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Technical Note: COMPARATIVE EFFECTS OF SCREW PRESS FOR HONEY EXTRACTION FOR SMALL SCALE HONEY PROCESSING

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Abstract

Honey extraction is the removal of honey from the honey bearing combs. Different local methods of honey extraction, their strengths and weaknesses were discussed. A screw press was fabricated to facilitate honey extraction. The fabricated screw honey extractor is good alternative to the existing methods of extraction. The extractor ensures timeliness, reduces drudgery involved in the extraction. Similarly, risk of contamination, overheating, overexposure to the environment, contact with hands and the filtering medium are bound to be reduced. It is affordable, durable and requires no special skill to be operated. It has an output capacity of 42.48kg/hr. The cost of fabricating the machine is ₦29, 000.00 only. It is highly recommended for both small and medium scale honey processors. Design related engineering properties of honeycomb should also be determined. Finally, containers and processing equipments such as stainless steel and other related food grade plastics compatible with acidic food should used for the construction.

Keywords: honey extraction, screw press, beekeeping, combs, comparative effect

1. Introduction

Honey is one of the most important and valuable hive products from beekeeping. It is used as a sugar substitute in cooking, baking, cereals, drinks and beverages. It is a preferable sweetener especially for diabetic patients. It is a quick source of replenish-able energy and therefore much used in medicine. It is used as sweetening base for pharmaceutical products and has several uses in cosmetics industry. It is used in medicine for the treatment of various ailments, burns and wound dressing; and generally stomach problems [1]. Honey is a Newtonian fluid [2].

Honey extraction is the central process in beekeeping. It involves removing honey from combs so as to isolate it as pure liquid [3]. There are three major different ways employed in extracting honey from the combs. These are floating; centrifuging and pressing. The floating is the simplest, but time consuming because the chopped combs are kept in an air tight container for two to three days after which the waxes are skimmed off while the remaining foreign materials are filtered.

The centrifugal extractor varying in designs and the capacity from 2 to 72 frames are the modern and most appropriate technology because they guarantee replacement of the honey combs, thereby increasing honey production efficiency by the bee colony as no energy is required for rebuilding the combs. Centrifugal extractors are not easily affordable as they are very expensive. The spare parts might also not be available because they have to be obtained from the manufacturers that are overseas [4].

In honey pressing, the comb is first decapped, chopped into pieces and pressure applied through various means to remove the honey. They include the use of two palms (hand pressing) without necessarily chopping the combs. This is time consuming, inadequate, occasioned by pains and muscle contraction. Screw pressing is characterized by low extraction efficiency of 58% [5]. The squeezing method is where the chopped /crushed combs are poured into a strainer of screen wire using hands to turn the end(s) of the strainer forcing the honey to drip into a container. This is tedious and results in low output. The gravity/dripping method is solar energy dependent; here the combs are poured into an inwardly bulged cloth and exposed to heat of the sun for hours with the sole aim of reducing the viscosity of honey to ease flow. Honey obtained from this could be contaminated af-

ter few days of extraction. The heating and sieving method is grossly discouraged as overheating to temperatures above 35℃could destroy or denature most of the micro nutrients and vitamins like vitamin C and folic acid which are unsuitable to heat. Also the smoky fire employed could give the honey a bitter and smoky taste. For the wet and basket methods, the combs are tired into a sieve and a heavy weight placed and allowed for several hours over the night. The method is less efficient and the honey collected could be infested. The average processing capacity from the various local processors was 2.124l/hr. Sanusi, [6]. The aim of this work is to fabricate and test a manually operated screw honey extractor made from acceptable food grade materials. The machine will help in minimizing the drudgery involved in the extraction of viscous honey; achieve timeliness and the resultant increase in the extraction efficiency; and also reduces the risk associated with most of the traditional methods.

2. Materials and Methods

The materials used for the construction were locally sourced and can be bought-out any time because they are affordable and available. The screw press extractor was constructed specifically to meet the need for efficient and adequate honey extraction rather than the time-consuming traditional practices still obtainable with most Bee hunters, Beekeepers and Honey processors. The extractor consists of extraction chamber, pressure plate, and threaded screw shaft turned manually with handle. The frame structure and various components were welded with gauge 12 electrodes, while assembly of parts was done with fasteners (bolt and nuts).

