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Evaluation the Performance of the Locally Fabricated Maize Sheller Machine

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ABSTRACT

The shelling process is one of the most critical of post-harvest operations which affects the quality and quantity of corn production. It could be done manually or mechanically. The main objective of this study was to evaluate the performance of a corn ear shelling which fabricated locally to meet the needs of small farmers. The studied factors were rotational speed of chains shaft 200, 250, 300 and 350 rpm & shelling time 20, 30 and 40 sec and feeding quantity of ears 9, 12 and 15 kg. The affected parameters were shelling efficiency, a ratio of broken grains, the shelling rate, the specific of shelling power and energy consumption. The obtained results using the shelling machine were increasing rotational speed of chains led to an increase in shelling efficiency, the specific of shelling power, energy consumption, shelling rate and broken grains ratio. Increasing feeding quantity led to an increase in both the specific of shelling power, energy consumption and shelling rate while decreased shelling efficiency and broken grains ratio and vice versa with increasing shelling time. The optimum operating parameters of the shelling machine were found at shelling time of 30 sec, 15 kg feeding quantity and 300 rpm shelling speed. The values of shelling rate, shelling efficiency and specific energy were 962.5 kg/h, 100% and 3.51 kJ/kg respectively at optimum operating parameters. The study recommends using this machine to meet the needs of small farmers.

***Keywords*:** Corn ear, Corn sheller, Shelling machine, Sheller evaluation.

INTRODUCTION

Corn is one of the greatest importance crops to animal, poultry production and its big role after rice and wheat, in human's and animal's food. Also, it being used for manufacturing industrial products like starch, syrup, alcohol,….etc. Corn, wheat and rice crops are considered the three main food grain crops. In 2020, the harvested area of the maize crop in Egypt amounted to 1.5 million hectares, and the average production was 7.5 million tons. (FAOSTAT 2022). The quality of maize is determined using suitable shelling techniques. One of the most important processing operations done to bring out the quality of corn is shelling and grinding of corn Aylor (2002). Manual shelling, in Egypt is mainly shelled by hand. It is the easiest traditional system, where the shelling process is done either by rubbing the kernels against each other by hand, or by direct removal of the grains with fingers, or using some small tools. Ismail (2010) investigate the reciprocating frication surface utilization to shell the kernel from corn ear. But, Agarwal and Broutman (1980) indicated that the traditional shelling methods do not support large-scale shelling of corn, especially for commercial purposes and the hand shelling takes a lot of time, even with some hand operated simple tools.

Adewole et al. (2015) Shelling is one of the most critical parts of post-harvest operation which affects the quality and quantity of corn production. It could be done manually or mechanically. In general, corn is shelled using three different methods: manual, semi-mechanical and mechanical method. Semi-mechanical, may be used in manual shelling, which makes shelling of corn ears easier and faster. It is usually equipped with a handle or pedal for ease of work, and it mostly requires only one worker (Wanjala, N. F. 2014). The mechanical machines contribute to the separation of grains from ears within a short period of time and are used if the cultivated area is large and the labor force is few or unavailable.

Patil et al., (2014) stated that the existing corn shellers are normally large and heavy, require high power input to operate and produce low product quality in terms of percentage grain breakage and purity. Whereas, Mali et al., (2015) separation, done by hand or machine by friction or by shaking the products is depend on the varieties grown, and on the moisture content as well as the degree of maturity of the grain.

Vinay (2016) defined shelling in the field after harvesting, manually or by using suitable machines depending on the friction force or shaking the ears.

Udom (2013) mentioned that shelling corn is considered among the productive processes, because it makes manufacturing transportation and storing easier. Threshing or shelling mechanism is the most important one on the machine that affects the consumed power and productivity, as well as engine rotational speed and machine feeding rate. James et al. (2011) stated that increasing the shelling speed led to increasing the productivity, broken grains, and required power, along with decreasing unshelled grains. Azeez et al. (2017) mentioned that increasing time of shelling led to an increase in the amount of the shelled grains, thus led to a decrease in the unshelled grains.

Zaalouk (2013), developed a small corn sheller for a rural dweller which operated by using an electric motor. The results revealed that productivity, kernels damage percentage and power consumption with all sizes of corn ears increased with the increase of shelling speed. He recommended the shelling speed 275 rpm which gave average shelling efficiency 99.35 %, unshelled kernels 0.65 %, damage kernels 5.25 % and productivity 98.8 kg/h.

