

EVALUATION OF DEVELOPED OILSEED EXPRESSION MACHINE

A. A. El Nakib⁽¹⁾, H. A. Abdel Mawla⁽²⁾

A. M. Rasmy⁽³⁾, M. M. Geasa⁽⁴⁾

ABSTRACT.

The aim of this study was to develop and test an oilseed expression machine for oil production. The tested parameters were: (1) Machine setting of one stage and double stage expression (2) Screw speeds of 30, 50, 70 and 90 rpm (3) Cake output clearance 0.5, 0.8, 1.1 and 1.4 mm (4) for double stage expression setting intermediate choke gap of 0.6, 0.8, 1.0 and 1.2 mm. and (5) Moisture content of oilseed 6 %, 8% and 10%.

Results obtained increasing in expression efficiency by: reducing the choke gap, reducing the screw rotational speed, increasing seeds moisture-content to 8% (d.b), and using double stage machine.

Maximum oil expression efficiency was 86% at 0.5 mm choke gap, 30 rpm screw rotational speed, 6% moisture content and two stage machine setting with 0.6 mm intermediate choke gap. On the other hand, minimum oil expression efficiency was 52% at 1.4 mm choke gap, 90 rpm screw rotational speed, 6% moisture content and single stage machine.

The evaluated parameters affecting the expression process, oil productivity, expression efficiency, expressed oil temperature, oil production cost are discussed in the paper.

1 - INTRODUCTION.

Separation of oil from oilseeds is an important processing operation. The process employed has a direct effect on the quality and quantity of oil obtained from the oilseeds. Mechanical pressing of oilseeds is the most widely used method for oil expression in the world. However, the mechanical oil expellers (screw presses) employed for this purpose leave more than 15% of the expressible oil in the deoiled cake, so that a large quantity of edible oil is

(1) and (3) Prof. and Assoc. Prof., of Agric. Eng., Fac. of Agric. Eng., Al-Azhar University.

(2) and (4) Prof. and Assoc. Lect., of Agric. Eng., Fac. of Agric., Eng. Dep. Al-Azhar University. Assiut branch.

not available for human consumption. To narrow edible oils production-consumption gap a modified oil expeller was developed based on principle of single feed double stage compression **Al-Ashry(1999)** showed that the factors contributing to extraction efficiency may be classified into two general categories: (1) those related to the properties of the oilseed itself, and (2) those related to conditions under which the seed is expressed. The factors that influence the yield of oil from a press include:

The maturity and growth conditions of the raw material, the extent of disruption of cell structure, the resistance of the solids to mechanical deformation, the rate of increase in pressure, the time of pressing, the maximum pressure applied, the thickness of the pressed solids, the temperature of solids and liquid and the viscosity of the expressed liquid.

Amin et. al. (2007) reported that edible oils are the least food products self-sufficient in Egypt, as its self-sufficiency rate is less than 10%, and its imports value per annum mount up to nearly 1\$ billion. So, Egyptian agricultural policy should be aimed to increase oil yield, not only by increasing cultivated oilseeds area or by increasing oilseeds productivity per unit area, but also by maximizing the extracted oil from oilseeds.

Beerens (2007) stated that mechanical screw pressing is the most popular method in the world to separate oil from vegetable oilseeds on small to medium scale. Reasons for its popularity are that the machines require low initial and operation investments, can easily be operated, maintained and adopted by semi-skilled personnel, can be adapted quickly for processing of different kinds of oilseeds, The oil expulsion process is continuous with product obtained within a few minutes of start of the processing operation; The safety and simplicity of the whole process is advantageous over the more efficient solvent extraction equipment. Furthermore, it is possible to manufacture screw presses locally creating additional local employment. Both the oil and the de-oiled press cake obtained using screw presses are free of solvents and other chemicals as opposed to the more efficient solvent extraction method.

The objective of this study was to evaluate developed expression machine. Some factors affecting the performance of the developed prototype such as screw speed, choke gap clearance. Machine setting and seed moisture-content are studied and discussed.

2 - MATERIALS AND METHODS.

Materials:

1 Oil expression-machine:

The fabricated expression machine was manufactured at a workshop in Mahala (المحلة). Figs. 1 and 2 show that the fabricated oil expression machine consists of:

a) Frame: The frame has the dimensions 200X42X60 cm made from iron angles (7.5X7.5 cm) welded together.

b). Choke mechanism A choke regulator permits a final adjustment of the expression machine pressure. The choke gap may be adjusted to change the pressure according to used oilseed condition.

c) Hopper The hopper was made from galvanized iron sheet as conical shape. Cone side incline is 60° ($\tan 60$ is much greater than the coefficient of friction of the seed in contact with galvanized iron) to ensure free flow of seeds into the expression unit.

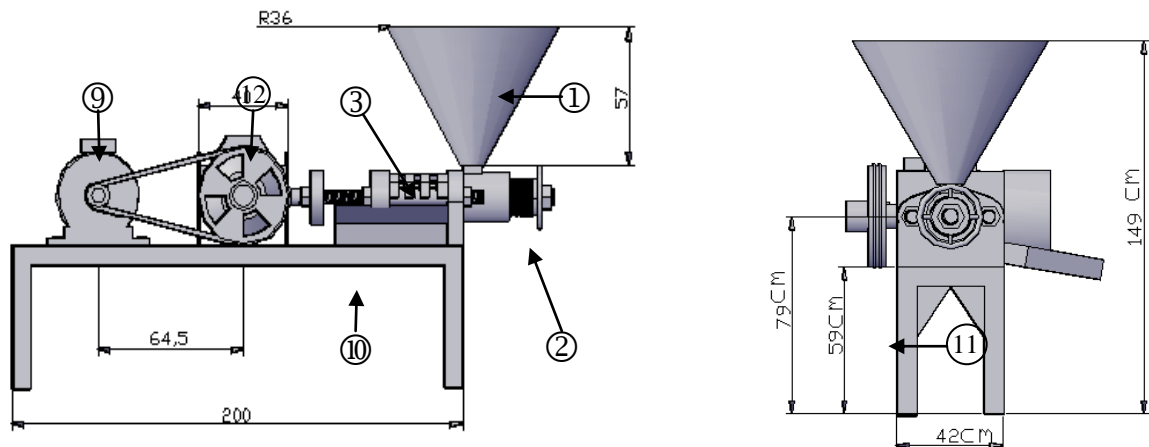
d) Barrel (cage) The cage consists of flat steel bars assembled to be parallel to the worm shaft. The whole set of bars functions as a screen, allowing the oil to pass but not the solids. The spacing of the bars ranged from 0.125 to 0.5 mm. The even spacing can't be achieved.

e). Screw Fig. (2) shows two different settings of screw used in the developed expression machine. The first was used to one stage oil expression machine setting and the second was used as two stage expression machine unit. Two screw sets can be used in the developed machine. A screw with an additional intermediate choke hypothesized that this would facilitate pressing the fed oilseed twice rather than once prior to its exit from the barrel which, may maximize the efficiency of oil recovery without generating the high pressures that absorb power and cause excessive wear of parts.

f) Electrical motor and power transmission.

