



Fabrication of Cashew Nut De-Shelling Machine

Denin Daniel¹, Rahul Ragunathan¹, Sachin Saijan¹,

Abhijith VR²

UG Students¹, Assistant professor², Department of Mechanical Engineering

Mount Zion Institute Of Science And Technology, Chengannur, Kerala, India

ABSTRACT

This paper deals with the mechanical characteristics of cashew nut and cutting the shell in a mechanical way to reduce the time. Presently shearing of shell of cashew nut is done manually. During shearing of cashew nut shell a liquid is coming out which is corrosive which is hazardous and in turn consumes the lot of time because of its oily property. This automatic power operated cashew nut Sheller may be operated by unskilled worker. An automatic power operated cashew nut Sheller is based on the principle of shear with respect to cutters is mounted on sliding guide ways. Now-a-days few automatic cashew nut shelling machines are present but there are some problems such as it cannot be adjusted along the guide as per the size of cashew nut therefore efficiency of machine may get reduced and cost may increase. This research overcomes the problem by manufacturing automatic cashew nut shelling machine using spring adjustment guide with respect to size of cashew nut and in turn improves the efficiency. This paper summarizes a semi-automatic method over manual method.

INTRODUCTION

In the beginning it was mainly used for soil binding to check erosion. The major cashew nut producing states in India are Maharashtra, Kerala, Andhra Pradesh, Orissa, Karnataka, Tamil Nadu, Goa and West Bengal. The annual production of cashew nut varied throughout the study and the variation ranged from -16.27 per cent to 14.37 per cent. Cashew nut is mainly made up of kernel and shell, as shown in. As components of the cashew nut have numerous economic uses, the cashew nut is of significant economic importance. The kernel of the cashew nut is high in oil and protein content, constituting about 40-57% and 21%, respectively. The kernel is mainly used in confectionery and as the desert nut. Now, the kernel is being considered as an additional source of protein concentrates and isolates for use in human food products. The shell liquid (CNSL) is a by-product of the cashew nut and is a natural source of saturated and unsaturated long-chain phenol. Recent studies show that the components of the CNSL have been used as antioxidants or as basis for the production of new compounds with antioxidant action. Because of the economic importance of the cashew nut,

a large number of cashew nut processing enterprises are established all over the world. Therefore, a lot of novel techniques on the cashew nut processing are invented. At present, the cashew nut shelling technique is the most difficult due to the size variance of the cashew nut, which has dramatically restricted the development of the cashew nut processing industry. Thus many scholars execute couples of studies about cashew nut shelling techniques. And also, the most studies mainly focus on the pre-shelling treatment of the cashew nut, cashew nut shelling machinery, and scientific cashew shelling method. In this paper, the recent study about pre-shelling treatment of the cashew nut, cashew nut shelling machinery, and cashew shelling method are reviewed; the barriers of the cashew shelling technology are analyzed; and the future research and prospects are discussed. The manual or semi-mechanized type of these machines still requires manual labour and cannot be used to process small nuts. These are disadvantages of the method. However, a high percentage of whole kernel recovery is achieved. Impact shelling methods on the other hand do not need any manual labour and can be used to process small nuts. This method however achieved a low percentage of whole kernel recovery. This is because previous works done using this method did not consider different sizes of the cashew nut. Cashew nut has large, medium and small sizes. The machine design was well outlined and executed. The study aims to improve on impact The manual or semi-mechanized type of these machines still requires manual labour and cannot be used to process small nuts. These are disadvantages of the method. However, a high percentage of whole kernel recovery is achieved. Impact shelling methods on the other hand do not need any manual labour and can be used to process small nuts. This method however achieved a low percentage of whole kernel recovery. This is because previous works done using

this method did not consider different sizes of the cashew nut. Cashew nut has large, medium and small sizes. The machine design was well outlined and executed. The study aims to improve on impact shelling method by determining the mechanical properties and machine design parameters that will improve the whole kernel recovery of the shelling method.