Mady (2016), stated that by increasing shelling speed led to increase each of damaged kernels, losses kernels and

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machine productivity. The least value of damaged kernels (1.5%) was obtained at the MC 13.3 %. Ali *et al*., (2018) stated that increasing the feeding quantity from 4 to 10 kg led to increase in the shelling rate and consumed power from 8.10 to 14.59 kg/h and from 2.09 kW to 2.33, respectively. While the shelling efficiency decreased from 94.08 to 91.28%. Also, the broken grains ratio decreased from 19.75 to 10.16%.

El-Sharabasy and Menna (2021) mentioned that increasing feed rate from 0.38 to 0.4 $Mg.h^{-1}$ lead to increase shelling efficiency values from 85 to 87 at drum rotating speed 760 rpm and moisture content 17%. While increasing feed rate from 0.4 to 0.55 $Mg.h^{-1}$ lead to decrease shelling efficiency values from 87 to 82% at the same previous conditions.

So, the main objective of this study was to fabricate and evaluate the performance of a motorized corn ear shelling prototype that can reduce drudgery, time of operation, losses amount, damaged grains. In addition, the study aimed also to achieve higher productivity of the local corn shelling machine and to meet the demands of small and medium farms in Egypt.

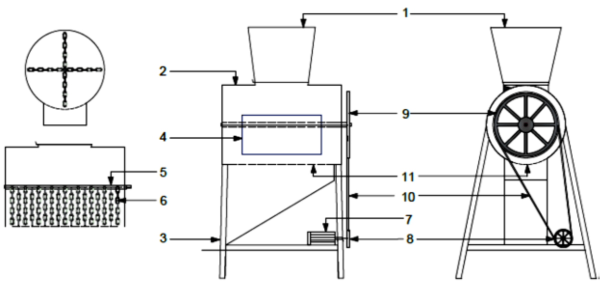
MATERIALS AND METHODS

The experiments were carried out in the workshop of the Department of Agricultural and Biosystems Engineering, Faculty of Agriculture, Menoufia University. The shelling machine and the required devices were prepared at the local workshop.

1 Shelling prototype

The elevation and side view of this prototype presented schematically in Fig. (1). The sheller is composed of a hopper (1) for feeding with corn ears, the hopper is equipped with a gate for precision sealing, the inlet is attached to a shelling cylinder (2). The cylinder has two outlets, the first outlet (3) is a perforated plate which located along the length of the shelling cylinder, for drain the shelled grains from the cylinder to a slopped surface, which is designed to roll the grains over to fall out easily into a bag or any available container.

The second outlet (4) for the ears, is located at the middle of the shelling cylinder and equipped with a gate to control the shelling period of the ears. A central rotor shaft is located longitudinally inside the cylinder (5), which attached to it several chains (6). The shaft takes its rotating power from an electric motor (7) by pulleys and belts (8, 9, 10) which used to choose the selected speed. The function of the metal chains is to shell the grains from the ears, whereby the corns are being hit with those metallic chains and then the grains are extracted and fall afterwards into a sieved plate (11) of the shelling cylinder.



1: Hopper; 2: Shelling cylinder; 3: Corn grains outlet; 4: Ears outlet; 5: Central rotor shaft; 6: Shelling chain; 7: Electric motor; 8: Motor pulley; 9: Machine pulley; 10: Belt; 11: Sieved plate

Figure 1. Fabricated sheller machine

The technical specifications of corn shelling prototype, the hopper used for feeding the machine with corn ears. The dimensions of the feed hopper were 50 cm in length, 50cm in width of the upper base, 40 cm in length, 31 cm in width of the lower base and 44 cm in the height. The inlet gate is equipped with a slide metal sheet to open and close the shelling cylinder during shelling action. The shelling cylinder made from steel sheet 2 mm thickness with total length of 87 cm and 60 cm in diameter. This cylinder was welded with the feed hopper from the upper side and the lower side acting as a concave with 12 mm hole diameter. A central rotor shaft is located longitudinally inside the cylinder with total length 87 cm and 3 mm diameter which attached to it 17 pairs of chains. The distance between two chains on the same row 10cm while the distance between each two consecutive chains 5cm. The distance between the first pair of chains and the cylinder wall equals the clearance between chains and sieve plate 3cm. The shaft takes its rotating power from a single-phase induction motor 220 V of 2 hp at maximum speed of 1420 rpm. The electrical motor transmits its rotating motion through four different pulley diameters of (7, 9, 11 and 13 cm) with a machine pulley diameter of 94cm.

