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Original paper

Construction of Melon Shelling Machine

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ABSTRACT: Melon seed is a widely produced and consumed oil seed crop in Nigeria and West Africa. The removal of the yellow exterior shell and the separation of the shattered shells from the white seeds are the two most difficult difficulties in the processing of melon seeds. Under the current condition, the commercial shelling and separation of melon seeds is done manually. Furthermore, the current automated process is inefficient since the melon seeds are shattered and no longer consistent after being removed from the de-husking machine. The purpose of this project is to construct and test a melon shelling machine; the results of the shelling operation revealed that the machine has a capacity of 71.3 kg/hr and an efficiency of 63%, which is quite high; the percentage of damaged and shelled seeds is low; there is less seed breakage; and there is less weight of the unshelled seeds throughout the shelling operation, which may be due to its physical characteristics and moisture content.

Keywords: Melon, shelling machine
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INTRODUCTION

Most families in Nigeria and other African nations are gradually domesticating egusi melons (colocynthis vulgaris). The Etsako people of Edo North cultivate melon extensively. Edo State is one of the five states in Nigeria—along with Niger, Akwa Ibom, Imo, and Delta—that produce more than 400,000 metric tonnes of melons each year (knoema.com 2021). The cosmetic and pharmaceutical industries increasingly employ the seeds for their oil in semi-arid areas (Ajibola et al., 1990). According to an examination of melon seeds, the seeds have a weight percentage of 50% oil, 37.4% protein, 2.6% fibre, 3.6% ash, and 6.4% moisture (Oyenuga, 2002). Certain melon species' immature fruits are frequently prepared as vegetables. Sometimes roasted seeds are consumed. It is consumed in a variety of forms that are high in protein, fat, and vitamins A, B, B2, and C. Intake of melon seed and its derivatives may lessen the risk of acquiring territorial or cardiovascular disease (Ajibola et al., 1990).

Melon, when correctly processed, produces a variety of byproducts that can be utilised as food or raw material in small and large-scale industrial manufacturing. It is extremely oil-rich. Melon has roughly 45% oil, which might be extracted to create a good supply of vegetable oil (Adekunle et al., 2009). After extracting the oil, the residual product can be utilized as human food or as an ingredient in the production of agro-feed. Melon without oil can be pulverized and utilized in the chemical and pharmaceutical industries as a thickening or binder. When gathered appropriately, the exterior shell of melon seeds can also be used in the manufacturing of agricultural feeds. Melon shell has a calorific value of roughly 12-55 MJ/kg and can thus be employed as a source of energy for industrial application (Sunday et al., 2015). The removal of the yellow shell and the separation of the broken shells from the white seeds, however, are the major issues encountered in the processing of melon seeds. For the time being, manual de-husking and

separation are utilized locally. As a result, production suffers, processing time increases, and human labour increases. The automated approach of de-husking and separation will boost production, cut processing time, and minimize human involvement to a bare minimum.

Designing and testing a melon shelling machine for our local communities and businesses was motivated by the problems posed by hand shelling and the separation of the melon white seed from the shelled. To meet the rising population's local food need and improve foreign earnings from melon exports, Nigeria must rapidly minimize the massive post-harvest losses caused by inadequate processing facilities. In terms of the number of farmers involved in its cultivation and economic worth, the production holds a prominent position in vegetable crop production. The state is one of the top five (Edo, Niger, Imo, Akwa Ibom, and Delta) in terms of melon output, accounting for 73.39% of total production. In 2005, total melon production was predicted to be 532.5 metric tonnes (National Statistics office, 2005). To address these issues, the following factors were considered:

i. To provide information on how to produce a melon shelling machine that will shell melon seeds and still retain their natural taste and quality
ii. To help in solving problems of wastage in harvested raw fruits of melon and
iii. To solve the problem of food insecurity by enabling the availability of melon products all year round.

Melons are still shelled using traditional techniques, such as breaking the fruit with the hands. Manual shelling is tiresome, time-consuming, and frequently results in operator finger scratches and bleeding injuries. The goal of developing the melon shelling machine is to improve quality so that it can satisfy both domestic and international demand. The objectives of the study are to:

(I) to develop a melon shelling machine using locally available materials that could help solve the problems of manual melon shelling in Auchi and its environments.
(ii) It serve as a point of reference for teaching, learning and student research in farm machinery studies.
(iii) It encourage our local farmers to massively engage in the cultivation of melon and possibly export the products.

