AMERICAN JOURNAL OF INNOVATION IN SCIENCE AND ENGINEERING (AJISE)

ISSN: 2158-7205 (ONLINE)

VOLUME 1 ISSUE 1 (2022)

Indexed in

doi | Crossref | Google Scholar | DRJI Directory of Research Journals Indexing | INDEX COPERNICUS INTERNATIONAL | OCLC WorldCat

PUBLISHED BY: E-PALLI, DELAWARE, USA

American Journal of Innovation in Science and Engineering (AJISE)

Volume 1 Issue 1, Year 2022
ISSN: 2158-7205 (Online)
DOI: https://doi.org/10.54536/ajise.v1i1.875
https://journals.e-palli.com/home/index.php/ajise

Improvement and Evaluation of Honey Extractor

Husen Bona[1*]

Article Information

Received: November 06, 2022

Accepted: November 18, 2022

Published: December 30, 2022

Keywords

Efficiency, Extractor, Honey

ABSTRACT

The traditional method of extracting honey leads to a reduction in nutritional value and quality thus, a honey extractor; a mechanical device that extracts honey from its comb was improved and evaluated using easily available materials. The main objective of this study is the improvement and performance evaluation of a honey extractor. The main functional parts of the machine are the net frame, wire mesh driving shaft, driving gear, operating handle to facilitate the winding process, and basket designed to hold and spin three honeycomb frames, constructed using a 1.5 mm thick aluminum sheet, placed vertically into the extractor. The honey extractor is cylindrical and operated by manually turning the operating handle. The time taken for honey extraction had a significant effect on the performance of the honey extractor; the machine capacity, efficiency, and weight of honey extracted decreased as the time taken for extraction increased, with optimum values of 93.37%, 40.46 kg/hr for machine efficiency, and capacity respectively. The machine is portable and can be operated without any special training or technical know-how, the machine also can preserve and leave the honeycomb undamaged after honey extraction.

INTRODUCTION

Raising honey bees for human economic, health, and other purposes are known as beekeeping (Shrestha, 2018; Dia *et al.*, 2018). Honeybees naturally construct their honeycomb within caves, on top of trees, and underneath the roofs of structures. However, keeping bee colonies is also practiced as a form of commerce (Dia *et al.*, 2018). Farmers raise bees primarily to harvest the honey they generate. The honey has been used for wound healing, anti-diarrhea medication, alcoholic beverages, tobacco curing, bakery and confectionery production, and cosmetics making.

According to its botanical and geographic origins, both natural and manmade influences have a significant impact on the composition of honey (Rahman *et al.*, 2019). Nearly all societies use honey as a traditional medicine or food, and whether it is sold cheaply in rural areas or more upscale packaging, honey generates cash and can support a variety of social segments (Chikamai *et al.*, 2009).

The majority of the economic significance spanned from many foods uses to medical significance. To satisfy this demand, beekeepers in the area must find a productive alternative to the antiquated and time-tested techniques they now employ for collecting honey from the honeycomb. A mechanical method for removing honey from honeycombs without affecting the honey's quality or natural form is required to remove the honey from the combs efficiently (Shaaban *et al.*, 2019). This is possible by using an extractor's design. According to reports, bacteria that impair honey's quality typically originate from nectar and pollen, but more specifically from the processing method, surroundings, and containers, which are frequently unhygienic (Adadi and Obeng, 2016).

This has been ascribed to quality concerns with honey that result from the existing honeybee keepers' conventional method of honey extraction, which hurts the honey's quality. According to Shaaban *et al.* (2019), beekeeping must be fully sustainable and utilize locally accessible equipment if it is to be encouraged and promoted.

Honey extraction is the central process in beekeeping. It involves removing honey from combs to isolate it as pure liquid. Research work of Abebe (2009) and Abera *et al.* (2016) reported that one of the major problems facing the profitability of beekeeping for honey production in developing countries, particularly in African countries is the lack of appropriate equipment for honey extraction.

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 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 centrifugal extractor varying in design and capacity from 2 to 72 frames is the modern and most appropriate technology because they guarantee a replacement of the honeycombs, thereby increasing honey production efficiency by the bee colony as no energy is required for rebuilding the combs.