Electrical motor of (15.4 kW), 970 rpm was used with a differential gearbox of speed reduction 7:1. A set of pulleys that transmit power from

the motor to the gearbox was used to vary the oil extraction screw rotational speed.



Figure(1): Expression machine components.

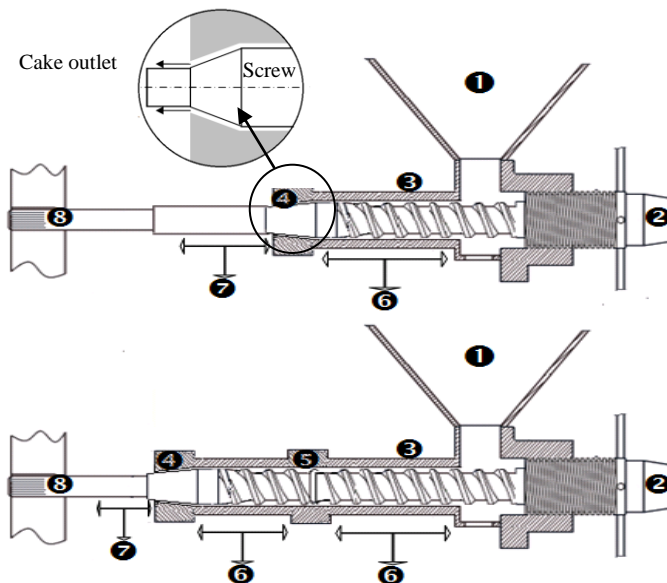


Figure (2): One and two stage oil expression unit.

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|-------------------|-----------------------|---------------|----------|----------------------|
| 1-Hopper | 2-Choke adjustment | 3-Cage | 4-Choke | 5-Intermediate choke |
| 6-Oil outlet | 7-Cake outlet | 8-Screw shaft | 9- Motor | 10- Frame |
| 11- Oil collector | 12- Differential unit | | | |

Methods:

Experiments were conducted to study performance and efficiency of oil expression unit. The tested parameters were:

- (1) Seed moisture content: 6%, 8% and 10% M.C.,
- (2) Machine settings: one stage and two stage machine setting,
- (3) Choke gap clearance: 0.5, 0.8, 1.1 and 1.4 mm,
- (4) Screw shaft speeds: 30, 50, 70 and 90 rpm, and
- (5) For double stage machine, intermediate choke gap clearance: 0.6, 0.8, 1.0 and 1.2 mm.

Experimental procedure:

The description of a typical experiment is used to explain the experimental procedure. First, the screw shaft rotational speed and choke gap were adjusted. Three LM35 temperature sensors located in the hopper; on the outer surface of a button expeller bar and on the choke outlet measured temperature changes. Before starting the measurement, the expression machine required preheating to 40°C by normal operation using pressed cake. After that seeds were used to measure the expression temperature. Expression temperature was measured until reaching to stable temperature for about three minutes. Whereupon the expression machine is empty. Sample of 5kg seed was used to determine the productivity. It was difficult to determine the instant at which the pressing was finished. Therefore, the time measurement was started when the Ammeter showed a steep increase after seeds were fed, and stopped once Ammeter drastically declined while the press was almost empty (**Beernes 2007**). Crude oil was collected at the oil outlet and press cake was also collected from choke outlet.

Estimating the oil expression efficiency:

Oil expression efficiency is defined as the ratio of filtered oil expressed to the total oil content in the oilseeds. According to **Sivakumoran (1983)** oil content of each sample was expressed on a moisture free basis.

It was calculated as follows:

$$\text{Expression efficiency \%} = \frac{W}{W_o} * 100$$

Where:

Wo = Oil content in the oil seed, kg and W = Oil expressed kg.

Oil expression cost:

Cost of operation was calculated according to the equation given by **Awady (1978)**, in the following form:

$$C = p/h (1/a + i + t/2 + r) + (Ec * Ep) + m/144,$$

Where: C = hourly cost, p = price of machine, h = yearly working hours, a = life expectancy of the machine, i = interest rate/year, t = taxes, r = overheads and indirect cost ratio, Ec = Electricity consumption kW, Ep = Electricity price L.E/kW.h, "144" are estimated monthly working hours. Notice that all units have to be consistent to result in L.E/h.

Production cost, L.E./ton = Operation cost,(L.E./h) / Machine productivity, (ton/h)

RESULTS AND DISCUSSION

1- Physical and mechanical properties of sunflower seeds:

Properties of sunflower seeds were measured. Table (1) shows the properties of the sunflower seed processed by the machine

Table(1): Properties of sunflower seed used in the test.

M.C, % d.b.	L, mm.	W, mm.	T, mm.	M, g.	True density, kg/ m ³	Bulk density, kg/m ³	Angle of repose, deg.	Coefficient of friction
6	11.74	5.83	3.42	0.072	650	392	30.7	0.47
8	11.76	5.84	3.44	0.073	658	388	31.2	0.49
10	11.8	5.84	3.45	0.074	669	385	31.5	0.52

L =Length, W=Width, T=Thickness and M=Mass.

2- Seed processing rate:

Fig. 3 shows the effect of choke gaps, screw rotational speeds, seed moisture contents, and machine settings on the seed processing rate

- Effect of choke gap on the seed feeding rate:

Decreasing the choke opening decreases the seed processing rate. The narrow choke gap reduces the flow of the material inside the expression cage. High pressure is generated to overcome this resistance, which means increase in the expression duration.

