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Development of power operated medicinal nut sheller

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■ **ABSTRACT :** Medicinal nuts like hirada and ritha have many medicinal properties and used for many pharmaceutical operations. Presently shelling of hirada (*Terminalia chebula)* and ritha (*Sapindus mukorossi*) nuts is done manually, which is labour intensive, slow and tedious operation. Therefore, a power operated medicinal nut sheller was developed on the basis of shear principle. The capacity of the machine has been observed to be 114 kg-h^{-1} and 170 kg-h^{-1} for hirada and ritha nuts, respectively. Shelling efficiency of nuts was 83 per cent and 80.66 per cent for hirada and ritha, respectively. Per cent broken seeds were observed as 28.9 per cent and 7.9 per cent for hirada and ritha, respectively.

■ **KEY WORDS :** Hirada, *Terminalia chebula*, Ritha, *Sapindus mukorossi*, Nut sheller, Shelling efficiency, Shear

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In India 45,000 plant species have been identified and out of which 15 to 20 thousand plants are of good medicinal value. According to World Health Organization (WHO) estimates, more than 80 per cent of the people in developing countries depend on the traditional medicine for their primary health needs. It is estimated that over 6000 traditional plants in India are in use as folk and herbal medicine, representing about 75 per cent of the medicinal needs of the Third World countries (Saraswathi *et al*., 2012).

Terminalia chebula (Hirada) is a popular traditional medicine due to the wide spectrum of pharmacological activities associated with the biologically active chemicals present in this plant. It has been reported as antioxidant, antidiabetic, antibacterial, antiviral, antifungal, anticancerous, antiulcer, antimutagenic, wound healing activities etc. (Suryaprakash *et al*., 2012). *T. chebula* is called as "The king of medicines" in the Tibet because of its astonishing power of healing with a wide range of biological and pharmacological uses (Chattopadhyay and Bhattacharyya, 2007). On long term use, it is very helpful in balancing weight of the person. It is given as adjuvant herb in chronic fever. It reduces the ill effects of fat rich, creamy and oil food (Thomas *et al*., 2000).

Sapindus mukorossi are used in Ayurvedic medicine to remove tan and freckles from the skin. It cleanses the skin of oily secretion and even used as a cleanser for washing hair as it forms a rich, natural lather. Also it is widely used as a detergent for the shawls and silks from ancient times (Choudhary, 2012). Fruits are of considerable importance for their medical value for treating a number of diseases like excessive salivation, pimples, epilepsy, eczema and psoriasis. The powdered seeds are employed in the treatment of dental caries, arthritis, common colds, constipation and nausea (Sabu and Kuttan, 2009).

The medicinal nuts like hirada and ritha have many medicinal properties and are used for various pharmaceutical applications. Outer shells of nuts of these two medicinal plants are used for preparing various pharmaceutical products and the seeds removed from these nuts are used for raising nursery. Hence, it is necessary to crush the nuts without damaging the seeds. The traditional cracking of hirada and ritha is done manually by using hammer or stone. It is labour-intensive, slow and tedious operation. So to reduce the drudgery and to save the time, a medicinal nut shelling machine is developed. The various properties of hirada and ritha were considered while designing the machine.

METHODOLOGY

Some of the physical properties of hirada and ritha nuts and seeds were determined. The three principle dimensions of 100 randomly selected nuts and seeds of each hirada and ritha nuts were measured with Vernier caliper having least count of 0.01 mm. The weight of the nuts and seeds were measured with electronic weighing balance of range 0 to 300 g. breaking force of nuts and seeds were measured on universal testing machine (UTM). Moisture content of the nuts was calculated by using air oven method (Table A). The per cent moisture content (w. b.) was determined as:

$$\text{Per cent moisture content} = \frac{W_1 - W_2}{W_1} \times 100$$

where,

W_1 = weight of the wet sample, g

W_2 = weight of the dry sample, g

Table A : Physical properties of hirada and ritha

Sr. No.	Properties / Type of fruit	Hirada	Ritha
	Nuts		
1.	Length, mm	30.83	20.25
2.	Width/diameter, mm	16.98	18.98
3.	Breadth, mm	16.82	18.28
4.	Breaking force, N	245.00	202.00
5.	Thickness of shell, mm	6.40	5.30
	Seeds		
1.	Length, mm	22.23	10.22
2.	Width/diameter, mm	10.35	10.04
3.	Breadth, mm	10.15	9.84
4.	Breaking force, N	252.00	238.00
	Weight of a nut, g	4.87	2.64
	Moisture content of nut, %	8.67	8.00
	Shell ratio	1.89	2.85

Development of power operated medicinal nut sheller:

A power operated medicinal nut sheller was designed and developed (Fig. A and B) on the principle of shear and on the basis of above mentioned physical properties. It consists of five functional components:

- Main frame,
- Feeding unit,
- Shelling unit,

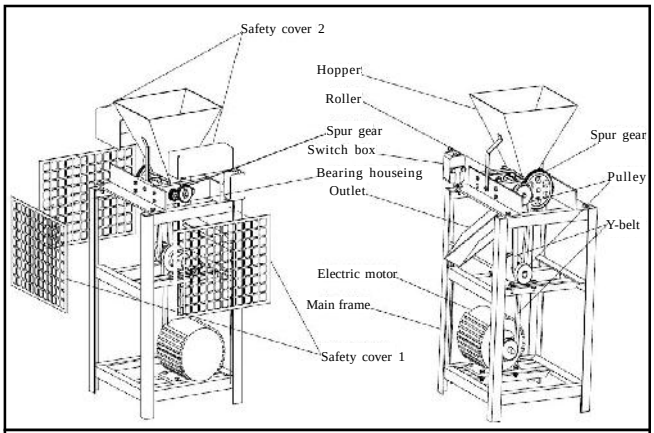
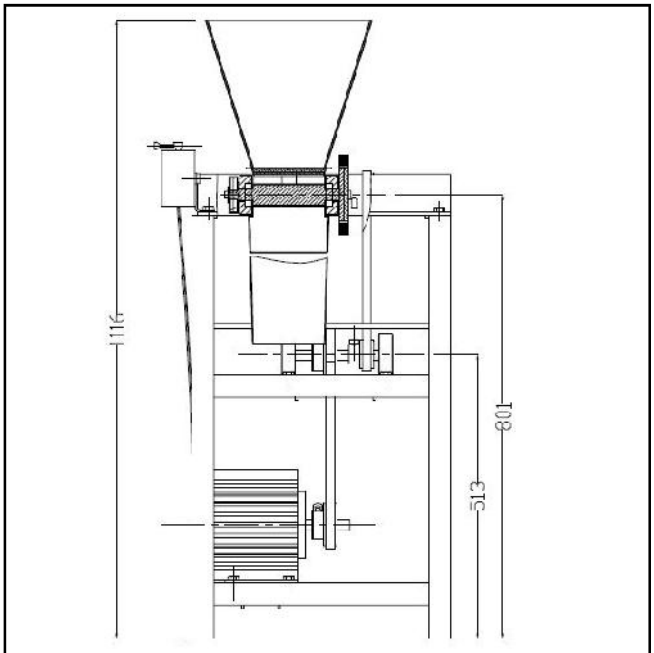


Fig. A : Isometric view of power operated medicinal nut sheller



(all dimensions are in mm, NTS)

Fig. B : Cut section of the power operated medicinal nut sheller

– Power transmission unit
– Discharging unit.

Main frame :

It was made of M.S. angle of size 40 × 40 × 5 mm. A circular rod of 10 mm diameter and 457.2 mm length had been welded at the height of 564 mm from ground level as a support for outlet. At the top of stand angle of size 75 × 75 × 7 mm was used to hold the shelling unit, attached with main frame with nut and bolt joint.

Feeding unit :

This unit consisted of hopper, which was made up of mild steel (17 gauge). Principle of positive feeding (gravity flow) was used. The capacity of the hopper is of 7.0 kg.

Shelling unit :

Shelling unit consisted of two rollers of 42 mm diameter. Length of these rollers were 146 mm and 172 mm. Rollers were made of white drawn bar. On these rollers there were six grooves of size 90 x 10 x 3 mm. Shelling of medicinal nuts was done between these two slotted rollers. Both the rollers were rotated in counter clock direction of each other with speed ratio of 2:1. Shelling of nuts occurred due to shear force due to differential speed of the rollers. The rollers were driven by meshing gears.

Power transmission unit :

A 0.75 KW AC motor (1441 rpm) was used to supply the power for operation. A belt and pulley arrangement was used to transmit power from motor to the shaft. Four pulleys of standard sizes, 2", 3" and 4" were used for speed reduction. Two belts of standard size 30B and 35B were used for power transmission to the shaft of shelling unit.

Discharging unit :

At the bottom of the shelling unit, mild steel (17 gauge) discharging unit of 380 mm length and 66 mm depth was attached. The inclination of 30^0 was provided to the outlet for smooth discharge.

■ RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under the following heads :

Operation of the power operated medicinal nut sheller :

The medicinal nuts were put in the feeding hopper manually. The rollers were rotated by the belt drive in counter direction; the nuts pass automatically into two rotating rollers by gravity force. Nuts were crushed due to roller rotates in counter direction. Grooves on rollers helped to hold the nuts till they were crushed. After crushing the crushed nuts along with the seeds were collected in the tray and then seeds were separated manually.

Fig. 1 : Power operated medicinal nut sheller

Performance of the sheller :

The performance of developed power operated medicinal nut sheller was conducted to obtain capacity of machine, per cent shelling nuts and per cent broken seeds (Fig. 1).

Capacity of machine :

The capacity of machine was calculated by considering weight of nuts fed into the machine per unit time. The capacity of machine varied from 90 to 130 kg-h^{-1} for hirada and 160 to 185 kg-h^{-1} for ritha. The average capacity of machine was found to be 114

kg-h^{-1} for hirada and 170 kg-h^{-1} for ritha.

Per cent shelled nuts :

The per cent nut shelled varied from 80.00 to 84.89 per cent for hirada and 78.6 to 82.0 per cent for ritha. The average percentage of shelled nuts was 83.00 per cent for hirada and 80.66 per cent for ritha.

Per cent broken seeds :

The average percentage of broken seeds was found to be 28.9 per cent for hirada and 7.9 per cent for ritha. As size of medicinal nuts was increased, per cent broken seeds were increased. Speed of roller has affected the percentage of broken seed. Percentage of broken seeds of ritha is less than hirada seeds.

Conclusion :

- The principle of shear works satisfactorily for shelling medicinal nuts like hirada and ritha.
- Capacity of machine was observed 114 kg-h^{-1} and 170 kg-h^{-1} for hirada and ritha, respectively.
- Per cent shelling of nuts was observed to be 83 per cent and 80.66 per cent for hirada and ritha, respectively.
- Per cent broken seed was observed to be 28.9 per cent and 7.9 per cent for hirada and ritha, respectively.

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