

Original Research Article

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Development and Testing of Different Models of Coconut Dehusker

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ABSTRACT

The existing models of coconut dehusking machines are pull type and suitable for right handed operators only. Therefore sitting models (pull and push type) suitable for both left handed and right handed operators were developed and the performance of newly developed both the models of coconut dehusker was tested on the basis of output capacity and dehusking efficiency. The tests were conducted at Department of Farm Machinery and Power Engineering, Dr. D. Y. Patil C.A.E.T, Talsande, Dist: Kolhapur (MS) in Sept.2016. The results shown that an output capacity of both pull type and push type coconut dehusker with left handed operator having the handle at left hand side, (LOLD) was 35.35 % and 34.87% higher than left handed operator having the handle at right hand side (LORD) respectively, which confirmed the provision of handle at left hand side had 34.87% to 35.35 % increase in output capacity of coconut dehusking. In case of LORD and RORD an output capacity of push type coconut dehusker was 7.73% and 8.87% higher than the pull type coconut dehusker. An output capacity of sitting model (pull type) of coconut dehusker (73.33 nuts/h) was 12.81 % more than the existing standing model of (pull type) coconut dehusker. Whereas, the dehusking efficiency of existing and all the newly developed of sitting models of coconut dehusker was at par and found in the range of 94.57% to 95.86%.

Keywords

Coconut dehusker,
Output capacity,
Dehusking
efficiency.

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Introduction

Coconut is grown in more than 86 countries worldwide in 12.5 million hectares of land which constitute about 0.7 per cent of the net crop of the world (Theerkhapathy *et al.*, 2014). India is the third largest coconut producing country, after Indonesia and the Philippines, having an area of about 1.78 million hectares under the crop. India's annual production is about 7562 million nuts with an average of 5295 nuts/hectare (Shashikumar *et*

al., 2014). Traditionally, the economic importance of coconut was laid on its nourishing water, kernel, copra, oil and coir, but laying emphasis on value addition and product diversification is widening the spectrum of its economy. Separation of its husk from the nut (dehusking) constitutes the, most difficult and dangerous operation in its processing. Presently, coconut dehusking with existing and popularly used models of coconut dehusking machines need the worker to bend from waist, to bring the coconut sharply down

into the blade, twisting to one side, loosen the husk and detaching the fiber from the shell. This action is repeated several times until the entire fibers are removed. As the dehusking is to be done in standing/bending posture, the work becomes not only hard but also causes pain in waist and legs. Also all the existing models of coconut dehusking machines are pull type and suitable for right handed operators only. Therefore a study was undertaken to develop and test the sitting models (pull and push type) suitable for both left handed and right handed operators.

Materials and Methods

Development considerations

An effort was made to develop different models of sitting type manual operated (pull type and push type) coconut dehusker suitable to operate by both left hand and right handed operator. Following points were considered for the development of different models of coconut dehusker.

- 1) It should be able to dehusk different size coconuts viz. small medium and large.
- 2) It should be easy to operate.
- 3) It should be fabricated by using locally available material.
- 4) It should be compact.
- 5) It should have less number of parts to reduce cost and complexity.
- 6) It should have minimum cost.

Working of coconut dehusker

The different models of sitting type manual operated coconut dehusker (pull type and push type) suitable to operate by both left hand and right handed operator were developed in the Dept. of Farm Machinery and Power Engineering, Dr. DYP CAET, Talsande Dist: Kolhapur (MS). The working of different developed models of coconut dehusker is explained as under

Pull type coconut dehusker

In order to dehusk the coconut, the coconut is impaled with both hands on the blades which were initially in juxtaposed position. Then coconut was held stable on the blades by one hand while other hand is used to pull the handle. As the handle is pulled upward the movable blade opens from the juxtaposed position and a small portion of the coconut husk is removed from coconut. This procedure needs to be repeated for 3-4 times for complete removal of husk from the coconut. For efficient dehusking, coconut shall be impaled horizontally on the wedge blades. Operator can adjust the height of the seat of stool to meet his comfort level. The handle can be attached either on the left hand side or right hand side as per the demand of the operator (Fig. 1a and 1b).

Push type coconut dehusker

The basic working of push type dehusker is similar to that of pull type dehusker except the movement of handle. The coconut is impaled with both hands on the blades which were initially in juxtaposed position, and after impaling coconut, it was held stable by one hand while the other hand is used to push the handle downwards. Due to pushing the handle downward, the movable blade opens from the juxtaposed position, to dehusk the coconut. Similar to the pull type coconut dehusker, the handle can be attached either on the left hand side or right hand side as per the demand of the operator (Fig. 2a and 2b).

