

Original Research Article

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Performance Evaluation of Power Operated Medicinal Nut Sheller for Ritha Nuts (*Sapindus mukorossi*)

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ABSTRACT

The shelling of medicinal nuts to obtain clean seed as well as outer shell for further processing is one of the most tedious operations. Presently shelling of medicinal nuts like Ritha, Hirada, Behada etc. is done manually by using hammer or stone, also some research has been done on handle operated shelling machines. Performance evaluation of the power operated medicinal nut sheller was conducted for Ritha nuts (*Sapindus mukorossi*) to obtain the capacity of machine, percentage of shelling of nuts and percentage of broken seeds. Results of the performance evaluation results for ritha nuts showed that the moisture content has a significant effect on each parameter and percentage of broken seeds at 5 per cent level of significance. The shelling capacity of developed machine for ritha nuts was observed to decrease as moisture content of nuts increased, and the average capacities were found to be 200.93, 174.15 and 143.24 kg^h⁻¹ at 6.4, 8.67 and 11.23 % content (w.b) respectively. The shelling efficiency was found to decrease as the moisture content of nuts increased and the average shelling efficiencies were found to be 86.25, 81.75 and 78.47 per cent at 6.4, 8.67 and 11.23 % moisture content (w.b) respectively. The quantity of damaged seed was observed to decrease as the moisture content of nuts increased and the average of damaged seeds were 14.32, 6.69 and 5.76 per cent at 6.4, 8.67 and 11.23 % moisture content (w.b) respectively.

Keywords

Ritha, *Sapindus mukorossi*, Nut sheller, Shelling efficiency, Shear

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Introduction

Sapindus mukorossi, is one of the oldest cultivated medicinal plants in the world. In fact Botanist traced it to the period of the Vedas about 5000 years ago. It is a medium sized deciduous tree growing wild in South India. *Sapindus mukorossi* belongs to the family Sapindaceae, rich in saponins. *Sapindus* grows at warm temperate and tropical regions (Rao *et al.*, 2012). *Sapindus mukorossi* is used in Ayurvedic medicines to

remove tan and freckles from the skin. It cleanses the skin of oily secretion and is 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 since ancient times (Choudhary *et al.*, 2012). Ritha has been put to use in cosmetics, detergents and several other products. However, modern scientific medical research has investigated the use of soapnuts in treating migraines. It is traditionally used for removing lice from the scalp. Fruits are of considerable importance

for their medical value which can treat many 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 et al.*, 2009).

Shelling of these medicinal nuts is a very difficult job. Presently shelling of medicinal nuts like ritha, hirads etc. is done manually by using hammer, wooden mallets, brick or stone. This process is time consuming and labour intensive. Also these conventional methods result in serious injury to human fingers coupled with low output (Nkakini, 2007).

Also some research is being done on handle operated shelling machines. Thus to avoid such injuries, make the process cheap and effective and also to reduce the time consumption a power operated medicinal nut sheller was developed at Department Of Farm Machinery and Power Engineering, Dr. Annasaheb Shinde College of Agricultural Engineering, Rahuri (Maharashtra, India).

Materials and Methods

Power operated medicinal nut sheller

On the basis of engineering properties of the ritha nuts (size, shape, thickness of shell, shell ratio and force required to break) as well as using the principle of shear, a power operated medicinal nut Sheller was designed and developed (Fig. 1).

The machine consists of five functional components i. e. main frame, feeding unit, shelling unit, power transmission unit and discharging unit. Shelling unit is the heart of the machine. Shelling unit consists of two rollers made up of white drawn bar. On these rollers, there are six grooves. The rollers are driven by meshing gears. These two gears rotate the rollers in counter direction.

Operation of the power operated medicinal nut sheller

The medicinal nuts are put in the feeding hopper manually. The rollers are then rotated by the belt drive in counter direction; the nuts pass automatically into two rotating rollers by gravity force. Nuts are crushed due to roller rotates in counter direction. Grooves on rollers help to hold the nuts till they are crushed.

After crushing the crushed nuts along with the seeds are collected in the tray and then the seeds are separated manually.

