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Performance Evaluation of Power Operated Coconut de-shelling Machine for different Varieties of Coconut

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ABSTRACT

Coconut de-shelling machine reduces both time and drudgery involved in the manual de-shelling process. A power operated coconut de-shelling machine, developed at ICAR-CPCRI, Kasaragod was evaluated for three varieties of coconuts namely Tiptur Tall, Kulashekhara Green Tall and West Coast Tall. The de-shelling capacity of machine, when operated by a skilled worker was found to be 141 nuts/h, 148 nuts/h and 144 nuts/h with de-shelling efficiency of 89%, 92% and 90% for Tiptur Tall, Kulashekhara Green Tall, and West Coast Tall varieties respectively. In context of, de-shelling capacity and de-shelling efficiency no significant difference among the varieties were observed and machine worked well for all three varieties.

KEYWORDS

Coconut, De-shelling capacity, De-shelling efficiency, Evaluation

INTRODUCTION

Coconut is known as "Kalpa Vriksha" as its every part is utilized in one or other way. It provides food in form of copra, drink in the form of tender-nut water, fibre for cushioning, wood is used as fuel and also in making shelter homes, it also gives us coconut oil, coconut sugar, coconut chips, virgin coconut oil, coco pit besides many other uses. Coconut is grown in different countries of the world covering around 93 countries. Major countries include India, Indonesia, Philippines and Sri Lanka which shared together major chunks of 77 and 79 percent of the world's coconut area and world's coconut production, respectively. India is the second largest producer of coconut in the world. It had a production of 16413 thousand million tonnes of coconut in the area of 20.88 lakh hectares with the productivity of 7.8 MT/ha for the year of 2017-18 (Anonymous, 2018). Coconut, Arecanut, Cashewnut, and Cocoa are the major plantation crops grown in India. As per the data available coconut covers 56% area of plantation crops and contributes 91% to the total production of the plantation crops (Anonymous, 2018). Kerala, Karnataka and Tamil Nadu are major coconut producing states, which together contributes around 84.27 percent of total coconut area and 87.17 percent of total coconut production in the country in 2017-18 (Anonymous, 2018). Kerala is the largest producer of coconut in the country with a production of 5.8 lakh million tonnes in the area of 8.07 lakh hectares followed by Karnataka and Tamil Nadu with a production of 4.3 lakh, 4.15 lakh million tonnes in the area of 5.18 and 4.41 lakh hectares respectively in 2017-18 (Anonymous, 2018). Outer cover of coconut is husk which is fibrous in nature and is used in coir industry. After primary operation of de-husking coconut comes out with hard cover called "coconut shell". This hard portion makes difficult to use coconut easily for further process of value addition. So, after de-husking of coconut de-shelling of coconut is second important process. First of all, harvested coconut is de-husked and then de-husked coconut are deshelled. Deshelled coconut is used for coconut chips making, grating preparation, oil extraction etc.

Coconut de-shelling is the second postharvest operation in coconut processing industry. De-shelling with traditional hand tools is a time consuming, cumbersome work and involves human drudgery and safety. Now-a-days, there is a shortage of workers. Keeping this in mind, a power operated coconut de-shelling machine was developed at ICAR-CPCRI, Kasaragod and evaluated for different varieties coconut, namely; Tiptur Tall, Kulashekhara Green Tall, and West Coast Tall.

Tonpe *et al*. (2014) designed and developed a power operated coconut de-shelling machine comprising of cutter with belt drive. The machine was tested for its performance based on its de-shelling capacity and de-shelling efficiency. Average de-shelling capacity and de-shelling efficiency were observed as 195 nuts/h and 90% respectively. The machine could de-shell the nuts without breakage. Singh and Udhaykumar (2006) designed and developed a power-operated coconut de-shelling machine. The deshelling capacity of the machine was observed as 400 half cups per batch, whereas de-shelling efficiency was 92%. The speed of the rotary drum was 10 rpm and it took 4 min/batch for de-shelling. Developed machine was four times faster than the manual method of de-shelling. Mondal and Prasanna (2016) developed an electric motor-powered coconut deshelling machine which

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worked on the principle that the coconut shell could be caused to fail on application of shear and compressive forces. De-shelling machine consisted of a toothed wheel, a deshelling rod, an electric motor, and a compound chain drive. The output capacity of the machine was found to be 24 coconuts/h with 95 % of the total time effectively used for deshelling. The developed coconut deshelling machine was recommended for the minimum annual use of 200 h or deshelling of 4700 coconuts per year.

This study was conducted to evaluate the capacity and efficiency of the coconut de-sheller developed by ICAR-CPCRI, Kasaragod, Kerala so that recommendation for coconut farmers may be provided.

