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Performance Evaluation of Manually Operated Coconut Dehuskers



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Abstract

The performance evaluation of a folding type and non-folding type manually operated coconut dehuskers was carried out at College of Agricultural Engineering and Technology, Dapoli for its suitability to farmers on the basis of dehusking capacity, dehusking efficiency, damage percentage and overall discomfort rating (ODR) and body part discomfort score (BPDS) during operation. Dehusking of coconut is very drudgerious operation. To reduce drudgeriousness in the operation Dr. BSKKV, Dapoli develop two types of coconut dehusker one is folding type and another is non-folding type manually operated dehusker. The performance of folding and non-folding type manually operated coconut dehusker was evaluated. The dehusking capacity and dehusking efficiency for folding and non type coconut dehusker were observed as 58 nuts/h and 93.7 % and 52 nuts/h and 93 % respectively. No damage to coconut shell dehusked was observed with both type. The mean value of overall discomfort rating of subjects for coconut dehusking operation with folding and non-folding type dehuskers was 3 (light discomfort) and 4 (more than light discomfort) respectively. The average BPDS score while performing the coconut dehusking operation using folding type and non-folding type manually operated coconut dehusker was 5.8 and 6.1 respectively.

Keywords: Coconut Dehusking, Coconut Dehusker, Dehusking Capacity, Dehusking Efficiency, ODR, BPDS

Introduction

Although coconut is of immense economic importance to both the industrialist and rural area, separation of its husk from the nut constitutes the first, most difficult and dangerous operation in its processing. 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 whereas fibre produces carpet/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. The coconut reaching markets are either partially husked or dehusked as per demand and requirement in distant market. Coconuts meant for distant market place are left with some fibre covering the eyes or on all around the nuts. Such partially husked minimizes the breakage during transportation and attains longer keeping quality. Dehusking is done manually by impairing the coconut on a sharp iron or wooden spike fixed to the ground. This process is laborious and time consuming, moreover it requires skilled labourers.

Presently, dehusking practices include use of sickle (koyta). This method is quite time consuming and risky. Another device used is inverted spear, where nut is impacted on spear and then rotated simultaneously so as to loosen the husk that can be removed easily. The reason to avoid this is it needs worker to bend from waist, which is uncomfortable when work continuous for many hours. Mechanized machines have applications in big industries due to their cost cause, mechanization in dehusking is necessary to increase output of farmer. The most frequently used dehusking method is by the use of pointed metal spike, secured in the ground in a slightly slanting position, with the pointed ends upward (Mishra and Sutar, 2007, Owata rate et al, 2008)

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 dehusking operation is a

Asian Resonance

drudgerious and may cause frequent injury to the operator. A folding type manually operated coconut dehusker and non-folding type coconut dehuskers were developed at Dr.BSKKV, Dapoli which can be easily transported and safe for operation with reduced the drudgery. The performance evaluation of this folding type manually operated coconut dehusker and non-folding type coconut dehusker were carried out in term of dehusking capacity, dehusking efficiency, damage percentage and drudgery involved by rating scale (Varghese et al,1994).

Materials and Method

Constructional Details of Manually Operated Coconut Dehusker

The Dr.Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli developed folding and non- folding type of coconut dehusker was selected for study. Folding type manually operated coconut dehusking unit selected for study consists of foldable base platform, pole, spike blade, detachable handle with grip for easy handling and transportation. Non-folding type manually operated coconut dehusking unit selected for study consists of base platform, pole, spike blade and handle. The both type of the dehusker selected for the experimental purpose as shown in Fig. 1 and Fig. 2 respectively. Specifications of manually operated coconut dehusker are given in Table 1.

Table 1: Specification of Manually Operated Coconut Dehuskers

Sr. No.	Particulars	Type A	Type B
		Non-folding	Folding
1	Base Platform	200 x 170 x 30(M. S.)	185 x 335 x 25 (M.S. flat 25 x 4)
2	Pole	600 (M.S.)	760 x 38 x 38 , 1.5 Thick
3	Blade	Case hardened Steel, Angle-60°	65 x 35, 4 thick, tipWidth 20 (2 Nos.)
4	Handle	Ø 12, 450 (M.S)	Ø 12 , 470 (M.S) Detachable
5	Grip	-	Ø 26. 120 (Plastic)
6	Hinge	-	Ø 12, 85 with 17 OD pipe (2 Nos.)
7	Overall dimensions	200 x 665	185 x 820 x 480
8	Weight	2.90 kg	2.95 kg
9	Size after Folding	Non-foldable	185 x 820 x 100

(All Dimensions are in mm)

