

Development of Pedal Operated Coconut Scraper

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Abstract: Coconut is very important ingredient of Indian food just because of its versatility in use. Extracting the edible part from coconut is not so easy task when it comes to process it from its initial state. Scraping of coconut shell takes much time when using the ordinary coconut scrapers available in the market. To make it possible and easier, a pedal-operated small scale coconut scraper was developed in order to save the time and energy. It has a hemispherical serrated grating tool having notches on its outer periphery, which grates the coconut. The average capacity of this developed coconut scraper was found to be 2.55 kg/hr with grating efficiency of 73.63%.

Keywords: Coconut scraper, chain drive, capacity, efficiency

I. INTRODUCTION

Coconut palm which is appropriately eulogized as 'kalpavriksha' is reflective of its uses and essentiality in everyday life of people. Each and every part of it is useful in one way or other and not even an inch of tree goes waste. The fruit of the coconut is technically a large, dry drupe composed of a thin outer layer (exocarp), a thick, fibrous middle layer (mesocarp) and a hard inner layer (endocarp). Inside the shell is a thin, white, fleshy layer, about 12.25 mm thick at maturity, known as the 'coconut meat'. Copra comes from the meat of dried coconut, while coir fibers are derived from the fibrous mesocarp. The nut varies from 147 to 196 mm in diameter and 245 to 294 mm long. The meat is soft and jelly-like when immature and becomes firm at maturity. The meat of immature coconut fruit can be made in to ice cream while that of mature coconut fruit can be eaten fresh or used for making shredded coconut and livestock feed. The white, fleshy part of the seed, the coconut meat is used fresh or dried in cooking, especially in confections and desserts. Fresh shredded or flaked coconut is also used as a garnish various dishes. Coconut flour has also been developed for use in baking to combat malnutrition. Per 100 gram serving with 354 calories, raw coconut meat supplies a high amount of total fat (33 gm), moderate content of carbohydrates (15 gm) and protein (3 gm) & significant content of micronutrients (more than 10% of the daily values) including the dietary minerals, manganese, copper, iron, phosphorus, selenium, and zinc.

By considering a major uses of coconut, it is necessary to process it very carefully. Grating is one of the necessary operation in processing of coconut to obtain the coconut meat & for it coconut grater/scraper is usually used. The grater/scraper is used to efficiently grate the coconut inside the shell. Various graters are available in the market depending on its use, capacity, size etc. Traditional graters which include coconut scrapers, hand coconut grater, rotary coconut grater etc. are laborious and its process is time-consuming. Modern graters include motor operated graters which are costly and depend on availability of electricity for its operation. For commercial/semi-commercial/household wet processing of coconuts, motor-operated graters are usually used but in rural areas, it creates problem due to

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electricity shortage. A pedal-operated grater/scraper based on pawl and ratchet mechanism can be an option against these problems. Therefore the study was undertaken with the objectives to develop a low cost small scale pedal-operated coconut scraper & to evaluate its performance.

II. MATERIALS & METHODS

Coconut was purchased from the local market. During the development of pedal operated coconut scraper, points regarding dimensions of material to be used, ease of maintenance, its development cost & durability were considered. For the development of pedal operated coconut scraper mild steel (MS) pipes ($30 \text{ mm} \times 30 \text{ mm}$) were used for making the frame of scraper. For providing structural support for overall assembly, MS angle frame was used along with two free-wheel sprockets of 16T and 48T. One meter long chain was selected for the operation because it provides a maximum power transmission. The coconut scraper consists of an angle frame, shaft, chain and sprocket mechanism, bearings, scraper blades, pedal, spring, and collecting troughs. The grating is accomplished by rotating the blades using the pedal and pressing the meat of the halved nut to the rotating blades. Chemical, physical and mechanical properties of the materials needed for the construction of the pedal-operated coconut scraper, its availability and cost were considered in selecting the materials of construction. Use of stainless steel material for the scraper blade enhanced the durability of the scraper because of its corrosive resistance. The length of chain used was calculated by following equation.

If, T1= Number of teeth on the smaller sprocket, p = Pitch of the chain

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T2= Number of teeth on the larger sprocket,
x = Centre distance
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Then, K = Number of the chain links = K = $\frac{T_1+T_2}{2} + \frac{2x}{p} + \left[\frac{T_2-T_1}{2\pi}\right]^2 \frac{p}{x}$ Mathematically, Length of the chain (L) = K.p





Fig. 1 Pedal Operated Coconut Scraper

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A. Principle of Operation of Pedal Operated Coconut Scraper

The blades of scraper scouring into coconut meat out of half shelled coconut with its teeth. The driven mechanism of coconut scraper works on the principle of Ratchet and Pawl mechanism. The purpose of a ratchet and pawl is to allow a shaft to rotate in one direction only. A ratchet is a wheel with a shape similar to a circular saw blade or horizontal milling cutter. A ratchet fits onto a shaft and is locked onto a shaft by a 'key'. The key fits into slots in the shaft and ratchet wheel. These slots are called 'keyways'. A pawl is a metal part that rests on the ratchet. As the ratchet rotates, the pawl drops onto each of the steps on the ratchet rim, preventing the ratchet from turning in the direction of the pawl. Sometimes spring was used to keep the pawl in contact with the ratchet. The ratchet and pawl mechanism was used wherever rotation was required in one direction only.