LITERATURE REVIEW

McNeill and Westby (1999) evaluated a manually operated machine for chipping cassava. This study demonstrated how agricultural machinery developed for use in a developing country can be improved by employing a participative and iterative approach to design, paying closer attention to human factors. By incorporating ergonomics into the design process, drudgery associated with the machine was reduced and productivity, user comfort and satisfaction were increased. Improving the posture adopted to operate the machine resulted in a significant reduction in physical strain and incidence of body-part discomfort. Kolsch et al. (2003) proposed an objective measure for postural comfort. The proposed method allows for assessment of postural comfort. They determined the comfort zone by measuring compensating motion that allows participants to freely pick a comfortable posture range with the body part under scrutiny. Their method does not rely on acquisition of subjective data. Instead, it is entirely objective and allows for participants that are naïve to the study purpose body part under scrutiny.

Ojolo and Ogunsina (2007) carried out the development of a cashew nut cracking device. The device was developed to improve the efficiency of the shelling operation in cashew nut processing. The performance of the machine is fairly satisfactory but an improvement on the percentage of whole

kernels is achievable with further modification and testing. They concluded that a device of this nature can be manufactured in small machine shops in the developing countries for small entrepreneurs and village level applications. Further research is carried out to evaluate the machine base on ergonomic considerations and to improve the design of the machine for better performance and user acceptance. The need to determine a suitable user and machine interface leads us to ergonomic evaluation of the cashew nut cracking device.

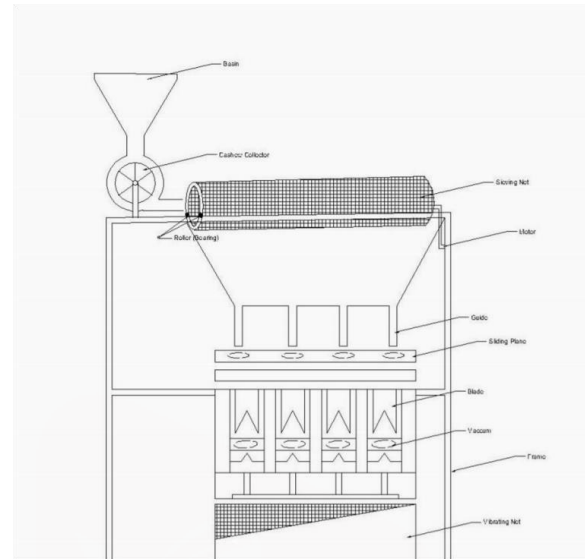
CONSTRUCTION AND WORKING

Cashew nut shelling machine was designed using impact method to improve shelling efficiency and whole kernel recovery for nuts roasted in hot oil. The pre-boiled cashew is dumped on the basin which is assembled on the top of the machine. The cashew is passed through a rotating leaf and this rotating leaf helps to collect cashew in a required quantity in a required speed. Then the cashew is passed through the filter or sieving component, this filter consist of holes having different measurement and it helps to categorize the size of the cashew and it is done by passing the cashew through the filter the holes of the filters are arranged in small to big in size.

Then cashews coming out from the filters are separated according to their size. After this separation, four pipes are provided to transfer the cashew of variable size and shape. A tray arrangement is provided for the proper fixing of cashews in the cutter as shown in the Fig.4.1.1 (d) (iii). The frame was made from mild steel equal angle iron. The parts of the machine are constructed using galvanized sheet metal of 1.5 mm thickness.

The cutting process is taken place by the action of a blade or cutter. The cutting blade consists of two types of motion mainly forward motion and shear action. The forward motion is applied here in order for the proper cutting of the cashews and the shear motion helps in the cutting of the top

most part of the cashews. After shear motion the cashew with the shell falls through the table where the blade is placed. This cashew with shell falls on a vibrating sieving machine which is placed underneath. The vibrating sieving machine consists of two types of operation mainly removal of cashews from the shell and the second operation is to separate the separated cashews and shells to the collector.