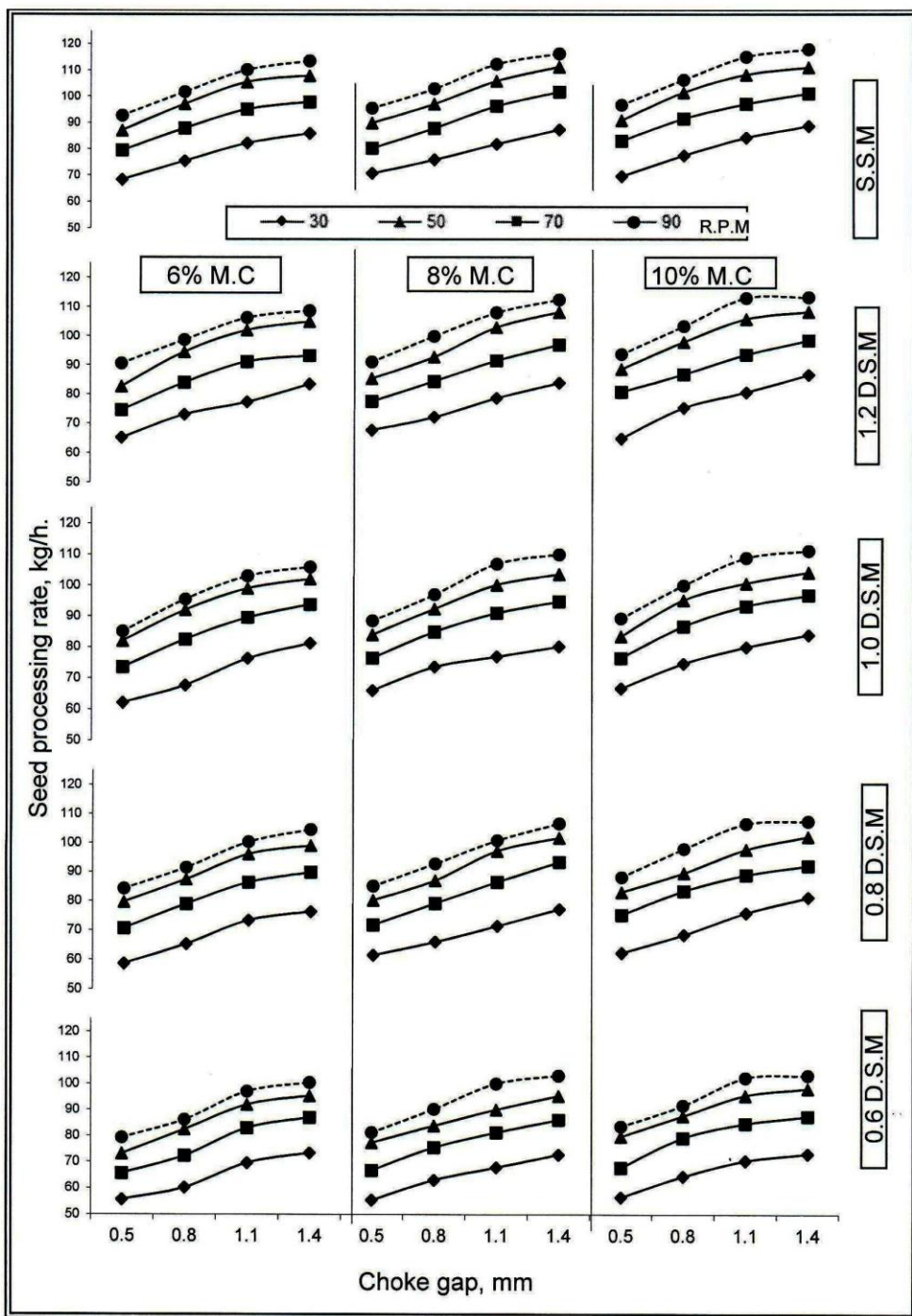


Fig.(3) Effect of choke gaps, screw speeds, moisture contents and machine settings on the seed processing rate, kg/h

When the choke discharge opening increased from 0.5 to 1.4 mm tended to increase seed processing rate from 75.35, 72.89, 67.58, 65.23 and 60.13 to 101.62, 98.56, 95.4, 91.4, 86.11 kg/h for single stage machine, and double stage machine with 1.2, 1.0, 0.8 and 0.6 mm intermediate choke gap at 50 rpm screw rotational speed and 6% seed moisture content.

- Effect of screw rotational speed on the seed feeding rate

-Increasing the screw speed tends to increase the seed processing rate.

Increasing screw rotational speed from 30 to 90 rpm tended to increase in seed processing rate from 83, 80.56, 76.24, 75.1 and 67.66 to 101, 98.27, 96.49, 91.9 and 87.4 kg/h for single stage machine, and double stage machine with 1.2, 1.0, 0.8 and 0.6 mm intermediate choke gap respectively at 10% seed moisture content and 0.8 mm choke gap.

-Effect of moisture content on the seed processing rate

The results show that with increasing moisture content, the seed processing rate increases.

It was noticed that when the seed moisture content increased from 6 to 10 % tended to increase in seed processing rate from 85.85 to 88.6 kg/h for single stage machine, and from 83.32 to 86.39 kg/h for double stage machine with 1.2 mm intermediate choke gap and; from 81.02 to 83.56 for double stage machine with 1.0 mm intermediate choke gap; and from 76.2 to 81 kg/h for double stage machine with 0.8 mm intermediate choke gap at 90 rpm screw rotational speed and 0.5 mm choke gap.

-Effect of the machine settings on the seed processing rate

The seed processing rate in general decreases in double stage machine settings. This may be due to an increase in the length of the screw and also due to pressing of the fed oilseed twice rather than once prior to its exit from the barrel.

3- Expressed oil productivity:

Fig. 4 shows the effect of choke gaps, screw rotational speeds, seed moisture contents, and machine settings on the expressed oil productivity.

