

Design & Fabrication of Coconut Breaker Extractor Grater Machine

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Abstract

Coconut farming is one of the main cultivation in India, especially in southern states of India. It is for this Kerala is one of the largest producers of tender coconut in India. Like other fruits, it has three layers: the exocarp, mesocarp, and endocarp. The exocarp and mesocarp make up the "husk" of the coconut. Coconuts sold in the shops of non-tropical countries often have had the exocarp (outermost layer) removed. The flesh inside the seed of the coconut is only edible. So it is required to dehusk the coconut, remove the fibre and break the coconut seed to access the flesh. The proposed machine a Coconut Breaker Extractor Grater which can break a de-husked coconut into two pieces, collect coconut water and grate the coconut pieces into desiccated coconut. The main highlight of the proposed project is that there is no contact between the tool and hands of the user both in breaking and grating of the coconut. For the proposed machine, it is required to introduce a de-husked coconut and fix it on the arms of the machine. The main merits of the proposed machine are it is feasible in terms of economy, time and effort, enhanced safety of the user by eliminating injuries caused primarily due to improper handling of the grater tool.

Keywords: Desiccated coconut, Endocarp, Exocarp, Grater, Mesocarp

I. INTRODUCTION

Coconut is widely used in our day to day home activities. The flesh of the coconut is the important product used by homemakers in preparing dishes. For this purpose, the coconut needs to be processed. The coconut is known for its great versatility as seen in the many uses of its different parts and found throughout the tropics and subtropics. The dimensions of the mature coconut are very much significant as far as the machine design is concerned. Various farms and sites were visited to comprehend the band of dimensions involved in the mature coconut. Some coconuts from Andaman and Nicobar Islands are very big when compared to the areas thrived with coconuts in India like Tamil Nadu and Kerala. The most common method used in breaking the coconut shell is by using a chef's knife or a meat cleaver. The coconut juice is extracted through the eyes of the coconut at the top portion by making a hole using a small pointy knife. For breaking the coconut it is important to hit it at the right spot. This is to ensure a proper and almost symmetrical cutting of the coconut.

The machine has been designed to overcome a large range of coconut sizes, with equal importance to productivity. The main merits of the proposed machine are it is feasible in terms of economy, time and effort, enhanced safety of the user by eliminating injuries caused primarily due to improper handling of the grater tool. It will be very useful for catering services and hotels for preparing food items. It will be useful in soap producing industries which uses coconut as their prime ingredient. It will have a great role in coconut ice-cream producing industries too.

II. RESEARCH PHASE

There have been several studies on the topic of waste processing coconut and also regarding the different methods of cutting and grating. Obviously these studies are of most importance as they focus on improving the overall performance of the machine- which is crucial given the fact that the time and effort of human is of prime importance. The studies conducted in the relevant fields of coconut processing were as follows:

- 1) 'Fabrication of coconut husk remover with shell cutter'.
- 2) 'Design and Fabrication of Dry Coconut Shell Breaking Machine'.

A. Conventional Breaking Methods:

- 1) By using a sharp knife
- 2) hitting on a hard surface

B. Conventional Grating Methods:

- 1) Traditional methods
- 2) Kitchen tool methods
- 3) Electric machines methods

III. DESIGN OF THE SYSTEM

The proposed machine which is to be designed for demonstration and experimental purposes is shown below in Fig. 1.

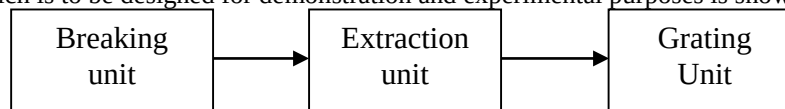


Fig. 1: Proposed system.

In the proposed system the coconut would be placed above the tool and would held between two jaws. The breaking was designed so that a hanged weight would strike the coconut from a height, thus splitting the coconut into two halves and the coconut water is collected by placing a collecting basin below. The coconut pieces thus obtained is then placed in a coconut holder and then grated using a motor driven grating tool.

Since the system is designed such that there is no direct contact between the tool and the human hands the effort is reduced substantially thereby decreasing the difficulty against which the machine has to operate. Hence, it can be theoretically reasoned that this new system of improves overall performance parameters such as time, energy, cost.

The subsequent sections of the paper mainly focus on a brief treatment of the methodology adopted during the design stage of the experimental setup and the various important considerations followed

A. Determining the Cutting Force:

The determination of the correct weight which is to be selected so as to be dropped to break is crucial in breaking the coconut. If the weight is less than adequate then the coconut will not be split in half. On the other hand, if the weight is much higher than the required, then it will lead to the coconut pieces being thrown out of the provision provided. Another drawback if the weight is more is that the weight of the machine rises and users will find it difficult to raise the weight. Thus the determination of the weight being required is crucial. We have adopted a trial and error method to determine the weight required and is done at a fixed height.