Existing coconut dehusker

The working of existing model of coconut dehusker is similar to that of pull type dehusker. The operator has to perform the work in standing posture by little bending in a waist. The existing model was pull type and had handle at right hand side only with no

provision of attaching the handle either on the left hand side or right hand side as per the demand of the operator (Fig. 3a and 3b).

Performance testing of coconut dehusker

The performance of newly developed both the models of coconut dehusker was tested on the basis of output capacity and dehusking efficiency. The tests were conducted at Department of Farm Machinery and Power Engineering, Dr. D.Y.P.C.A.E.T, Talsande, in Sept.2016. The properties of coconuts used for the study are given in Table 1.

Two sitting models of coconut dehusker (pull type and push type) and one traditional standing type coconut dehusker were tested by using left handed as well as right handed operators. Three left handed and three right handed operators were used for the testing. The procedure was replicated 3 times.

Output capacity

The total dehusking time included time for coconut impaling, splitting time, unloading time and time required to remove the loosen husk. The time required for dehusking 20 coconuts with each model operated by left handed as well as right handed operators was recorded and The coconuts dehusking rate was calculated as:

Output capacity (Nuts/hr) =

$$\frac{\text{Number of coconut dehusked}}{\text{Time,hr.}} \dots (1)$$

Dehusking efficiency

Initially, the husk was weighed on the weighing balance after dehusking on the dehusker. Then the remaining husk present in coconut was removed completely from the dehusked coconut manually to know the total weight of husk.

The dehusking efficiency was calculated by the following formula.

Dehusking efficiency =

$$\frac{\text{weight of husk obtained after dehusking}}{\text{weight of total husk present in coconut}} \times 100 \dots (2)$$

Results and Discussion

Performance evaluation of newly developed coconut dehusker

The performance of newly developed sitting models of coconut dehusker (pull type and push type) and traditional standing type coconut dehusker were tested by using three left handed and three right handed operators. The observations and the values of performance parameters calculated are given in Table 2.

Performance of sitting model of pull type dehusker

The existing models of coconut dehusker have the handle to right hand side only. No coconut dehusker was found with left hand side handle. Therefore, the performance of sitting models (pull type) of coconut dehusker with handle at left hand side, operated by both left handed and right handed operator was studied and compared with sitting models (pull type) coconut dehusker having the handle at right hand side and existing standing model (pull type) of coconut dehusker (EXD) using right handed operator.

The results of performance testing are presented in Figure 4 which shows that, sitting models (pull type) coconut dehusker operated by right handed operator having the handle at right hand side (RORD) has highest output capacity (73.33 nuts/h) and it is 12.81% higher than existing standing model (pull type) of coconut dehusker using right handed operator.

At the same time it can be seen from the Figure 2 that, the output capacity of left handed operator having the handle at left hand side, (LOLD) is 71.44 nuts/h, which was at par with the output capacity of right handed operator having the handle at right hand side (RORD). Also the output capacity of left handed operator having the handle at left hand side, (LOLD) was 35.35 % higher than coconut dehusker with left handed operator having the handle at right hand side (LORD) which confirmed the provision of handle at left hand side had 35.35 % increase in output capacity of coconut dehusking.

The coconut dehusking efficiency of all the cases viz. left handed operator having the handle at left hand side (LOLD), left handed operator having the handle at right hand side (LORD), right handed operator having the handle at right hand side (RORD), and existing standing model (pull type) of coconut dehusker (EXD) using right handed operator was in the range of 94.57 to 95.86%.

The higher output capacity of coconut dehusking in case of sitting model was might be due to less pain and fatigue experienced by operator in sitting posture than the standing posture which maintained uniform rate of coconut dehusking and resulted in higher output capacity. Also higher output capacity in case of right handed operator having the handle at right hand side, (RORD) was might be due to use right hand with more strength for pulling the handle and left hand with comparatively less strength for holding the coconut on the blades of dehusker which caused delayed response of both the hand with respect to each other and required more time to dehusk the coconut. Similarly, in case of left handed operator having the handle at left hand side, (LOLD) was might be due to comparatively more strength in left hand used for pulling the handle than right hand used for holding the coconut on the blades of dehusker.

