Development of Locally Fabricated Honey Extracting Machine

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***Abstract* — An indigenous honey extracting machine was designed, fabricated and evaluated at the workshop of the department of Agricultural Technology, Federal Polytechnic, Ile-Oluji, Nigeria using locally available materials. It has the extraction unit, the presser, the honey collector and the frame. The harvested honeycomb is placed inside the cylindrical extraction unit with perforated holes. The press plate is then positioned on the honeycomb while the hydraulic press of 3 ton was placed on it and supported by the frame. The hydraulic press which is manually operated forces the oil out of the extraction chamber through the perforated holes into the honey collector positioned at the lowest part of the extraction chamber. The honey extracting machine has an average throughput of 2.59 kg/min and efficiency of about 91%. The cost of producing the honey extracting machine is NGN 31, 700: 00, thirty-one thousand, and seven hundred naira only or $70 at NGN 452.8 to a dollar. This cost is affordable to beekeepers and would-be honey entrepreneurs. The honey extracting machine is easy to operate and maintained without any complex technical know-how. This simple technology solves the challenge of honey extraction among our peasant farmers in Nigeria.**

***Keywords* — Cost and Efficiency, Extractor, Honey.**

I. Introduction

Bee is a winged, flower-feeding insect which have branched body hairs. They are dependent on pollen as a protein source and on flower nectar or oils as an energy source. Bees are the most important pollinating insects. Their interdependence with green plant makes them an excellent example of the type of symbiosis known as mutualism; in which two parties of an unlike organisms benefits from each other. Bees generally produce honey mainly from the nectar of flowers, plant saps and honeydew [1]. Babajide *et al.* [2] and Vallianou *et al.* [3] discovered that honey is a mixture of sugar comprising of glucose and fructose, in addition to water, usually 17- 20%. It also contains very small number of other substances like minerals, vitamins, proteins and amino acids.

These researchers observed that pure honey is so unique in taste that does not need the addition of any other sweetening substance.

However, Akinnuli *et al.* [4] observed that the traditional method of extracting honey leads to reduction in its nutritional value and quality detected by Babajide *et al.* [2] and Vallianou *et al* [3]. This was because the unripe and capped honeycomb are collected at night and the extraction is achieved by squeezing manually with the hand. A knife is used to cut open the comb of the honey before extracting it into a container thereby damaging the honeycomb. The local procedures of using bare hands include the use of buckets or containers, match, dry leaves or palm kernel shaft, torch light, because the operation is done at night. This operation also destroys the bees through the flame used to chase them away. Although these techniques seem to be the quickest for an average honey tapper who cannot afford a honey extracting machine or solar wax melter. But the hand contaminates the honey and unripe honey ferments within few days after extraction, the materials collected are left untouched until the next morning and bee-wax which has become hardened at the top of the honey is removed and the harvested honey is later poured into bottles.

As discovered by Akinwumi *et al.* [4], different types of honey extractors such as tangential, radial and electrical driven have been developed in advanced countries like Italy, Germany, Australia, United States of America and Turkey. But the cost of purchase, importation and the technical know-how are making peasant farmers in Nigeria not to have access to them, hence they extract their honey traditionally [4]. Whereas Manyi-Lohi *et al.* [5] discovered that honey extracted traditionally does not meet up with international market standard; therefore, there is the need to construct and evaluate a locally fabricated honey extracting machine; a mechanical device that extracts honey from the honeycomb without destroying the combs which are returned back to the beehives after the extraction. In addition to this, the honey extracting machine developed should not be too expensive, easy to operate and maintained by peasant farmers and young entrepreneurs, hence the usage of local and readily available materials for this fabrication. Fig. 1 and Fig. 2 shows the picture of a typical honeycomb and extracted honey respectively.

Fig. 1. Honeycomb.

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Fig. 2. Extracted Honey.

