 290 MPa for mild steel (Ryder 1985). Therefore, since none of the hoop stress, longitudinal stress or radial stress has a value that is up to the value of the yield stress, the expression barrel will not fail under any of these stresses.

2.2.3 Determination of Pump Flow Rate

The hydraulic pump flow rate gives an index of the volumetric displacement of the hydraulic fluid per unit time. This index was needed in selecting a suitable hydraulic pump that will be capable of supplying the needed hydraulic fluid for the actuation of the hydraulic rod inside the hydraulic cylinder for the purpose of expressing the sesame oil out. The hydraulic cylinder selected for the purpose had inner bore diameter of 40 mm and the hydraulic rod stroke length was 400 mm. A period of 6 seconds was chosen for each round of oil expression based on experience from the UTM machine. The pump flow rate was calculated using the formula given by Nakayama and Boucher (2000).

Corresponding author's e-mail address: istab@unilorin.edu.ng

$$Q = \frac{120 \times A \times S}{N \times t} \qquad (6)$$

where: A = Bore area of the hydraulic cylinder = 0.005 m2, S = Stroke length of the hydraulic rod = 0.4 m, N = Speed of the prime mover to run the pump = 1500 rpm and t = Oil expression time 6 seconds, Q = Pump flow rate was calculated as 0.0000267 m3/s.

2.2.4 Determination of the power required to run the hydraulic pump

As earlier determined the pressure required to express the oil was found to be 17.78 MPa = 17780 kPa. Also, the hydraulic pump flowrate was found to be 0.0000267 m3/s = 0.0267 L/s. Hence, the power required to run the hydraulic pump was calculated by the formula given by Khurmi and Gupta (2005).

$$P_p = \frac{Q \times P}{1000} \qquad (7)$$

where: P = Pressure required from the hydraulic pump was 17780 kPa. Q = Pump flow rate was 0.0267 L/s and Pp = Power required to run the hydraulic pump was calculated to be 0.475 kW.

2.3 Component of the Motorized Hydraulic Press

The motorized hydraulic sesame oil press (Figures 1) comprised of the following components as described below.

2.3.1 Hopper

The hopper (5) which was constructed using gauge "16" mild steel sheet is a truncated inverted cone in shape having an upper diameter of 300 mm, a protruded base diameter of 200 mm and a vertical height of 350 mm. These values were selected since the quantity of the ground paste of sesame was small. It is through the hopper that 500g of ground paste of sesame wrapped in cheese cloth is fed into the expression barrel. The base diameter of the hopper was selected to be wide enough to allow the passage of the 500g ground wrapped sesame paste.