However, the hand contaminates the honey and unripe honey ferments within a 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 (Crane, 2013). The traditional methods of extracting honey lead to a reduction in

[1] Oromia Agricultural Research Institute, Jimma Agricultural Engineering Research Center, Ethiopia
[*] Corresponding author's e-mail: husenifnaan@gmail.com

nutritional value and quality; the unripe and capped honeycomb are collected at night and the extraction is achieved by squeezing manually with the hand. It involves the use of bare hands with a knife to cut open the comb of the honey before extracting it into a container thereby damaging the honeycomb.

Thereafter, an extracting knife is used to pull off the uncapped comb and then put it inside the bucket or container. After the extraction, the honey is then taken home and pressed with the hands to separate the honey from the residue. The raw honey is filtered with a sieve to remove the remaining particles after this the honey is ready and fit for consumption. Although, this technique seems to be the quickest for an average honey tapper who cannot afford a honey extractor the hand contaminates the honey and unripe honey ferments within a few days after the extraction. All equipment for low-technology beekeeping must be made locally as reported by Martin *et al.* (2011).

Southwestern Oromia has a good potential for honey production and they extract their honey traditionally, which is tedious, time-consuming, inefficient, reduces the quality, and contaminates the honey. It is therefore imperative that machines be designed that will help the local farmers not only increase production to meet the demands but also in extracting honey from honeycomb in a more hygienic process. Therefore, to reduce the honey extracting problem this activity was initiated to improve and evaluate the performance of the existing Jimma Agricultural Engineering Research Center plastic-type honey extractor.

MATERIALS

The Material Used To Construct The Machines Are

1. Bevel gears
2. Aluminum sheet
3. Rivet
4. Stainless wire mesh
5. Flat bars and paint (silver paint),

The Instrument Used During the Evaluation of the Machine

1. Stopwatch
2. Weighing balance

METHODOLOGY

Description of study areas

The experiment was carried out at Jimma zone, Gomma district located at 7° 59'N & 36°42'E. The location lies at 1500 m above sea level and has average maximum and minimum temperatures of 31°C and 18°C, respectively with an annual average rainfall of 1143 mm.

Machine Description

The improvements undertaken were the power transmission system changed from chain to gear, the extracting chamber changed from plastic to aluminum, the Outlet of the extractor changed from side to bottom the extractor, and the size reduction. The machine mainly consists of extracting the chamber, frame holders, and power transmitting unit.

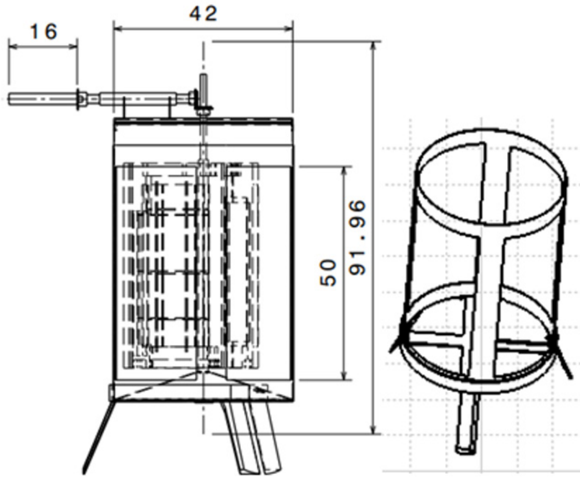

Figure 1: Pictorial View of Honey Extractor

Extracting unit

It was made from an aluminum sheet and connected by the rivet with the shape of a cylinder and the bottom cover of the cone shape. It has a volume of 0.09 m3.

The frame holder

It holds three frames at once and is attached to the driven shaft at the center

Power transmitting unit.

The main power source for the machine is human power and the power transmitting unit consists of three main components of driver shaft with a handle, a driven shaft, and two bevel gears with a 1:2 ratio for changing the rotation of the driver shaft and increasing rotation speed by the ratio of driven and driver gear.

