



A study on the comparative performance evaluation of different types of coconut dehuskers

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Abstract : Dehusking of coconut is a very tedious job and many of the labourers show reluctance for this work as it causes injury to them by following traditional method. Development of a suitable coconut dehusker is, therefore, very much important in the state Odisha where there is a great potential for coconut cultivation and marketing of commercial products from coconut husk. The present study was conducted at College of Agricultural Engineering and Technology, OUAT, Bhubaneswar to develop a power operated coconut dehusker suitable among the coconut growers of the state, Odisha and to compare its performance with other prevailing manually operated coconut dehuskers. It was observed that the number of nuts dehusked per hour, dehusking efficiency and cost of dehusking per nut in case of power operated dehusker were 300, 92 per cent and Rs. 0.10, respectively and 125, 83 per cent, Rs. 0.20 in case of hand operated dehusker, and 170, 85 per cent, Rs. 0.15 in case of pedal operated dehusker, respectively. The power operated dehusker was found to be safe to operate, easy to fabricate, commercially feasible and economically viable compared to other manually operated dehuskers.

Key Words : Coconut dehusking, Coconut dehusker, Copra, Coir, Dehusking efficiency

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INTRODUCTION

Dehusking is the process of removing the outer covering called husk from the coconut to get two important commercial products such as copra or dried kernel and fibre or coir. Copra yields oil and oil cake where as fibre produces carpets/mattresses and coir pith briquettes. Coconut shell obtained after dehusking is also a very useful industrial product to get coconut shell charcoal, activated carbon and coconut shell powder which have a good market value (Jacob and Bastian, 1998). Dehusking is, therefore, an important operation for coconut processing industry. The coconuts reaching markets are either partially husked or dehusked as per demand and requirement in distant markets. Coconuts meant for copra making are fully husked. Coconuts meant for distant market places are left with some fibres covering the eyes or on all around the nuts. Such partially husked coconut minimizes the

breakage during transportation and attains longer keeping quality. It is also observed that even when coconuts are fully husked, a tuff of husk is left at the end of the nut over the eyes as it is considered to be auspicious and believed to preserve the nuts from spoilage. It has been reported that about 20 per cent of the total coconut produced in Odisha are consumed as tender nuts and 5 per cent are retained by the farmers for household and seed nut purposes (Anonymous, 2007). About 42 per cent of the coconut produced is consumed in the state itself and 33 per cent are exported to the other states like Bihar and Madhya Pradesh where cultivation of coconut is not favourable. Hence, dehusking of coconut needs to be done not only to increase the bulk density for easy transportation but also to process quickly for industrial purposes. Mechanization of dehusking operation is needed in the state like Odisha as coconut is one of the most important plantation crops of the state. The area under coconut production in the

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State is about 43.3 thousand hectares producing 296.05 million nuts. The present productivity of the crop has been reported to be 8741 nuts per hectare as against the productivity of 6285 nuts per hectare in India (Anonymous, 2004).

The most frequently used dehusking method in the state is by the use of pointed metal spike, secured in the ground in a slightly slanting position, with the pointed ends upwards (Mishra and Sutar, 2007). The nuts are brought down with force on the spike, followed by twisting the nut sideward against the spike, causing loosening of the husk. Care is taken for the desired entry of the sharp end of the spike into the husk so as to avoid the damaging of shell. It is, therefore, clear that dehusking is a hard work, and may cause frequent injury to the operator. This job is not very popular as it is often difficult to find labour for this operation due to the every possibility of accidents. It involves a lot of drudgery and needs precaution against injury. Since dehusked coconut is an important material of commerce, dehusking needs to be mechanized and this study has, therefore, been taken up with the following objectives:

- To develop a power operated coconut dehusker
- To study its performance in terms of number of nuts dehusked per hour along with dehusking efficiency by various dehuskers for different varieties of coconut available in Odisha
- To compare the performance of power operated dehusker with hand and pedal operated coconut dehuskers and local method of dehusking
- To calculate the economics of using power, hand and pedal operated coconut dehuskers.

