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Chironji (*Buchanania lanzan*) Decorticator

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Abstract

The chironji decortication machine address the inefficiencies of traditional processing methods, which are labour-intensive and yield low-quality kernels. This machine integrates several key components: a hopper for smooth seed feeding, a cylindrical housing with emery black stones for effective shelling, and a multi-screen grader for sorting kernels by size. Powered by a 1 hp electric motor and a precision belt drive system, the machine enhances kernel recovery, reduces seed damage, and minimizes labour costs. Its design not only increases processing efficiency but also improves the economic viability and sustainability of chironji production by increasing yield and reducing overall processing time.

Keywords: Chironji, decortication, traditional processing methods, kernels

Introduction

Chironji (*Buchanania lanzan*) is the most prevalent tree of dry deciduous forests. It is a native variety of Anacardiaceae family and is found in India. Central India and North west are home to trees native to arid regions. Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Jharkhand, Madhya Pradesh, Maharashtra, Odisha and Uttar Pradesh are the states where these trees are commonly found. It is a medium-sized tree with tomentose branches and have a straight, cylindrical trunk that reaches up to the height of 10 to 15 meters. Chironji fruit pulp can be used to prepare excellent juice. The kernel of chironji is very nutritious and contain high amount of protein (25.0%-30.0%.) and produces sweet oil, which can be used in place of almond and olive oil. The oil content in the kernel is about 33.50% in which 1.90% of oil is unsaponifiable. The part of the oil which is saponifiable contain 20.0% of linoleic acid. Chironji oil is healthy for the human intake and is neither toxic nor unpleasant (Banerjee and Jain, 1988). The total amount of lipid obtained from the chironji is 65.60% of the dry kernel and contain 90.40% of neutral lipids, 3.4% glycolipids, and 6.2% of phospholipids (Hemawathy and Prabhakar, 1988) (Malakar *et al*., 2022). The fruit is considerably less valuable to the collectors

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than the kernel and the collector generally grind the seed to extract the kernel, 5kg of fruit can yield nearly 1 kg of chironji. A single tree can yield 3-4kg of chironji. The presence of hard seed coat is one of the major challenges in the decortication of the nuts. The small size of the seed causes damage and spoilage during decortication process which lowers the seed's economic worth and reduces its shelf life and results in poor storage stability. Chironji decortication is a labour-intensive, and time-consuming process when it is done through traditional methods. Around 20% of the kernels is recovered from the whole and the remaining is either cracked or mashed. The processing method that was used is primitive which results in huge losses. These losses are not only in terms of financial loss but also in terms of nutritional loss. In addition to this, the processing cost rises because the method requires an extensive amount of work (Singh *et al*., 2016).

Fig:1 Indigenous technique of chironji decortications (Singh *et al*., 2016)

Design and development of machine

The machine consists of electric motor, emery black stone, gap adjustment screw, cylindrical housing, reciprocating grader, lower frame, starter, driving system, hopper, grader stand and sieves. Various components of machine were designed in accordance with standard operating methods and pre-fabricated parts such as bearings, bearing housing, belts, pulleys, etc were utilised as well in accordance with market availability (Singh *et al*., 2016).

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- **Hopper:** The square shaped hopper was constructed from 20-gauge mild steel sheet. The upper side (section A) measuring 380 mm by 380 mm and lower side (section B) measuring 110 mm by 110 mm that facilitated the chironji seeds to be easily feed into the decortication unit. The decortication unit had a total height of 500mm. The overall capacity of the hopper is about 15kg and have a discharging slope of 60˚ which allows the chironji seeds to fall freely from hopper to the shelling equipment (Singh *et al*., 2016).
- **Cylindrical Housing:** The decorticator consists of cylindrical housing which is made up of 18-gauge mild steel sheet. This cylindrical housing had a circular diameter of 530mm and a height of 210mm. The housing had a longitudinal rib and an emery black stone spin. The 50mm gap is maintained between the stone disc and cylindrical housing because this is when the seeds scatter after the impact. Subsequently, the seeds were pushed against the cylindrical housing wall and this caused the seeds to break down and rupture, leading to the overall kernels which detached from the cell (Singh *et al*., 2016).
- **Lower frame;** It is rectangular shaped with 630mm width and 910 mm in height. The frame had an angle of 50×5mm. The supportive base for the machine components, such as bearing, shaft, pulley, motor, and others were supported by 630 mm long angles measuring 35×5mm (Singh *et al*., 2016).
- **Grader:** The primary function of the grader is to separate the kernels from the hulls and it also categorise the kernels based on size. The dimensions of the sieve/grader were 1000×610mm. The kernels, either splitted or shelled, will go through the grader. The grader consists of four different screens that were operated by a shaft which provides the oscillating motion to the screens and the produce were shelled according to size of its aperture (Singh *et al*., 2016).
- **Emery Black Stone:** The black emery stone was brought from the local market. The black emery stone had a rough surface which enhances the friction between the disc surface and chironji surface. The centrifugal force is operating in the decortication unit. The ribs are designed into the inner side of the disc. It had a concentric cylindrical housing which contain an iron ribbed cylinder that was set on revolving shaft and the shaft is supported by a ball bearing. The inner ribbed cylinder is composed of helical

