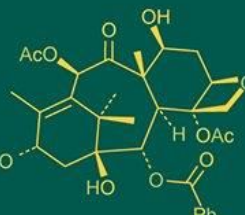


## International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693  
ISSN Online: 2617-4707  
NAAS Rating: 5.29  
IJABR 2025; SP-9(3): 394-396  
[www.biochemjournal.com](http://www.biochemjournal.com)  
Received: 08-12-2024  
Accepted: 12-01-2025

**Jaspal Singh**

Department of APFE,  
SVCAET & RS, FAE,  
I.G.K.V., Raipur,  
Chhattisgarh, India

**Rajesh Naik**

Department of FMPE,  
SVCAET & RS, FAE,  
I.G.K.V., Raipur,  
Chhattisgarh, India

**S Patel**

Department of APFE,  
SVCAET & RS, FAE,  
I.G.K.V., Raipur,  
Chhattisgarh, India

## Performance evaluation of design and developed char (*Buchanania lanzan*) sheller machine

**Jaspal Singh, Rajesh Naik and S Patel**

**DOI:** <https://www.doi.org/10.33545/26174693.2025.v9.i3Sf.3992>

**Abstract**

The machine was tested by decortications of chironji seeds (sample weight = 10 kg) in the laboratory as well as in the field. The laboratory tests showed that the hulling efficiency of chironji decorticator in feeding pass 7<sup>th</sup> was highest 80% followed by 78.78%, 75.44%, 68.06%, 56.01%, 39.38% and 21.2% for passes 6<sup>th</sup>, 5<sup>th</sup>, 4<sup>th</sup>, 3<sup>rd</sup>, 2<sup>nd</sup> and 1<sup>st</sup> respectively. The unit price of the experimental prototype was Rs. 65000/-.

**Keywords:** Performance, evaluation, chironji decorticator, hulling, milling, efficiency, coefficient, fractions and husk

**Introduction**

The fruit is worth less to lenders compared to the kernel, so lenders usually grind the seed to benefit the kernel. For example, 5 kg of fruit can produce around 1 kg of chironji. Each tree can yield three to four kilograms of chironji, which is sold to the village buyers for a fee of Rs. 707.25 per kilogram. As a result, a dedicated farmer who owns five timber trees can earn approximately Rs.1500 by selling chironji every three and a half months. The cost of chironji in the nationwide market has been approximately Rs. 3454-1200 per kilogram (ntfp). The chironji nut has gained popularity in distant markets, leading to its cultivation becoming an essential crop. Therefore, to earn foreign exchange the government and personal groups have evinced eager hobby in growing this enterprise corporation, each by way of way of manner of developing its production and processing functionality. The presence of hard seed coat is one of the shelling issues in decortications of nuts, its small period permit's to harm the seed at the time of decortications and harm the seeds which reduce its finances friendly fee and additionally go to pot the shelf lifestyles of it which leads to low storage balance (Singh, 2012) [6]. traditional processing technique chironji is probably very bulky, time consuming and labour huge There can be a lot of recovery of whole kernel, nearly 40% rest is every broken and mashed. The processing method may result in significant loss, not only in terms of technique efficiency but also in the loss of essential nutrients. Additionally, due to the fact that the technique involves extensive labor, the processing cost will be more favorable (Kumar, 2007) [3].

**Materials and Methods**

The have a have a look at emerge as done in swami Vivekananda college of agricultural engineering and generation and research station, college of agricultural engineering, igkv, raipur (cg) located at 21° 14' 02' n range and 81° 3' 11' e longitude. The operational challenge was determined from the demonstration / study location of the university. the raw fabric chironji emerge as amassed from one-of-a-type area of the Chhattisgarh for the present research The fabric became nicely smooth and dry after being removed from the outer skins or pulps of chironji seeds, resulting in a uniform pattern. They were meticulously cleaned by hand to eliminate any foreign topics and other impurities, such as stones.

**Milling Efficiency Parameters**

The chironji seed was used for decortications as part of a laboratory experiment to determine its moisture content. The samples had undergone decortications /shelling in a decorticator. The feed rate remained consistent throughout the decortication process, which was adjusted

**Corresponding Author:****Jaspal Singh**

Department of APFE,  
SVCAET & RS, FAE,  
I.G.K.V., Raipur,  
Chhattisgarh, India

by setting the metering mechanism of the decorticator to the lowest level of the feed hopper. A pattern duration similar to 10 kg of chironji seeds fed to the decorticator has consistent walking parameters. The milling parameters were determined using the method described by Kate *et al.* (2003) [2].

### Decortication efficiency

The overall efficiency of the decortication was calculated by Kupritz formula, by the following expression.