MATERIALS AND METHODS

Traditional coconut dehusker:

The most frequently used dehusking method in the state is by the use of pointed metal spike, secured in the ground in a slightly slanting position, with the pointed ends upwards. The nuts are brought down with force on the spike, followed by twisting the nut sideward against the spike, causing loosening of the husk. Care is taken for the desired entry of the sharp end of the spike into the husk so as to avoid the damaging of shell. The number of nuts dehusked per hour is around 100. Slight carelessness during operation leads to injury to the operator.

Hand operated coconut dehusker:

It is operated with the help of the hand of the operator. It works in the principle of first class lever. It can dehusk 125 nuts per hour at optimum moisture content of about 15 per cent. The operator is to bend forward while working which causes discomfort and fatigue within a short period. The technical details of the dehusker and its photograph are given below.

Technical details:

- Base = 12 cm x 12 cm
- G.I pipe (medium) = 30mm dia round rod
- 35 x 5 MS flat
- Knife = 7 cm
- Angle = 25 mm x 25 mm x 5 mm
- Overall dimension = 65cm x 58cm x 20cm



Fig. 1: Photograph of hand operated coconut dehusker

Pedal operated coconut dehusker:

It is a modified form of the hand operated coconut dehusker. Its operation becomes easier compared to hand operated one because of using both the foot as per the requirements of the operator. The women can also operate the dehusker. It can dehusk 170 nuts per hour at optimum moisture content of about 15 per cent. The technical details of the dehusker and its photograph are given below.

Technical details:

- Height = 50cm
- Base = 38 cm x 38 cm
- Pedal = 6" x 6"
- Rod = 38 cm
- Lever knife = 7 cm
- Shaft = 8 cm spring
- Angle = 25 mm x 25 mm x 3mm
- 40mm x 5 mm M.S. flat nut bolt
- G.I. pipe (medium) = 30mm diameter

Constructional details of power operated coconut dehusker:

A coconut dehusker has been developed which is operated by an electric motor with a reduction unit for actuation of sharp edged metallic fingers (one fixed and other movable) with the help of a movable cam to dehusk the manually fed coconut. The various components of the dehusker are as follows;

- A prime mover-1 hp motor



Fig. 2 : Photograph of pedal operated coconut dehusker

- Reduction unit (for reducing speed of motor)
- Belt and pulley
- Shaft
- Cam
- Lever and knife
- Hand protecting cover (safety ring)
- Concave chute

The prime mover used for the study is an electric motor of 1 hp capacity running with 1440 rpm and fitted at the bottom of the experimental set up. The reduction unit is used to reduce the rpm of motor to 25 rpm so that coconut can be easily fed to the fingers by their slow movement. Power is available at the pulley connected to the prime mover. With the help of belt and pulley arrangement, the power is transmitted to the shaft of the coconut dehusker. An idler pulley is used to maintain the belt tension. The pulley at the end of the shaft of dehusker revolves with 15 rpm and the power is finally transmitted to the cam. The cam is attached to the other end of the shaft of the coconut dehusker. This cam transmits the rotary motion to the linear motion of the movable finger through a lever. The two fingers are hinged in such a way that one finger is fixed and other one moves forward and backward periodically to make a separation of approximately two inches between them. After switching on the motor, the operator is to feed the coconut on the sharp edge of the knives when both the knives are closer to each other. When the knives are separated from each other, the husk in the coconut is loosened and then the coconut is again put on the knives when both the knives are closer to each other for second time for further loosening of the husk at the other portion of the nut. This practice is

repeated 3-4 times for complete loosening of the husk. Then the loosened coconut is handed over to the helper who is to completely remove the loosened husk from the nut and the nut is now in dehusked condition for its easy transportation and for use in some other purposes. The technical details and photograph of the dehusker is given below;

Technical details:

- Table : 77cm x 96cm x 96cm
- Angle : 40mm x 40mm x 5mm
- 2mm mild steel sheet : 77cm x 96cm
- Electric motor : 1HP, single phase
- V-pulley
- Pulley at the shaft (driven) : 10²
- Pulley at motor (driving) : 6²
- Idler pulley : 5²
- V-belt : B80
- MS shaft : 64cm length, 2.5cm \varnothing
- Bearing and bearing housing : 2 Nos
- Knife : 7cm
- Nut bolts : 3/8²
- Cam lift : 13.75cm
- Knife opening : 5cm