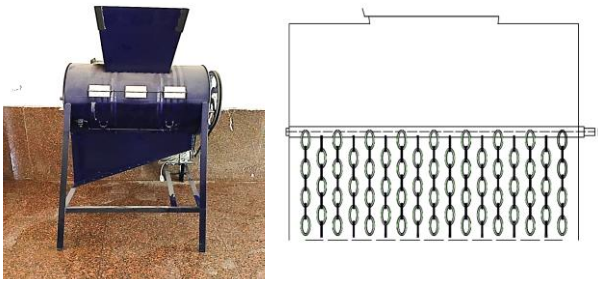


Figure 2. Shelling machine

2 Corn (*Zea mays*)

White corn (single hybrid 2031) ears were used in this study. Corn was bought from the local farmers, with a moister content of 10% which is measured using an electric moisture analyser (KERN DAB). The average measured physical characteristics before shelling operation for corn and grains are shown in table (1).

Table 1. Some values of average measured physical characteristics for corn cobs and grains

Item	Value
Corn grains	
Length	11 mm
Width	8.31 mm
Thickness	4.65 mm
Corn ears	
Mean diameter	45.23 mm
length	190 mm

3 Studied factors

The study focused and concerned with the effect of changing three main factors which were: time of shelling (20, 30 and 40 sec), speed of shelling unit (200, 250, 300 and 350 rpm) and the feeding quantity (9, 12 and 15 kg).

4 Measuring instruments

Many measuring devices were used in evaluating the affected parameters. These devices were:

1. **Digital balance**

Two kinds of digital balance were used, one was used for determining the weight samples of shelled corn grains and the other was used for determining the weight of corn ears before shelling.

2. **Electric moisture analyser (KERN DAB) Version 1.3**

An Electrical drying oven was used for determining the corn moisture content. Type of an electric moisture analyser DAB 100-3 with maximum load 110g, radiator type halogen (1×400 W) and temperature rage 40º C - 199º C.

3. **Rotational speed of the rotating shaft:**

The speed of the rotating shaft was measured by means of a multirange tachometer. It gives the rotational velocity in rpm.

4. **Electrical current**

Electrical current was measured by Energy Meter (DDS238-2 SW) to gauge the electrical current change during conducting the shelling process.

5. Measurements

The corn shelling machine was evaluated according to the following indicators:

Shelling rate

When the grains are collected after being separated from the ears in a certain time, the shelling rate (kg/h) is determined according to the following formula given by Bako and Boman (2017):

$$\text{Shelling rate} = \frac{\text{Mass of shelled grains (kg)}}{\text{Time (h)}} \quad \textbf{(1)}$$

Power required

Power required **(kW)** was measured by Energy Meter (DDS238-2 SW) to gauge the electrical current change during conducting the shelling process. This instrument also measured the power factor for the used motor, which was (0.8). The required power was determined according to:

$$P = \cos\theta \times I \times V \times \frac{1}{1000} \quad \textbf{(2)}$$

Where,

P: Power required (kW); I: Electrical current (A);

V: Voltage (V); cos θ : Power factor (0.8)

1. **Specific energy consumption**

Specific energy (kJ/kg) was determined according to the following formula:

$$Es = \frac{P}{SR} \quad \textbf{(3)}$$

Where,

Es: Specific energy (kJ/kg);

P: Required power (kW) and SR: Shelling rate (kg/sec)

2. **Shelling efficiency**

Shelling efficiency (%) was calculated as a percentage by getting the division of the mass of unshelled grains from a sample in relation to the total mass of the sample, then the division result is subtracted from 100 according to the following formula given by Al-Desouky et al. (2007):

$$\text{Shelling efficiency} = 100 - \frac{\text{Mass of unshelled grains}}{\text{Total mass of shelled grains}} \quad \textbf{(4)}$$

3. **Unshelled grains**

Unshelled grains percentage **(%)** was calculated by the following formula given by Vinay (2016):

$$\text{Unshelled grains} = \frac{\text{Mass of unshelled grains}}{\text{Total mass of grains}} \times 100 \quad \textbf{(5)}$$

4. **Mechanically broken grains**

It was determined by getting a random sample of 200 g, out of each treatment. Afterwards, the broken grains were isolated by suitable sieves. The percentage of the broken grains (%) was calculated according to the following formula given by Naveenkumar (2011):

$$\text{Broken grains} = \frac{\text{Mass of broken grains}}{\text{Total mass of grains}} \times 100 \quad \textbf{(6)}$$

RESULTS AND DISCUSSION

The affected parameters due to changing the studied factors were, shelling efficiency, ratio of broken grains, the shelling rate, required shelling power and energy consumption.