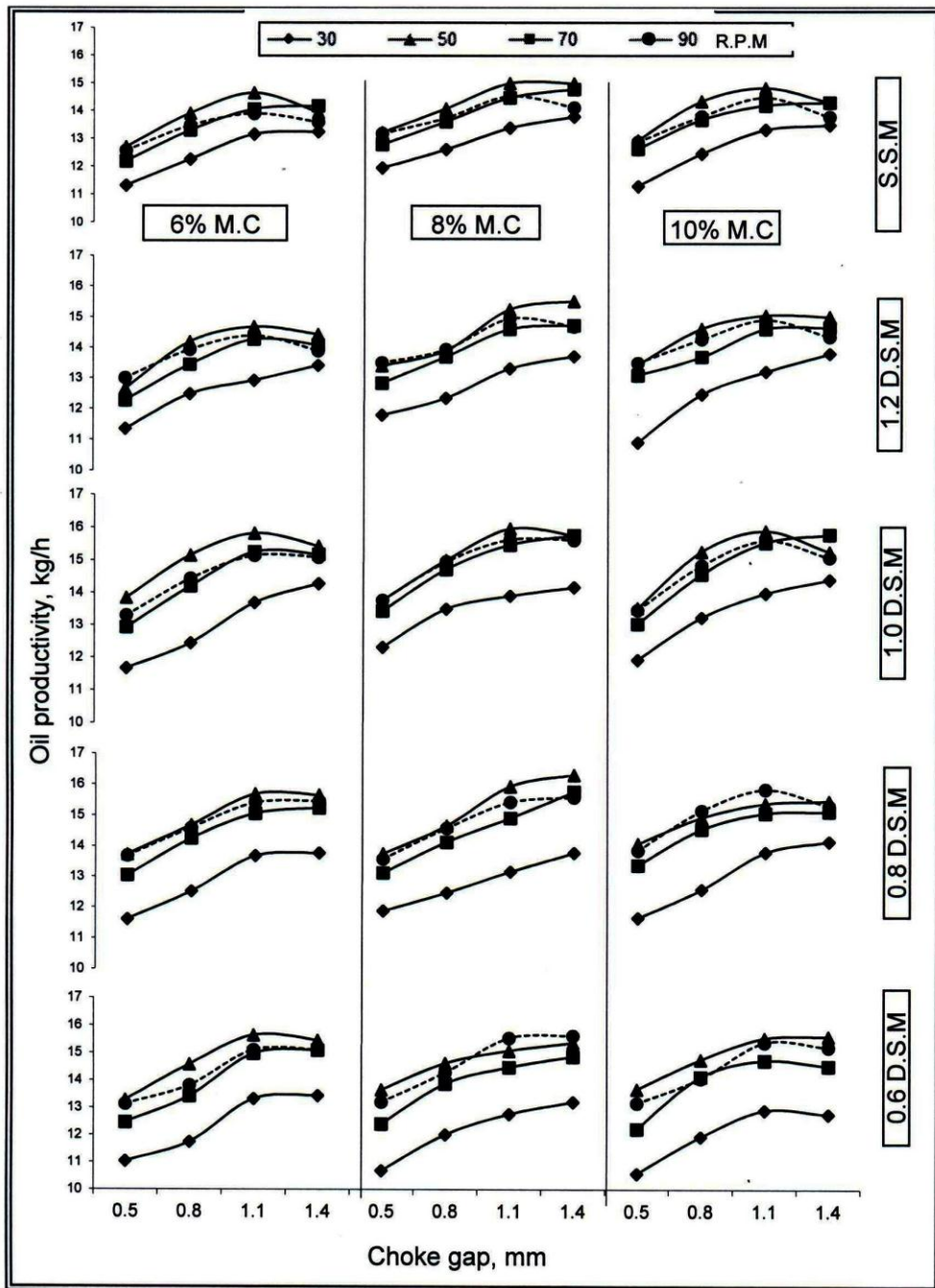


Fig.(4): Effect of choke gaps, screw speeds, moisture contents and machine settings on the oil productivity, kg/h

-Effect of choke gap on the expressed oil productivity

Reducing the opening discharge area decreases the expressed oil productivity. This may be explained by decreased seed material flow.

When the choke discharge opening increased from 0.5 to 1.4 mm, oil productivity increased from 11.94, 11.78, 12.29, 11.86 and 10.68 to 13.17, 13.49, 13.75, 13.57 and 13.2 kg/h for single stage machine, and double stage machine with 1.2, 1.0, 0.8 and 0.6 mm intermediate choke gap at 30 rpm screw rotational speed and 8% seed moisture content.

-Effect of screw rotational speed on the oil productivity

Increasing screw rotational speed tends to increase the oil productivity.

Increasing screw rotational speed from 30 to 90 rpm, oil productivity increased from 12.56, 12.99, 13.29, 13.68 and 13.13 to 13.58, 13.88, 15.07, 15.45 and 15.1 kg/h for single stage machine, and double stage machine with 1.2, 1.0, 0.8 and 0.6 mm intermediate choke gap respectively at 6% moisture content and 0.5 mm choke gap.

-Effect of moisture content on the expressed oil productivity

As explained before, increasing in seed moisture content tends to increase in the seed processing rate, but on the other hand, it also tends to decrease the seed oil content. So the seed moisture content has a little effect on the expressed oil productivity.

Maximum expressed oil productivity was obtained at 8% moisture content at most different rotational screw speeds; choke gaps, and machine settings.

It was noticed that the seed moisture content increase from 6 to 8 % tended to change the expressed oil from 11.31, 11.34, 11.66, 11.6 and 11.03 to 11.94, 11.78, 12.29, 11.86 and 10.68 kg/h for single stage machine, and double stage machine with 1.2, 1.0, 0.8 and 0.6 mm intermediate choke gap respectively at 30 rpm screw rotational speed and 0.5 mm choke gap. On the other hand, increasing seed moisture content from 8 to 10 % tends to change the expressed oil from 11.94, 11.78, 12.29, 11.86 and 10.68 to 11.28, 10.88, 11.9, 11.63 and 10.57 kg/h for single stage machine, and double stage machine with 1.2, 1.0, 0.8 and 0.6 mm intermediate choke gap respectively at the same conditions.

Effect of machine settings on the expressed oil productivity

The expressed oil productivity increases in double stage machine settings. This may be due to an increase in the length of the screw which

means more expression duration and also due to pressing of the fed oilseed twice rather than once prior to its exit from the barrel.

When the single stage screw setting machine is used, the expressed oil productivity was 14.99 kg/h. using a double stage machine arrangement with 1.2 mm intermediate choke tends to increase in expressed oil productivity to 15.23 kg/h. Changing intermediate choke to 1.0 mm tends to increase the expressed oil productivity to 15.94 kg/h at 8% moisture content and 1.1 mm choke gap.

4- Oil expression efficiency:

Fig. 5 shows the effect of choke gaps, screw rotational speeds, seed moisture contents, and machine settings on the oil expression efficiency

-Effect of choke gap on the expression efficiency

The outlet clearance was the most important designation parameter that controls the other variables of oil expression process as well as the output material characteristics. Decreasing the choke opening, decreases cake oil content and increasing oil recovery. The narrow choke gap may reduce the flow of the material inside the expression cage that may increase the duration of extraction also include more seed breakage and fine size of the seed material that may contribute higher expression efficiency.

When the choke discharge opening increased from 0.5 to 1.4 mm it tended to decrease oil expression efficiency from 75.1, 77.5, 82.9, 85.7 and 85.7 to 61.3, 65.9, 69.2, 71.0 and 72.3 % for single stage machine, and double stage machine with 1.2, 1.0, 0.8 and 0.6 mm intermediate choke gap at 30 rpm screw rotational speed and 8% seed moisture content.