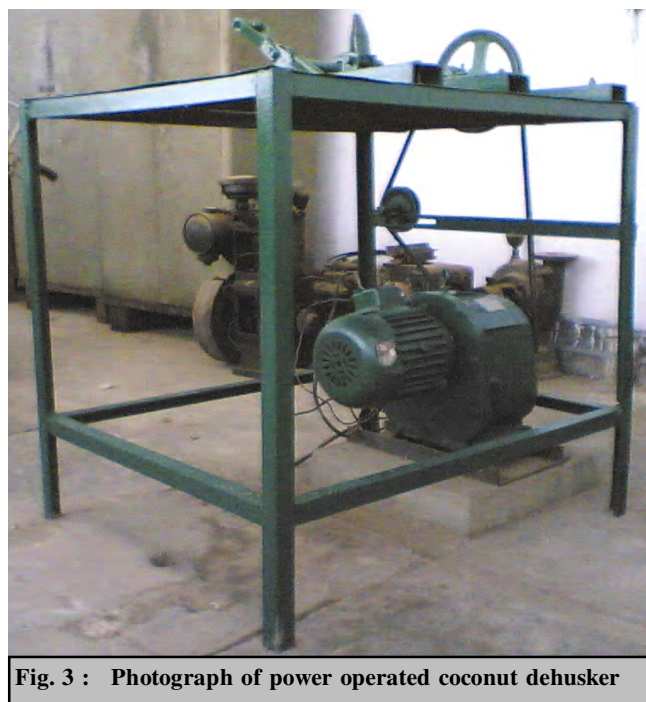


Fig. 3 : Photograph of power operated coconut dehusker

Parameters measured to study the performance of dehuskers:

The freshly harvested coconuts are generally dried in the sun for 8-12 days to reduce the moisture content suitable for easy dehusking. Before dehusking, a small strip of the husk is removed from any one coconut out of a heap of coconuts harvested at the same time. The removed husk is



Fig. 4 : Working of power operated coconut dehusker

put inside the oven at 105°C for 24 hrs for determination of moisture content. Before putting the husk inside the oven, the weight of the husk is taken. Then after 24 hrs, the dried husk is taken out of the oven and weighed again. After that the moisture content of the coconut is calculated. Usually the moisture content (M.C.) of a substance is expressed in percentage by weight on wet basis. Moisture content can also be determined on dry basis by the following formulae.

$$\text{M.C. wet basis (W}_b\text{) \%} = \frac{\text{Weight of moist material} - \text{Weight of dry material}}{\text{Weight of moist material}} \times 100$$

$$\text{M.C. dry basis (D}_b\text{) \%} = \frac{\text{Weight of moist material} - \text{Weight of dry material}}{\text{Weight of dry material}} \times 100$$

$$\text{Dehusking efficiency \%} = \frac{\text{Weight of husk obtained after dehusking}}{\text{Weight of total husk present in the coconut}} \times 100$$

At first the husk is weighed after dehusking. Then the remaining husk present in the coconut is removed completely from the dehusked coconut manually to know the total weight of the husk. For experimental purpose, three varieties of coconut *viz.*, Sakhigopal, Guamal and Hazari were taken at different moisture contents for different coconut dehuskers. The dehusking operation was performed continuously for 20 minutes with a rest interval of 10 minutes for providing comfort to the operator. Finally the number of coconuts dehusked per hour is calculated for the same variety and at same moisture content for one type of dehusker.