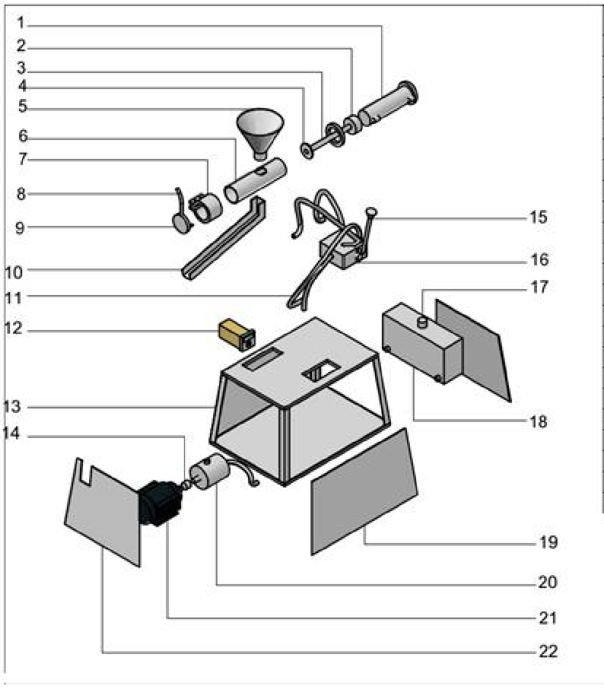
2.3.2 Oil Expression Unit

This consisted of the oil expression barrel (6) that has internal diameter of 100 mm and a length of 600 mm. The thickness of the barrel was earlier determined as 8.11 mm. A 10 mm thick oil pressing plate (4) was connected to a connecting rod (3) that comes out of hydraulic cylinder (1) by actuation from a hydraulic pump. Forward movement of the oil pressing plate leads to expression of oil. The expression barrel was surrounded with a 650W cylindrical heater band (7) for heating the sesame seed paste during expression. The temperature of the expression barrel was maintained at a set value by a Temperature Controller (12) (Model No: TED-2001) which uses thermocouple and thermostat for this purpose. The expression barrel was cylindrical in shape but had 3 mm perforations on the stopper end plate (9) of the barrel for oil to flow out as such enhancing maximum oil extraction. The barrel was an 8.11 mm thick stainless steel cylinder capable of withstanding the internal pressure that is built up due to the pressing pressure. The stopper end plate at the end of the barrel was a 12mm thick plate which held the wrapped paste of sesame seed during expression. It is opened after the expression to discharge sesame seed cake left.

Corresponding author's e-mail address: istab@unilorin.edu.ng

2.3.3 Sesame Oil Collector

The sesame oil collector (10) was a rectangular shaped trough made from gauge "16" mild steel sheet and placed directly below the barrel in order to collect the extracted oil passing through the little perforations. It was inclined at an angle from the horizontal plane in order to enable the extracted oil flow freely into the collecting container.



LEGEND

KEY	DESCRIPTION
1	Hydraulic Cylinder
2	Piston
3	Connecting Rod
4	Oil Pressing Plate
5	Hopper
6	Barrel
7	Heater Band
8	Stopper Handle
9	Stopper
10	Oil Collection Trough
11	Pressure Connection Hose
12	Heat Regulator
13	Frame and Support
14	Power Transmission Link
15	Lever/ Actuator
16	Two-way Control Valve
17	Hydraulic Tank Inlet
18	Hydraulic Tank
19	Front cover
20	Pump
21	Electric Motor
22	Side Cover