1 Shelling efficiency

Increasing the rotational speed of chains led to an increase the shelling efficiency at all levels of shelling time and feeding quantity. Also, increasing the shelling time led to an increase the shelling efficiency at all levels of feeding quantity and all levels of chain rotational speed. And increasing the feeding quantity led to a decrease the shelling efficiency at all levels of shelling time and all levels of chain rotational speed.

Figure (3) shows that the increasing time of shelling in the sequence of 20, 30 to 40 sec led to an increase in the shelling efficiency of 27.92, 48.38 to 64.79 % respectively at 200 rpm shelling speed and 9 kg feeding quantity. This is due to the increase in the shelling time accompanied by an increase in the grain amount causing a decrease in the unshelled grains. So, the efficiency of shelling did increase.

Also, this figure shows that increasing the speed of shelling chains in the sequence of 200, 250, 300 and 350 rpm led to an increase in the shelling efficiency of 40.27, 77.99, 98.05 and 100 % respectively at shelling time 30 sec and feeding quantity 12 kg. This is due to the speeds of 350 rpm characterized by a complete shelling of grains out of the ears.

Increasing the feeding quantity led to a decrease the shelling efficiency at all levels of shelling time and shelling speed. Increasing the feeding quantity in the sequence 9 to 12 then 15 kg caused a decrease in the shelling efficiency of 76.34 to 62.81 then 59.06 % respectively at shelling time 20 sec and 250 rpm shelling speed as a result of the increase in the unshelled grain that comes with the increase in feeding quantity.

The lowest values of shelling efficiency were observed at 200 rpm of chain rotational speed and 20 sec of shelling time. These lowest values were 25.17, 26.64 and 27.92% at 15, 12 and 9 kg respectively of feeding quantity.

The highest shelling efficiencies were observed with the lower levels of feeding quantity and the higher levels of both the rotational speed of chains and shelling time.

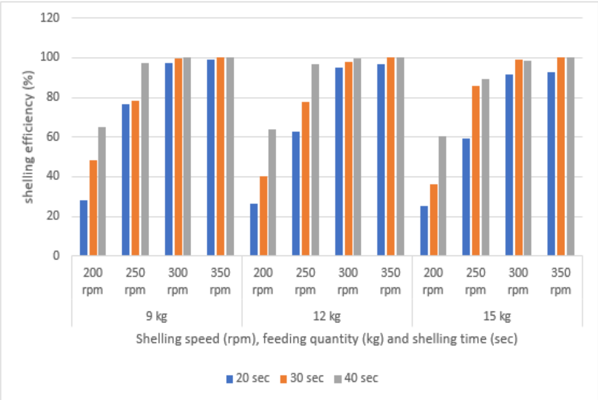


Figure 3. shelling efficiency (%) at different levels of rotational speed of chain (rpm), feeding quantity (kg) and shelling time (sec)

2 Required power (kW)

Normally, the required power increases with an increase in the rotational speed of chains. This has occurred with all levels of feeding quantity. Also increasing the feeding quantity led to an increase in the required power for all levels of shelling time and rotational speed of chains.

Figure (4) shows the effect of shelling time, speed of shelling and machine feeding quantity, on the required power. It can be seen that the increase of shelling time in the sequence of 20 to 30 then 40 sec, didn't influence on the required power. This is due to the time of shelling is not among the affecting factors on the required power while shelling the grains from the ears.

Also, this figure illustrates that an increase in the shelling speed in the sequence of 200, 250, 300 and 350 rpm led to an increase in the required power 0.48, 0.65, 0.75 and 0.93 kW respectively at 20 sec shelling time and 9 kg feeding quantity. This is due to the increase in the engine load along with an increase in the speed of the rotating shaft which demands more power out of the engine to rotate the shaft.

Moreover, this figure shows that increasing the feeding quantity in the sequence of 9 to 12 then to 15 kg led to an increase in the required power 0.75 to 0.9 then to 1 kW respectively at 20 sec of that enters the shelling cylinder resulted in more power required by the rotating shaft to overcome this mass.

