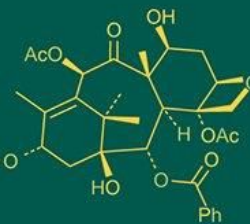
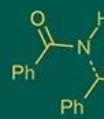
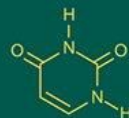
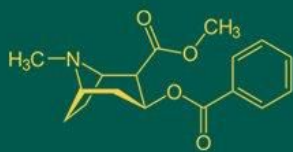


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Design and development of *Chironji* (*Buchanania lanzan*) decorticator

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Abstract

The presence of hard seed coat of *chironji* is one of the shelling problems in decortications of nuts, its small size let's to damage the seed at the time of decortications and spoil the seeds which reduce its economical value and also deteriorate the shelf life of it which leads to low storage stability. Traditional processing method *chironji* is very cumbersome, time consuming and labour extensive. There is very less recovery of whole kernel nearly 20% only rest is either broken or mashed. Reduces broken losses and improve its recovery and economical value to needs design of *chironji* decorticator.

The drawings were prepared already using the CAD software. The selection of materials and fabrication was done following the standard manufacturing processes. The shelling chamber consists of the cylindrical housing, and the shelling disc. Above to the chamber a hopper was provided at appropriate height to make constant feeding with a control baffle. The cylindrical housing was made from mild steel. The shelling disc was made from a pair of emery black stone which rotate at 240 rpm. The upper disc was fixed and the lower one is revolving clockwise direction. An adjustable screw was provided for adjustment of clearance between the discs. The disc was operated by a single phase electric motor having 1440 rpm. They are arranged inside the cylindrical housing. The shelling chamber incorporates an opening at the bottom part which serves as an outlet for the shelled *chironji* seeds. A reciprocating shaker was provided in the lower front side of the machine to grade the *chironji* kernels, shells and mealy dust particles.

Keywords: *Chironji* (*Buchanania lanzan*), Decorticator, Traditional method, and Indigenous technology for *char* processing

1. Introduction

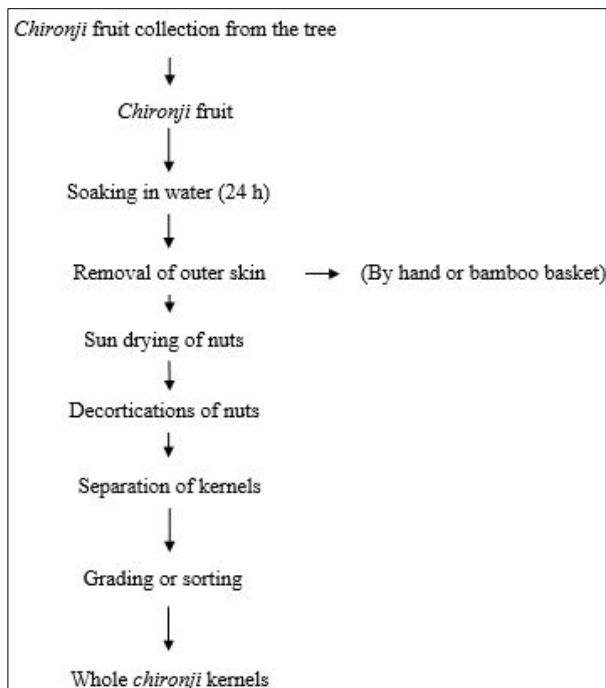
Chironji (*Buchanania lanzan*), belongs to family Anacardiaceae. It is a medium sized tree, with straight, cylindrical trunk, up to 10-15 m height and tomentose branches. This multipurpose tree provides food, fuel, fodder, timber and medicine to the local community. (Dwivedi *et al.*, 2012) [1]. The *chironji* seed is small sized slightly flattened and has an almond-like flavor and highly nutritious. There is a problem in the storage due to high oil content and an association of fungi with seeds (Sharma, 1998) [3].

Traditional processing and some properties of *chironji* nut (*Buchanania lanzan*) and kernels. Seed is collected and kernel is extracted either manually at home or in the large quantity taken to the local market for mechanical extraction of kernel by breaking the nut using manually. To remove the skin the fruit is soaked in water for 10-12 hours and rubbed to remove the outer skin. To get clean nuts it is further washed with clean water and dried. The dried nuts are shelled by rubbing with a stone-slab on a rough surface for breaking of nuts and manually separate the seeds after decortications of nuts (Kumar *et al.* 2007) [2].



