PERFORMANCE EVALUATION STUDIES ON TAMARIND DEHULLER-CUM-DESEEDER

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Abstract: The performance of machine was evaluated at 3 different rings clearance i.e. 3, 4, & 5 cm for dehulling and 3, 3.5 & 4mm machine clearance for deseeding. Similarly different feed rate was taken for dehulling and deseeding operations *i.e.*, 4, 5 & 6 and 1, 1.5 & 2 kg/min respectively.The result from the above process show that for dehulling operation the optimum ring clearance and feed rate was 4 cm and 5 kg/min respectively, as the output obtained from them was more than the other two parameters i.e. 239.97 kg/h and 251.94 kg/h for before sun drying and after sun dried tamarind fruits. Similarly 3.5 mm machine clearance and 1.5 kg/min feed rate was optimum for deseeding with output of 48.6 kg/h and 52.02 kg/h before and after sun drying respectively. Hence we conclude that for dehulling the optimum rings clearance and feed rate is 4 cm and 5 kg/h with dehulling efficiency of 79.99 % before sun drying and 83.98 % after sun drying and for deseeding machine clearance of 3.5 mm and feed rate of 1.5 kg/min is best with deseeding efficiency 54.23 % & 57.8 % for before sun drying and after sun drying respectively.

Keywords: Dehuller-cum-deseeder, tamarind

INTRODUCTION

Tamarind (*Tamarindus indica* L.) fruit was at first thought to be produced by an Indian palm, as the name tamarind comes from a Persian word 'Tamar-u1-hind', meaning 'Date of India', Its name 'amlika' in Sanskrit indicates its ancient presence in the country. Survey of minor forest produce of C.G. (2006-07) reported that the Chhattisgarh is among the major producer state of tamarind. Its yearly production of tamarind is 50000 tones from which about 10000 tones are used for processing and sale to other state. And in the other major tamarind producer state presented in the table 1. (http://www.indianspices.com/pdf/spice-state-arprd.xls)

Table 1. Area wise production of tamarind in other state Year (2006-07)

State	Area (Hect.)	Production (Tones)
Andhra Pradesh	5586	19483
Karnataka	15674	80020
Kerala	16876	26188
Tamil Nadu	20488	64382

Tamarind production in Chhhattisgarh is fairly high but the post harvest technique adopt for its processing (dehulling and deseeding) neither developed and nor optimum. Its a traditional practice of hulling the ripe fruit is by stick beating which is crude, unhygienic and time consuming operation. Dehulling, deseeding and removal of fibre, are manual and crude, since they are highly labour intensive operations and inefficient.

In order to make the proper use of produced tamarind fruits at an optimum cost and less time consumption we need to have a tamarind dehuller-cum-deseeder machine in C.G. Since the awareness of the machine is not among common people of C.G. and no study related to evalution of tamarind dehuller-cum-deseeder machine has been carried out in our state.

MATERIAL AND METHOD

To evaluate the performance of tamarind dehuller-cum-deseeder (Plate 1); Tamarind fruits under two different treatments was used (before sun drying and after sun drying)and machine parameter different machine clearance was used & the data was calculated in the terms of output, efficiency of machine and mechanical damaged of pulp.

Mechanical dehulling of tamarind fruit

Tamarind fruits were dehulled using the dehuller-cum-deseeder (Plate 1) developed at the Post Harvest Technology Scheme, University of Agricultural Sciences, and Bangalore. The Tamarind dehulling unit (Plate 2) consisted of a mild steel (MS) frame, a hopper, MS shafts, dehulling rings and a 1 hp motor. The MS frame was made of angle iron measuring 40 x 40 mm. Two parallel MS shafts having a diameter of 20 mm were mounted on the MS frame with two end bearings. The dehulling rings were made of 8 mm MS round rods. The diameter of each ring was 170 mm. All along the surface of the rings, small pins measuring 15mm length were welded in a cris-cross manner at equal spacing to get maximum beating action. The shafts were made to rotate in opposite direction by means of a V-groove pulley.

The separated pulp falls down on a screen by gravity and the husk was removed.

For the evaluation of dehulling section of the machine we used three different feed rate (4,5 &6kg/min) of the tamarind fruits at the three different clearance between rings (3 , 3.5 & 4cm). Observations were recorded on dehulled fruit weight (kg), damaged pulp weight (kg) and dehullig time (h)

Mechanical deseeding of tamarind fruit

Tamarind fruits were deseeded using the deseeder developed at the Post Harvest Technology Scheme, University of Agricultural Sciences, and Bangalore. The selected pulp shearing unit (Plate 3) consisted of a serrated roller mounted on to a MS frame. The roller had a diameter of 170 mm and a length of 150 mm. The MS flat measuring 12 mm widths and 3mm thick was welded together all along the circumference of the roller in a serrated fashion. The pitch between the two serrations was maintained at 20 mm. Parallel to the roller, a stationery rashbar was mounted. The 300 rpm of the drum was maintained. The roller was attached to a 1 hp motor by means of a V-groove pulley.