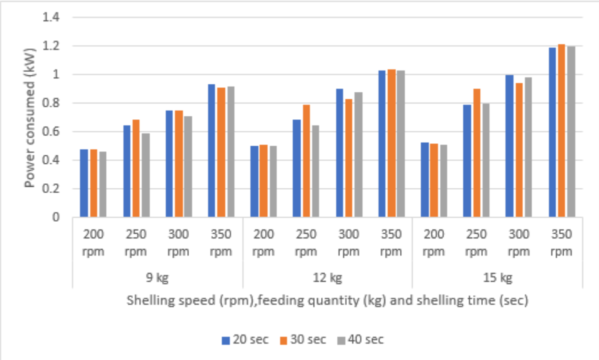


Figure 4. power required at different levels of rotational speed of chain (rpm), feeding quantity (kg) and shelling time (sec)

The highest value shelling power 1.2 kW was observed at 350 rpm of chain rotational speed and 15 kg of feeding quantity. The lowest value shelling power 0.48 kW was recorded at 200 rpm of the rotational speed of chains under 9 kg of feeding quantity.

3. Shelling rate (kg/h)

The shelling rate (kg/h) in considered an important operating parameter used in evaluating the efficient performance of the shelling machine. Increasing the rotational speed of chains led to an increase in the shelling rate at all levels of shelling time and feeding quantity. Also, an increase in the feeding quantity led to an increase in the shelling rate at all levels of shelling time and chains rotational speed.

Figure (5) shows that the increasing shelling time in the sequence of 20, 30 and 40 sec led to a decrease in shelling rate under shelling speed of 250, 300, and 350 rpm at all levels of feeding quantity. While increasing the shelling time in the sequence of 20, 30 and 40 sec led to an increase shelling rate under shelling speed of 200 at all levels of feeding quantity.

This figure also revealed that increasing the rotational speed of shelling in the sequence of 200, 250, 300 and 350 rpm led to an increase in the shelling rate of 325.6, 526.8, 670 and 672.9 kg/h respectively at 9 kg feeding quantity under 30 sec shelling time. This is due to an increase in the amounts of shelled grains that are getting out of the shelling sieve with increasing shelling speed.

Also, this figure shows that increasing the feeding quantity in the sequence of 9, 12 to 15 kg led to an increase in the shelling rate of 252.7, 291.3 to 314.6 kg/h, 526.8, 649.8 to 834.2 kg/h and 535.6, 669.3 to 781 kg/h respectively at shelling time 20, 30 and 40 sec respectively and shelling speed 200, 250 and 300 rpm respectively. This is due to the increase in the amounts of shelled grains that are getting out of the shelling sieve with increasing shelling speed.

Results in Fig. (5) show that the increasing shelling time in the sequence of 20, 30 to 40 sec led to an increase in the shelling rate of 252.7, 325.6 to 347, 291.3, 335.5 to 428.8 and 314.6, 352.4 to 482.9 kg/h respectively under all levels of feeding quantity 9, 12 and 15 kg respectively at 200 rpm of shelling speed. This is obvious because the rotational speed was too slow and increasing time makes the amounts of shelled grains increased too due to more time is given to separate corn from cobs.

While increasing the shelling time in the sequence of 20, 30 to 40 sec led to a decrease in the shelling rate of 690.9, 526.8 to 520.9 kg/h, 1041.7, 816.9 to 669.3 kg/h and 1158, 972 to 795.3 kg/h respectively under shelling speed of 250,300 and 350 rpm respectively at all levels of feeding quantity.

The higher value shelling rate 1158 kg/h was obtained at shelling time 20 sec, shelling speed 350 rpm and 15 kg feeding quantity. The lowest value shelling rate 252.7 kg/h was obtained at shelling time 20 sec, shelling speed 200 rpm and 9 kg of feeding weight.