MATERIALS AND METHODS

Design considerations

The components were designed based on the established theories and principles. It components include the followings:

i Design of Hopper – hopper flow characteristics (coefficient of mobility, size of opening, hopper side slope)
ii Design of Belt – velocity ratio of V- belt, velocity of belt.
iii Design of power to shell –The power to drive the cylinder and the blower.
iv Design of shaft

Machine evaluation

The engine was started and left running for a little while before the performance evaluation test of the melon shelling to help the device reach its operational speed. After each trial, the seeds were carefully removed from the outlets, separated into shelled, broken, and unshelled seeds, and then correctly weighed. Machine inputs and outputs were also weighed. The performance test only utilized one type of melon. Shelling and damage efficiency metrics were computed using equations 1 and 2, respectively, during the machine's evaluation utilizing normal procedures.

Mass of melon Shelling efficiency

$$\Sigma\ (\%) = \frac{Mms}{TM} \times 100 \quad \text{.....(1)}$$

Mass of melon Unshelled,

$$\Sigma\ (\%) = \frac{Mmu}{TM} \times 100 \quad \text{.....(2)}$$

Where:
Q_U is the Quantity of shelled melon sample (g),
Q_T is the Total melon seeds fed into the machine (g),
Q_B is the Quantity of damaged melon (g).

RESULTS AND DISCUSSION

The calculated results include the weight of all seeds supplied into the machine, as well as the weight of shelled, broken, and unshelled seeds, as well as the length of time required for each operation. Results of the experimental tests are displayed in (Table 1). Using Excel calibration graphs, the sensitivity simulation analysis of the machine performance is displayed and demonstrated.

Therefore, the following were determined using the following formula below;

Machine capacity was calculated as follows:

$$\text{Machine Capacity} = \frac{TOTAL\ MASS\ OF\ MELON\ SHELLED\ (KG)}{TIME\ TAKEN\ (SEC)}$$

$$\text{Machine Capacity} = \frac{38.7\ X\ 3{,}600\ (KG)}{1703\ (HRS)}$$

$$\text{Machine Capacity} = \frac{121{,}320\ (kg)}{1703\ (hrs)}$$

Machine Capacity = 71.24kg/hr.

Table 1: Quantities of melon loaded and time taken to shell

S/N	Tm (kg)	Time (sec)	M_{MS} (kg)	M_{MU} (kg)	M_{MB} (kg)
1	1.0	30	0.6	0.28	0.12
2	2.0	63	1.2	0.72	0.08
3	3.0	94	1.7	1.21	0.09
4	4.0	118	2.4	1.32	0.28
5	5.0	146	2.8	1.90	0.30
6	6.0	180	3.4	2.22	0.38
7	7.0	210	4.0	2.60	0.40
8	8.0	240	5.4	2.02	0.58
9	9.0	270	5.7	2.46	0.84
10	10.0	352	6.5	2.71	0.79
Total	55.0	1703	33.7	17.44	3.86

Where
Tm = Total Mass of melon used for the Experiment
M_{MS}= Mass of melon shelled
M_{MU} = Mass of melon unshelled
M_{MB} = Mass of melon broken