Operation of manually Operated Coconut Dehusker

The both type of coconut dehusker has one fixed and one movable blade. At normal position, both the blades are works as one unit. The nuts are brought down with force on the blade. After pierce of blade into husk, handle is lifted up which loosen the husk. To completely loosen the husk of coconut, 4-5 strokes have to be given at different positions. After

loosening of husk at 4-5 locations, the loosen husk can be removed manually and dehusking operation can be completed. Care is taken for the desired entry of the sharp end of the blade into the husk so as to avoid the damage to shell. The coconuts variety selected for performance evaluation is of Banawali cultivar. The moisture content of seeds selected for dehusking was in range of 15-20 % (wb). The dehusking operation was performed in batches. The number of coconut dehusks per

Fig. 1



Folding type Coconut Dehusker

Fig. 2



Non-Folding Type Coconut Dehusker

Four, damage percentage and dehusking efficiency was determined by formulae given below. The experiment was conducted with ten different operators. The following parameter were recorded.

1. Moisture content of husk
2. Time required to dehusk one coconut
3. Weight of husk obtained after dehusking
4. Weight of total husk present in the coconut
5. Number of damage coconut
6. Number of coconut dehusked

Moisture Content

Moisture content of husk is determined by oven drying method as described in ASAE (1982) standards. 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 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 weighted again. Moisture content is calculated by using following formulae (Ghoshal and Mohanty, 2011)

$$\text{Moisture Content, wet basis (wb)} = \frac{\text{Weight of moist material} - \text{Weight of dry material}}{\text{Weight of total material}} \times 100$$

$$\text{Moisture Content, dry basis (db)} = \frac{\text{Weight of moist material} - \text{Weight of dry material}}{\text{Weight of dry material}} \times 100$$

Dehusking Capacity and Efficiency

The dehusking capacity and efficiency of the coconut dehusker were evaluated using ten experimental tests. Each test involved operating the dehusker by a different operator. The fifty coconuts were dehusked by each operator and time required for dehusking 50 nuts was recorded. The dehusking process for each operator was timed with a stop-watch. The dehusked husk obtained and total husk in the five selected coconuts were weighed and recorded. Thereafter, the efficiency and capacity of the machine were computed in each case using the following relationship as given by Nwankwojike *et al.*, 2012.

$$\text{Dehusking capacity, no /hr} = \frac{\text{Number of coconuts dehusked}}{\text{Time .hr}}$$

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

Damage Percentage

The damage percentage of the coconut dehusked was evaluated using ten experimental tests. Each test involved operating the dehusker by a different operator and recording of the total number of fruits, each of the ten operators dehusked in a given time. During dehusking process the total number of damage fruit by each operator was recorded. The damage percentage of the dehusked coconut was computed in each case using the following relationship as given by Nwankwojike *et al.*, 2012.

$$\text{Damage percentage, \%} = \frac{\text{Number of damage coconuts}}{\text{Total coconuts}} \times 100$$

Assessment of Drudgery of Dehusking Operation Overall Discomfort Rating (ODR)

The procedure adopted by Shrishia D. *et al.*, 2008 equipment performance was used as basis for economic evaluation. For the assessment of overall discomfort rating a 10 point psychophysical rating scale (0 – no discomfort, 10 extreme discomforts) was used which is an adoption of (Corett and Bishop 1976) technique. A scale of 70 cm length was fabricated having 0 to 10 digits marked on it equidistantly. A movable pointer was provided to indicate their overall discomfort rating on the scale. The overall discomfort rating given by each subject is added averaged to get the mean rating.

Body Part Discomfort Score (BPDS)

In this technique the subject's body is divided into 27 regions. The subject was asked to mention all parts all body parts with discomfort, starting with the worst, the second worst and so on until all parts have been mentioned (Lusted *et al.* 1994). The body chart has been shown to the subject after finishing the dehusking operation. The subject was asked to fix the pin on the body part in the one pin for maximum pain, two pins for next maximum pain and so on. The number of different groups of body parts which are identified from extreme discomfort to no discomfort represented the number of intensity levels of pain experienced. The body part discomfort score of each subject was measured by multiplying by number of body parts corresponding to each category. The total body parts score for a subject would be the sum of all individual scores of body parts assigned by the subject. The body discomfort score of the subjects is to be added and average to get mean score.

Results and Discussion

The experiments were conducted with ten male operators using Banawali variety coconuts. The moisture content of coconut selected were in the range of 15-20 %. Each operator was asked to dehusked 50 coconuts and parameters were noted. The performance of folding and non-folding type manual dehusker is presented in table 2 and 3.