Figure 1: Exploded drawing of the Hydraulic Press for Sesame Oil

Corresponding author's e-mail address: istab@unilorin.edu.ng

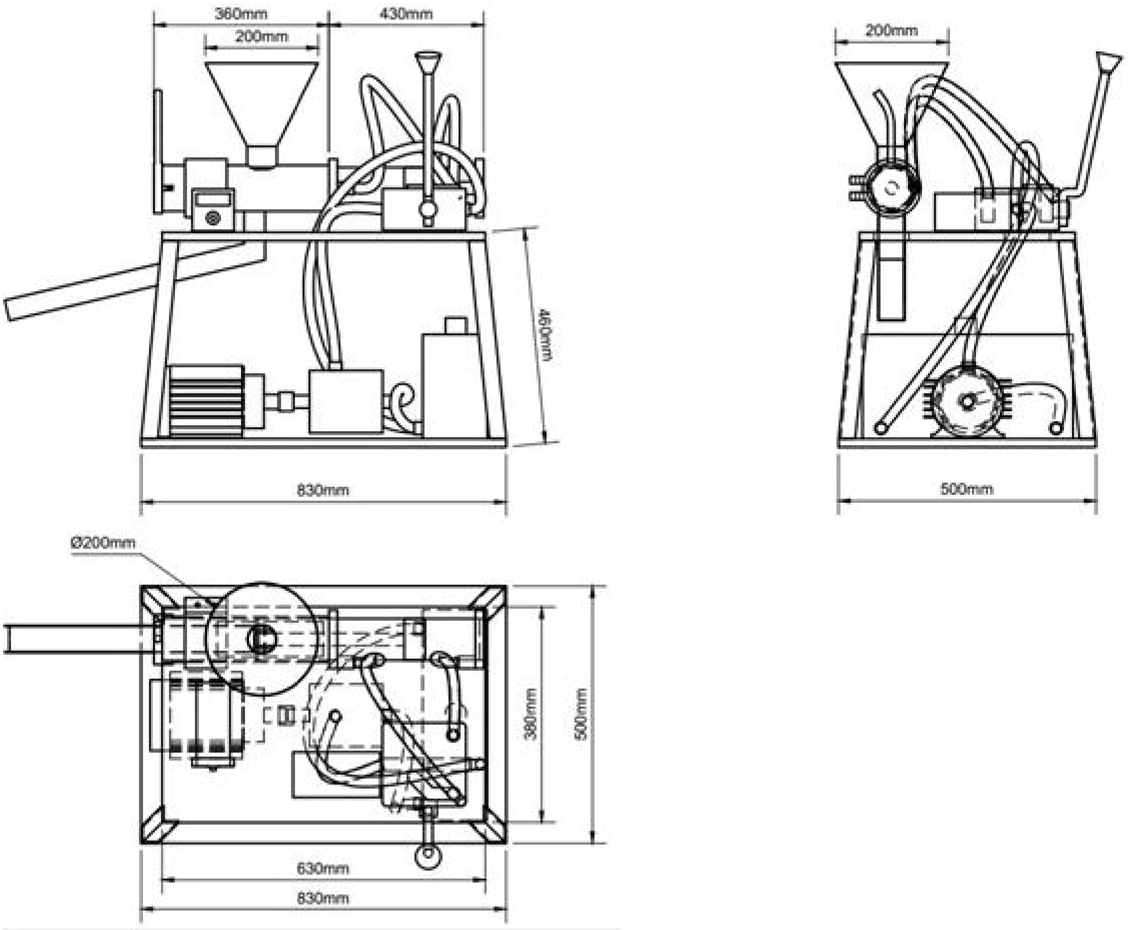


Figure 2: Orthographic Projection of the Hydraulic Press for Sesame Oil

2.3.4 Hydraulic control unit

This comprised of the hydraulic tank (18), hydraulic pump (20), two-way hydraulic control valve (16) and hoses (11). The hydraulic tank was a cuboidal shaped box measuring 200 x 170 x 300mm made from thick plastic material which served as the reservoir to hold the hydraulic fluid. An upper opening was provided at the top of the tank through which the hydraulic fluid was poured into the tank. An outlet pipe of 20mm was connected at the bottom to serve as inlet to the pump. The hydraulic pump was a Nachi vane pump (20 l/min at 58.61 bar). The two-way hydraulic control valve controlled flow of hydraulic fluid to the upper and lower chamber of the hydraulic cylinder. This valve was connected the hydraulic tank via the connecting pressure hoses. The hydraulic pump and control valve actuated forward movement of the connecting rod during pressing operation and backward movement after the pressing operation. A pressure relief valve was incorporated on the hydraulic circuit to forestall any accident. This whole unit was powered by a 2 hp electric motor which was connected to the hydraulic pump via a coupling.

2.4 Mode of Operation of the Sesame Oil Press

The fabricated hydraulic sesame oil press (Figure 3) was operated as follow. After switching on the electric motor, the heater band and the temperature controller, the hydraulic pump and temperature controlling unit became operational. Oven dried sesame seeds at specific moisture contents were ground using an attrition mill to form sesame paste. The sesame paste wrapped in a cheese cloth was fed into the extraction unit through the hopper. The operational heater band and the temperature controller ensured that the oil expression occurred at set

Corresponding author's e-mail address: istab@unilorin.edu.ng

temperatures. The oil expression was achieved by movement of a oil pressing plate attached to the end of a connecting rod. The outward and inward movement of the connecting rod inside a hydraulic cylinder was actuated by hydraulic fluid from hydraulic pump which is powered by the electric motor. The stopper end plate at the end of the barrel held the wrapped paste of sesame seed during expression. It is opened after the expression to discharge sesame seed cake left. The expressed oil flew through the perforations at the end of the barrel and was collected via the oil collector. After oil expression and the discharge of the cake the oil press was ready for another cycle of expression. 500g of sesame seed paste wrapped in cheese cloth was pressed for 6 seconds in order to express the oil out.