MATERIALS AND METHODS

Description of coconut de-sheller

Coconut de-sheller (Fig. 1) consisted of an electric motor of 1 hp capacity as prime mover running with 1440 rpm and fitted at the bottom of the machine. A gear reduction and chain-sprocket arrangement were used to reduce the rpm of a horizontal shaft to the level of 24 rpm. Two concentrically circular blades having 24 numbers of teeth, rotating at 24 rpm and a stationary shaft on which coconut was placed, were the major components of the de-shelling machine. Coconut to be processed was pressed towards the rotating blades by firmly placing on the stationary shaft. Shell get detached from the kernel due to the impact force of the rotating blade.

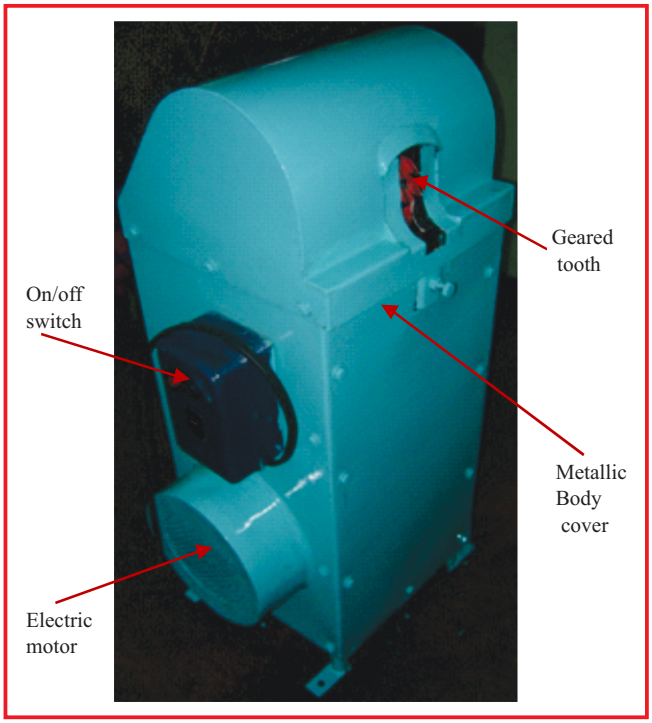
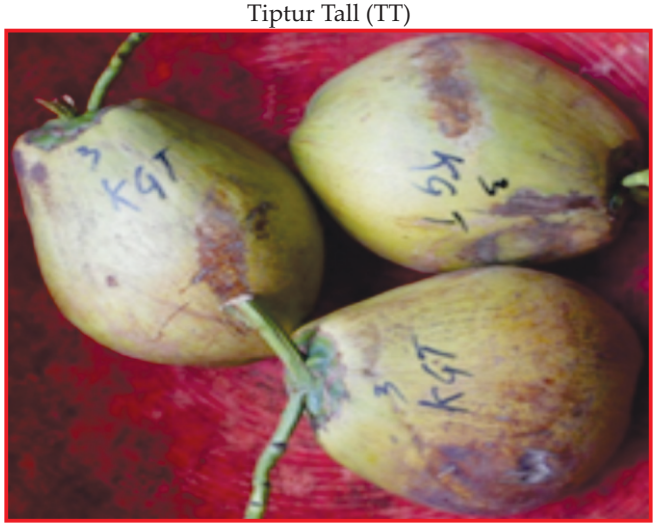


Fig. 1: Coconut de-shelling machine

Evaluation of coconut de-sheller

ICAR-CPCRI developed power operated coconut de-sheller was evaluated for its performance for three varieties of coconut namely Tiptur Tall (TT), Kulashekhara Green Tall (KGT) and West Coast Tall (WCT) (Fig. 2). Firstly, coconuts were de-husked and de-husked coconuts were taken for testing of de-shelling machine (Fig. 3).

Tiptur Tall (TT)



Kulashekhara Green Tall (KGT)

West Coast Tall (WCT)