$\eta$  (%) = coefficient of decortication ( $E_d$ )  $\times$  coefficient of wholeness of kernel ( $E_{wk}$ )

### Coefficient of decortication

$$E_d(\%) = 100 \left( 1 - \frac{n_2}{n_1} \right)$$

### Coefficient of wholeness of kernel

$$E_{wk} = \frac{k_2 - k_1}{(k_2 - k_1) + (d_2 - d_1) + (m_2 - m_1)}$$

Where,

$\eta$  = Overall decortication efficiency, (%);

$E_d$  = Coefficient of decortication, (%);

$E_{wk}$  = Coefficient of wholeness of kernels;

$n_1$  = Amount of undecorticated pits before decortifications, (g);

$n_2$  = Amount of undecorticated pits after decortifications, (g);

$k_1$  = Amount of whole pits after decortifications, (g);

$k_2$  = Amount of whole pits before decortifications, (g);

$d_1$  = Contents of broken kernels before decortifications, (g);

$d_2$  = Contents of broken kernels after decortifications, (g);

$m_1$  = Weight of decortication waste before decortifications, (g); and

$m_2$  = Weight of decortication waste before and after decortifications, (g).

### Broken kernel percentage

$$B_r(\%) = \frac{\text{Weight of broken kernels}}{\text{Weight of total kernel}} \times 100$$

### Husk percentage

$$H(\%) = \frac{\text{Weight of husk after decoortication}}{\text{Weight of sample}} \times 100$$

Husk% becomes decided at the quit of every run. the quantity of shells winnowed out and those gathered with the kernels have been stated. The checks had been conducted using a factorial design involving 4 moisture tiers within the variety of 6.2-28% (dry foundation), 4 feed rates in the range of 11.4-45.2 kg/h. every check turned into repeated three instances and the common values of the above numbers of nut were recorded. The statistics acquired had been analyzed to decide the effect of moisture content, feed charge and disc configuration (Oluwole *et al.*, 2004) [5].

### Capacity

Output capacity (kg/h) was determined by the following equations:

#### (a) Percentage effective cracking

$$E_r \approx \frac{N_1}{N_T} \times 100$$

#### (b) Percentage of breakage

$$\eta_b \approx \frac{[N_2 + N_4]}{N_T} \times 100$$

#### (c) Percentage partially cracked

$$\eta_p \approx \frac{[N_3 + N_4]}{N_T} \times 100$$

#### (d) Percentage of uncracked nuts

$$\eta_b \approx \frac{N_5}{N_T} \times 100$$

Where,

$N_1$  = Numbers of nuts that was completely cracked and unbroken;

$N_2$  = Numbers of nuts completely cracked but broken;

$N_3$  = Numbers of nuts partially cracked and unbroken;

$N_4$  = Numbers of nuts partially cracked but broke;

$N_5$  = Numbers of un-cracked nuts; and

$N_T$  = Total numbers of nuts.

## Results and Discussions

### 1 Hulling Efficiency ( $\eta_h$ ) %

#### 1. Fractions of hulled *chironji* seeds

The pattern of 10 kg chironji seeds is used for the decortications in chironji decorticator. The rate and feed fee remained constant throughout the entire decortication process. The ten kg pattern transformed into a feeder and its metering tool opened up to allow the seeds to be fed into the decorticator for the decortication process. After the decortications, the seeds were examined at different stages, including unhulled seeds, entire kernels, broken kernels, husk, and dust. These fractions were separated using a sieve or a grater. The sieve/grader became connected with the decorticator, resulting in the separation of fractions from the sieve/grader's outlet. This allowed for the completion of the first bypass. After the initial evaluation and reweigh of all the fractions. To complete the decortications of 10 kg chironji seeds, seven passes were necessary. Additionally, a previous evaluation was required for the final all passes. The weight and time limits are gradually reduced after each skip. The entire chironji kernels, broken, husk, and dust/mealy waste of kernels were transformed into a valuable yield. 14.22% 14.41%, 82.forty one% and 9.28% respectively is proven in Table.

**Table 1:** Fractions of hulled 10 kg *chironji* seeds sample in seven passes

| Sample Fractions            | 1 <sup>st</sup> pass (kg) | 2 <sup>nd</sup> Pass (kg) | 3 <sup>rd</sup> Pass (kg) | 4 <sup>th</sup> pass (kg) | 5 <sup>th</sup> pass (kg) | 6 <sup>th</sup> pass (kg) | 7 <sup>th</sup> Pass (kg) | Total weight (kg) |
|-----------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|-------------------|
| Whole <i>Chironji</i> Seeds | 10.000                    | 7.500                     | 5.300                     | 3.300                     | 1.800                     | 0.800                     | 0.300                     | 0.00              |
| <i>Chironji</i> Kernel      | 0.386                     | 0.315                     | 0.294                     | 0.225                     | 0.130                     | 0.050                     | 0.022                     | 1.422             |
| Broken                      | 0.039                     | 0.038                     | 0.035                     | 0.033                     | 0.031                     | 0.019                     | 0.010                     | 0.205             |
| Husk                        | 2.045                     | 1.819                     | 1.646                     | 1.209                     | 0.823                     | 0.422                     | 0.277                     | 8.241             |
| Dust/Mealy Waste of kernels | 0.030                     | 0.028                     | 0.025                     | 0.021                     | 0.016                     | 0.009                     | 0.003                     | 0.132             |
| Total                       |                           |                           |                           |                           |                           |                           |                           | 10.00             |