B. Trial and Error Method Procedure:

At first coconuts of different sizes and shapes were selected. Coconuts are of different sizes. In order for the breaking unit to be successful, all kinds of coconut must be split in 2 pieces. The procedure to find the required weight of the breaking unit started with a 2kg mass. Initially 2kg was chosen so as to reduce the weight of the breaking unit. Upon using this no crack was observed on the coconut. So, another kilogram weight was added to make 3kg. This brought about a small crack and nothing more. Still it was not sufficient to break the coconut. When a 4kg weight was used, a halfway crack was found on the surface of the coconut shell. Again, the experiment was conducted for a 5kg mass. This time the coconut was split in two halves. Using a 6kg or 7kg weight also breaks the coconut, but the coconut gets displaced from its seating position and adds unnecessary weight.

The 5kg weight was chosen and further tests were done to ensure the reliability of the weight that has been chosen. So, coconut of different sizes and shapes were tested to verify whether the 5kg weight would break them all. Upon testing with 10 coconuts, it was seen that all of the coconut were split in two halves and that too without the coconut been shattered into dissimilar units. It was clear that 5kg would be sufficient to break the coconut exactly in two halves.

C. Parts and Specifications:

Table - 1
Units for Magnetic Properties

Parts Used	Specification
Motor	0.25 HP single phase AC, 1440 rpm
Breaking tool	Mild Steel
Grating tool	Stainless steel
Body	Galvanised Iron sheet
Angle plate	Mild steel
Hanged weight	5 Kg Mild steel
Pulley(Motor)	2 inch

Pulley(Shaft)	3 inch
Bearing	UC 208
Spring	1-10 mm

D. CAD Designing:

The design of the CBEG machine was done on Creo Parametric 2.0 CAD Software.

E. Parts Design:



Fig. 2: V-belt



Fig. 3: Spring

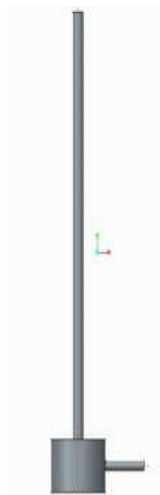


Fig. 4: Hanging weight



Fig. 5: Driver pulley



Fig. 6: Cutting tool

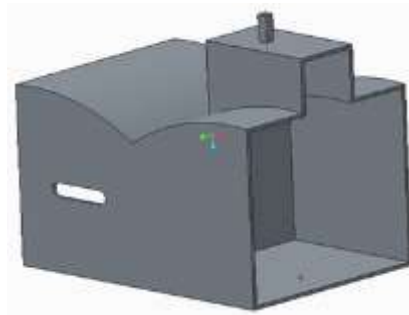


Fig. 7: Outer case

F. Working:

The three processes breaking the coconut into two halves, grating the coconut half and extracting the coconut water has been integrated in a single machine. The breaking operation is accomplished without any power supply. Electrical power is needed to rotate the grating tool so as to desiccate the coconut into thin shreds.

G. Breaking System:

Coconut is placed in between the breaking tool supported by the clamp. The hanged weight is then allowed to hit on the breaking tool under effect of gravity thus splitting the coconut into two pieces.

H. Extracting System:

After the coconut is split into two, coconut water is made to flow through a collecting hole. The collecting hole is attached to a hose. The fresh coconut juice can be collected in a collector.

I. Grating System:

The grating tool is rotated using a 0.25 HP AC motor with 1440rpm. In order to reduce the speed of the grating tool, a belt-pulley arrangement is implemented. The coconut holder is designed eccentrically such that all parts of coconut can be grated. It consists of 3 jaws for holding coconut piece in which 2 are fixed and 1 can be used to fix the coconut. A linear movement bearing is used for the linear movement of holder. The holder is attached to a threaded shaft so that while rotating the shaft externally the holder moves forward and the coconut are grated. Thus desiccated coconut is obtained.