Fig. 2: Different coconut varieties tested for de-shelling

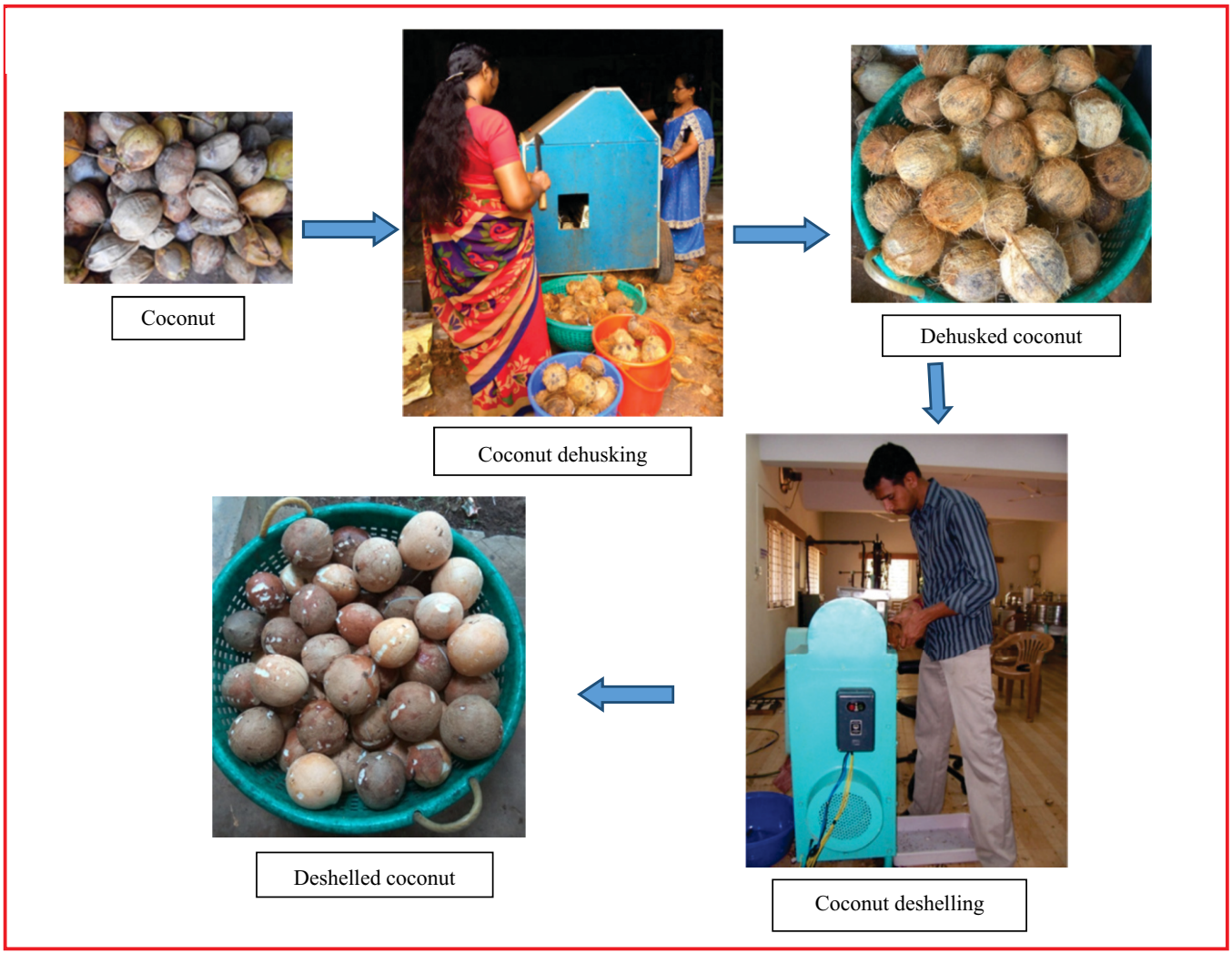


Fig. 3: Coconut de-shelling process flow diagram

In order to evaluate the performance of developed coconut de-sheller, the deshelling capacity and deshelling efficiencies were determined. Initially three varieties coconuts were de-husked using ICAR-CPCRI, developed de-husker, then de-husked coconuts were deshelled on coconut de-sheller. For evaluation 30 de-husked coconuts of each variety were taken in three replications each and time was noted down using stop watch. De-husking capacity and de-husking efficiency were determined by the following relation (Tonpe *et al*., 2014):

$$Deshelling\ capacity, \frac{coconuts}{h} = \frac{Total\ no.of\ nut\ deshelled}{time\ taken(h)} \quad \ldots (1)$$

$$Deshelling\ efficiency\ (\%) = \frac{Na}{Nt} \times 100 \quad \ldots (2)$$

Where,

N_a= number of well deshelled nuts without distortion on the length of the Shell extract, and N_t= number of well deshelled nuts with distorted husk extract

RESULTS AND DISCUSSION

Results of performance evaluation of three varieties namely; Tiptur Tall (TT), Kulashekhara Green Tall (KGT) and West Coast Tall (WCT) were determined in terms of de-shelling capacities and de-shelling efficiencies.