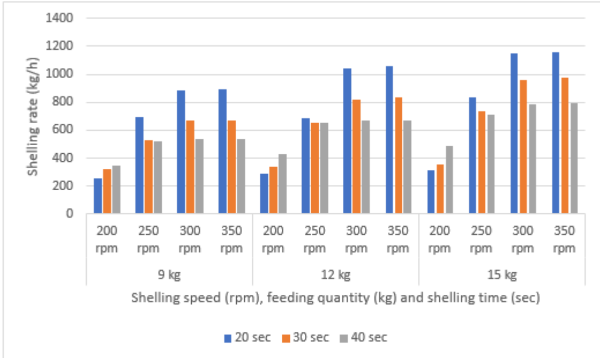


Figure 5. shelling rate at different levels of rotational speed of chain (rpm), feeding quantity (kg) and shelling time (sec)

4. Specific Energy (kJ/kg)

Results in table (3) show the effect of feeding quantity, rotational speed of chain and three different levels of shelling time on specific energy. Increasing rotating speed in the sequence of 200, 250 to 300 rpm led to a decrease in the specific energy at 20 and 30 sec shelling time under all levels of feeding quantity. While increasing the rotational speed from 300 to 350 caused an increase in specific energy at 20 and 30 sec shelling time under all levels of feeding quantity.

At shelling time 40 sec, increasing the rotational speed from 200 to 250 rpm led to a decrease in specific energy at all levels of feeding quantity. While increasing the rotational speed from 300 to 350 rpm led to an increase in specific energy at all levels of feeding quantity.

Increasing rotating speed in the sequence of 200, 250 to 300 rpm led to a decrease in the specific energy of 6.89, 3.4 to 3.08 kJ/kg, 6.22, 3.62 to 3.11 kJ/kg and 6.02, 3.85 to 3.14 respectively at 20 sec shelling time under feeding quantity 9, 12, 15 kg respectively.

Table (2) shows that increasing the shelling time in the sequence of 20, 30 to 40 sec led to a decrease in the specific energy of 6.89, 5.33 to 4.72 kJ/kg, 6.22, 5.42 to 4.17 kJ/kg and 6.02, 5.36 to 3.79 kJ/kg respectively at 200 rpm shelling speed under 9, 12 and 15 kg feeding quantity respectively. While increasing the shelling time in the sequence of 20, 30 to 40 sec led to an increase in specific energy at all levels of feeding quantity under 300 and 350 rpm shelling speed.

The lowest values of specific energy were observed at 300 rpm of chain rotational speed and the lowest level of shelling time 20 sec. These lowest values were 3.08, 3.11 and 3.14 kJ/kg were observed at 9, 12 and 15 kg feeding quantity respectively.

The highest specific energy 6.89, 6.22 and 6.02 kJ/kg were observed with the lower levels of both shelling time 20 sec and rotational speed of chain 200 rpm at 9, 12 and 15 kg feeding quantity respectively.

Table 2. Specific Energy (kJ/kg) at different levels of rotational speed of chain (rpm), feeding quantity (kg) and shelling time (sec).

Feeding quantity		9 kg				12 kg				15 kg			
Shelling speed		**200 rpm**	**250 rpm**	**300 rpm**	**350 rpm**	**200 rpm**	**250 rpm**	**300 rpm**	**350 rpm**	**200 rpm**	**250 rpm**	**300 rpm**	**350 rpm**
Shelling time	20 sec	6.89	3.4	3.08	3.73	6.22	3.62	3.11	3.52	6.02	3.85	3.14	3.7
	30 sec	5.33	4.76	4.05	4.88	5.42	4.39	3.65	4.5	5.36	3.88	3.51	4.49
	40 sec	4.72	4.07	4.8	6.18	4.17	3.61	4.74	5.52	3.79	3.54	4.52	5.42

5. Broken grains (%)

Figure 6 represents the calculated values of the broken grains that recorded at all the studied factors for the shelling machine.

Generally, increasing the rotational speed of the chain led to an increase in the ratio of broken grains at all levels of both feeding quantity and shelling time. While increasing the feeding quantity let to a decrease in the ratio of broken grains at all levels of chain rotational speed and all levels of shelling time.

Increasing the shelling speed in the sequence of 200, 250, 300 and 350 rpm led to an increase in broken grains ratio of 0, 2.75, 5.7 and 9.5 % respectively at shelling time 20 sec and feeding quantity 9 kg.

This figure also shows that increasing the feeding quantity in the sequence of 9, 12 to 15 kg led to a decrease in broken grains ratio of 9.5, 8.1 to 7.1 % respectively at shelling speed 350 rpm and shelling time 20 sec respectively. This is due to increasing the mass entering the machine which acts as a cushion that reduces the effect of the grains with the shelling chains, this results in reducing the ratio of the broken grains.