Figure 3 : Hydraulic Sesame Seed Oil Press

2.5 Performance Evaluation of Hydraulic Sesame Oil Press

2.5.1 Test Procedure

A batch of 10 kg of sesame seed (NCRI-98-60) was obtained from the National Cereals Research Institute Badeggi, Bida, Niger State. The sesame seeds were cleaned of impurities and oven dried at 105 °C for 4 hours to achieve 6 % moisture content dry basis (MCdb). Instant moisture meter (Model-PM650) was used to ascertain the moisture content. The dried sesame seeds was divided into three. The first part was left at 6 % (MCdb). The second part was conditioned to be at 9 % (MCdb) by adding water. Likewise, the third part was conditioned to be at 12 % (MCdb) by adding water. The quantity of water required to achieve the higher moisture contents was determined using the equation given by Sacilik et al. (2003).

$$Q = W_i \left(\frac{M_f - M_i}{100 - M_f} \right) \qquad (8)$$

where: Q = quantity of water added (kg), W_i = initial mass of sample (kg), M_f = desired final moisture content (% db) and M_i = initial moisture content (% db).

Each part was divided into two samples (sample A and sample B). All the sample A from each moisture content were roasted at 120 °C for 15 minutes while all the sample B were left as unroasted sample. The samples were properly labelled and kept in desiccators according to their respective moisture conditions in order to maintain the needed moisture contents. Hence,

Corresponding author's e-mail address: istab@unilorin.edu.ng two seed conditions (roasted and unroasted) were maintained and placed in desiccators prior to pressing oil from the sesame seeds. The samples were ground and kneaded to form pastes following the method of Makeri et al (2011). This was to enhance maximum oil extraction in the press during the expressing operation. The heater band was wrapped around the pressing barrel and connected to electronic temperature controller to ensure that the expressing occurred at temperatures of 70, 80, 90 and 100 °C as given by (FAO, 1986). The thermocouple Probe of the temperature controller was attached to the pressing barrel which enables it to turn off the heater band when the set temperature is attained and off when the temperature falls below the set value. The oil was obtained by wrapping 500g of sesame seed paste in muslin (cloth) and placed in the hopper for onward passage into the barrel. By actuating the lever arm of the control valve, the connecting rod moved forward and with the expression temperature set as required, the oil pressing plate pressed the paste against the stopper end plate. This led to expression of oil from the perforations on the stopper end plate. The oil was collected via the oil collection trough. This expression continues until oil stop coming out of the perforations. The pressing time for each operation was also noted and recorded. The average time of each expression operation was observed to be 6 seconds.

The performance evaluation of the Sesame Seed Oil Press was carried out by using 2x3x4 factorial experiment in a completely randomized design. The three factors that were considered in the factorial design were two levels each of seed conditions (S) (roasted and unroasted), three levels of moisture contents (M) (6, 9 and 12% wet basis) and four levels of temperature (T) (70, 80, 90 and 100 °C). Each treatment factor was done in three replicates.

The data obtained for the performance indices from the performance evaluation of the Sesame Seed Oil Press was subjected to statistically analysis using Analysis of Variance (ANOVA) to ascertain the significance of the each treatment factor considered. Also, Duncan's Multiple Range Test was used to check if the differences in mean values of the performance indices were significant.

2.5.2 Performance Indices

The following parameters were used in carrying out the performance evaluation of the machine:

2.5.2.1 Throughput Capacity of Machine (C_m): This is the ratio of the mass of pressed sesame paste to the total time taken to obtain the oil expressed in kg/h and is given as:

$$C_m = \frac{W_g}{t} \qquad (5)$$

where: C_m = Throughput Capacity of Machine with respect to time (kg/h), Wg= mass of sesame paste fed into the hopper (kg) and t = Total time taken to press the sesame paste to obtain oil (h)

2.5.2.2 Percentage Oil Yield: This is the ratio of the mass of sesame oil extracted to the mass of sesame paste fed into the hopper expressed in percentage and is given as:

$$OY = \frac{W_o}{W_g} \times 100 \qquad (6)$$

where: OY = Percentage oil yield (%), W0 = mass of oil extracted (kg) and Wg = mass of sesame paste fed into the hopper (kg)

Corresponding author's e-mail address: istab@unilorin.edu.ng

2.5.2.3 Percentage Extraction Efficiency: This is the ratio of the mass of sesame oil extracted to the total oil content of the seeds expressed in percentage and is given as:

$$\mathrm{EE} = \frac{\mathrm{W_o}}{\mathrm{W_c}} \times 100 \qquad (7)$$

where: EE = Percentage extraction efficiency (%), W_o = mass of oil extracted (kg) and W_c = Total oil content of the seed (kg)