For the evaluation of the deseeding section of the machine we used three different feed rate (1, 1.5 & 2kg/min) of the tamarind fruits at the three different machine clearance (3, 4 & 5 mm). Observation was recorded on output of deseeded fruit weight kg, damaged pulp weight kg, deseeding time h, no. of seed removed, no. of seed inside and no. of seed damaged.

Formulae used in the present study

Dehulling efficiency **(%)**

$$= \frac{\text{Dehulled fruit weight}}{\text{Total weight of sample}} \times 100$$

Deseeding efficiency **(%)**

$$= \frac{\text{Deseeded fruit weight}}{\text{Total weight of sample}} \times 100$$

Mechenichal damaged pulp **(%)**

$$= \frac{\text{Weight of damaged pulp}}{\text{Total weight of sample}} \times 100$$

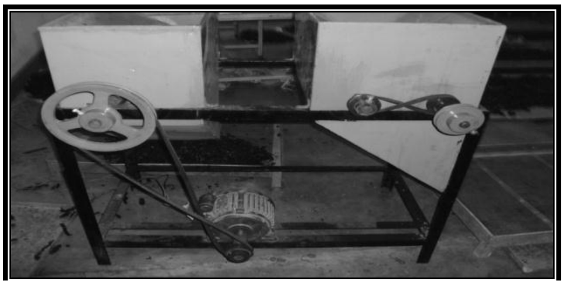

Plate 1. Tamarind Dehuller-cum-Deseeder

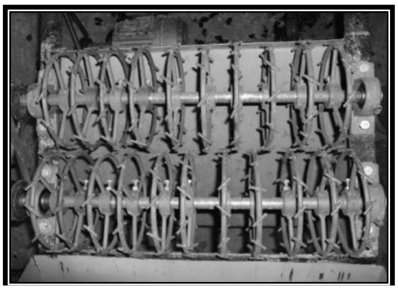

Plate 2. Dehulling section

Plate 3. Deseeding section

RESULT AND DISCUSSION

Mechanical dehulling before sun drying

Table 2. Output of dehulled fruits (kg/h) at different feed rate and different rings clearance

Different feed rate (kg/min)	Output of dehulled fruits (kg/h)		
	Different rings clearance (cm)		
	3	3.5	4
4	183.11	190.70	189.20
5	235.80	239.97	237.30
6	277.56	282.50	281.16

Table 3. Dehulling efficiency (%) of machine at different feed rate and different rings clearance

Different feed rate (kg/min)	Dehulling efficiency (%) Different rings clearance (cm)		
	3.0	**3.5**	**4.0**
4	76.29	79.04	78.62
5	78.60	79.99	79.10
6	77.10	78.50	78.11

Table 4. Mechanical damage to the pulp (%) at different feed rate and different rings clearance

Different feed rate (kg/min)	Mechanically damaged pulp (%) Different rings clearance (cm)		
	3.0	**3.5**	**4.0**
4	13.46	9.87	10.60
5	10.88	9.30	10.30
6	12.58	10.52	11.45

The variation of the result as shown in Table 2, 3, 4 are due to the different feed rates and different rings clearances. It is clearly observed that at minimum feed rate *i.e.*, 4 kg/ min the output of dehulled fruits and dehulling efficiency obtained were very low which are increases by increasing the feed rate *i.e.*, 5 kg / min. But as soon as we increase the feed rate up to 6 kg / min the mechanical damaged pulp caused loading to low output and that same time the rings clearances are varied *i.e.,* 3cm the mechanical damaged of the pulp was more, on increasing the clearance *i.e.*, 3.5cm the dehulling efficiency was high with less mechanical damage of pulp, on further increasing the rings clearance *i.e.*, 4cm the dehulling efficiency recorded more than 3cm rings clearance but less than 3.5 cm rings clearance and the mechanical damage of pulp was high due to the more loads to the passage of two or more fruits together causing mechanical damage of pulp.