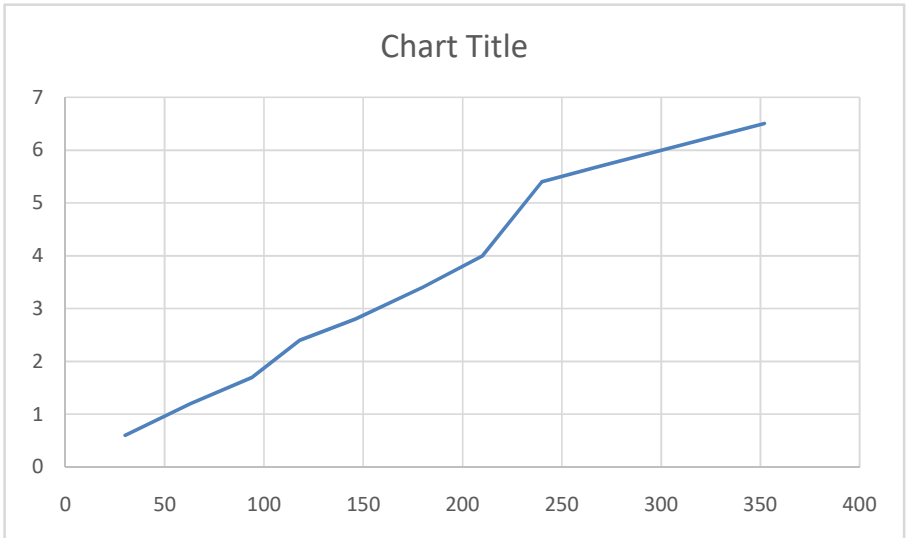

Figure 1: Effect of time on melon shelled.

To determine the machine efficiency

$$\text{Machine Efficiency} = \frac{\textit{Mass of Melon Shelled}}{\textit{Total Mass of Melon}} \times 100$$

$$\text{Machine Efficiency} = \frac{33.7}{55} \times 100$$

Machine Efficiency = 61.27 %

Effect of time on melon shelling

Figures 1 and 2 show the effect of time on melon shelling. The variation of the melon shelled increased with an increased time. It was observed from the experiment that, at lower time of 30 seconds, melon shelled was 0.6kg and unshelled was 0.28kg while at a higher time of 352 seconds, melon shelled was 6.5kg and melon unshelled was 2.71kg. Therefore; melon shelled is higher at a longer time and lowered at a shorter time.

The performance of the machine was evaluated in terms of melon shelled, unshelled and preset time. It was observed from the experiment that, at lower time of 30 seconds, melon shelled was 0.6kg and unshelled was 0.28kg while at a higher time 352 seconds, melon shelled was 6.5kg and melon unshelled was 2.71kg. Using equations 1 to 2 and values obtained from the experiment in table 4.1 and 4.2, the shelling efficiency of the machine was 61.27% and the melon machine shelling capacity is 71.24kg/hr.

These levels of performances are satisfactory when operated within the stipulated parameters.

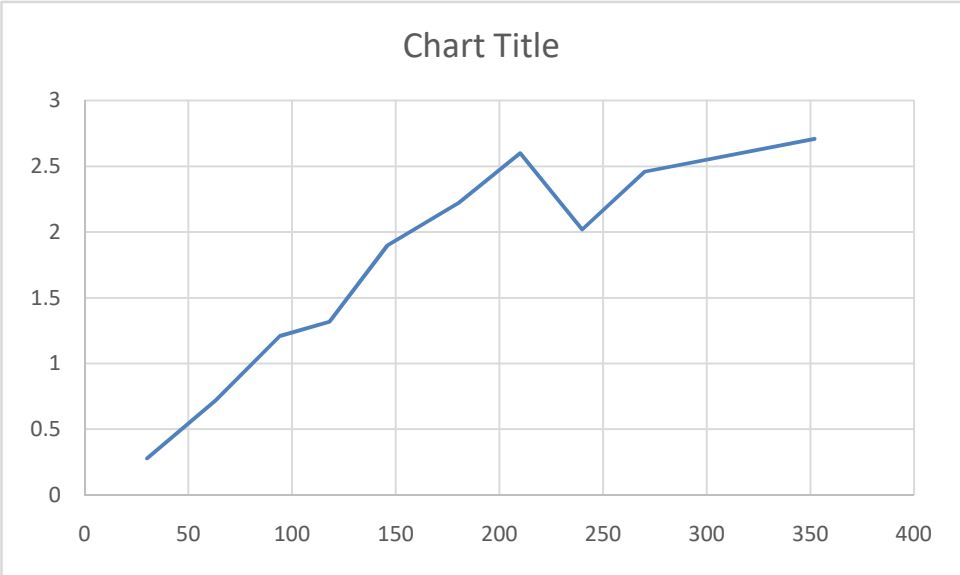

Figure 2: Effect of time on mass of melon unshelled

Conclusion

The melon shelling device was constructed and put to the test. It was discovered to be reliable and capable of shelling roughly 71.24g per hour. Due to its low manufacturing costs and accessibility, this machine can be used for small and medium-sized applications. If the equipment is made available to small and medium-scale farmers, it will produce more melons with less effort and in less time thanks to these results.