COMPONENTS

FRAME

This is made of mild steel material. The whole parts are mounted on this frame structure with the suitable arrangement. Frame is done with box-pipe and L-angles which has a length of 122cm, 31cm width and 107cm height.

BOX-PIPE

Frame is made out of Box-pipe for desired shape and size. This pipe is done by cutting and grinding. To make a hole drilling is also done, stand of height 107cm is made by box-pipe or square pipe. Guide hole according to cashew sizing is made by box pipe. Material for box pipe is mild steel.

DC MOTOR

An electric motor is a machine which converts electrical energy to mechanical energy. Its action is based on the principle that when a current-

carrying conductor is placed in a magnetic field, it experiences a magnetic force whose direction is given by Fleming's left hand rule.

Here, we have used 775 motor which delivers 16000rpm at 24v, 5amp for vacuum that holds the cashew for further operation. A 7000rpm motor is also used running sieving net which rotates at 5000rpm at 12v, 555 motor is used to drive a shaft for cashew collector which runs at 60rpm in 12v.

SHEET

Sheet metal is metal formed by an industrial process into thin, flat pieces. Sheet metal is one of the fundamental forms used in metal working, and it can be cut and bent into a variety of shapes. Most of our machine part is made by sheet metal like basin, cashew collector, sieving net, box pipe guides. This sheet metal is welded and drilled for our desired shape and sizing.

WOOD

Wood is designed for tangential sliding of cashew for proper positioning in the groove. This is placed after box guide ways that is in between main table and box guide ways. MDF material is used here because it is light weight and can be moved easily, this wood can be easily cut out of our desired shape.

NET

Sieving roller net, vibrating net are introduced in this machine. This net is made of steel and can be bended easily.

BEARING, BELT & PULLEY

Ball bearings are used widely in instruments and machines in order to minimize friction and power loss. This technology was brought to its present state of perfection only after a long period of research and development. The benefits of such specialized research can be obtained when it is possible to use a standardized bearing of the proper size and type.

CASHEW NUT COLLECTOR

Cashew nut collector is fixed on the support of a frame structure made of mild steel. This rotary

motion is driven by a 10rpm with 10kN/cm torque in which small amount of cashew is carried to the sieving part. A 6mm shaft diameter and a 15mm of shaft length drive the cashew collector in rotary motion.

SIEVING ROLLER NET

Sieving roller has a rotary movement which is driven belt pulley mechanism. This roller is attached with a 500rpm gear motor with a 10kN/cm torque which can be adjusted. Here the mechanism is rotary motion that is sieving roller is driven by a motor with specified belt and pulley so that we can reduce the speed of this roller and less wear to the motor gears. Sieving roller net which has a total length of 90cm is mounted on the main frame. According to the cashew grading and size difference this roller net has different sizing holes provided this net can support a load of 8-10kg of cashews. A bearing is provided onto the sieving roller net for smooth running and performance this bearing is slightly fitted on the frame.

GUIDE

At first we planned a v-shaped guide for our machine then due to technical problems and matter of sizing we have changed the plan to a box guide so that the cashew can fall easily in to the guide ways. This guide is made of box pip mild steel which is made out of desired shape and size. Here the mechanism is when the cashew falls on the path, the guide provided arrange the cashew properly so that cutting stage will be easier.

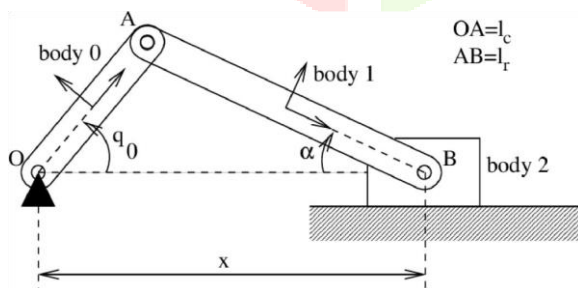
AXIAL SLIDING TABLE

Here the mechanism is axial sliding of a sliding table is done. This is for the action of cashew proper arrangement on the table. The table moves in an axial position, when the cashew is brought to the slider table with a gap made for the next coming cashew this table is adjusted and bring the cashew in the horizontal position. Then the lower table slides to fit the cashew in the position. This axial and sliding table is driven by a motor.