Fig. 2 Ratchet and Pawl Mechanism

B. Working of Pedal Operated Coconut Scraper

Two pieces of coconut can be manually grated on the grating/scraping tool arrangement as per the requirement of the type of product the consumer needs. The grating tool was mounted on the shaft which is driven by ratchet and pawl mechanism by pedaling via chain and sprocket drive. The hemispherical grating tool was selected over the other types of tools for removing more amount of material in one pass. Dimensions of the tool were selected in such a way that a major possible part of coconut will be grated. The disadvantage of using a tool with a smaller diameter was that there would be a need of rotating the tool along the inner periphery of the coconut for grating and that would be a tedious task. The tool, having serrated teeth on its flaps comes in contact with the part to be grated from coconut, which chips down the maximum part of the edible part of the shell. As no electricity was required, this would reduce the manpower, time, and power consumption. As the power transmitted for scraping/grating is dependent on the user, it simple to operate.

Brown mature coconuts were purchased from the local market. De-husking was done by the de-husker machine and then nuts were broken into two pieces. Halved nuts then one by one pressed against the grating tool/scraper blade. The blades must be sharp and tightly secured to the shaft. The meat should be in contact with the rotating blades. Halved nut was firmly held and turn counter-clockwise opposite to the direction of the shaft rotation. This was to effect faster grating of the meat and to facilitate uniformity in the meat shreds. Collecting troughs under the blades automatically catches the shredded meat.





Fig. 3 Operation of developed Coconut Scraper

C. Performance Evaluation Pedal Operated Coconut Scraper

The grated meat was weighted and also the time taken for grating of one nut was noted down. The developed coconut scraper was evaluated based on the below equations. The capacity of the scraper is nothing but the amount of grated meat per unit time. The performance evaluation of developed coconut scraper was determined in terms of its capacity & grating efficiency by using the equations (1) and (2).

Grating Capacity = $\frac{\text{Amount of grated meat (grams)}}{\text{unit time}}$ (1)

Grating Efficiency = $\frac{grated \ weight \ of \ coconut \ meat}{total \ weight \ of \ coconut \ meat} \times 100$ (2)

III. RESULTS & DISCUSSION

A. Grating Efficiency of Pedal Operated Coconut Scraper

It is the amount of the grating meat to the amount of grated meat and un-grated meat. Grating efficiency of developed coconut scraper mainly depended on blade size. The average grating efficiency for 6 cm diameter blade was found to be 58.81%, whereas it was 73.63% for 7.6 cm diameter blade. As the size of the blade changes, the grating efficiency changed accordingly. The bigger the blade size, the greater was the efficiency. But this also had some limitations. Grating efficiency was found to be depends on the thread type of blade. R thread type blade had given maximum output as they had tapered thread, which helped to penetrate inside the center of the halved nuts for maximum grating efficiency.





Fig. 4 Grating Efficiency of Pedal Operated Coconut Scraper

B. Grating Capacity of Pedal Operated Coconut Scraper

It is nothing but amount of grated meat per unit time. As the scraper was manually operated, its capacity varied from person to person. Also it was found to be dependent on size of coconut. It was observed that the average capacity of pedal operated coconut scraper with 6 cm diameter blade was 1.30 kg/hr, whereas it was found to be 2.55 kg/hr for 7.6 cm diameter blade. It was observed that scraping capacity of pedal operated coconut scraper varied with blade diameter. From this, it was confirmed that scraping capacity of pedal operated coconut scraper changes not only with coconut size and person but also with blade size and time.





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Production cost of pedal operated coconut scraper was estimated as Rs 3170/- with its assumed life span of 5000 hrs (about 5 years). Therefore operating cost of developed pedal operated coconut scraper per hour was found as Rs. 0.63/- per hour.

IV. CONCLUSIONS

- 1) This prototype is energy friendly with the cost of fabrication about 50% less than that of available in the market.
- 2) This prototype has low operating cost, hence usable to small scale farmers and food processors.
- 3) Maximum grating efficiency & scraping capacity can be obtained at 7.6 cm blade size.

V. REFERENCES

- Anmol Bhatia, Abheek Arora, Nischay Arora and Vaibhav Manchanda (2019). Design of coconut dehusker, cutter and grater machine. International Journal of Advanced Engineering Research and Applications, vol. 5(1), pp. 41-45.
- [2] Jerry James, Jacqwin Joy, Abin Shaji, Basil Chandy and Vinay Mathew John (2016). Design and fabrication of coconut breaker, extractor grater machine. International Journal for Innovative Research in Science and Technology, vol. 2(11), pp. 179-184.
- [3] Senthil Kumar G, Kamraj K, Kaviraju S and Mano Bharathi T (2018). Design and fabrication of multi blades coconut scraping machine with single drive. International Journal of Recent Engineering Research and Development, vol. 3(2), pp. 19-23.

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