Performance of sitting model push type dehusker

The performance of sitting models (push type) of coconut dehusker with handle at left hand side, operated by both left handed and right handed operator was studied and compared with sitting models (push type) coconut dehusker having the handle at right hand side and existing standing model (pull type) of coconut dehusker (EXD) using right handed operator.

The results of performance testing are presented in Figure 3 which shows that, sitting models (push type) coconut dehusker operated by right handed operator having the handle at right hand side (RORD) has highest output capacity (79 nuts/h) and it is 21.54% higher than existing standing model (pull type) of coconut dehusker using right handed operator. At the same time it can be seen from the Figure 5 that, the output capacity of left handed operator having the handle at left hand side, (LOLD) is 77.78 nuts/h, which was at par with the output capacity of right handed operator having the handle at right hand side (RORD). Also the output capacity of left handed operator having the handle at left hand side, (LOLD) is 34.87 % higher than coconut dehusker with left handed operator having the handle at right hand side (LORD) which confirms the provision of handle at left hand side has 34.87 % increase in output capacity of coconut dehusking.

The coconut dehusking efficiency of all the cases viz. left handed operator having the handle at left hand side (LOLD), left handed operator having the handle at right hand side (LORD), right handed operator having the handle at right hand side (RORD), and existing standing model (pull type) of coconut dehusker (EXD) using right handed operator was in the range of 94.57% to 95.39%.

The reasons for the higher output capacity of coconut dehusking in case of sitting model and an increase in output capacity in case of left handed operator having the handle at left hand side, (LOLD) are as postulated in section 3.1.1.

Comparative performance of pull type and push type dehusker

The performance of sitting models (pull type and push type) of coconut dehusker operated by both left handed and right handed operators by attaching the handle on either sides was studied and compared. The comparative performance is presented in Figure 4 shows that the output capacity of push type coconut dehusker was higher than the pull type coconut dehusker in each case viz. left handed operator having the handle at left hand side (LOLD), right handed operator having the handle at left hand side (ROLD), left handed operator having the handle at right hand side (LORD), right handed operator having the handle at right hand side (RORD). At the same time, an output capacity in case of LORD and RORD was found at par and maximum for both the models (pull type and push type) of coconut dehusker. The reason for this is explained in section 3.1.1

In case of LORD and RORD, an output capacity of push type coconut dehusker was 7.73% and 8.87% higher than the pull type coconut dehusker. In case of pull type dehusker, the frame needed additional force to be applied by the legs to make it stable. Whereas in case of push type dehusker the

downward force applied on the handle (to push it for dehusking of coconut) added into the weight of the machine which increased ground reaction making the machine more stable during the operation and reduced the time required for dehusking. Hence the the output capacity of push type coconut dehusker was higher than the pull type coconut dehusker in all the cases studied. The coconut dehusking efficiency of all the cases studied was at par and found in the range of 94.57% to 95.86% (Fig. 6).

Effect of posture on performance of dehusker

The existing standing model of coconut dehusker was pull type and the handle was provided to the right hand side of the dehusker. The existing standing model had no provision of connecting the handle to either sides. Therefore to know the effect of posture on performance of dehusker, the performance of sitting model of pull type coconut dehusker operated by right handed operator with handle to right hand side only was compared with the performance of existing standing model of coconut dehusker (Fig. 7).

The graph shows that, the output capacity of sitting model (pull type) of coconut dehusker (73.33 nuts/h) was 12.81 % more than the existing standing model of coconut dehusker. Whereas, the dehusking efficiency of both the existing standing model and newly developed of sitting model (pull type) coconut dehusker was at par.

Table.1 Properties of coconuts used for the study

Parameter	Value
Variety	Banavali
Weight of coconut (gm)	286 gm
Roundness	0.63
Sphericity	0.798
Moisture content in husk (W.B) (%)	23.73

Table.2 The observations and the values of performance parameters of newly developed manually operated coconut dehusker