CUTTING BLADE

Here, the cutting blade is done with crank mechanism as shown in the fig. 6.2.5. A crank is an arm attached at right angles to a rotating shaft by which reciprocating motion is imparted to or received from the shaft. It is used to convert circular motion into reciprocating motion, or vice versa. The arm may be a bent portion of the shaft, or a separate arm or disk attached to it. Attached to the end of the crank by a pivot is a rod, usually called a connecting rod. The end of the rod attached to the crank moves in a circular motion, while the other end is usually constrained to move in a linear sliding motion. The term often refers to a human-powered crank which is used to manually turn an axle, as in a bicycle crank set or a brace and bit drill. In this case a person's arm or leg serves as the connecting rod, applying reciprocating force to the crank. There is usually a bar perpendicular to the other end of the arm, often with a freely rotatable handle or pedal attached. This can be driven with a motor so that cutting process will be easier at each blade's. Cutting blade made like a Y-shaped so that cutting process will be easier at a time. This cutting mechanism is driven by a 220v motor, this motor is also a gear motor which has a single action and crank mechanism is also used.

DESIGN CALCULATIONS



The shelling efficiency was evaluated by:

$$\text{Shelling efficiency} = \left(\frac{\text{Completely Shelled nuts}}{\text{Total feed}} \right) \times 100\%$$

The whole kernel recovery was evaluated by:

$$\text{Whole kernel recovery} = \left(\frac{\text{Whole Kernels Recovered}}{\text{Total Feed}} \right) \times 100\%$$

The throughout was evaluated by:

$$\text{Throughout (kg/h)} = (\text{mass} \times \text{selling rate} \times 1\text{h})$$

With shelling rate evaluated as:

$$\text{Shelling Rate} = \left(\frac{\text{Completely Shelled Nuts}}{\text{Shelling Times}} \right)$$

Results;

$$\text{Shelling Efficiency} = \left(\frac{49}{50} \right) \times 100\%$$

$$\text{Shelling efficiency} = 98\%$$

$$\text{Whole Kernels Recovery} = \left(\frac{35}{50} \right) \times 100\%$$

$$\text{Whole kernel recovery} = 70\%$$

$$\text{Throughout} = \left(\frac{48}{25} \right) \times 3600 \text{ nuts/hrs.}$$

$$\text{Throughout} = 6912 \text{ nuts/hrs.}$$

$$\text{Throughout} = 15.57 \text{ kg/hrs.}$$

ADVANTAGES

- Many cashew nuts can be cut at one single operation.
- The process can be simply operated without the requirement of skilled labours.
- It can be used up in large scale industries for the large cutting operation.
- Extracting the cashew nuts is done more easily as compared to other machine.
- The cashew nuts are arranged in a size arrangement pattern in order for making the cutting operation easier without any issues.
- The size arrangement of the machine helps to cut all types of cashew nut in precised manner.
- The cutter consists of 4 types of cutting blades at each cutting sections.
- Irregular shape of the cashew nuts can be separated.

- Fixed and movable box guide.
- Production rate increases as productivity increases.
- Increase in efficiency and reliability of processing.
- The shelling machine avoids health issues due to hazardous liquids during handling of process.

CONCLUSION

The conventional cashew nut process and shelling is more time consuming and with low rate of production. Hence all conventional processes must be mechanized. Shelling of roasted cashew nut is conventionally accomplished by cracking the nut by manual hand beating method to release the edible kernel. The irregular shape of the cashew nut and the brittleness of the kernel inside the hard shell make the shelling process complicated and results in breakage of kernels leading to reduction of market price and acceptability for export.

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