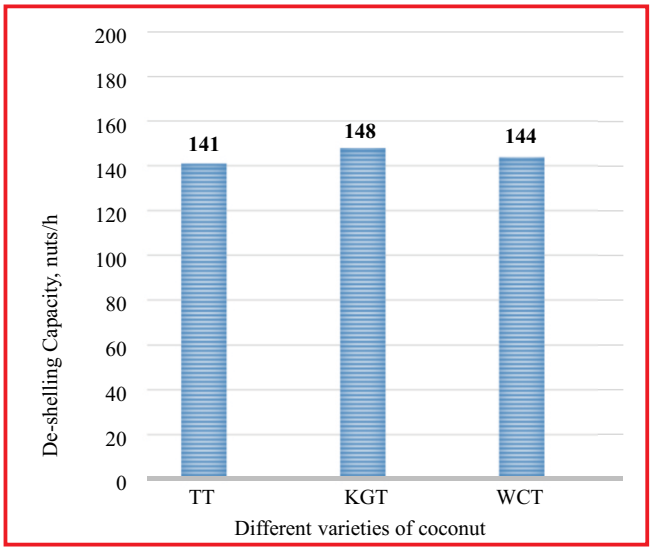


Fig. 4: De-shelling capacities of different varieties of coconut

Table 1: Analysis of Variance (ANOVA) for de-shelling capacity

Source	Degree of Freedom	Sum of Squares	Mean Sum	F-Value	Probability
Total	8	236.000000	29.500000		
Replication	2	48.666667	24.333333		
Treatment	2	74.000000	37.000000	1.3059	0.366
Error	4	113.333333	28.333333		

SEd= 4.3461, CD (.05)=12.0670, CD(.01)= 20.0117, CV% =3.70

Table 2: Analysis of Variance (ANOVA) for de-shelling efficiency

Source	df	SS	MS	F	P
Total	8	201.555556	25.194444		
Replication	2	93.555556	46.777778		
Treatment	2	10.888889	5.444444	0.2243	0.809
Error	4	97.111111	24.277778		

SEd =4.0231, CD (.05) =11.1700, CD (.01) =18.5242, CV%= 5.46

De-shelling capacity

De-shelling capacities of Tiptur Tall (TT), Kulashekhara Green Tall (KGT) and West Coast Tall (WCT) were observed as 141, 148, and 144 nuts/h (Fig. 4), respectively. Deo *et al.*, 2020 reported de shelling capacity of 155-193 nuts/h for medium and large sized WCT coconut variety. An Analysis of variance (Table 1) of de-shelling capacities showed that de-sheller performed similarly for all three varieties and there is no significant difference (P<0.05) observed among de-shelling capacities for all three varieties.

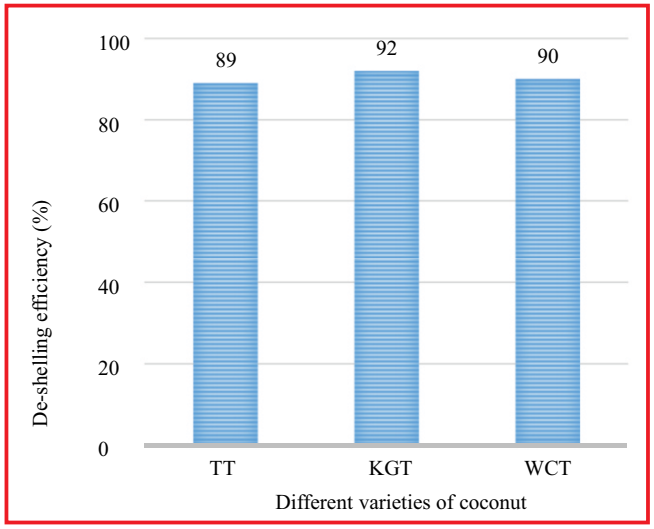


Fig. 5: De-shelling efficiencies of different varieties of coconut

De-shelling efficiency

De-shelling efficiencies of Tiptur Tall (TT), Kulashekhara Green Tall (KGT) and West Coast Tall (WCT) were observed as 89, 92, and 90% (Fig. 5), respectively. Analysis of variance (Table 2) of de-shelling efficiencies showed that de-sheller performed similarly for all three varieties and there is no significant difference (P<0.05) observed among de-shelling efficiencies for all three varieties.

CONCLUSION

De-shelling capacity of Tiptur Tall, Kulashekara Green Tall and West Coast Tall varieties of coconuts were observed as 141 nuts/h, 148 nuts/h and 144 nuts/h with de-shelling efficiency of 89%, 92% and 90%, respectively. There was no significant difference observed in de-shelling capacity and de-shelling efficiency of different varieties of coconuts. De-shelling machine worked well for all the three varieties. The machine can be recommended for coconut farmers.

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