RESEARCH PAPER | International Journal of Agricultural Engineering | Volume 11 | Issue 2 | October, 2018 | 289-293
ISSN–0974–2662 ■ Visit us : *www.researchjournal.co.in* ■ **DOI: 10.15740/HAS/IJAE/11.2/289-293**

Development of a marking nut desheller

A.K. Bhardwaj, S.R. Patil, R.S. Sharma and V.V. Malwade

Received : 16.05.2018; **Revised :** 04.08.2018; **Accepted :** 21.08.2018

See end of the Paper for authors' affiliation

Correspondence to :

A.K. Bhardwaj
Department of Agricultural Engineering, Maharashtra Institute of Technology,
Aurangabad (M.S.) India
Email : adityabhardwaj128@gmail.com

■ **ABSTRACT :** Marking nut or *'Semecarpus anacardium* L.*'* is a versatile tree found abundantly in humid regions of world. Its unique physical trait sets it apart from other agricultural produce; no nut has same shape and size there is a tremendous variation in length, width and thickness of nuts. Nut is a double walled shell and between the cellular space of double walls there is a presence of toxic resin called BSL (Bhilawan shell liquid). Present desheller is simple in its operation and is developed focusing its future potential. It comprises of a double acting pneumatic cylinder (32 bore), solenoid valve, a nut placing die, operative tool and air compressor. Nuts are placed in a specific flat position at centre of cylindrical die, this die is drilled in center so that the stroke passes completely through its centre and is positioned just below the stroke of pneumatic cylinder. A tapered tool screwed with cylinder stroke of 50mm and when stroke occurs its cuts through the nuts center and kernel separation is done. It provide 100 per cent protection from splashing of BSL and no human strength for deshelling. Trails were conducted at three different pressures to evaluate performance of machine at 4.8,6.2 and 7.8 kg/cm^2 and 300 nuts at 2.38 per cent M.C. (dry basis) were cracked at each pressure. Highest efficiency was observed at 6.2 kg/cm^2 and removal of whole kernel was also good. At 6.2 kg/cm^2 pressure 86.20 per cent efficiency and 0.68kg/hr capacity were observed. Machine cost with optimum design is approx. 7500INR.

■ **KEY WORDS :** Marking nut, Double walled shell, Toxic resin, Pneumatic cylinder

■ **HOW TO CITE THIS PAPER :** Bhardwaj, A.K., Patil, S.R., Sharma, R.S. and Malwade, V.V. (2018). Development of a marking nut desheller. *Internat. J. Agric. Engg.*, **11**(2) : 289-293, **DOI: 10.15740/HAS/IJAE/11.2/289-293.**

Marking nut or *'Semecarpus anacardium* L., is a well known medicinal plant in Indian medicinal system 'Ayurveda' which belongs to the family of 'Anacardiacea'. It has been used over centuries in India as folk medicine. More than 5000 poor women from districts of Aurangabad, Akola, Buldhana, Washim and Parbhani are engaged in marking nut cracking which is carried out traditionally. This primitive method of de-shelling is harmful which includes beating of nut with stones or metal plate to remove the seed inside shells. Nut is a double walled shell and BSL (Bhilwan shell liquid) is a toxic liquid similar to CSL (Cashew nut shell liquid) is exuded from nuts shells. Bhilawanol is a toxic phenol found in nuts resin due to which mere exposure to nut can cause severe contact dermatitis. There are medicinally proved severe side effects of long exposure to this toxic resin on workers where it causes lesions, deformities and inflammation all over body which causes disturbing pain (Choudhari and Deshmukh, 2012). Urushiol is an active allergen found in marking nut and is responsible for allergic contact dermatitis (Bhatia *et al.,* 2014). Similar deshelling practices are carried out for cashew nut in some parts (Ojolo and Ogunsina, 2007 and Osunde and Oladeru,