II. Methodology

The development of honey extracting machine was carried out in the workshop of the Agricultural Technology Department of the Federal Polytechnic, Ile Oluji, Nigeria. The honey extracting machine was designed to extract 50 kg of honey from harvested honeycomb. It works on compression principle using a hydraulic jerk to force the honey out of the comb through a perforated cylindrical chamber into a base collecting tray with a discharge outlet to collect the extracted honey. The honey extracting machine has a frame to support the honey extractor without collapsing.

The design consideration includes safety of the operator, portability, cost, ergonomic, ease of operation and maintenance. The materials used for the fabrication were selected based on their availability, durability, ease of fabrication and cost. The hydraulic jerk of 3 ton was the only bought out item.

The specific materials selected for the fabrication of the honey extracting machine components, the criteria for selection, the most suitable materials, the materials eventually selected, the reasons for such selection and the limitations of the materials selected is as tabulated in Table I.

Fig. 3 is the conceptual drawing of the honey extracting machine, while Fig. 4 is the actual fabrication of the honey extracting machine.

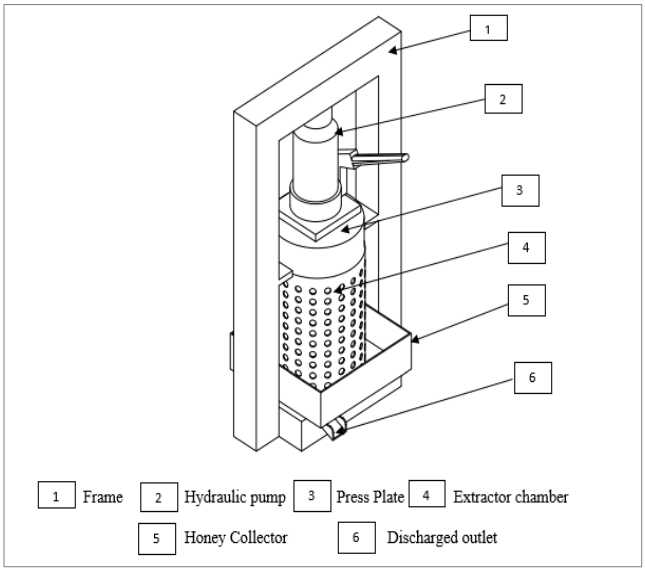

Fig. 3. Conceptual view of Honey Extractor.

Fig. 4. Honey extractor developed.

TABLE I: Material Selection Criteria for Honey Extractor Development

Machine Components	Criteria for Materials Selection	Most Suitable Materials	Materials Selected	Reasons for Selection	Limitations
Jack	To press the honeycomb adequately	2 tones hydraulic presser, stone, cap capacity thread presser	2 tones hydraulic presser	The capacity to press the honey out of the honeycomb	Corrosion Need to be painted
Frame	To support the honey exactor without collapsing	Mild angular, iron and wood	Mild angular Iron	Strength to carry the jack and the extraction chamber	Corrosion Should be painted
Wood press	To press the honeycomb without damage	Wood, iron, stone	Wood	Softness not to damage the honeycomb	Could give way over time Extra ones need to be projected for
Extractor Chamber	To hold the honeycomb for the presser to extract the honey	Mild iron, Galvanized steel	Galvanized steel	To avoid contamination	None that could endanger human's health
Honey collector	To collect without contaminating of the honey	Galvanized Steel	Galvanized steel	To avoid contamination	None that could be hazardous
Press Holder	To hold the jack and the wood presser in place	Mild iron/ Wood	Mild iron	Ability to withstand the pressure of the jack without bending	Corrosion over time. Need to be painted