2.5.2.4 Cake recovery efficiency: This is the ratio of the mass of sesame cake obtained to the mass of sesame paste fed into the hopper expressed in percentage and is given as:

$$\mathrm{CR} = \frac{\mathrm{W_d}}{\mathrm{W_g}} \times 100 \qquad (8)$$

where: CR = cake recovery efficiency (%), W_d = mass of sesame cake obtained (kg) and W_g = mass of sesame paste fed into the hopper (kg)

Quality of oil obtained

The oil expressed from the roasted seeds was pale brown in colour while that obtained from the unroasted seeds was pale yellow in colour. There was no seeds particles in the oil. Each experiment was replicated three times.

3 Results and Discussion

3.1 Results

The results generated from the calculated values of the average oil yield, extraction efficiency and cake recovery efficiency at the four levels of temperature, three levels of moisture content and two levels of seed conditions are summarized in Table 1.

3.2 Discussions

From Table 1, it could be seen that the highest oil yield was recorded when the seeds were roasted and milled prior to pressing giving an oil yield of 33.3 % at a moisture content of 6 % and extraction temperature of 90 ºC while for the milled sample that was pressed without roasting recorded the highest oil yield of 31.0 % at a moisture content of 6 % and extraction temperature of 90 ºC. Similar result was reported by Fasina and Ajibola (1989) who noted that in conophur nut, there was increase in oil yield when the seeds were pre-heated prior to extraction. Hamzat and Clarke (1993) and Okegbile et al. (2014) heated samples of groundnut at temperature of 65 °C for 45 minutes and temperature of 60 °C for 30 minutes respectively. It was observed that there was an increase in the oil yield of groundnut oil after extraction. Roasting of oilseeds helps to boost oil yield because the oil cells are broken down, protein is coagulated in the seeds for easy separation of the proteinaceous fraction and oil viscosity is reduced which leads to easier flow of the oil (Fasina and Ajibola, 1989).

Corresponding author's e-mail address: istab@unilorin.edu.ng

Table 1 : Average Performance Indices of the Sesame oil press

The format of values in the table is mean value ± standard deviation

Moisture Content (%)	Heating Temperature (°C)	RS Oil Yield (%)	URS Oil Yield (%)	RS Extraction Efficiency (%)	URS Extraction Efficiency (%)	RS Cake Recovery (%)	URS Cake Recovery (%)
6	70	30.0±0.0	28.3± 0.6	62.5±0.0	59.0±1.1	70.0±0.0	71.7±0.6
	80	32.3±1.5	30.3±0.6	67.3±3.2	63.1±0.3	67.7±1.5	69.7±0.6
	90	33.3±0.6	31.0±1.0	69.4±1.1	64.6±1.2	66.7±0.6	69.0±1.0
	100	32.7±0.6	30.3±0.6	68.1±1.2	63.1±1.1	67.3±0.6	69.7±0.6
9	70	29.0± 1.0	26.3±0.6	60.4±2.1	54.8±0.3	71.0±1.0	73.7±0.6
	80	32.0±1.0	30.0±1.0	66.7±2.1	62.5±1.2	68.0±1.0	70.0±1.0
	90	33.0±0.0	30.3±0.6	68.8±0.0	63.1±1.1	67.0±0.0	69.7±0.6
	100	32.0±1.0	29.7±0.6	66.7±2.1	61.9±0.3	68.0±1.0	70.3±0.6
12	70	28.0± 1.0	26.0±1.0	58.3±2.1	54.2±2.1	72.0±1.0	74.0±1.0
	80	30.0± 1.0	28.6±1.2	62.5±2.1	59.6±2.4	70.0±1.0	71.4±1.2
	90	31.0±1.0	30.0±1.0	64.6±2.1	62.5±2.1	69.0±1.0	70.0±1.0
	100	29.0± 1.0	29.0±1.0	60.4±2.1	60.4±2.1	71.0±1.0	71.0±1.0

It could also be seen from Table 1, that the highest extraction efficiency of the machine was recorded when the sample was roasted and milled giving a value of 69.4 % at 90 °C heating temperature and 6 % moisture level while the highest extraction efficiency recorded when the sample was milled and pressed without roasting was 64.6 % at 90 °C heating temperature and 6 % moisture level. Hamzat and Clarke (1993) reported an increase in oil yield emanating from seed conditioning (roasting) also reported that when seeds are preheated, the extraction efficiency also increases.