Performance of the sheller

The performance of developed power operated medicinal nut sheller was conducted for three different moisture contents to obtain the capacity, shelling efficiency and damaged seeds.

Capacity of machine

Capacity of machine was calculated by using following formula

$$\text{Capacity of machine} = \frac{\text{Wt of nuts fed,kg}}{\text{Time required for shelling,h}} \quad (1)$$

Shelling efficiency

The percent shelled nuts was calculated by using following formula

$$\text{Percent shelled nuts} = \frac{\text{Qty of shelled nuts obtained from outlet,kg}}{\text{Total output,kg}} \times 100 \quad (2)$$

Damaged seeds

The percent broken seed was calculated by using following formula

$$\text{Percent broken seed} = \frac{\text{Qty of broken seeds obtained from outlet,kg}}{\text{Total seed obtained from outlet,kg}} \times 100 \quad (3)$$

Results and Discussion

The performance of power operated medicinal nut sheller was conducted at Workshop Technology Laboratory, Dr. A. S. College of Agriculture Engineering, MPKV, Rahuri. The tests were analyzed to determine the capacity of machine, shelling percentage of nuts and broken percentage of seeds. The results of tests are given in Table 1.

All data are average of 3 replications

Effect of moisture content on shelling efficiency

The result for the performance tests analysis shows that the moisture content of ritha nuts significantly affected the shelling efficiency at 5 per cent level of significance. The effect of moisture content on shelling efficiency is shown in the figure 6. From the figure, it can be seen that the shelling efficiency decreased with increase in moisture content. The maximum shelling efficiency of 86.25 per cent was observed at 6.4 per cent moisture content (w. b.).

Almost similar results were found in the study by Sharma *et al.*, (2013) for Tung fruits in which they recorded 52.24% recovery of whole seeds and machine efficiency of 74.63% were recorded at fruit moisture content of 8.65% (d.b.).

Omoruyi and Ugwu (2013) have reported that cracking efficiency of palm nuts was highest at 9% (db) moisture content and lowest at 13% (db) moisture content. A similar decreasing trend in decortications efficiency in jatropha fruit was recorded by Pradhan *et al.*, 2010.

The low shelling efficiency at high moisture content must be because wet fruits become more elastic than dry fruits and hence are not easily decorticated.

Effect of moisture content on damaged seeds

The result for the performance tests analysis shows that the moisture content of ritha nuts significantly affected the quantity of damaged seeds at 5 per cent level of significance (Fig. 5). The effect of moisture content on quantity of damaged seed is shown in the figure 7. From the figure, it can be seen that the quantity of damaged seed decreased with increase in moisture content. The minimum seed damage of 5.76 per cent was observed at 11.23 per cent moisture content (w. b.). This may be because fruit become more brittle and susceptible to mechanical damage at low moisture content (Oluwel *et al.*, 2007).

Similar trend was seen in the study by Omoruyi and Ugwu (2013) where in the mechanical damage was highest as well as recovery rate was lowest at 13% (db) moisture content. Pradhan *et al.*, (2010) reported that percentage of broken seed decreased from 4.77% to 2.87% with increase in moisture content from 7.97 to 15.65% (d.b.). Similar increasing trend in percentage of partially shelled fruit and unshelled fruit has been reported for okra seed and bambara groundnut (Oluwel *et al.*, 2007 and Khushwaha *et al.*, 2005).

Effect of moisture content on capacity of machine

The result for the performance tests analysis shows that the moisture content of ritha nuts significantly affected the capacity of the machine at 5 per cent level of significance. The effect of moisture content on Capacity of machine is shown in the figure 6. From the figure, it can be seen that the Capacity of machine decreased with increase in moisture content. The maximum capacity of 200.93 kg h^{-1} was observed at 6.4 per cent moisture content (w. b.).