Table 2: Details of Performance Parameter of Manually Operated Folding type Coconut Dehusker (Average of three Replications)

Subject	Time Required to Dehusk 50 Coconuts, Min	Time For Dehusking One nut, Sec	Number of Stroketo remove Husk/Nut	Dehusking Capacity, Nut/H	Dehusking Efficiency, %	Damage Percentage, %
1	48	42	4	62	92	0
2	45	48	4	66	93	0
3	65	55	5	46	92	0
4	59	52	5	50	93	0
5	47	45	4	63	94	0
6	50	40	4	60	95	0
7	65	54	5	46	96	0
8	47	44	4	63	94	0
9	62	50	5	48	95	0
10	52	38	5	55	93	0
Mean	54	46.8	4	58	93.7	0

From table 2 and 3, it is observed that folding type coconut dehusker perform better than non-folding type coconut dehusker. The dehusking capacity and dehusking efficiency for folding and non-folding type were found to be 58 nuts/h, 93.7 % and

52 nuts/h, 93 % respectively. No damage was observed during operation by both the dehusker. This may be due to higher height of vertical trunk/post, comfortable handle grip and sufficient footrest platform to hold coconut dehusker rigidly.

Table 3:Details of Performance Parameter of Manually Operated non-Folding type Coconut Dehusker (Average of three Replications)

Subject	Time Required to Dehusk 50 Coconuts, Min	Time for Dehusking One Nut, Sec	Number of Stroke To Remove Husk/Nut	Dehusking Capacity, Nut/H	Dehusking Efficiency, %	Damage Percentage, %
1	52	46	5	57	93	0
2	48	52	4	62	94	0
3	69	59	4	43	92	0
4	64	56	5	60	90	0
5	50	49	5	56	91	0
6	53	46	5	43	93	0
7	69	57	5	57	94	0
8	52	48	4	45	95	0
9	66	54	5	51	96	0
10	58	45	5	43	92	0
Mean	58.1	51.2	5	52	93	0

The values of ODR and BPDS of subjects while operating folding and non-folding type manually operated coconut dehusker are presented in Table 4. As shown in Table 4, it was observed that the coconut dehusking with manually operated folding type coconut dehusker, the mean value of ODR was 3 which is light discomfort operation. The coconut dehusking with manually operated non-folding type coconut dehusker, the mean value of ODR was 4

which is more than light discomfort operation. For folding type coconut dehusker, the mean value of BPDS of subjects was 6.45 and non-folding type was 6.75. It is observed that average BPDS score for coconut dehusking with folding and non-folding manual coconut dehusker is marginal and can be considered at par. This may be due to similar type of operation carried on both the coconut dehusker.

Table 4:Overall Discomforts Rating and Body Part Discomfort Score of Subjects for the Dehusking Using Folding and Non-Folding Type Coconut Dehusker

Subject	Folding Type			Non-Folding Type		
	ODR	Scales	BPDS Score	ODR	Scales	BPDS score
1	3	Light discomfort	4.5	4	More than light discomfort	4.5
2	2	No discomfort	7.5	3	Light discomfort	7.5
3	4	More than light discomfort	6	2	No discomfort	7.5
4	4	More than light discomfort	7.5	4	More than light discomfort	6
5	3	Light discomfort	7.5	3	Light discomfort	6
6	3	Light discomfort	4.5	4	More than light discomfort	7.5
7	4	More than light discomfort	7.5	4	More than light discomfort	7.5
8	2	No discomfort	7.5	2	No discomfort	6
9	4	More than light discomfort	6	5	Moderate discomfort	7.5
10	3	Light discomfort	6	4	More than light discomfort	7.5
Mean	3	Light discomfort	6.45	4	More than light discomfort	6.75

Conclusions

The following conclusions are made from the study

- The average time required for dehusking one nut is 46.8 seconds for folding type and 51.2 seconds for non-folding type, dehusking capacity for folding type coconut dehusker is 58 nuts/h and for non-folding type coconut dehusker is 52 nuts/h, average stroke to remove husk for folding type is 4 and for non-folding is 5.
- The average dehusking efficiency observed for folding type coconut dehusker is 93.7 % and for non-folding type coconut dehusker is 93 %.
- No damage to coconut shell dehusked using both folding and non-folding type coconut dehusker was observed.
- The mean value of overall discomfort rating of subjects for coconut dehusking operation with folding and non-folding type dehuskers was 3 and 4 respectively. The average ODR scale for dehusking operation on folding type coconut dehusker was light discomfort and for non-folding type dehusker was more than light discomfort.
- The average BPDS score while performing the coconut dehusking operation using folding type and non-folding type manually operated coconut dehusker was 5.8 and 6.1 respectively. The

maximum number of intensity level of pain experienced while operating both folding and non-folding type coconut dehusker were 3 and 4 respectively.

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