2006). Physical and mechanical properties of nuts are useful in developing a desheller. (Patil *et al.,* 2014). Large tents are created where cracking is done in an open field and women are primary laborers. Workers apply coconut oil on hands, arms and wrap clothes around. Stones are used to crack the nut, while holding the nut with other hand. Dry kernel removal from the mesocarp without damaging is a critical step even after efficient deshelling. Kernel or seed has an almond like taste, it is eaten to stimulate mental ability, for its aphrodisiac properties, for bodybuilding and as strengthening food in winter season (Premlatha, 2000 and Reddy, 1994). The marking nut Kernel can replace usage of other oil seed because of its high protein and rich fat content. However, the vesicant nature of bhilawa juice and manufacturing difficulties of kernel prevents its usage (Ramasastri and Shenolikar, 1974). If this vesicant nature is abolished, this juice forms a good source for pharmaceutical industry (Gouthaman *et al.,* 2008). The black corrosive shell juice is used in India as an efficacious drug : internally in dyspepsia, nervous deliblity, asthma and cough; externally for piles, swellings and various cutaneous affections (Naidu, 1923). The fatal dose of marking nuts juice is 5 to 10g which can cause death within 12 to 24 hours (Khajja *et al.*, 2011). There are marking nut dehullers to separate kernel which reduce toxic oil splashing but worker still has to apply physical strength throughout the working hours. In traditional practices worker can judge as where to hit the nut but cannot move the nut while hitting. Efficiency of traditional cracking of the marking nut is also on workers skill and experience. Traditional cracking is time consuming with very less productivity and workers complain about neck and back aches due to constant physical stress, further kernel breakage and blackening of kernel reduces its commercial value. The MAU dehuller for marking nut (More *et al.*, 2008) has efficiency of 75 per cent with 6.5 kg/day capacity. The MNPH (Multi Nuts Post Harvest Mechanism) deshelling results for marking nut (Shinde *et al.,* 2015) has 87.22 per cent product efficiency, 12.78 per cent mechanical damage and 0.60 kg/hr capacity. This proposed research work design considerations are complete protection against toxic oil splashing, reduce physical stress and increase capacity and kernel production.

METHODOLOGY

Desheller fabrication :

The materials required for marking nut desheller were collected from Aurangabad and Walunj MIDC as well as fabrication works carried out at same places. Present desheller comprised of a double acting pneumatic cylinder, solenoid valve, nut placing die, a operative tool and air compressor for pressure generation. List of parts with their specifications are given in Table A.

Working mechanism :

When desirable air pressure is generated by compressor, deshelling stroke can be actuated with help of a solenoid valve; solenoid valve is shut off/on device which is controlled by a simple button switch. The nut placing die is half circled or C curved from top surface where nuts are placed, nuts at low moisture that is 2.38 per cent dry basis are placed flat on the die and resulting

Table A : Dimensional specification of all parts of desheller and their feature

Sr. No.	Name of the parts used	Specifications	Feature of work
1.	Double acting pneumatic cylinder	Bore 32 mm, stroke 50 mm, max cap.145 psi	To provide impact stroke for cracking nuts
2.	Pneumatic solenoid valve 5/2 port	Input I.D 8 mm, 220V AC 25mA, 5.5VA Solenoid coil	To actuate upstroke and down stroke
3.	Air compressor	7 to 12kg/cm^2	Provide air to pneumatic cylinder
4.	Pressure gauge	Measuring cap. 200 psi	To measure air pressure at inlet
5.	Base frame (Cast iron)	300 * 300 square, length 150 mm, thickness 30 mm	To hold the deshelling assembly
6.	Covering box (Mild steel and acrylic sheet)	150*120 mm rectangle	Provide 100% protection from oil splashing
7.	Nut holding die (Stainless steel)	Outer dia. 50 mm, inner dia. 18.5 mm, length 30 mm	Hold the nut at centre while deshelling
8.	Nut die holding frame (Cast iron)	Outer dia. 52 mm	To adjust holding die position
9.	Tapered cracking tool (stainless steel)	Length 40 mm, taper degree 62, Max. dia. 18 mm, min dia. 8mm	To crack nuts placed on die with an single stroke

stroke cracks the centre of nut and delivers it on collection tray below. Operative tool is tapered, it is at height of 4 cm from nuts surface when upstroke and completely passes throughout the length of die at downstroke. Kernel separation is achieved at optimum pressure but in some cases enclosed kernel has to be removed manually by a tong or fingers. Covering box provides 100 per cent protection from splashing of BSL (Bhilawan shell liquid), box is provided with a acrylic door so to ease the visual of operation, removal of tool and die, cleaning purposes etc.