Likwise, seed condition has a tremendous effect on the Cake recovery efficiency as shown in Table 1. The Table shows that the highest cake recovery was recorded when the sesame seed was milled without roasting prior to pressing, giving a cake recovery efficiency of 74 % at a moisture content of 12 % and extraction temperature of 70 °C while for the roasted, milled and pressed sample, the highest cake recovery efficiency was 72 % at a moisture content of 12 % and extraction temperature of 70 °C. Pressing sesame seed without first roasting will result to more cake and lesser oil. This is because roasting of oilseeds increases oil yield as the oil cells are broken down, protein is coagulated in the seeds for easy separation of the proteinaceous fraction and oil viscosity is reduced which leads to easier flow of the oil (Fasina and Ajibola, 1989).

4. Conclusion

A motorized hydraulic sesame oil press was designed, constructed and tested. Based on the performance evaluation carried out on the oil press, the hydraulic press had a throughput capacity of 35 kg/h. The maximum oil yield and extraction efficiency of 33.3 % and 69.4 % respectively was achieved when the sesame seeds were roasted, ground and pressed at a heating temperature of 90 °C and moisture content of 6 %. The maximum cake recovery of 74 % was achieved when the sesame seeds were not roasted and pressed at a heating temperature of 70 °C and moisture content of 12 %. The developed sesame oil press would be found very

Corresponding author's e-mail address: istab@unilorin.edu.ng

useful in the edible oil production industry. Thus, increasing indigenous oil production and reducing edible oil importation.

References

Borchani, C., Besbes, S., Blecker, CH. and Attia, H. 2010. Chemical characteristics and oxidative stability of sesame seed, sesame paste, and olive oils. Journal of Agriculture, Science and Technology, 12: 585-596.

Elleuch, M., Besbes, S., Roiseux, O., Blecker, C. and Attia, H. 2007. Quality characteristics of sesame seeds and by-products. Food Chemistry, 103 (2): 641 – 650.

Food and Agricultural Organisation (FAO). 1986. Monthly Bulletin statistics vol. 9 July /August, Rome.

Fasina, OO. and Ajibola, OO. 1989. Mechanical expression of oil from conophor nuts (Tetracarpidium Conophonum). Journal of Agricultural Engineering Research, 44: 275 -287.

Global AgriSystems. 2010. Dehulled and roasted sesame seed oil processing unit. Retrieved July 20, 2016 from http://www.mpstateagro.nic.in/

Hamzat, KO. and Clarke, B. 1993. Prediction of oil yield from groundnuts using the concept of quasi- equilibrium oil yield. Journal of Agriculture Engineering Research, 55(1): 79-87.

Khurmi, RS. and Gupta, JK. 2005. Machine design, 14th Edition. S. Chand and Company Ltd., Ram Nagar, New Delhi- 110055.

Lee, J. 1995. Varietal differences in sesame breeding, Journal of Agricultural Science, 37(2): 169-185.

Makeri, MU., Bala, SM. and Kassum, AS. 2011. The effects of roasting temperatures on the rate of extraction and quality of locally-processed oil from two Nigerian peanut (Arachis hypogea L.) cultivars. African Journal of Food Science, 5 (4): 194 – 199.

Nakayama, Y. and Boucher, RF. 2000. Introduction to fluid mechanics. Butterworth-Heinemann Publication. Linacre House, Jordan Hill, Oxford OX2 8DP.

Okegbile, OJ., Mohammed, A., Hassan, AB. and Obajulu, O. 2014. Fabrication and testing of a combined roaster and oil expeller machine. American Journal of Engineering Research, 3(4):230 – 235.

Ramsdale, R. 2006. Reference Tables: Fluid power formulars . Retrieved January 26, 2016 from http://www.engineershandbook.com/Tables/fluidpowerformulas.html.

Ryder, GH. 1985. Strength of materials. 3rd edition. MacMillan Publishers Ltd, London

Corresponding author's e-mail address: istab@unilorin.edu.ng