Type of Operator	Operator No.	Coconut dehusking rate, (Coconuts/h)					Coconut dehusking efficiency, (%)				
		Pull Type (sitting model) with handle at		Push Type (sitting model) with handle at		Existing model (standing model)	Pull Type (sitting model) with handle at		Push Type (sitting model) with handle at		Existing model (standing model)
		LHS	RHS	LHS	RHS		LHS	RHS	LHS	RHS	
Left Handed	I	71	52	77	56	54	94.16	96.91	93.22	96.07	95.77
		69	54	74	58	52	96.62	96.64	94.51	95.68	94.62
		73	55	78	57	53	96.45	93.95	95.88	95.07	92.14
	II	71	51	77	59	56	97.65	94.76	95.77	92.68	91.88
		73	52	80	57	55	96.34	96.34	92.90	96.55	94.02
		68	54	76	59	51	94.32	95.05	94.53	96.00	96.05
	III	74	51	78	61	53	91.93	94.15	94.36	96.70	94.48
		71	54	80	58	55	95.24	96.82	94.41	95.86	96.78
		73	52	80	62	54	96.72	94.54	95.56	93.88	93.06
	Average	71.44	52.78	77.78	57.67	53.67	95.49	94.57	94.57	95.39	94.31
Right Handed	I	55	72	61	79	63	92.16	95.71	95.13	96.61	94.31
		52	75	59	82	66	91.27	96.84	91.16	96.30	97.76
		53	71	60	80	64	97.10	96.92	95.77	91.28	94.02
	II	56	75	59	81	67	95.26	96.33	94.62	95.26	95.00
		53	73	62	82	65	94.94	96.50	96.05	96.91	96.91
		55	70	58	81	64	95.60	97.52	94.48	96.64	94.69
	III	56	73	57	79	65	95.07	96.62	95.56	95.13	94.02
		52	75	58	77	67	91.28	95.13	96.07	91.16	96.05
		51	74	57	80	64	95.26	91.16	94.40	95.77	94.21
	Average	56.33	73.33	58	79	65	94.21	95.86	94.80	95.01	95.22