Performance testing of desheller :

Performance of developed machine is evaluated to determine machines throughput capacity (kg/hr), product material efficiency, mechanical damage and deshelling efficiency. Large sized nuts for present study were purchased from local market in Pandariba and Mondha, Aurangabad. Nuts were dried using a tray drying method and were dried intermittently, maintaining medium blow to minimize oil losses until constant weight was observed and moisture content 2.38 per cent on dry basis was determined. Nuts were de-shelled at 3 different pressures that is 4.8, 6.2 and 7.8kg/cm^2. Following relationships are used for performance testing (Maduako *et al.*, 2006 and Shinde *et al.*, 2015).

$$\text{Through put capacity (kg/h)} = \frac{Qs}{Tm}$$

$$\text{Product material efficiency (\%)} = \frac{Qu}{Qu + Qd} x100$$

$$\text{Mechanical damage (\%)} = \frac{Qd}{Qu + Qd} x100$$

where: Qt = total weight of shelled and unshelled nuts (kg), Tm= time of shelling operation (hrs.), Qs= mass of shelled nuts (kg), Qu= mass of undamaged kernels (kg), Q_d= mass of damaged kernels (kg).

The data was statistically analyzed for analysis of variance (ANOVA) at alpha value 0.05 and results presented in Table 2.

■ RESULTS AND DISCUSSION

Table 1 gives the summary of the performance parameters of marking nut desheller, the deshelling pressure, time required for deshelling and mass of feed, are given with the corresponding material efficiency, mechanical damage and capacity.

At pressure 4.8 kg/cm^2 material efficiency was

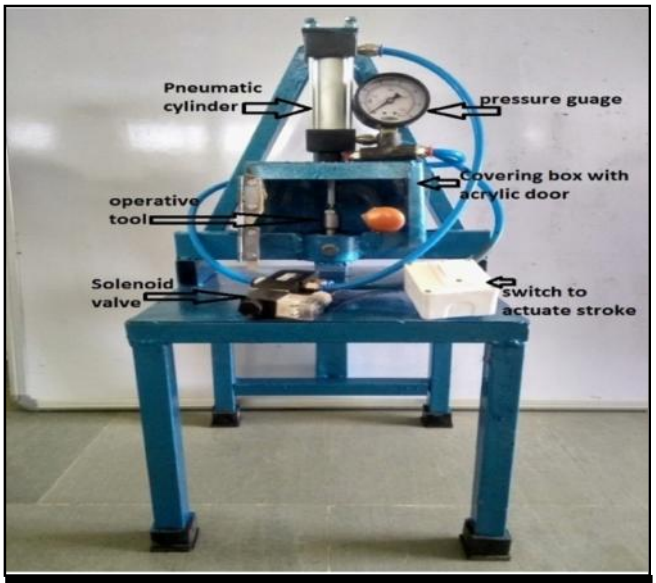

Fig. 1 : Pictorial view of developed desheller

Table 1 : Performance parameters of marking nut desheller at three pressures

Pressure (kg/ cm^2)	Wt. of marking nuts (g) Q_t	Time required for shelling (min) T_m	Wt. of whole kernels removed (g) Q_u	Wt. of broken kernels (g) Q_d	Mechanical damage (%)	Capacity (kg/hr)	Material efficiency (%)
4.8	312	26	91	22	19.46	0.72	80.53
6.2	330	29	75	12	13.79	0.68	86.20
7.8	300	29	62	26	29.54	0.61	70.45

Each value is average of 3 replications

Table 2 : Analysis of variance (ANOVA) test table

Source	SS	Df	MS	F-value	P-value
Pressure (Between)	1294.222	2	647.111	82.028	0.0000439** <0.05
Whole kernel (Within)	47.333	6	7.888	-	-
Total	1341.555	8			

Where SS- Sum of Squares, Df- degrees of freedom, MSS- Mean sum of squares, F-value- Variance ratio, P-value- **Significant difference

Fig. 2 : Kernels obtained after deshelling

80.53 per cent and mechanical damage was 19.46 per cent, highest capacity was observed that is 0.72 kg/hr. The kernel removal from enclosed mesocarp after cracking required manual help. The highest efficiency 86.20 per cent was observed at pressure 6.2 kg/cm^2, at this pressure kernel separation from cracked shell was good and mechanical damage was lowest that was 13.79 per cent. The statistical analysis indicates that pressure affects whole kernel output significantly, but variation of whole kernel output among three pressures is non-significant.

Conclusion :

– Present dehsheller protects 100 per cent from splashed toxic oil and no human strength is required for deshelling.

– Optimum pressure observed was 6.2 kg/ cm^2, with highest efficiency when nuts were at 2.38 per cent moisture dry basis.

– The operation is simple with a huge scope for modification, present desheller cost is approx 7500 INR.