Indigenous techniques of *chironji* decortications

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Flow chart of indigenous technique for *char* processing

Hand operated disk huller similar to the burr plates are also use. These disks were made of either stone or backed clay or sun dried clay. The bottom disk is generally fixed on the ground and the top one is rotated by hand.

A steel or wooden axle projecting from the centre of the bottom disk serves as a guide for the top disc. The efficiency was low and it causes more broken and powder (Kumar J, Srivastave PP and Bhowmick PK *et al.*, 2007) ^[2]. The *chironji* seed was fed through the top disk.

2. Materials and Methods

The study was conducted in Swami Vivekananda College of Agricultural Engineering and Technology and Research Station, Faculty of Agricultural Engineering, IGKV, Raipur (CG) situated at 21° 14' 02" N latitude and 81° 43' 11" E longitude. The operational field meant for the study was selected from the demonstration / research field of the faculty.

The raw material *chironji* was collected from different region of the Chhattisgarh for the present investigation. The material was properly cleaned and drying after remove of

outer skins or pulps from the *chironji* seeds to have a uniform sample. They were further cleaned manually to remove foreign matters and other impurities like stones.

Machine design consideration

While working on the procedure, the designer must be careful to consider every important factor which should rightfully influence his design. In general, the most important things to be considered can be listed as follows:

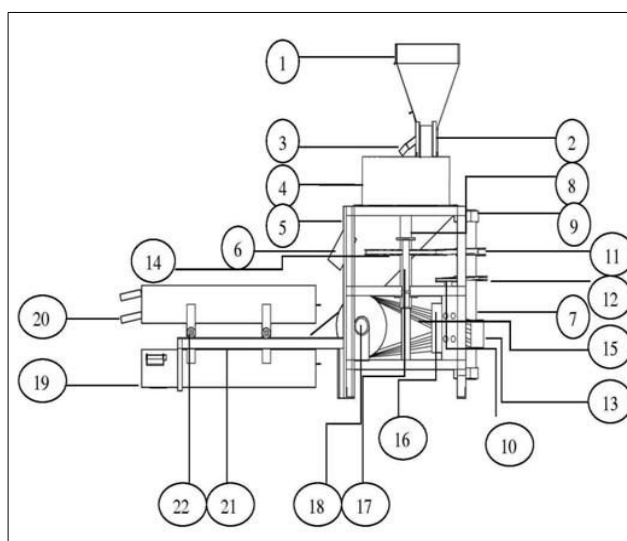
- The machine should work properly to achieve desired *chironji* kernel quality
- The cost of the machine should be as low as possible
- Proper lubrication should provided in moving parts
- The machine should be manufacture and assemble easily
- Sufficient strength and rigidity should be provided to the parts of the machine
- Sources of power available should be as low as possible and single phase motor so that it can be used as household machine.
- The machine should be ease to operate.
- Sufficient safety precautions should be provided in the machine.

Details of *Chironji* Decorticator Machine Components

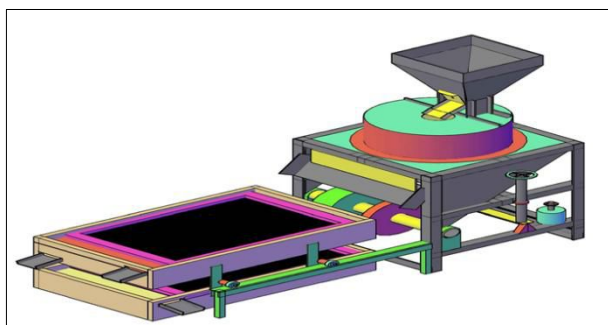
The *Chironji* decorticator machine consisted of various components such as hopper, decorticating unit, grader/sieve, outlets and power transmission system and the descriptions of each component are illustrated.

Hopper: The hopper with rectangular top and trapezoidal bottom type was considered suitable for feeding due to its inherent advantages. The feed hopper was made of mild steel sheet. Its upper dimension is 380 mm × 380 mm and lower dimension is 110 mm × 110 mm, respectively, and mounted on the cylinder housing to feed *Chironji* nuts into decorticating unit in order to have advantage of gravity force for free flow of the material from the hopper to the decorticating unit.

Flow rate control device: A nut flow rate control device is located between the hopper and the cracking unit. By this means, the quantity of walnut entering into the cracking unit per unit time can be regulated and varying feed rates achieved.