RESULTS AND DISCUSSION

The experiment was conducted with two numbers of operators using different varieties of coconut at various moisture contents for each type of the dehusker. One was to feed the coconut into the dehusker and another one was to assist him as and when required and to remove the rest of the husk from dehusked coconut according to the requirements. Interim rest was given to the operators looking into their comfortability. The economics of using different coconut

Table 1 : Testing of Sakhigopal variety of coconut

Type of dehusker	Moisture content (% Wb)							
	0-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45
	No. of nuts dehusked/hour							
Locally	75	100	85	75	72	70	68	55
Hand operated	118	150	130	128	115	103	86	75
Pedal operated	122	180	151	145	138	112	94	87
Motor	288	330	282	276	204	192	180	156

Table 2 : Testing of Guamal variety of coconut

Type of dehusker	Moisture content (% Wb)							
	0-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45
	No. of nuts dehusked/hour							
Locally	72	92	81	76	70	69	67	54
Hand operated	115	147	128	126	113	100	85	74
Pedal operated	120	176	148	143	137	110	92	85
Motor	282	324	276	270	210	192	174	150

Table 3 : Testing of Hazari variety of coconut

Type of dehusker	Moisture content (% Wb)							
	0-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45
	No. of nuts dehusked/hour							
Locally	71	91	87	85	69	60	55	51
Hand operated	97	125	119	102	98	92	83	71
Pedal operated	113	170	140	135	133	105	98	82
Motor	282	324	270	264	192	188	168	144

Table 4 : Dehusking efficiency for Sakhigopal variety of coconut

Sr. No.	Dehusker	Total wt. of husk present (g)	Total wt. of husk removed (g)	Dehusking efficiency (%)
1.	Locally	525	225	48.57
2.	Hand operated	550	460	83.63
3.	Pedal operated	540	460	85.18
4.	Motor	530	490	92.45

Table 5 : Dehusking efficiency for Guamal variety of coconut

Sr. No.	Dehusker	Total wt. of husk present (g)	Total wt. of husk removed (g)	Dehusking efficiency (%)
1.	Locally	535	278	51.9
2.	Hand operated	496	405	82.05
3.	Pedal operated	480	400	83.33
4.	Motor	533	492	92.3

Table 6 : Dehusking efficiency for Hazari variety of coconut

Sr. No.	Dehusker	Total wt. of husk present (g)	Total wt. of husk removed (g)	Dehusking efficiency (%)
1.	Locally	480	240	50.0
2.	Hand operated	453	365	80.5
3.	Pedal operated	462	383	62.9
4.	Motor	482	444	92.11

Table 7 : Comparison of cost analysis for using different dehuskers

Sr. No.	Particulars	Power operated Cost : Rs. 10000/- Life : 10 years Annual use 1000h	Hand Operated Cost : Rs. 500/- Life : 10 years Annual use : 300h	Pedal operated Cost : Rs. 750/- Life : 10 years Annual use : 300h
1.	Fixed cost (Rs./hour)			
	Depreciation	950.00	118.75	178.12
	Interest	630.00	31.5	47.25
	Shelter	52.50	2.62	3.93
	Total fixed cost/year	1632.50	152.87	229.3
	Total fixed cost/hour	1.63	0.50	0.76
2.	Variable cost (Rs./hour)			
	Repair and maintenance cost/hour	0.50	0.08	0.12
	Labour charges/hour (2 labourers @ Rs. 100/day/person)	25.00	25.00	25.00
	Electricity charges/hour	3.15	-	-
	Total variable cost/hour	28.65	25.08	25.12
3.	Total cost (fixed + variable)cost/hour	28.28	25.58	25.88
4.	Cost of dehusking/coconut	0.10 (for 300 nuts/h)	0.20 (for 125nuts/h)	0.15 (for 170nuts/h)

dehuskers was also studied to know the comparative cost of using the dehuskers by the coconut growers. The performance of the dehuskers and their cost of using are mentioned in the following Table 1-7.

Conclusion:

The following conclusions were made from the study:

- The number of coconut dehusked per hour was highest in power operated coconut dehusker followed by pedal operated dehusker, hand operated dehusker and local method of dehusking.
- The number of coconut dehusked per hour in power operated coconut dehusker was almost double than that of pedal operated dehusker.
- The dehusking efficiency was observed to be highest in power operated coconut dehusker followed by pedal operated dehusker, hand operated dehusker and local method of dehusking.
- The cost of use of the power operated dehusker was also nominal *i.e.* Rs. 0.10 per nut followed by Rs. 0.15 for pedal operated dehusker and Rs. 0.20 for hand operated dehusker.

- The power operated dehusker was safe to use, easy to fabricate, economically viable and may be commercialized among the coconut growers of the state.

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