Recommendations

(1) Efforts should be made to adopt and popularize this melon shelling machine, especially for the benefits of rural people who make up a greater percentage of the nation's population.
(2) The output capacity of the machine could be improved upon.

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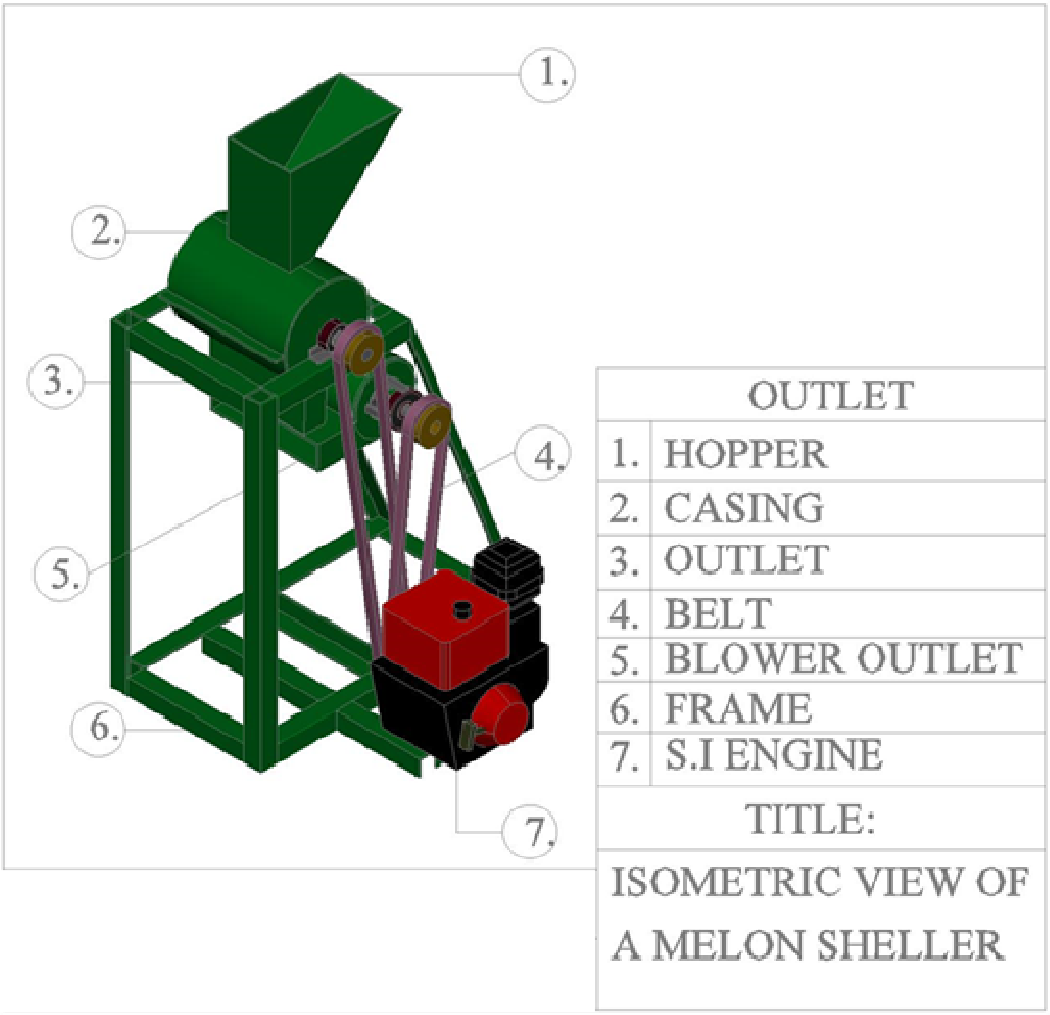
Appendix



OUTLET	
1.	HOPPER
2.	CASING
3.	OUTLET
4.	BELT
5.	BLOWER OUTLET
6.	FRAME
7.	S.I ENGINE
TITLE:	
ISOMETRIC VIEW OF A MELON SHELLER	