Effect of screw rotational speed on the expression efficiency

Results show a reduction in oil expression efficiency by increasing rotational speed. This behavior may be explained increasing the throughput. Increased throughput means reduced expression duration and thus less chance for the oil to flow from between the solid material.

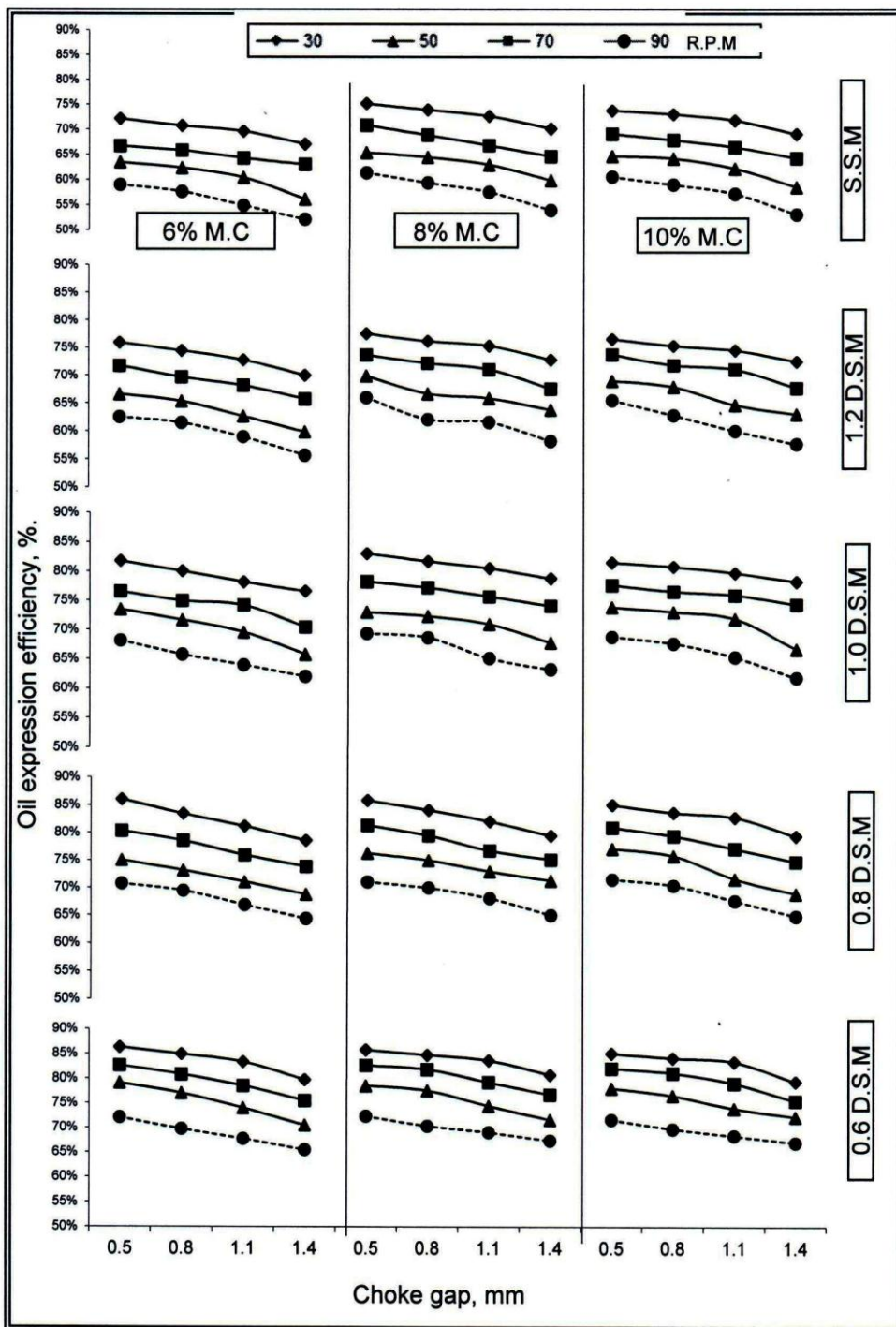


Fig.(5): Effect of choke gaps, screw speeds, moisture contents and machine settings on the oil expression efficiency.%,

Increasing screw rotational speed from 30 to 90 rpm tended to decrease in oil expression efficiency from 72.1, 75.9, 81.7, 86.0 and 86.3 to 67.0, 69.9, 76.5, 78.5 and 79.7 % for single stage machine, and double stage machine with 1.2, 1.0, 0.8 and 0.6 mm intermediate choke gap respectively at 6% moisture content and 0.5 mm choke gap.

Effect of moisture content on the expression efficiency

The effect of moisture content on oil expression efficiency is considerable. Higher seed moisture content reduces the temperature of the expression and increases the flow rate inside the expression cage.

Maximum oil recovery was obtained at seeds moisture content 8% (d.b). The oil expression efficiency increased by increasing seeds moisture-content from 6 to 8% and decreased by increasing seeds moisture-content from 8 to 10 % for all tested screw speeds, choke gaps and machine settings.

Effect of machine settings on the expression efficiency

The expression efficiency was increased by using double stage machine. This may be due to the increase in screw length which means exposing the fed oilseed to longer time pressure and also due to an additional intermediate choke which tends to press the fed oilseed twice rather than once prior to its exit from the barrel cage.

When the single stage screw setting machine was used the oil expression efficiency was 65.4. %. Using a double stage machine arrangement with 1.2 mm intermediate choke tends to increase oil expression efficiency to 69.8 %. Changing intermediate choke to 1.0 mm tends to increase the oil expression efficiency to 72.9 at 8% moisture content, 30 rpm screw rotational speed and 1.1 mm choke gap.

5-The expressed oil temperature:

Fig. 6 shows the effect of choke gaps, screw rotational speeds, seed moisture contents, and machine settings on the expressed oil temperature. Oil temperature less than 70 C^o, during the pressing operation, may help processors satisfy the cold pressing requirement of organic oil.

Effect of choke gap on the oil temperature

Decreasing the choke opening increases oil temperature. This may be due to the friction forces between material, screw and barrel cage.