The highest broken grains ratio observed with the lower levels of feeding of feeding quantity and the higher levels of rotational speed of chains. The highest value of broken grains ratio were 9.5, 9.7 and 10 % observed with shelling time of 20, 30 and 40 sec respectively, the lowest level of feeding quantity 9 kg and the highest level of chain rotational speed 350 rpm. The lowest values of broken grains ratio were observed at 200 rpm of chain rotational speed and the highest level of feeding quantity 15 kg.

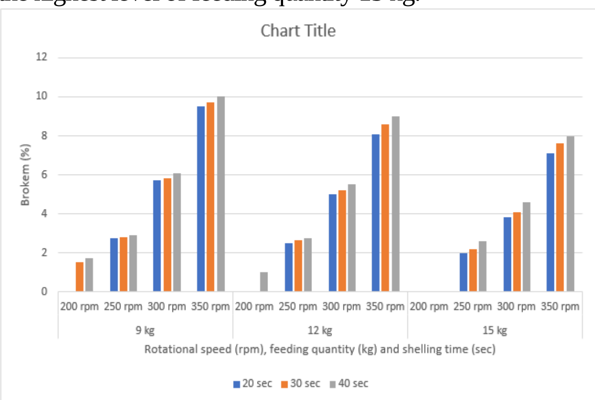


Figure 6. broken grains ratio at different levels of rotational speed of chain (rpm), feeding quantity (kg) and shelling time (sec)

CONCLUSION

This study was evaluated the performance of a maize cob Shelling prototype fabricated locally. The study focused and was concerned with the effect of changing three main factors which were: time of shelling, speed of the shelling and weight of the machine's feeding material. The affected parameters due to changing the studied factors were, shelling efficiency, ratio of broken grains, the shelling rate, required shelling power and energy consumption. The time of shelling was affected significantly the ratio and efficiency of shelling as well as unshelled grains, while it had less impact on the consumed power and broken grains.

The experimental results illustrate that increasing rotational speed of chains led to an increase in both shelling efficiency, the required power for shelling processes, energy consumption, shelling rate and broken grains ratio. Increasing feeding quantity led to an increase in both the required power for shelling processes, energy consumption and shelling rate while decreased shelling efficiency and broken grains ratio. Increasing shelling time led to an increase both shelling efficiency and energy consumption. The optimum operating parameters of the shelling machine were found at shelling time of 30 sec, 15 kg feeding quantity and 300 rpm shelling speed. This is due to this treatment, it achieved the lowest specific energy consumption, the highest shelling efficiency and the highest shelling rate. Which leads to the lowest energy cost and the highest quantity and quality of the product. The values of shelling rate, shelling efficiency and specific energy were 962.5 kg/h, 100% and 3.51 kJ/kg respectively at optimum operating parameters. At the end of this study, we recommend using this machine to meet the needs of small farmers

REFERENCES

Adewole CA, Babajide TM, Oke AM, Babajide NA, Aremu DO and Ogunlade CA. 2015. Critical evaluation of locally fabricated maize shelling machine. *International Journal of Engineering Science and Innovative Technology*, 4(2): 67-73.

Agarwal B. D. and Broutman Wiley L. J. Analysis and performance of fibre Composites, - Interscience, New York, 1980.

Al-Desouky N, Mousa E and Lotfy A. 2007. Feasibility of using corn seller machine in threshing sunflower. *Journal of Agriculture and Environmental Science Alex-andria University*, 6(3): 17-33.

Ali Mohammed Ali, Ahmed Akbar Ali and Basim Aboud Abbas., 2018. Studying and evaluating the performance of locally fabricated and developed maize sheller. Journal of Research in Ecology, ISSN No: Print: 2319 –1546; Online: 2319– 1554.

Aylor D. E. 2002. "Setting Speed of Corn (Zea mays) Pollen." Journal of Aero Goal Science 12 (7): 33-57.

Azeez TM, Uchegbu ID, Babalola SA and Odediran OO. 2017. Performance evaluation of a developed maize sheller. *Journal of Advancement in Engineering and Technology*, 5(2): 1-4.

Bako T and Boman JB. 2017. Design, fabrication and performance evaluation of a hand operated maize sheller. *Journal of American Science*, 13(8): 68-76.

El-Sharabasy, M. M. A. and Menna Allah M. Elmaleh 2021. Development of a Simplified Machine for Shelling Maize Grain. J. of Soil Sciences and Agricultural Engineering, Mansoura Univ., Vol. 12 (12):845 – 853.