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ribs up to the 1/4th of its length and the remaining part of the cylinder consist of 4 to 6 straight ribs. The cylindrical disc with ribs is rotating at a speed of 240rpm (Singh *et al*., 2016).

- **Electric Motor:** The electric motor was utilised to transfer power or rotational motion to the shelling disc through its projection shaft. The electric motor has a single phase 1hp power rating or 1440rpm (Singh *et al*., 2016).
- **Bearing housing:** In order to provide the stability and to minimize the vibration of the rotating shaft, a ball bearing housing and hanger is incorporated. Bearing prevents the rotating shelling disc from colliding with the stationary wall of the shelling drum which in turn decrease the quality of the crashed chironji seeds (Singh *et al*., 2016).
- **Shaft:** The chironji decorticator consist of three shafts of different sizes. The main shaft that receives the power from the electric motor through the v belt and the power is transmitted to the other two shaft using a flat belt and v belt respectively. This main shaft is supported by the ball bearing which prevents the shaft from a mechanical rear (Singh *et al*., 2016).
- **Pulley:** The velocity ratio between the two pulleys in a belt drive can be calculated by diving the follower by the driver (Singh *et al*., 2016).

$$\text{Velocity ratio} = \frac{\text{diameter of follower}}{\text{diameter of driver}} = \frac{D_2}{D_1} = \frac{N_2}{N_1}$$

where,

D_1 = diameter of the driver;

D_2 = diameter of the follower;

N_1 = rpm of the driver; and

N_2 = rpm of the follower.

Belt Drive:

The belt drive helps in transmitting the power between two parallel shafts that either rotate in the same direction or in the opposite direction. The friction provides the power transmission between two parallel shaft. The system of power transmission 1hp single phase electric motor (1440 rated rpm) is provided. The motor shaft is held with the step pulleys of 50.8, 63.5 and 76.2. The vertical shaft of the machine is fixed at the rear side. The machine contains different sizes of the pulleys (101.6, 127 and 88.9 mm respectively) (Singh *et al*., 2016).

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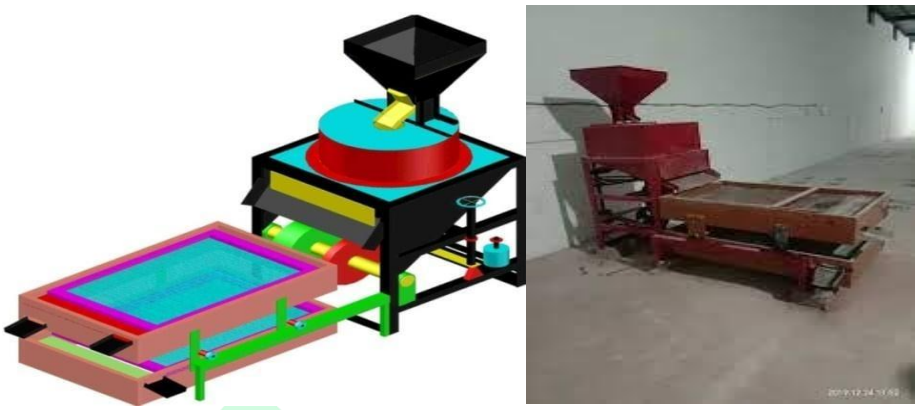

Fig: 2 Isometric view and fabrication of chironji decorticator machine (Singh *et al.*, 2016)

Conclusion

The newly designed chironji decortication machine significantly improves processing efficiency and economic value. It effectively addresses traditional method shortcomings by enhancing kernel recovery rates, reducing seed damage, and lowering labour costs. Key features include an engineered hopper, cylindrical housing with emery black stones, and a multi-screen grader that separate kernels from hulls efficiently. The 1 hp electric motor and precise power transmission system ensure smooth operation. Overall, the machine increases yield, reduces processing time, and makes chironji production more profitable and sustainable.

References

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