S.N.	Descriptions
01	Hopper
02	Hopper stand
03	Seed feeder
04	Casing
05	Main frame
06	Chute
07	Driver Shaft
08	Driven Shaft
09	Bearing block
10	Pulley no.1
11	Pulley no. 2
12	Pulley no. 3
13	Patta Pulley no.4
14	Pulley no.5
15	Belt
16	Electric motor
17	Adjustable screw
18	Crank shaft
19	Discharge plate
20	Sieve/ grader
21	Grader stand
22	Bearing(small)



3-D model view of design and developed of *char* decorticator machine

Decorticating unit

The decorticating unit consists of two main parts viz., cylinder housing and shelling disc. The cylinder housing is made of mild steel sheet which is circular shape. The shelling discs consist of an iron ribbed cylinder mounted on rotating shaft on ball bearing and fitted in concentric cylinder housing. The inner ribbed cylinder has helical ribs up to one-fourth of its length and four to six number of straight ribs for rest of the length. The gap between the ribbed cylinder discs is variable and this is enough to crack the *Chironji* nut.

Main frame

The frame which is the rectangular in shape it is made of mild steel with the height of the frame is 910 mm and width is 620 mm. The main frame are used for supporting base for

the machine components i.e. shaft, bearing, motor and pulley etc. and their length is 630 mm.

Clearance adjustable screw

The adjustable screw is used for adjustment of gap between two discs surfaces. This is applicable for applied pressure/load on the seeds for shearing action when the decortication process. The length of adjustable screw shaft is 440 mm. The circular valve is used to adjustment of screw either tightened or loose. The valve diameter is 120 mm.

Separator/Grader

The main purpose of grader is separates the kernels from shells and to separate the kernels of different sizes. The shelled or splitted kernels pass through grader. It is having 4 screens of various sizes and screens are moving by oscillating motion driven by shaft. Here shelled produced as per its opening size. The grader is made of mild steel and the dimension of 890 mm x 560 mm for each screen.

The power transmission system

This consists of an electric motor of 1hp with its pulley and the shelling cylinder shaft pulley as well as the grader pulley. The motor, the shelling cylinder shaft and grader are connected by v-belts. The electric motor is used to transmit power or rotational motion to the shelling disc through its protruding shaft with the aid of a key that fastened them together. The power rating of the electric motor is 1440 rpm.

Principle of Operation of the Machine

The *Chironji* decorticator machine works on the principle of energy absorbed beyond the elastic limit of the *Chironji* seeds as a result of impact force experienced during collision between the seeds and the stationary wall which result in the cracking and removal of the seeds shells. The un-decorticated *Chironji* nuts are fed into the hopper which opened directly into the decorticating unit. Preliminary studies were carried out for setting up discharge gap of the hopper depending upon the speed of cylinder such that it should be able to carry the material under the free flow to the decorticating unit uniformly with-out choking it. The space between the two abrasive cylinder plates is adjusted with the external screw. After decorticating, the oily kernels, escaped whole nuts, hard nuts without kernels and other by products of the cracking operation would pass through the discharge chute into a grader/sieve. The main purpose of grader is separates the kernels from shells and to separates the kernels of different sizes.

3. Results and Discussion

The *chironji* decorticator was fabricated and tested by decortications of *chironji* seeds. The machine comprises of hopper, cylindrical housing, black emery stones, lower frame, electric motor, driving systems, sieves, reciprocating grader, gap adjustment screw, starter, grader stand etc.

The *chironji* shelling machine works on the principle of energy absorbed beyond the elastic limit of the *chironji* seeds as a result of impact force experienced during collision between the seeds and the stationery wall which results in the cracking and removal of the seeds shells. Unshelled *chironji* seeds are fed into the machine through the hopper which opened directly into the shelling unit. The shelling ribs are provided inner surface of the shelling disc in order to increase the speed and rate of collision of the

unshelled seeds with the rough body of the shelling unit, thereby leading to the breakage and subsequent removal of the *chironji* shells from the kernels. The unshelled seeds and the peeled shells are blown out of the shelling ribs through the conveyor chute under gravity and thus separate the cotyledon from the unshelled seeds and peeled shells. The shelling disc connected to a shaft powered by an electric motor of one horse power (1hp) which rotates at 1440 rpm. A ball bearing housing and hanger was designed to stabilize the rotary shaft and reduce vibration, thereby preventing collision of the rotating shelling disc with the stationery wall of the shelling drum and in turn reduce the amount of crushed *chironji* seeds as compare to traditional method of *chironji* decorticator.

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