A. Performance Evaluation of Honey Extractor

The experimental procedure of the evaluation of the honey extractor followed these steps:

a. Harvest Honeycombs, (HC),
b. Weigh the HC as W_1,
c. Load the HC into the extraction chamber,
d. Place the honey press on top of the HC and use the hydraulic pump to compress it,
e. Collect the honey through the discharged unit of the extract base,
f. Use stopwatch to measure the time taken in min for the honey to stop coming out of the perforated holes on the extracting chamber,
g. Remove the honeycomb and weigh again as W_2,
h. Repeat this procedure for five different weights of the honeycomb harvested,
i. The throughput, TP (kg/min) and the efficiency, E (%), of the honey extractor are calculated from (1) and (2) according to [2] as;

$$TP = \frac{W_1 - W_2}{t} \quad (1)$$

$$E = \frac{W_1 - W_2}{W_1} \quad (2)$$

j. Descriptive analysis using Microsoft Excel (2013) version is used to analyse the result. Analysis of variance (ANOVA) was also used to test if there are any statistical differences between the means of the five honeycombs used for the experiment.

III. Results and Discussion

The result of the performance evaluation of the honey extractor is shown in Table II.

It was observed during the five runs that the longer the time taken for the extraction, the more honey is extracted. This was also the observation of [2] in a related study.

As shown in Fig. 5 the five runs of the extractor were of values with little or no variance as this was also confirmed from the ANOVA of Table III at *(P ≤ 0.05)* level of significance, where the *p-value = 1* which is greater than *0.05*. The extractor has an average throughput of 2.59 kg/min and average efficiency of about 91%.

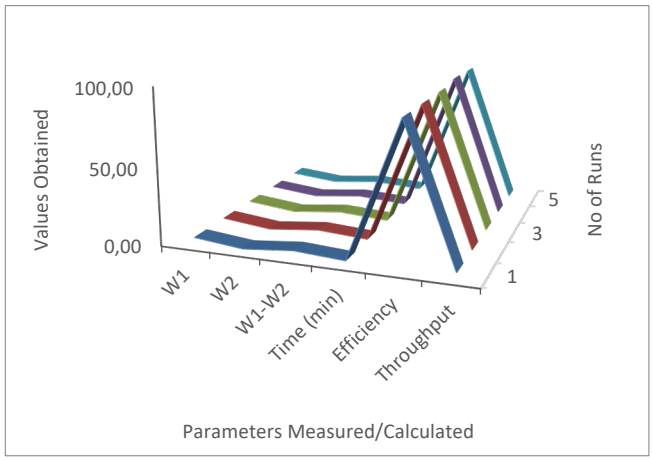

Fig. 5. Efficiency and Throughput of Honey Extractor.

TABLE II: Result of Honey Extractor Performance Evaluation

Runs	W1 (kg)	W2(kg)	W1 - W2	Time (min)	Through put (kg/min)	Efficiency (%)
1	3.8	0.38	3.42	1.3	2.63	90
2	4.1	0.41	3.69	1.47	2.51	90
3	4.1	0.41	3.69	1.48	2.49	90
4	3.9	0.31	3.59	1.32	2.72	92
5	3.77	0.34	3.43	1.32	2.6	91
Average	3.93	0.37	3.56	1.38	2.59	90.61

TABLE III: ANOVA – Honey Extractor Performance Evaluation

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.511777	5	0.1024	7.876E-05	1^{ns}	2.533555
Within Groups	38987.43	30	1299.58	-	-	-
Total	38987.95	35	-	-	-	-

^{ns} *not statistically significant at (P-value ≤ 0.05) probability level.*

IV. Conclusion

A locally fabricated honey extractor at the department of Agricultural Technology, Federal Polytechnic, Ile-Oluji, Nigeria has an average throughput of 2.59 kg/min and efficiency of about 91%. The cost of producing the honey extractor is ₦ 31, 700: 00, thirty-one thousand, and seven hundred naira only or $ 70. The honey extracting machine is easy to operate, maintained and affordable. It does not need any special skills to use and portable for ease of movement from one location to another as the need arises. The honey extractor is recommended for beekeepers and young entrepreneur in the bee keeping industry.

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