a. Left handled model



b. Right handled model

Fig. 1 Working of Pull type coconut dehusker



a. Left handled model



b. Right handled model

Fig. 2 Working of Push type coconut dehusker



a. Left handled model



b. Right handled model

Fig. 3 Working of existing model coconut dehusker

Fig.4 Performance of sitting model of pull type dehusker

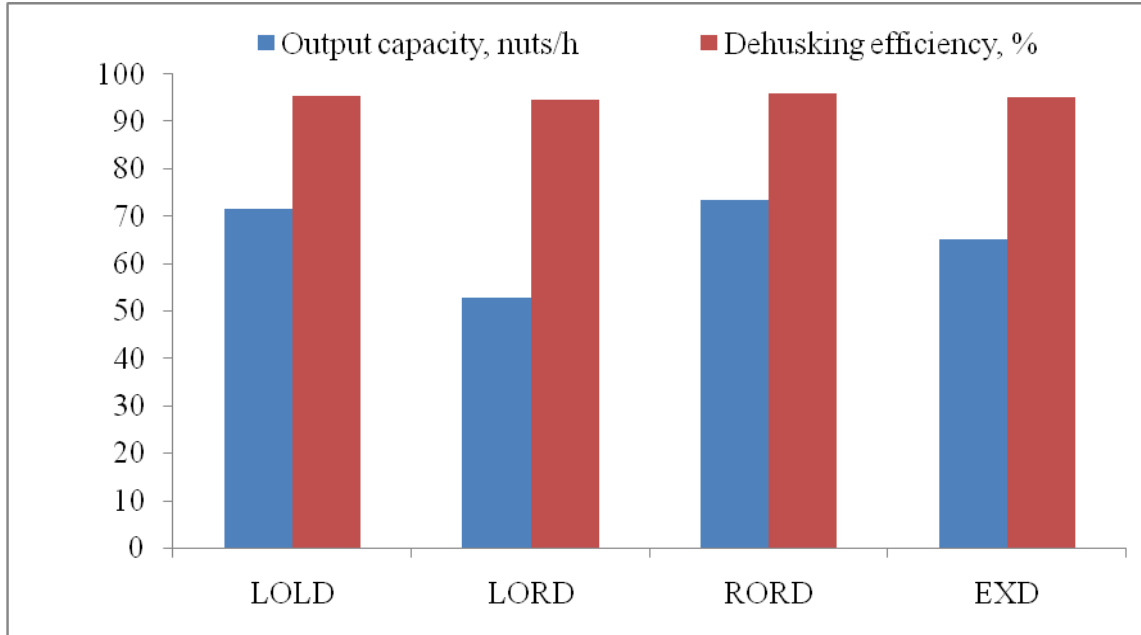


Fig.5 Performance of sitting model of push type dehusker

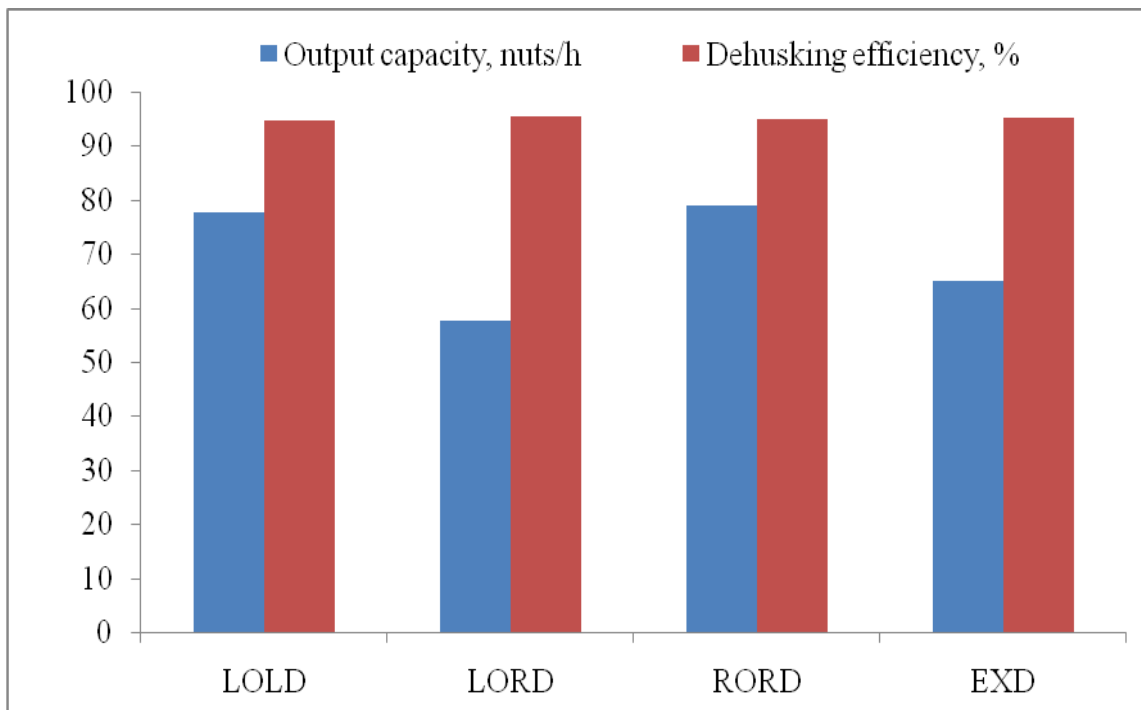


Fig.6 Comparative performance of pull type and push type dehusker

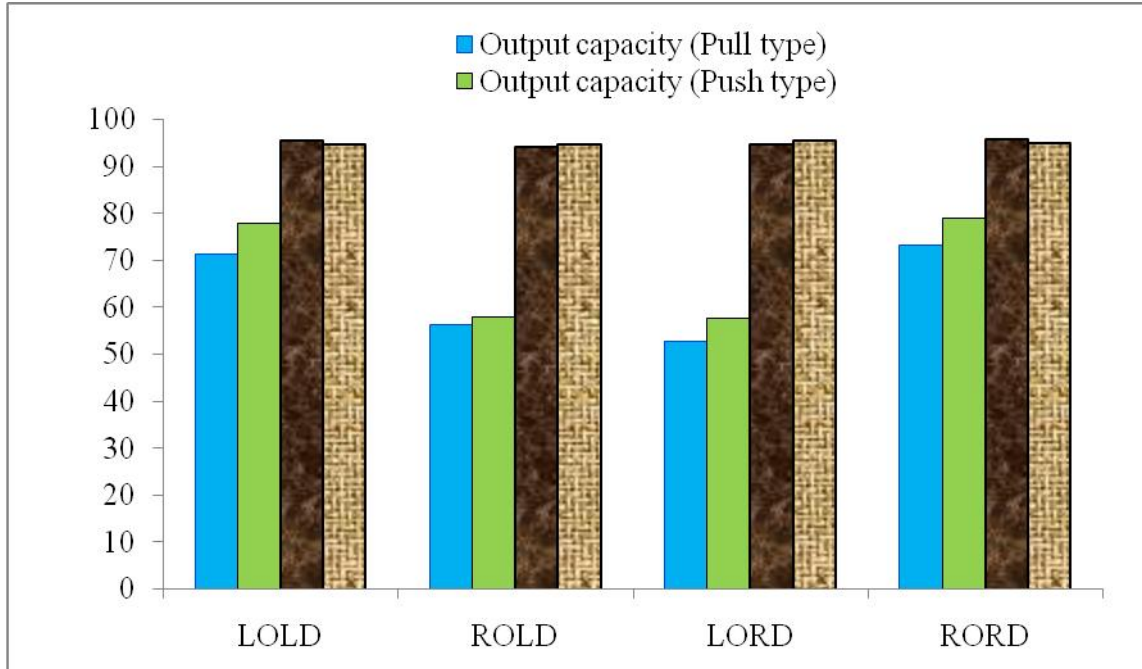
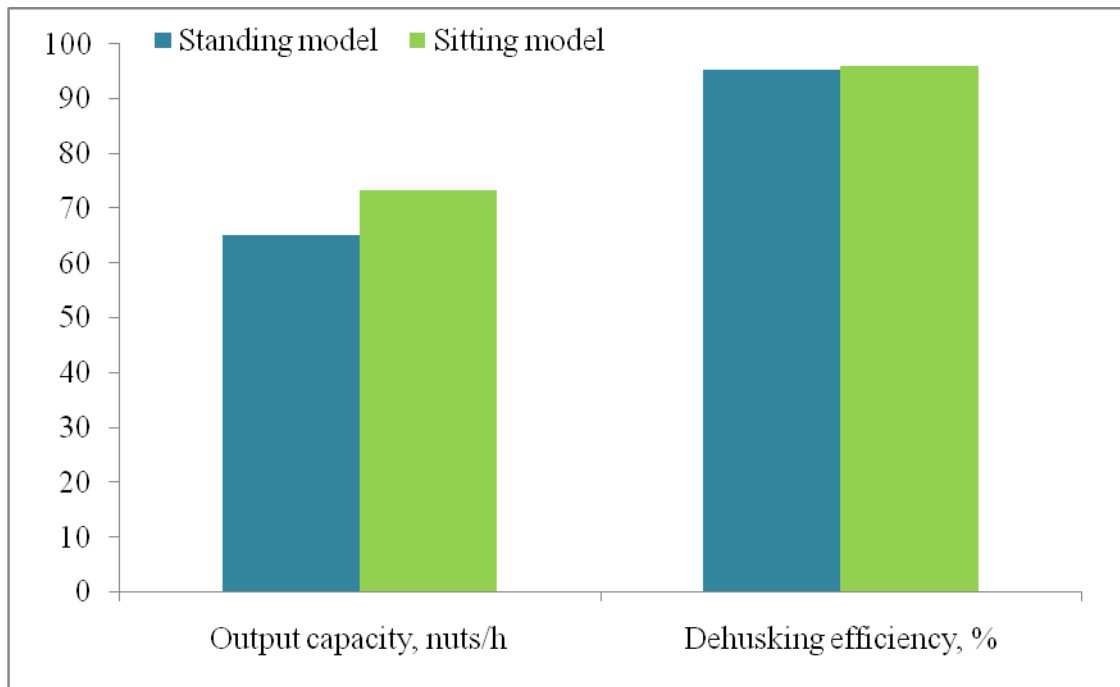


Fig.7 Effect of posture on performance of dehusker



The more output capacity in case of sitting model (pull type) of coconut dehusker was mainly due to less fatigue caused due to more comfortable posture. In case of existing standing model of coconut dehusker the bending posture during dehusking caused more pain in back causing more fatigue and resulted in lower output capacity.

It is concluded that

An output capacity of both pull type and push type coconut dehusker with left handed operator having the handle at left hand side, (LOLD) was 35.35 % and 34.87% higher than left handed operator having the handle at right hand side (LORD) respectively, which confirmed the provision of handle at left hand side had 34.87% to 35.35 % increase in output capacity of coconut dehusking.

An output capacity in case of left handed operator having the handle at left hand side, LORD and right handed operator having the handle at right hand side, RORD was found at par and maximum for both the models (pull type and push type) of coconut dehusker.

In case of left handed operator having the handle at left hand side, LORD and right handed operator having the handle at right hand side, RORD, an output capacity of push type coconut dehusker was 7.73% and 8.87% higher than the pull type coconut dehusker.

An output capacity of sitting model (pull type) of coconut dehusker (73.33 nuts/h) was 12.81 % more than the existing standing model of coconut dehusker. Whereas, the dehusking efficiency of existing and all the newly developed of sitting models of coconut dehusker was at par and found in the range of 94.57% to 95.86%.

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