Operation principles of Honey Extractor

The developed extractor was made of an axial solid shaft carrying the gear driving system on its accommodations, the bearing topmost part of the shaft. This solid shaft accommodates the triangular-shaped basket which holds the matured honeycomb ready for extraction. The whole mechanism was housed in a galvanized stainless steel cylindrical container for honey collection and withdrawal. The driving mechanism which gives the machine a drive (rotary motion) consists of a gear, shaft, and handle which transmits the motion from the handle to the shaft, connected to the shaft that always drives the basket inside the drum due to the gear mechanism incorporated.

The driver gear set in motion the driven gear which regularly set the basket in motion. The machine operates by the principle of radial motion of the basket inside the drum. The basket was loaded with matured honeycombs, and the metal basket was turned to rotation by force on the handle. The rotational effect caused centrifugal force that made the honey flow out of its comb. As the centrifugal force increases, the rate of honey outflow increases until the combs are empty of their honey. The

Figure 2: Developed Honey Extractor

extracted honey flows down by gravity into the collector for collection.

Performance Evaluation of honey extractor

Honeycomb was obtained from local farmers and used for the evaluation of the extractor. The extraction was repeated four times. The efficiency and capacity of the machine were computed using the following Equations

Efficiency of machine

Ee=We/Wbe×100 (1)

Capacity of machine =We/Tt (2)

Where:Ee = the extracting efficiency in percentage, %

We = the weight of honey extracted, (kg),

Wbe = the total weight of honey extracted by machine and manually, (kg),

Mc = the capacity of the machine, (kg/hr) and

Tt = the time taken for extraction of the honey, (hr)

Experimental design and Statistical Analysis

The experimental design is a spilt-spilt plot with three replications. Treatments consisted of factorial combinations of three operating times (3 min, 5 min,7 min), two types of extractors (Improved and Imported), and three operator weights (55kg, 65 kg, 75 kg). Data were subjected to analysis of variance following a procedure appropriate to the design. Analysis was done using R-software. The treatment means that were different at a 5% level of significance were separated by using LSD.

RESULTS AND DISCUSSION

Effect of Time, the weight of the operator, and the type of extractor on the efficiency of a machine

Table 1 and 2 shows the effect of operating time, the weight of the operator, and the type of extractor on the mean percent of the efficiency of the machine. The

Table 1: Effect of Time and type of extractor on the efficiency of the machine

Time * Type of extractor						
Time(min)	**Type of extractor**		**Time (min)**	**Mean**	**Type of Extractor**	**Mean**
	Imported	**Improved**				
3	87.99^{c}	86.90^{d}	3	87.45^{b}	Imported	93.51^{a}
5	96.49^{ab}	95.91^{b}	5	96.20^{a}	Improved	93.23^{a}
7	97.15^{a}	95.78^{b}	7	96.47^{a}		
Mean						93.37
LSD						0.77
CV						1.19

Table 2: Effect of Weight of operator and type of extract on the efficiency of the machine

Weight of operator * Type of extractor						
Weight of operator(kg)	**Type of extractor**		**Weight of operator(kg)**	**Mean**	**Type of Extractor**	**Mean**
	Imported	**Improved**				
55	93.73^{ab}	92.51^{c}	55	93.21^{a}	Imported	93.51^{a}
65	93.44^{abc}	92.97^{bc}	65	93.21^{a}	Improved	93.23^{a}
75	93.37^{abc}	94.21^{a}	75	93.79^{a}		
Mean						93.37
LSD						1.08
CV						1.19

analysis of variance (ANOVA) revealed that the operating time had a significant effect ($p<0.05$) on the efficiency of the machine and also the combination of the weight of the operator and type of extractor and the combination of time and type of extractor had a significant effect ($p<0.05$) on the efficiency of the machine. Whereas the type of extractor, weight of the operator, and their combination had no significant effect.