## 2. Hulling efficiency of *chironji* seeds

From the Table 2 the hulling efficiency of *chironji* decorticator was highest after 7<sup>th</sup> pass 80% followed by 78.78%, 75.44%, 68.06%, 56.01%, 39.38% and 21.2% for passes 6<sup>th</sup>, 5<sup>th</sup>, 4<sup>th</sup>, 3<sup>rd</sup>, 2<sup>nd</sup> and 1<sup>st</sup> respectively. The

coefficient of hulling was increased after each pass but the coefficient of wholeness of kernel was reduced after each pass. The hulling efficiency was increased after each pass significantly.

**Table 2:** Hulling efficiency of *chironji* seeds

| S. N. | Coefficient of hulling<br>$E_h = 100 \left(1 - \frac{n_2}{n_1}\right)$ | Coefficient of wholeness of kernel<br>$E_{wk} = \frac{k_2 - k_1}{(k_2 - k_1) + (d_2 - d_1) + (m_2 - m_1)}$ | Hulling efficiency<br>$\eta (\%) = E_h \times E_{wk}$ |
|-------|------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| 1     | 25.0                                                                   | 0.846                                                                                                      | 21.20                                                 |
| 2     | 47.0                                                                   | 0.838                                                                                                      | 39.38                                                 |
| 3     | 67.0                                                                   | 0.836                                                                                                      | 56.01                                                 |
| 4     | 82.0                                                                   | 0.830                                                                                                      | 68.06                                                 |
| 5     | 92.0                                                                   | 0.820                                                                                                      | 75.44                                                 |
| 6     | 97.0                                                                   | 0.812                                                                                                      | 78.76                                                 |
| 7     | 100.0                                                                  | 0.808                                                                                                      | 80.80                                                 |

The 10 cm clearance was maintained between stone discs during decortications of *chironji* seeds. The disc was revolved constant 240 rpm speed an entire duration of decortications process. Throughout the capacity of machine

80 kg/h was yield. The individual hulling efficiency was found to be after each pass and overall hulling efficiency was yield due to the mixing of one pass to another to each other respectively is shown in Table 3.

**Table 3:** Comparison between individual hulling efficiency and overall hulling efficiency

| S. N. | Shelling disc (rpm) | Clearance between stone disc (m) | Capacity (Kg/h)    | Decortications efficiency, % |                      |                      |                      |                      |                      |                      |                      |
|-------|---------------------|----------------------------------|--------------------|------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|       |                     |                                  |                    |                              | 1 <sup>st</sup> pass | 2 <sup>nd</sup> pass | 3 <sup>rd</sup> pass | 4 <sup>th</sup> pass | 5 <sup>th</sup> pass | 6 <sup>th</sup> pass | 7 <sup>th</sup> pass |
| 1.    | 240                 | 0.10                             | 80                 | Efficiency                   | 25.0                 | 29.3                 | 37.7                 | 45.5                 | 55.5                 | 62.5                 | 100.0                |
|       |                     |                                  | Overall efficiency |                              | 25.0                 | 47.0                 | 67.0                 | 82.0                 | 92.0                 | 97.0                 | 100.0                |

## Conclusion

The decortication process of *chironji* seeds, using a pattern of 10 kg and maintaining a constant feed rate, required seven passes to achieve optimal separation of kernels and by-products. Each pass showed an increase in hulling efficiency, reaching a maximum of 80% by the 7th pass. While hulling efficiency improved with each pass, the coefficient of kernel wholeness declined. The machine, operating at a consistent speed of 240 rpm and with a 10 cm clearance between stone discs, yielded an overall capacity of 80 kg/h. These results demonstrate the effectiveness of the decorticator in optimizing seed processing.

## References

1. Anonymous. Special issue dedicated to cashew processing and marketing. Food Chain: The International Journal of Small-Scale Food Processing; 2001.
2. Kate AE, Lohani UC, Shahi NC, Pandey JP. Optimization of machine parameters of wild apricot pit decorticator using response surface methodology. International Agricultural Engineering Journal. 2013;22(1):27-33.
3. Kumar J, Srivastav PP, Bhowmick PK. Traditional processing and some properties of *chironji* nut

(*Buchanania lanzan*) and kernel. Presented at: National Workshop CIPHET; 2007; Ludhiana. p. 20-26.

4. Mehta MH. Conservation of *chironji* and cultivation of off-season rainfed tomato. Current Science. 2011;96(10):1297.
5. Oluwole FA. Development and performance tests of a sheanut cracker. Journal of Food Engineering. 2004;65:117-123.
6. Singh J, Chauhan PS, Kavita A. Morphology and features of seeds of different species of dry deciduous forest of Malwa plateau region. Indian Forester; 2012