Mechanical dehulling after sun drying

Table 5. Output of dehulled fruits (kg/h) at different feed rate and different rings clearance

Different feed rate (kg/min)	Output of dehulled fruits (kg/h) Different rings clearance (cm)		
	3	**3.5**	**4**
4	192.36	199.68	197.04
5	241.35	251.94	248.10
6	288.82	300.52	297.00

Table 6. Dehulling efficiency (%) of machine at different feed rate and different rings clearance

Different feed rate (kg/min)	Dehulling efficiency (%) Different rings clearance (cm)		
	3	**3.5**	**4**
4	80.15	83.00	82.10
5	80.45	83.98	82.70
6	80.23	83.48	83.50

Table 7. Mechanical damaged pulp (%) at different feed rate and different rings clearance

Different feed rate	Mechanical damaged pulp (%)

(kg/min)	Different rings clearance (cm)		
	3	3.5	4
4	9.12	5.6	6.90
5	8.70	4.7	6.23
6	9.00	5.3	6.46

In the case of dehulling of sun dried fruits, the output of dehulled fruits were recorded higher as compare to the before sun dried fruits due to almost no attachment of shell with pulp, which made easy separation of shell, beside to its high brittleness. The variation of the result as shown Table 5, 6, 7 were due to the different feed rate and different rings clearances. It is clearly observed that the minimum feed rate *i.e.*, 4 kg/ min the output of dehulled fruits and dehulling efficiency obtained were very low which are increases by increasing the feed rate *i.e.*, 5 kg / min, but as soon as we increase the feed rate up to 6 kg / min the mechanical damaged pulp caused loading to low output and that same time the rings clearances are varied *i.e.*, 3cm the mechanical damaged of the pulp was more, on increasing the clearance *i.e.*, 3.5cm the dehulling efficiency was high with less mechanical damaged of pulp, on further increasing rings clearance *i.e.*, 4cm the dehulling efficiency recorded more than 3cm rings clearance but less than 3.5 cm rings clearance and the mechanical damaged of pulp was high due to the more loads to the passage of two or more fruits together causing mechanical damage of pulp.

Mechanical deseeding before sun drying

Table 8. Output of deseeded fruits (kg) in different feed rate at different machine clearance

Different feed rate (kg/min)	Output of deseeded fruits (kg/h)		
	Different machine clearance in mm		
	3	4	5
1.0	30.66	31.38	33.14
1.5	47.89	48.6	47.73
2.0	58.92	61.56	60.6

Table 9. Deseeding efficiency (%) of machine at different feed rate and different machine clearance

Different feed rate (kg/min)	Deseeding efficiency (%)		
	Different machine clearance (mm)		
	3	4	5
1.0	51.1	52.3	51.9
1.5	52.62	54.23	53.13
2.0	49.1	51.3	50.5

In case of deseeding in before sun drying table 8 to 10 it was observed that the best feed rate and clearance was 1.5kg/min and 4mm respectively. The reason behind this is because at the feed rate 1 kg /min the output obtained was low in proportion to the feed rate and on increasing the feed rate *i.e.*, 2kg/min leads to the mechanical damage of pulp. Similarly, in the case of clearance it was observed that on increasing and decreasing the clearance *i.e.*, 3mm & 5 mm respectively mechanical damage caused was higher and thus output obtained was lower.

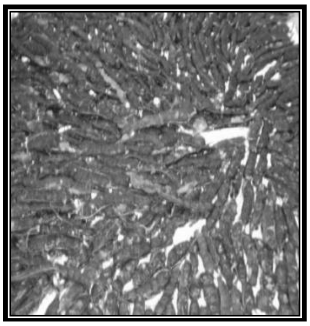

Plate 4. Dehulled tamarind fruits

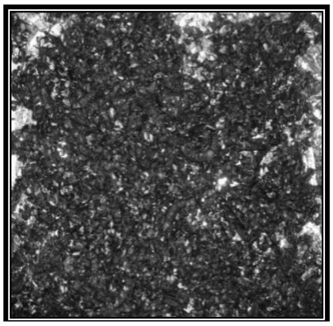

Plate 5. Deseeded pulp

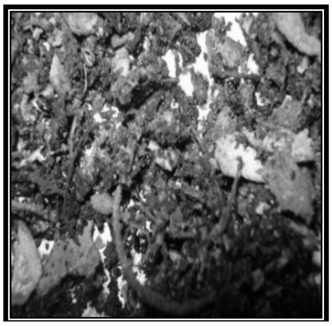

Plate 6. Mechanical damaged pulp

Table 10. Mechanically damage pulp (%) at different feed rate and different machine clearance

Different feed rate (kg/min)	Mechanically damaged pulp (%) Different machine clearance (mm)		
	3	4	5
1.0	19.03	17.13	17.7
1.5	18.55	17	18.62
2.0	22.21	18.7	20