Fig.1 Power operated medicinal nut sheller

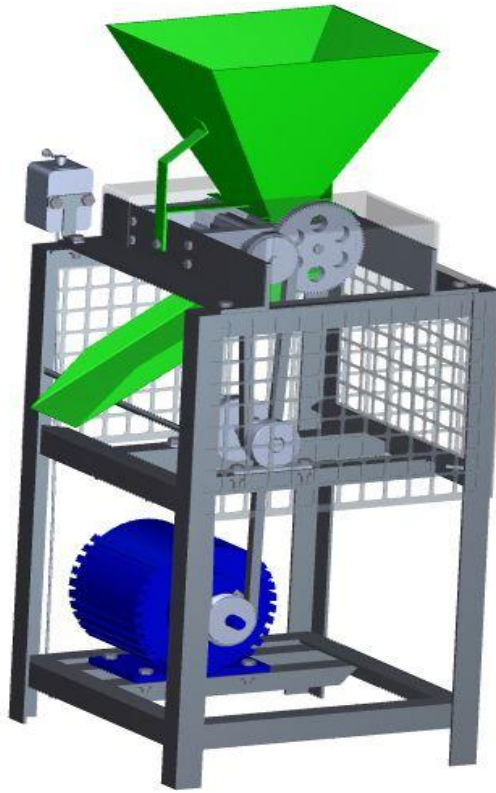


Fig.2 Ritha Nuts

Fig.3 Shelled Ritha



Fig.4 Shelled Ritha seeds

Fig.5 Damaged Ritha seeds



Fig.6 Effect of moisture content on shelling efficiency of Ritha Nuts

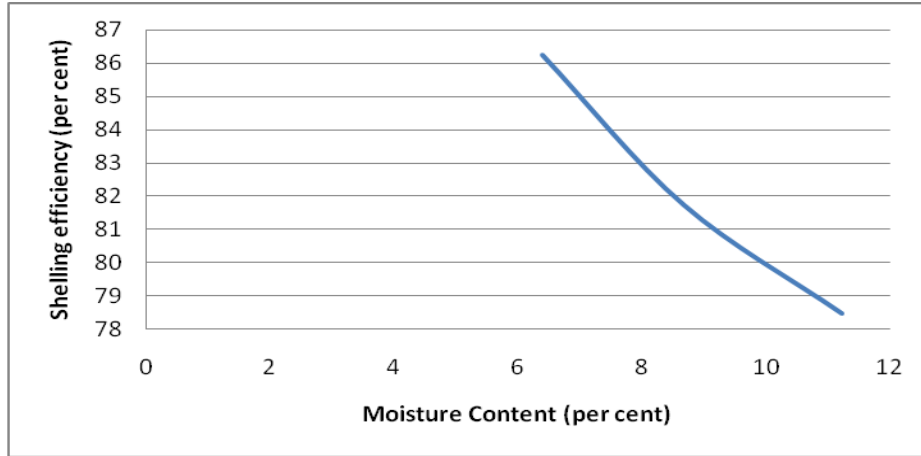


Fig.7 Effect of moisture content on damaged seeds

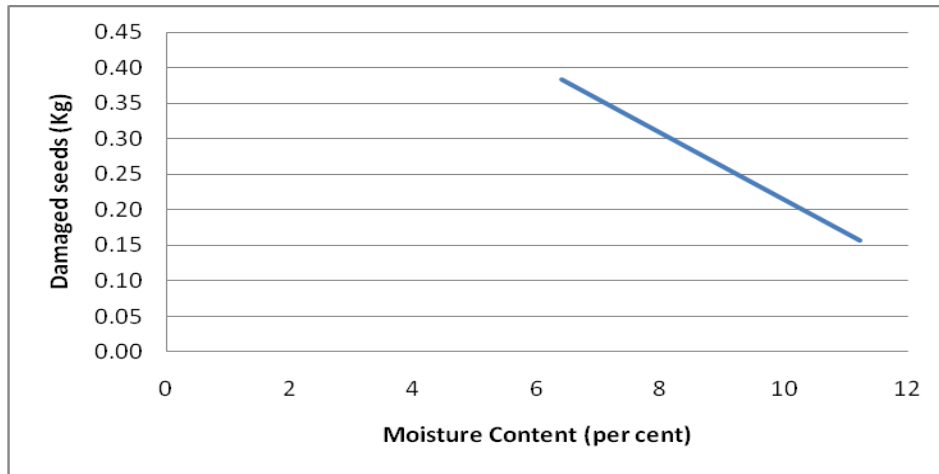


Fig.8 Effect of moisture content on capacity of machine

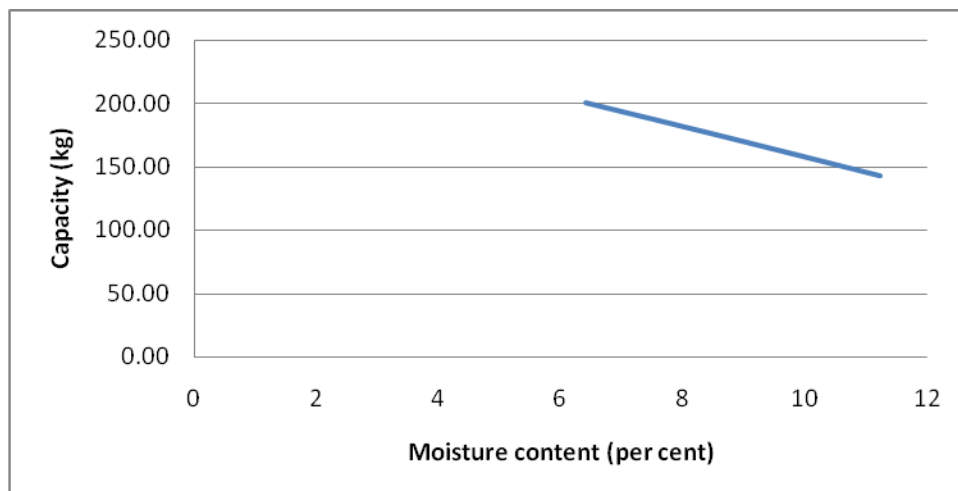


Table.1 Observations of power operated medicinal nut sheller for Ritha

Particulars	Moisture content (per cent)		
	6.40	8.67	11.23
Total weight of nuts fed, kg	12.60	14.56	14.33
Total weight at outlet, kg	12.35	14.51	13.47
Shelled nuts, kg	7.60	7.69	7.70
Whole seed, kg	2.67	3.89	2.70
Damaged seed, kg	0.38	0.27	0.16
Unshelled nuts, kg	1.71	2.64	2.91
Output, per cent	98.00	99.63	93.96
Shelling efficiency, per cent	86.25	81.75	78.47
Damaged seeds, per cent	14.32	6.69	5.76
Capacity of machine, kgh ⁻¹	200.93	174.15	143.24

In study of cracking palm nut by Omoruyi and Ugwu (2013) percentage losses of the machine was highest using moisture content of 13% (db). Pradhan *et al.*, (2010) have stated in their study that the best set of conditions under which the decorticator can be operated is at fruit moisture content of 7.97% d.b. at which maximum whole seeds of 67.94% can be achieved and machine efficiency of 90.96% can be obtained. In the same study they found that with increase in moisture content, efficiency of machine decrease because highest efficiency of 90.96% was found at 7.97% (d.b) while lowest of 73.25% at 15.65% (d.b.) moisture content. At par with our study was found the study by Adewumi and Fatusin (2006) where efficiency of machine was 85-100% for cocoa pod using an impact-type hand-operated cocoa pod breaker.

The efficiency of the machine decrease because at high moisture content, the seed coats or shells were stick resulting in a high force of friction to separate the shell from seeds. But at lower moisture content and at a optimum concave clearance, the fruits were less sticky and get required force to split and therefore were able to separate much more easily.

Performance evaluation of power operated medicinal nut sheller for ritha nuts was done to see the effect of moisture content on several performance parameters. The results showed that moisture content had a significant effect on shelling efficiency, damaged seed and the capacity of machine. The nut sheller works more efficiently as the moisture content of the fruit decreases. The shelling efficiency of the machine decreases with increase in fruit moisture content, while percentages of damaged seed decreased with increase in moisture content. The best moisture content for ritha nut shelling was found at moisture content of 6.4% (w.b.). It is a power operated machine thus enables timely operations and more production per unit time enhancing the business ritha nut for farmers. Due to the commercial demand of ritha nut farmers can be benefited by the use of this sheller and it can also be used for several other fruits and nuts

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