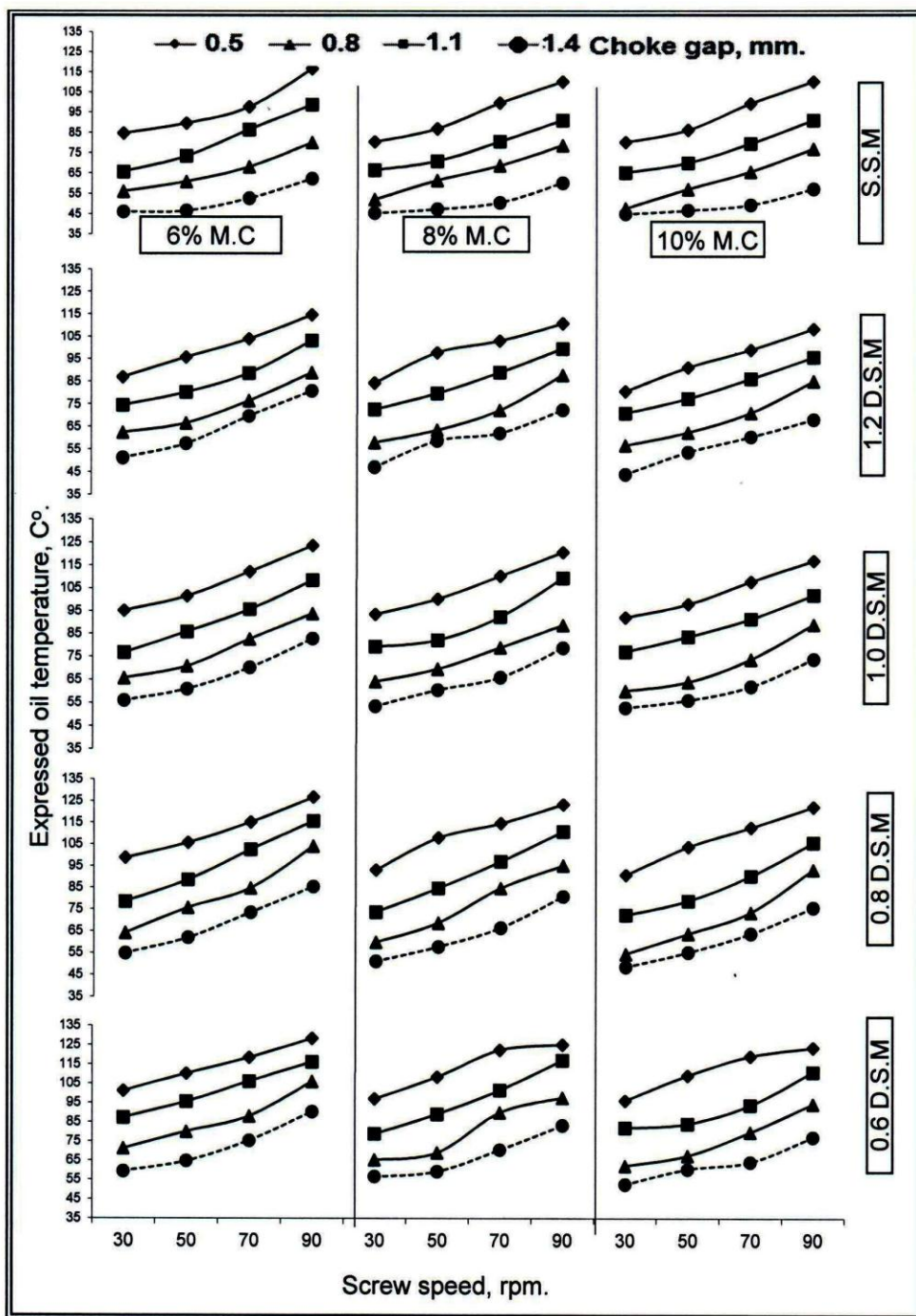


Fig.(6): Effect of choke gaps, screw speeds, moisture contents and machine settings on the expressed oil temperature, C°.

This friction forces were increased by the increasing the resistance to flow at the end of the screw press. decreasing choke discharge opening from 1.4 to 0.5 mm tended to increase in oil temperature from 80.3, 84, 93.2, 92.9 and 96.9 to 110, 110.5, 120.3, 123 and 125 Co for single stage machine, and double stage machine with 1.2, 1.0, 0.8 and 0.6 mm intermediate choke gap at 30 rpm screw rotational speed and 8% seed moisture content.

Effect of screw rotational speed on the oil temperature

Increasing the screw rotational speed increases oil temperature.

Increasing screw rotational speed from 30 to 90 rpm tended to increase in oil temperature from 65.0, 70.6, 76.6, 72 and 82 to 90.8, 95.3, 101.4, 105.3 and 110.8 C° for single stage machine, and double stage machine with 1.2, 1.0, 0.8 and 0.6 mm intermediate choke gap respectively at 10% moisture content and 0.8 mm choke gap.

Effect of moisture content on the oil and cake temperature

Increasing moisture content tends to decrease oil temperature. This was explained by **Willems (2007)** who suggested that during expression, water can only be removed by evaporation bringing up another contribution to the cooling effect. Also **Singh et al. (2002)** suggested that moisture acts as a lubricant during pressing.

Increasing moisture content from 6 to 10 % tended to decrease in oil temperature from 116.5, 114.4, 123.4, 126.5 and 128.2 to 101, 108, 116.4, 121.7 and 123.4 C° for single stage machine, and double stage machine with 1.2, 1.0, 0.8 and 0.6 mm intermediate choke gap respectively at 90 rpm screw rotational speed and 0.5 mm choke gap.

The oil temperature in general increases in double stage machine settings. This may be due to an increase in the length of the screw which means more friction upon the seeds between the screw and parallel cage.

6-Oil expression cost:

Fig. 7 shows the effect of choke gaps, screw rotational speeds, seed moisture contents, and machine settings on the oil expression cost.

Effect of choke gaps on the oil expression cost per L.E./ton

Decreasing the choke opening increases the expression oil cost. Decreasing choke gap outlet from 1.4 to 0.5 tends to increase oil expression cost from 660.46 to 581.99, 667.53 to 571.95, 661.21 to 559.8, 669.83 to 544.56 and finally from 706.24 to 571.95 L.E./ton for single stage machine and double stage machine arrangement with 1.2, 1.0, 0.8 and 0.6 mm intermediate choke respectively at 6 % moisture content and 30 rpm screw rotational speed.

Effect of screw rotational speed on the oil expression cost

Increasing the screw rotational speed decreases oil expression cost, this effect may be due to increase in throughputs rate.

Increasing screw rotational speed from 30 to 90 oil expression cost decreased from 656.06 to 583.21, 693.95 to 575.87, 643.69 to 561.3, 664.68 to 572.56 and finally from 733.2 to 639.22 L.E./ton for single stage machine and double stage machine arrangement with 1.2, 1.0, 0.8 and 0.6 mm intermediate choke respectively at 10 % moisture content and 0.5 mm choke gap.