FAOSTAT 2022. https://www.fao.org/faostat/en/#data/QCL

Ismail Z. E. 2010. Reciprocating frication surface utilization to shell the kernel from corn ear. *Journal of soil sciences and Agr. Eng*., 2(11): 1115-1128.

James KM, Umogbai V and Itodo I. 2011. Development and evaluation of a melon shelling and cleaning machine. *Journal of Emerging Trends in Engineering and Applied Sciences*, 2(3): 383-388.

Mady, M.A. (2016). Manufactured and evaluation of corn sheller suitable for Egyptian farmer. Misr J. Agric. Eng., 33 (2): 319 - 334.

Mali P.K., C.N. Sakhale, and S.D. Shelare. 2015. A literature review on design and development of maize thresher. *International journal of pure and applied research in engineering and technology*, Volume 3 (9): 9-14.

Naveenkumar DB. 2011. Modification and evaluation of power operated maize (*Zea mays* L.) sheller. Thesis, University of Agricultural Sciences, Bangalore. 107 p.

Patil S.B., A.D. Chendake, M.A. Patil, S.G. Pawar, R.V. Salunkhe, and S.S. Burkul. 2014. Development and performance evaluation of pedal operated maize sheller. *International Journal of Advanced Research*, Volume 2, Issue

Udom SC. 2013. Operating factors of Thai threshers affecting corn shelling losses. *Journal of Science and Technology*, 35(1): 63-67.

Vinay. 2016. Design and development of pedal operated maize sheller. College of Agricultural Engineering and Technology, CCS Haryana Agricultural University, Thesis, 62 p.

Wanjala, N. F. 2014. Design of a Modified Hand Operated MaizeSheller. Engineering Design Project Report submitted to the University of Nairobi.

Zaalouk, A.K. (2013). Development a packed vertical disk corn sheller for rural dweller. Misr J. Agric. Eng., 30(4):1023-1040.

تقييم أداء آلة تفريط الذرة المصنعة محليا

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تعتبر عملية تفريط حبوب الذرة من أهم عمليات ما بعد الحصاد والتي تؤثر على جودة وكمية إنتاج حبوب الذرة. تتم عمليه التفريط اما يدويا أو ميكانيكيا. الهدف الرئيسي من هذه الدراسة هو تقييم أداء آلة تفريط الذرة المصنوعة محليا لتلبية احتياجات صغار المزارعين. تم تصنيع آلة تفريط الذرة محليا في ورشة خاصة بمحافظة المنوفية – وتم أجراء تجارب الأداء بورشة قسم الهندسة الزراعية والنظم الحيوية – كلية الزراعة – جامعة المنوفية. تم تقييم آلة تفريط الذرة بأخذ عوامل التشغيل التالية: أربعة مستويات من السرعة الدورانية للدرفيل الحامل لسلاسل التفريط وهي 200 ، 250، 300 و 350 لفة/الدقيقة. ثلاثة مستويات من كميات التغذية وهي 9، 12 و 15 كجم. ثلاثة مستويات من زمن التفريط 20 ، 30 و 40 ثانية. تم تقييم اداء الآلة بناء على القياسات التالية: كفاءة التفريط ، معدل التفريط ، استهلاك الطاقة و نسبة الكسر في الحبوب. النتائج التي تم الحصول عليها باستخدام آلة التفريط: أدت زيادة سرعة دوران السلاسل إلى زيادة كلا من كفاءة التفريط ، الطاقة المطلوبة لعمليات التفريط ، استهلاك الطاقة ، معدل التفريط ونسبة الحبوب المكسورة. أدت زيادة كمية التغذية إلى زيادة كل من الطاقة المطلوبة لعمليات التفريط ، استهلاك الطاقة ومعدل االتفريط مع انخفاض كفاءة التفريط ونسبة الحبوب المكسورة. أدت زيادة وقت التفريط إلى زيادة كفاءة التفريط واستهلاك الطاقة. أظهرت النتائج التجريبية أيضا أن أعلى قيمة لكلا من معدل التفريط وكفاءة التفريط كانت 1158 كجم/ساعة و 100٪ على التوالي. كانت أدنى قيم للطاقة النوعية 3.08 ، 3.11 و 3.14 كيلو جول/كجم كانت عند سرعة دوران 300 لفة/دقيقة للسلاسل وعند كمية تغذية 9 ، 12 و 15 كجم على التوالي.