Capacity of machine

Tables 3 and 4 show the effect of operating time, the weight of the operator, and the type of extractor on the mean percent of the capacity of the machine. The analysis of variance (ANOVA) shows that operating time had an extremely significant effect ($p<0.05$) on the capacity of the machine and also the weight of the operator and type of extractor had a significant effect ($p<0.05$) on the capacity of the machine. Whereas, other combinations of the parameters had no significant effect ($p>0.05$) on the capacity of the machine

Table 3: Effect of operating Time and Weight of Operator on the capacity of the machine

Weight of operator * Operating Time							
Weight of operator(kg)	**Operating Time**			**Weight of operator(kg)**	**Mean**	**Operating Time (min)**	**Mean**
	3	**5**	**7**				
55	54.66b	34.20c	24.57d	55	37.81b	3	59.77a
65	61.00a	34.60c	24.71d	65	40.10ab	5	34.80b
75	63.66a	35.60c	31.14c	75	43.46a	7	26.80c
Mean							40.46
LSD							5.65
CV							14.37

This shows the effect of the weight of the operator on the capacity of the machine. The weight of the operator has a direct relationship with the capacity of the machine i.e. as the weight of the operator increase the capacity of the machine increases.

Table 4: Effect of operating Time and Type of extractor on the capacity of the machine

Time * Type of extractor						
Time(min)	**Type of extractor**		**Time(min)**	**Mean**	**Type of Extractor**	**Mean**
	Imported	**Improved**				
3	62.44^{a}	57.11^{a}	3	59.77^{a}	Imported	43.28^{a}
5	37.60^{b}	32.00^{bc}	5	34.80^{b}	Improved	37.64^{b}
7	29.81^{c}	23.80^{b}	7	26.80^{c}		
Mean						40.46
LSD						4.00
CV						14.37

The above tables show the effect of operating time on the capacity of the machine. The operating time has an inverse relationship with the capacity of the machine i.e. as the operating time increases the capacity of the machine decreased. Because as operating time increased the honeycomb was start broken.

CONCLUSION

Hand operated honey extractor was improved from the pre-existing machine by changing the chain driving method to the gear driving method to solve the problem that occurred on the existing machine i.e. removal of the chain from the teeth of the sprocket during operation and also the replacement of the plastic container to aluminum to improve the durability of the machine. The improved honey extractor was evaluated with the imported honey extractor with three parameters i.e. operating time, the weight of operator, and types of extractor for capacity and efficiency of the machine and we gate 93.51% and 93.23% efficiency for imported and improved respectively and 43.28 kg/hr and 37.64 kg/h capacity for imported and improved respectively. The improved honey extractor is an effective and hygienic means of extracting honey from the honeycomb without damaging the comb. Also, the machine was simple for operating and operated for a long time without being tired and the user of this machine will find it interesting to operate.

RECOMMENDATION

It is recommended that operating the machine for 5 minutes is the best time to gate good efficiency and capacity for the machine and a demonstration is recommended.

REFERENCE

Abebe, A. (2009). Market chain analysis of honey production in Atsbi Wemberta District, eastern zone of Tigray national regional state (Doctoral dissertation, Haramaya University).

Abera, A., Yakob, H., & Yasin, G. (2016). Assessment of production system and constraints of beekeeping practices in damot gale woreda, wolaita zone, southern Ethiopia. *Assessment, 6*(11.

Adadi, P., & Obeng, A. K. (2017). Assessment of bacterial quality of honey produced in Tamale metropolis (Ghana). *Journal of food and drug analysis, 25*(2), 369-373.

Chikamai, B., Tchatat, M., Tieguhong, J. C., & Ndoye, O. (2009). Forest management for non-wood forest products and services in Sub-Saharan Africa.

Crane, E. (2013). Local method of extracting honey. *Journal of Technology, 8*(5), 1-7.

JI, O., & AAU, J. (2018). Economics of Beekeeping in Ganye Local Government Area of Adamawa State, Nigeria.

Marshall, E., & Mejia, D. (2011). Traditional fermented food and beverages for improved livelihoods. *FAO Diversification booklet, 21*.

Rahman, M., A. Gupta, and T. H. Dar. (2019). A study on various physio-chemical and biological properties of the honey bee. *Journal of the Gujarat Research Society, 21*(11), 332– 337.

Shaaban, Y. A., El-Ghobashy, H. M. T., El-Ashkar, A. M. O., El-Reheem, A., Solaf, S., & Ghania, A. M. M. (2019). Development and Evaluation of a Honeycomb Uncapping Machine. *Journal of Soil Sciences and Agricultural Engineering, 10*(7), 377-381.

Shrestha, A. (2018). Study of Production Economics and Production Problems of Honey in Bardiya District, Nepal. *Sarhad Journal of Agriculture, 34*(2).