Effect of moisture content on the oil expression cost

Seed moisture content has a little effect on the oil expression cost. Increasing the seeds moisture content tended to slight decrease in the expression cost.

Increasing seed moisture content from 6 to 10% oil expression cost increased from 623.65 to 608.50, 619.89 to 619.76, 630.73 to 593.19, 634.68 to 625.81, and finally from 679.71 to 665.54 L.E./ton for single stage machine and double stage machine arrangement with 1.2, 1.0, 0.8 and 0.6 mm intermediate choke respectively at 50 rotational speed and 0.5 mm choke gap

Effect of machine settings on the oil expression cost

Oil expression cost increased in double stage machine settings this may be due to an increase in the length of the screw, which means more power consumption and more expression residual time.

When the single stage screw machine setting is used, the oil expression cost was 560.99 L.E./ton. Using a double stages machine arrangement with 1.2 mm intermediate choke tends to increase in oil expression cost to 549.39. L.E./ton. Changing intermediate choke to be 1.0 mm tends to increase oil expression cost to be 549.1 L.E./ton.

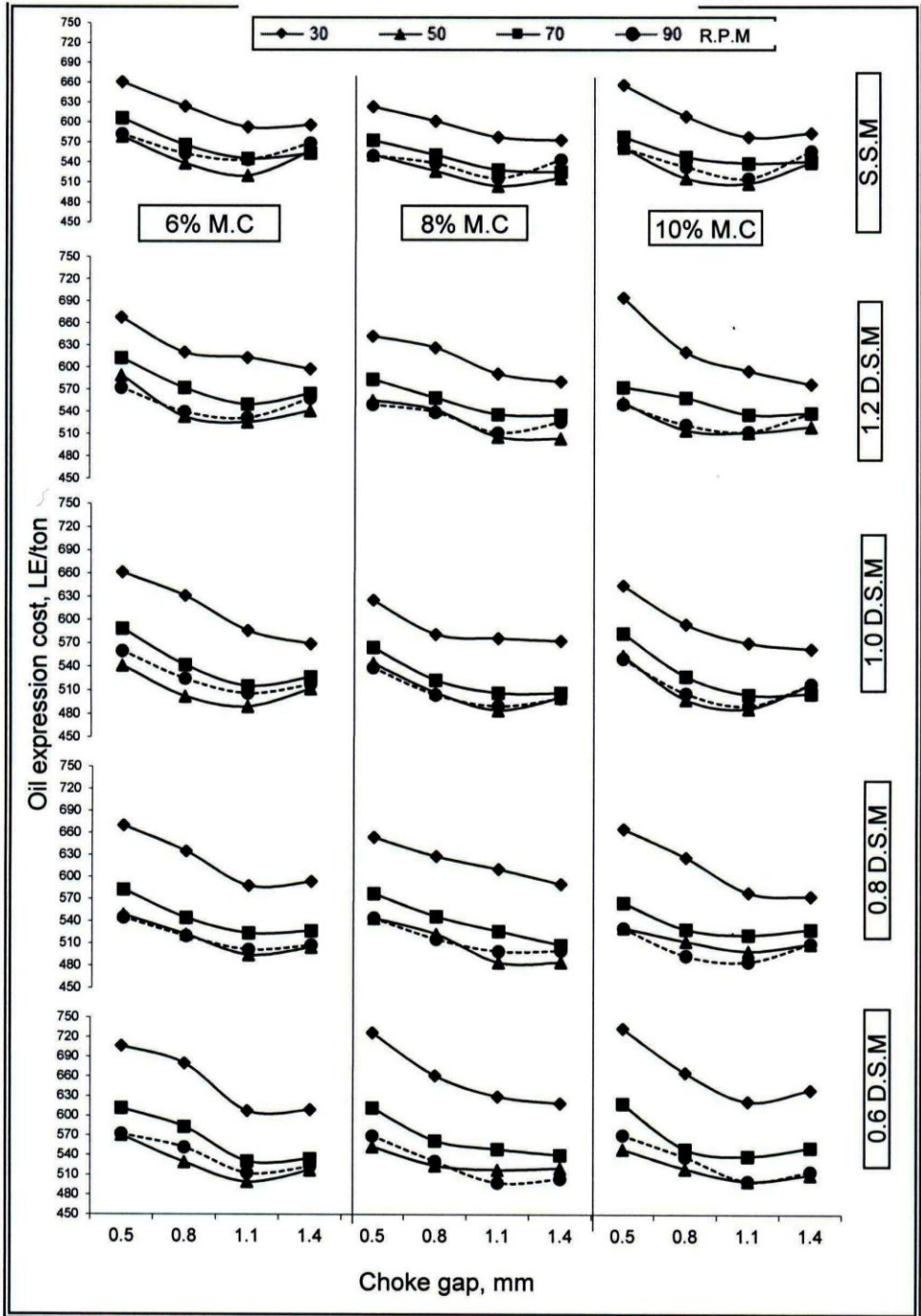


Fig.(7): Effect of choke gaps, screw speeds, moisture contents and machine settings on the oil expression cost, LE/ton.

Changing intermediate choke to be 0.8mm tends to increase oil expression cost to be 530.34 L.E./ton. Finally changing intermediate choke to be 0.6 mm tends to increase oil expression cost to be 569.91 L.E./ton at 10 % moisture content and 1.4 mm choke gap.

SUMMARY AND CONCLUSION

The optimum conditions of oil production by the developed machine are different according to many parameters. From the oil expression efficiency view, the maximum oil expression efficiency of 86% was obtained with 0.5 mm choke gap clearance, 30 rpm screw rotational speed, 6% seed moisture content and double stage machine with 0.6 mm intermediate choke. From the oil productivity side of view, the maximum oil productivity of 16.28 kg/h was obtained with 1.1 mm choke gap clearance, 90 rpm screw rotational speed, 8% seed moisture content and double stage machine with 0.8 mm intermediate choke. For the processed oil temperature, the minimum expressed oil temperature of 43.66 C° was obtained with 1.4 mm choke gap, 10 % seed moisture content, 30 rpm screw rotational speed and double stage machine with 0.5 mm intermediate choke machine setting. Finally from the produced oil cost view the minimum expressed oil cost of 484.29 LE/ton was obtained with 1.1 mm choke gap, 8 % seed moisture content, 70 rpm screw rotational speed and double stage machine with 0.8 mm intermediate choke machine setting

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الملخص العربي

تقييم آلة مطورة لعصر البذور الزيتية

أ.د. عبد القادر على النقيب^(١)، أ.د. حسن عبد الرازق عبد المولى^(٢)،
د. أحمد محمد سليم رسمى^(٣)، م. محمد محمد ممدوح جعيسه^(٤)

تعانى مصر من نقص شديد قد يتجاوز ٩٠% من احتياجاتها من زيوت الطعام فضلا عن الزيوت الصناعية مما يتطلب معه بذل جهد مكثف في هذا الجانب سواء إنتاج البذور الزيتية و التوسع في زراعتها أو محاولة رفع كفاءة وحدات إنتاج الزيت من تلك البذور.