2.1. Description and operation of the screw press honey extractor

The screw press honey extractor shown in Figure 1, consists of a turning bar (A), threaded pressing shaft (B), nut, flat iron bar (C), pressure plate, pressing chamber (D), filtering medium, and the frame (F). The frame is to provide the system with rigid support. The flat iron bar that support the screw thread is detachable from the pressing chamber. This is for easy removal of the pressure plate in order to feed the harvested combs for pressing. The base of the pressing chamber was tilted outwardly with a discharge outlet made from galvanized steel for the flow of the extracted honey. The turning bar is made of threaded shaft of 45.0mm diameter and a length of 600mm long. It is used with the help of a handle (that has a T shape and 25.0mm long) in rotating the pressing ram, which results into linear motion of the pressure plate. The nut is welded to the flat iron bar for both the downward and upward movement of the screw within a considerable clearance. A short hollow pipe of 45.0mm

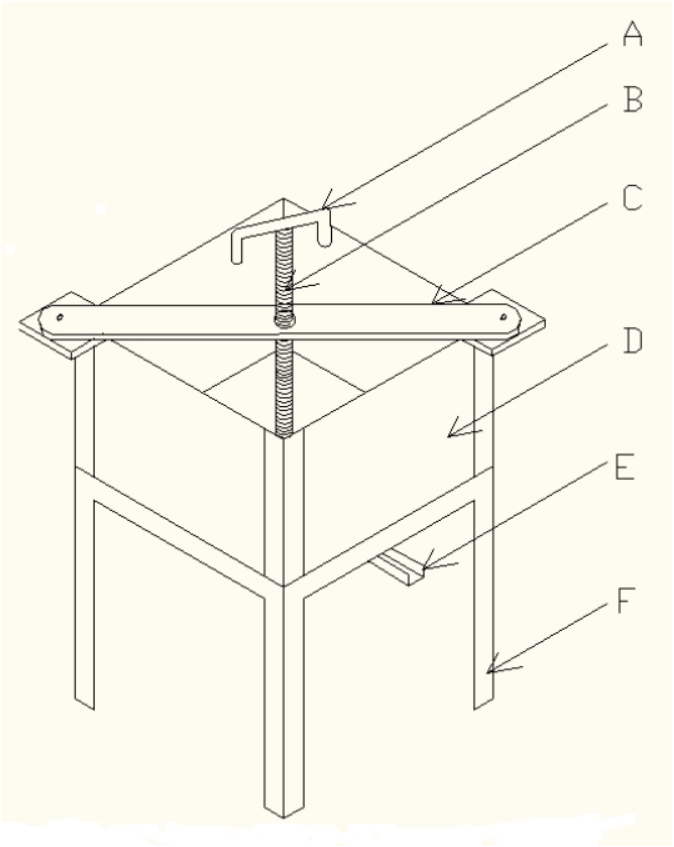

Figure 1: Isometric projection of screw press. (A = Turning bar; B = Threaded pressing shaft; C = Flat iron bar; D = Pressing chamber; E = Discharge outlet; F = Frame.)

diameter and 50.0mm long was welded to a well reinforced pressure plate through which the pressing ram touches for pressing combs. The feeding is done manually. The total weight of the extractor is 64.2kg.

2.2. Material test

Two methods of honey extraction were used i.e. the weight and sieve method (traditional method) and the screw press method. In each method, three trials using 5.0kg each of honey combs were used, taking into cognizance time taken for each trial. The quantity of honey extracted from each sample and the residues after the extraction were collected and recorded. The following were the measurement taken before and after the extraction, total weight of a sample before and after the extraction. Weight of honey extracted, weight of residues obtained and the time taken for each extraction.

2.3. Machine/ Extraction Capacity

2.3.1. Extraction Capacity (Weight and Sieve method) [5]

$$\text{Extraction Capacity} = \text{Input (kg)}/\text{Time taken (hr)} \quad (1)$$

Table 1: Test results of different extraction methods..