Acknowledgement :

We thank our colleagues from Maharashtra Institute of Technology, Aurangabad who provided assistance for the research. We thank D.T. Bornare, Sachin R. Patil and Vaishali Wankhade for Guiding and providing expertise and assistance for methodology, comments which greatly improved the manuscript.

Authors' affiliations:

S.R. Patil and V.V. Malwade, Department of Agricultural Engineering, Maharashtra Institute of Technology, **Aurangabad (M.S.) India** (Email : sachin.patil4005@gmail.com)

R.S. Sharma, Department of Mechanical Engineering, Marathwada Institute of Technology, **Aurangabad (M.S.) India**

REFERENCES

Bhatia, Kailash, Kataria, Rajesh, Singh, Ashish, Safderi, Zainab and Kumar, Ravindra (2014). Allergic contact dermatitis by *Semecarpus anacardium* for Evil eye: A prospective study from Central India. *Indian J. Basic & Appl. Med. Res.*, **3**(3):122-127.

Choudhari, C.V. and Deshmukh, P.B. (2012). Effect of *Semecarpus anacardium* extract on physiology of brain in Albino Rat. *Indian J. Innovations & Developments*, **1**(1):1-8.

Gouthaman, T., Kavitha, M.S., Ahmed, B.A., Kumar, S. and Rao, M.V. (2008). Recent progress in medicinal plant (RPMP), *Phytopharmacy & Therapeutic Values-I*, **19**:194-222.

Khajja, Balvant S., Sharma, Mukesh, Singh, Rajveer and Mathur, Girish K. (2011). Forensic study of Indian toxicological plants as Botanical Weapon(BW): A Review, *J. Environ. & Analytical Toxicol.*, **1**(4):1000112.

Kumar, A., Sawant, N.S., Raut, A., Amonkar, A. and Vaidya, A. (2007). Bhallatak (*Semecarpus anacardium* Linn.)-A Review, *Indian J. Traditional Knowledge*, **64**(4) : 653-659.

Maduako, J.N., Saidu, M., Matthias, P. and Vanke, I. (2006). Testing of an engine-powered groundnut shelling machine, *J. Agric. Engg. & Technol.* (JAET), **14**:29-37.

Mahatma Gandhi Institute of Rural Industrialization (MGIRI) Newsletter (Oct .2010) , 2(10).

More, G.R., Kamble, K.J., Soni, S.B. and Bhagywant, R.G. (2008). Comparative study of markingnut dehulling. *Karnataka J. Agric. Sci.*, **21**(2) : 316-317.

Osunde, Z.D. and Oladeru, O.E. (2016). Design, fabrication and testing of cashew nut shelling machine. *J. Agric. Engg. & Technol.* (JAET), **14** : 52-57.

Ojolo, S.J. and Ogunsina, B.S. (2007). Development of a cashew nut cracking device, *Agric. Engg. Internat. : The CIGR Ejournal*, Manuscript PM 06030, 10.

Patil, Bhagyashree, Mulani, Harshal, Gupta, Suchita and Nimkar, Prabhakar (2014). Design parameters of marking nut cracker; *Ecoscan, An Internat. Biannual J. Environ. Sci.*, **8** (1&2):173-176.

Premlatha, B. (2000). *S.A Linn.* Nuts-A boon in alternative medicine. *Indian J. Experimental Biol.*, **38**: 1177-1182.

Priortised Plants Brochure, The Additional principal chief conservator of forests, Maharashtra State-Forest Dept.

Ramasastri and Shenolikar (1974). Nutritive value of unusual foods: Adda & marking nut kernels. *Indian J. Med. Res.*, **62** (11) : 1673-1677.

Reddy, M.M. (1994). Ethnobotony of *Semecarpus Anacardium*

L. marking nut. Abstracts of the International Congress of Ethnobiology, Lucknow, **73** : 7117-7321.

Satyavati, G.V. (1969). Anti-inflammatory activity of *S.A*- a preliminary study. *Indian J. Physiological Pharmacol.*, **13** : 37-43.

Shinde, G.U., Patil, S.R., Sethi, P. and Kumar, R. (2015). Development of multi-nuts post harvest mechanism by computer aided engineering analysis. *Internat. J. Mechanical & Production Engg. Res. & Development* (IJMPERD), **5**(4):53-60.

Udo, S.B., Adejuyibe, S.B., Adisa, A.F. and Ismaila, O.S. (2016). Performance evaluation of palm kernel nut cracking machine. *J. Nat. Sci., Engg. & Technol.*, **14**(1):111-116.