يهدف البحث إلى اختبار عسارة حلزونية مطورة وضع في الاعتبار أثناء عملية التطوير أن يتم على الوحدات القائمة بالفعل عن طريق زيادة مرحلة أخرى للعصر مما يعمل على عصر البذور مرتين بدلا من مرة واحدة ومما يعنى نظريا زيادة كفاءة الإستخلاص للأله لتقترب من الوحدات المستورده مع الإبقاء على ميزة التصنيع المحلى بنسبة تقترب من ١٠٠%.

لتقييم الآله المطورة تم إختبار المتغيرات التالية ؛ تجهيزتان لمراحل العصر (مرحلة واحدة ومرحلتين) وعند العمل بالآله بمرحلتين تم إستخدام أربعة مسافات للخلوص الأوسط كما يلي (٠.٦، ٠.٨، ١.٠، ١.٢، ١.٤ مم)، أربع سرعات للحلزونات الضاغطة (٠.٣، ٠.٥، ٠.٧، ٠.٩ ل/د)، أربعة مسافات خروج بقايا العصر (٠.٥، ٠.٨، ١.١، ١.٤ مم)، وثلاثة نسب رطوبة لبذور دوار الشمس المستخدمة (٦، ٨، ١٠%). وتم الحصول على النتائج التالية:

(١) الخصائص الطبيعية و الميكانيكية لبذور دوار الشمس: وجد أن هناك علاقة طردية بين نسبة الرطوبة للبذور وبين كلا من الطول والعرض و الإرتفاع والكتلة و الكثافة الحقيقية و زاوية المكوث و زاوية الإحتكاك بين البذور و بين سطح من الحديد المجلفن المصنع منه قادوس التقييم كما وجد ان هناك علاقه عكسيه بين نسبة الرطوبة للبذور و الكثافة الظاهرية.

(١) ، (٣) أستاذ وأستاذ مساعد الهندسة الزراعية، كلية الهندسة الزراعية جامعة الأزهر،
(٢) ، (٤) أستاذ ورئيس قسم ومدرس مساعد الهندسة الزراعية بزراعة الأزهر فرع اسيوط

(٢) **معدل تشغيل الآلة:** تم الحصول علي أعلى معدل تشغيل وهو ١١٧.٨ كج/س عند إستخدام الآلة بمرحلة واحدة للعصر وخلوص خروج مخلفات العصر ١.٤ مم وسرعة الحلزون الضاغط ٩٠ ل/د ونسبة رطوبة للبذور ١٠%. بينما وجد أن أقل إنتاجية تم الحصول عليها هي ٥٥.٣٦ كج/س عند إستخدام الآلة بمرحلتى عصر وخلوص المرحلة الأولى ٠.٦ مم وخلوص خروج مخلفات العصر ٠.٥ مم وسرعة الحلزون الضاغط ٣٠ ل/د ونسبة رطوبة ٨%.

(٣) **معدل إنتاجية الزيت:** تم الحصول علي أعلى معدل لإنتاجية الزيت وهو ١٦.٢٨ كج/س عند إستخدام الآلة بمرحلتين للعصر وخلوص المرحلة الأولى ٠.٨ مم وخلوص خروج مخلفات العصر ١.١ مم وسرعة الحلزون الضاغط ٩٠ ل/د ونسبة رطوبة للبذور ٨%. بينما وجد أن أقل إنتاجية تم الحصول عليها هي ١٠.٥٧ كج/س عند إستخدام الآلة بمرحلتى عصر وخلوص المرحلة الأولى ٠.٦ مم وخلوص خروج مخلفات العصر ٠.٥ مم وسرعة الحلزون الضاغط ٣٠ ل/د ونسبة رطوبة ١٠%.

(٤) **كفاءة العصر:** تم الحصول علي أعلى كفاءة إستخلاص للزيت و هي ٨٦% عند إستخدام الآلة بمرحلتين للعصر وخلوص المرحلة الأولى ٠.٦ مم وخلوص خروج مخلفات العصر ٠.٥ مم وسرعة الحلزون الضاغط ٣٠ ل/د ونسبة رطوبة للبذور ٦%. بينما وجد أن أقل كفاءة إستخلاص للزيت تم الحصول عليها هي ٥٢% عند إستخدام الآلة بمرحلة عصر واحدة وخلوص خروج مخلفات العصر ١.٤ مم وسرعة الحلزون الضاغط ٩٠ ل/د ونسبة رطوبة ٦%.

(٥) **درجة حرارة الزيت:** كلما انخفضت درجة حرارة الزيت المعصور كلما زادت قيمته الغذائية. تم الوصول الى أقل درجة حرارة للزيت المعصور وهي ٤٣.٧ م° عند إستخدام الآلة بمرحلة عصر واحدة وخلوص خروج مخلفات العصر ١.٤ مم وسرعة الحلزون الضاغط ٣٠ ل/د ونسبة رطوبة للبذور ١٠%. بينما وجد أن أعلى درجة إستخلاص للزيت تم تسجيلها هي ١٢٨ م° عند إستخدام الآلة بمرحلتى عصر وخلوص المرحلة الأولى ٠.٦ مم وخلوص خروج مخلفات العصر ٠.٥ مم وسرعة الحلزون الضاغط ٩٠ ل/د ونسبة رطوبة ٦%.

(٦) **تكاليف استخدام الآلة:** تم الحصول علي أقل تكلفة وهي ٤٨٤.٣ جنيه /طن زيت عند إستخدام الآلة بمرحلتين للعصر وخلوص المرحلة الأولى ٠.٨ مم وخلوص خروج مخلفات العصر ١.١ مم وسرعة الحلزون الضاغط ٧٠ ل/د ونسبة رطوبة للبذور ٨%. بينما وجد أن أعلى تكلفة وهي ٧٣٣.٢ جنيه/طن زيت تم الحصول عليها عند إستخدام الآلة بمرحلتين للعصر وخلوص المرحلة الأولى ٠.٦ مم وخلوص خروج مخلفات العصر ٠.٥ مم وسرعة الحلزون الضاغط ٣٠ ل/د ونسبة رطوبة ٦%.