Fig. 8: Coconut holder

J. Design of Breaking, Water Extraction and Grating section:

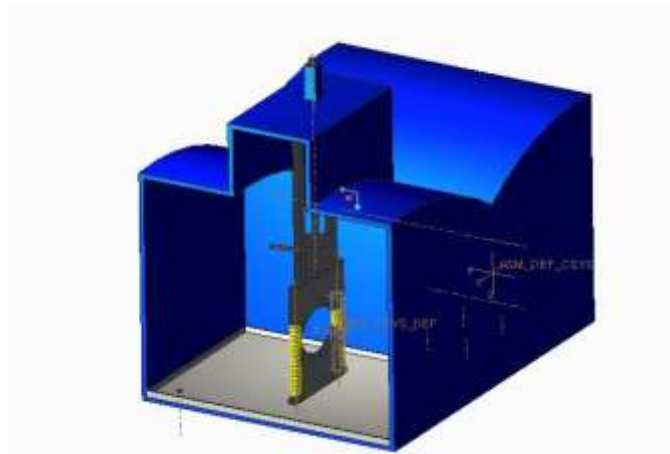


Fig. 9: CAD Design (Breaking side)

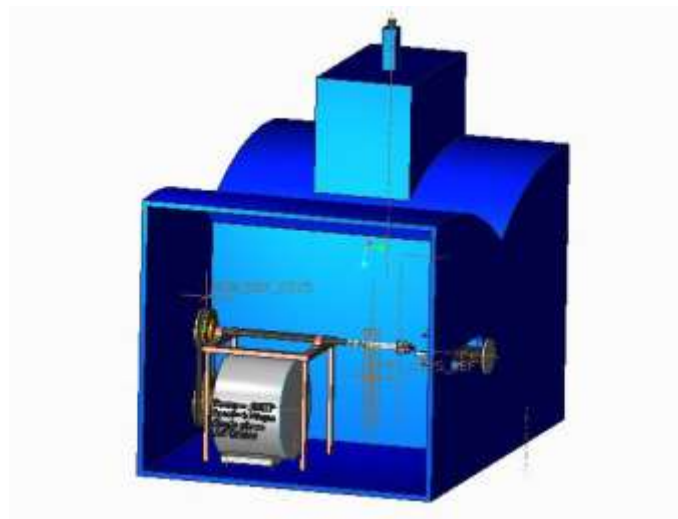


Fig. 10: CAD Design (grating side)

IV. TESTS AND RESULTS

After the completion of the prototype the machine was taken to the college canteen to test it and to get their feedback. Upon testing at the canteen, we were able to break 45 coconuts in 5 minutes duration and found that all were broken in their first attempt. People were excited with the idea of the project, especially for the workers. The following results were obtained from testing of machine.

Table - 2
Results

Particulars	Traditional way of breaking	Proposed machine
Breaking		
Quantity per 5 minutes	30	45
Time taken per coconut	9.5 sec	5 sec

<i>Extracting coconut water</i>		
<i>Quantity saved</i>	<i>less</i>	<i>high</i>
<i>Grating</i>		
<i>Time taken for one coconut</i>	<i>15 minutes</i>	<i>5 minutes</i>
<i>Risk factors</i>	<i>High (Injuries in hands and other parts of the body)</i>	<i>Less</i>
<i>Ease of use</i>	<i>Difficult</i>	<i>Easy</i>
<i>Effort required</i>	<i>Very high</i>	<i>Less</i>

V. CONCLUSIONS

The experimental setup was fabricated and tested. The major aim of the experiment was to design and fabricate a machine which could be used to break, extract coconut water and to grate coconut. The results obtained during the experiment were promising as it was seen that the designed machine could function with less effort, minimum time, reduced cost which can be directly observed from the test results.

A. Advantages of the Proposed System:

The proposed machine has several benefits such as:

- 1) Can be used to reduce time and effort of homemakers
- 2) Will be very useful in conducting large functions such as marriages, hotels.
- 3) Will be very useful in soap producing industries which uses coconut as their ingredient.
- 4) Will have a great role in coconut ice-cream producing industries.

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REFERENCES

- [1] Nagarajan.N, Sundararajan.P.N, "Fabrication of coconut husk remover with shell cutter", International Journal of Research and Innovation in Engineering Technology ISSN, 2394 – 4854 Volume: 01 Issue: 12 Pages: 13 – 18.
- [2] Ranganath.P, Sujay.B.S, Vinaykumar.K.S, Yashwanth.K.S, "Design And Fabrication Of Dry Coconut Shell Breaking Machine", Project reference no. : 37s1087.
- [3] Roshni T., Jippu J., Ratheesh C.S., Sachin J., Sreevisakh K.L. "Development of a Household Coconut Punch-cum-Splitter". Agricultural Engineering International: the CIGR Ejournal. Manuscript 1188. Vol. XI. May, 2009.
- [4] Venkataramanan S, Abhinav Ram B, Rahul R, Design and Development of Automated Coconut Dehusking and Crown Removal Machine, International Journal of Sciences: Basic and Applied Research (IJSBAR) ISSN 2307-4531