S/no	**Wt of sample before extrac.** (kg)	**Wt of extracted honey,** kg (W1)	**Vol. of honey extracted** (L)	**Wt of residues,** kg	**Time taken** (min)	**Method of extract.**	**Extrac. Effic.** %
1	5.0	2.82	1.95	2.12	60	*WS	56.4
2	5.0	2.81	1.94	2.11	65	*WS	56.2
3	5.0	2.82	1.95	2.13	62	*WS	56.4
Mean	5.0	2.816	1.946	2.12	62.33		56.33
4	5.0	3.54	2.45	1.44	6.0	*SP	70.8
5	5.0	3.52	2.43	1.43	7.0	*SP	70.4
6	5.0	3.53	2.44	1.45	6.5	*SP	70.6
Mean	5.0	3.53	2.44	1.44	6.5		70.6
*WS = Weight and Sieve, *SP = Screw Press							

From (1), Input = 8.45kg; Time taken= (60 + 65 + 62 = 187min = 3.12hrs). Extraction Capacity = 8.45/3.12 = 2.71kg/hr

2.3.2. Extraction Capacity (Screw press method)

From (1) Input = 10.59kg ; Time taken = (6 + 7 + 6.5min = 19.5min = 0.33hr); Extraction Capacity 10.59/0.325 = 32.58 kg/hr. Extraction Efficiency [7]

$$E_{ef} = w_0/w_1 \times 100 \quad (2)$$

Where w_0 = Density of honey × Total weight of honey extracted from the 1st three sample; density of honey = specific gravity × density of water, i.e. 1.4457 × 1000 = 1446kg/m^3 [3].

2.3.3. Extraction efficiency of the "weight and sieve method"

From eqn (2)

$$E_{ef} = w_0/w_1 \times 100 = 8.45/15100 = 57\%$$

2.3.4. Extraction efficiency of the screw press method

From eqn (2)

$$E_{ef} = w_0/w_1 \times 100$$

where, w_0 = total weight of honey extracted the three samples (w_0 = 3.54 + 3.52 + 3.53 = 10.59); w_1 = total weight of the sample before extraction (w_1 = 5 + 5 + 5 = 15); E_{ef} = 10.59/15 × 100 = 70.6%.

3. Results and Discussions

Table 1 shown below gives the test results of the two different extraction methods. The extraction efficiency as well as the total weight recovery of the machine is better when compared to the traditional method of extraction as shown in table 2. It is 10 times faster to extract same quantity of honey combs using the screw press compared to the weight and sieve method. Presence of fewer bubbles compared to the bubbles found in the honey from the traditional method. Honey with a very few bubbles has higher market value especially in places where honey appearance has an aesthetic concern. with the screw press extractor, risk of contamination resulting from post-harvest exposure to environment is minimized, this is because honey is hygroscopic in nature, hence, absorb moisture on exposure to environment. The screw press is a good substitute for the traditional method, it is recommended to be mass-produced by government and relevant partners fir purposes of creating jobs for teeming unemployed youths and enhance the economic status of the forest dependent communities in Nigeria. Research into engineering properties of honeycomb and its by-products is recommended so that a better and more efficient extractor can be evolved.

Table 2: Differences between the weight of sample before and after extraction.

Expt. No.	**Wt of sample (A) before extraction**, kg	**Wt of sample (B) after extraction, B**	**Diffr. (A-B) mean weights**, kg
1	5.0	4.94	0.06
2	5.0	4.92	0.08
3	5.0	4.95	0.05
Mean	5.0	4.936	0.063
4	5.0	4.98	0.02
5	5.0	4.95	0.04
6	5.0	4.98	0.02
		4.97	0.023

After every batch of operation, the weight of the honey extracted and the residue that was left was collected and measured. A slight variation was noticed between the weights of samples before and after extraction. This may be due to honey smearing or hanging on the components making up the pressing chamber as shown in Table 2.

4. Conclusion

A screw press honey extractor was fabricated and the performance test was carried out and compared with the traditional method, using 5.0kg. of honey combs in each case. The result indicates that, the screw press has an extraction efficiency of 70.6%, (against 56.33% for the weight and sieve method), better honey recovery and saves time (average of 6.5min. as against 62.33min for the weight and sieve method) and slow honey recovery. The machine components were sourced from local available materials. The production cost of the machine was N29, 000:00. The machine is recommended for both small and medium scale honey processors and beekeepers.

5. Recommendations

i. Containers and processing equipment such as stainless steel, glass and good grade plastic compatible with this very acidic food are recommended be used in the construction of the machine to avoid contamination.
ii. Design related engineering properties honeycomb and its by-products and construction materials should be determined.
iii. Discharge outlet should preferably be sited directly under the base of the pressing chamber to ease the flow by gravity.

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