Table 11. Effect of different machine clearance on deseeding (before sun drying)

Machine clearance (mm)	Parameters			
	Average Seed content	No. of Seed removed	No. of Seed inside	No. of Seed damaged
3	6.5	5.3	1.2	0.8
4	6.3	5.04	1.25	0.49
5	6.4	4.95	1.44	0.16

Mechanical deseeding after sun drying

Table 12. Output of deseeded fruits (kg) in different feed rate at different machine clearance

Different feed rate (kg/min)	Output of deseeded fruits (kg/h) Different machine clearance (mm)		
	3	4	5
1.0	32.64	33	32.88
1.5	49.68	52.02	51.21
2.0	64.2	66.24	65.88

Table 13. Deseeding efficiency (%) of machine at different feed rate and different machine clearance

Different feed rate (kg/min)	Deseeding efficiency (%) Different machine clearance (mm)		
	3	4	5
1.0	54.4	55.0	54.8
1.5	55.2	57.8	56.9
2.0	53.5	55.2	54.9

Table 14. Mechanically damaged pulp (%) at different feed rate and different machine clearance

Different feed rate (kg/min)	Mechanically damaged pulp (%) Different machine clearance (mm)		
	3	4	5
1.0	13.80	12.80	13.17
1.5	15.52	11.54	12.92
2.0	15.24	12.50	13.02

Table 15. Effect of different machine clearance on deseeding (after sun drying)

Machine clearance (mm)	Parameters			
	Average Seed content	No. of Seed removed	No. of Seed inside	No. of Seed damaged
3	6.05	5.36	0.69	0.82
4	5.95	5.13	0.81	0.45
5	6	5.01	0.99	0.18

In case of deseeding after sun drying Fig. 12 to 14 it was observed that the there was increased in output and deseeding efficiency when the moisture content of the pulp was less might be due to the establishing the required frictional contact to effect proper shearing between the roller mechanism which made easy separation of seed from pulp and we also observed that the best feed rate and clearance was 1.5 kg/min and 4mm respectively. The reason behind this may be because at the feed rate 1 kg /min the output obtained wad low in proportion to the feed rate and on increasing the feed rate i.e. 2kg/min leads to the mechanical damage of pulp. Similarly, in the case of clearance it was observed that on increasing and decreasing the clearance *i.e.*, 3mm & 5 mm respectively mechanical damaged caused was higher and thus, output obtained was lower.

CONCLUSION

Experiments conducted during the investigation led to the following conclusion.

i) For dehulling operation it was observed of that the efficiency of the machine increased when the tamarind fruits were sun dried and the clearance of the ring were kept at 3.5 cm while maintaining the feed rate at 5kg/min.

ii) Whereas for the deseeding operation sun dried tamarind with machine clearance of 4 mm and feed rate of 1.5 kg/min was found to be most appropriate.

Hence we conclude that the dehulling efficiency is best with sun dried tamarind with 3.5 cm ring clearance and 5 kg/min feed rate and sun dried tamarind with machine clearance of 4 mm and 1.5 kg/min feed rate is best suited for deseeding providing lowest mechanical damage and high degree of output.

REFERENCES

Anonymous (1982). Tamarind juice concentrate plant starts production in Mysore. *Ind. Food Indust.* **1** (1/2): 43-44.

Bhattacharya, S., Bal, S. and Mukherjee, R. K. (1993). Some physical and engineering properties of tamarind seed. *J. Food Engg.* 18 (1):77-89.

http://www.indianspices.com/pdf/spice-state-arprd.xls

Hiregoudar, S. (2000). Development and testing of a prototype tamarind (Tamarindus indica L) defibring machine. M.tech.thesis UAS Bangalore 76-80.

Ramakumar, M.V., Babu, C.K., Subramanya, S., Ranganna, B. (1996). Design and development of pulp shearing / seed expelling machine. *Ann. Rep.,* UAS/PHT/98/25: 16-22

Ramakumar, M.V., Babu, C.K., Subramanya, S., Ranganna, B. and Krishnamurthy, K.C. (1997). Development of a tamarind dehuller and short-term storage of pulp. Proceedings of National Symposium *on* Tamarindus indica *L.*, Tirupathi (A.P.)Organized by the Forest Department of A.P. 27-28 June 1997: 145-150.

Ramakumar, M. V., Babu, C. K. and Ranganna, B. (1997). Development of tamarind pulp shearing / seed expelling machine *Ann. Rep.,* UAS/PHT/98/25: 16-22.