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Design & Fabrication of Kokum Cutting Machine

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ABSTRACT

Kokum (scientific name: Garcinia indica) is an important fruit widely grown in the coastal regions of Maharashtra, Goa, and Karnataka. It is commonly used in food products such as kokum syrup, dried kokum (amsul), and traditional beverages. In small-scale industries and rural areas, the cutting of kokum fruits is generally carried out manually using knives. This traditional method requires significant human effort, consumes more time, and may lead to inconsistent cutting and possible injuries to workers. To overcome these limitations, a semi-automatic kokum cutting machine is designed and developed to improve productivity and efficiency. The proposed machine consists of a feeding hopper, rotating shafts, cutting blades, frame structure, and an electric motor. The kokum fruits are fed through the hopper and move between rotating shafts where sharp blades cut the fruit into halves. The semi-automatic mechanism reduces manual labor and ensures uniform cutting of fruits. The machine is simple in construction, easy to operate, and suitable for small-scale food processing units. The main objective of this project is to increase cutting efficiency, reduce processing time, and improve safety compared to the traditional manual method. The developed kokum cutting machine can help farmers and small industries process large quantities of kokum fruits with better productivity and reduced labor cost.

***Keywords*: Garcinia indica, Fruit processing, Marketing, Employment, Kokum wine, Dilution levels, pH levels, Capital investment, Cost and returns, Value addition, Kokum fruits**

1. INTRODUCTION

Kokum (scientific name: Garcinia indica) is an important fruit widely grown in the coastal regions of Maharashtra, Goa, and Karnataka in India. It is commonly used in food products, beverages, and traditional medicine because of its sour taste and health benefits. For processing kokum into products such as dried kokum (amsul) and kokum syrup, the fruit must first be cut and the seeds removed. Traditionally, kokum cutting is done manually using knives or small hand cutters. This manual process requires significant human effort and time, especially when large quantities of fruits are processed during the harvesting season. The traditional cutting method is also labor-intensive and may lead to uneven cuts, lower productivity, and risk of hand injuries. To overcome these challenges, the development of a semi-automatic kokum cutting machine becomes necessary. The semi-automatic system is designed to reduce human effort while improving cutting efficiency and uniformity. It combines mechanical components with simple automation to perform the cutting operation faster and more safely than manual methods. The machine helps small-scale processors and farmers increase productivity and maintain consistent quality of kokum pieces. Additionally, it reduces processing time and improves overall operational efficiency. Therefore, designing a semi-automatic kokum cutting machine is an important step toward modernization of small-scale kokum processing industries.

1.1 Traditional Method of Cutting Kokum

Traditionally, workers collect ripe kokum fruits and wash them. Each fruit is then cut manually using a knife, usually into two halves, to remove the seed. After seed removal, the outer rind is further cut and dried in sunlight to produce kokum (amsul). This process is slow, requires skilled labor, and is not suitable for large-scale production.

Fig- 1 Traditional Kokum Cutting process

2. LITERATURE REVIEW

Sonali P. Pawaskar et al. [1] The study focused on kokum fruit processing and highlighted that cutting is a crucial step before rind and seed separation. It was observed that manual cutting is still widely practiced and is time-consuming. The research emphasized the need for a mechanized kokum cutter to improve efficiency and reduce labour efforts.

K. Shinde et al. [2] This paper examined kokum's physicochemical properties, such as acidity, pigment content, and moisture level, which influence its processing and storage. The fin

dings showed that maintaining quality during processing depends on proper cutting and handling, supporting the idea of developing an efficient cutting mechanism that prevents damage to the fruit's nutritional content.

S. R. Naik et al. [3] The authors studied the production of kokum wine and found that cutting plays an important role in juice extraction and fermentation quality. Their research indirectly indicated that a uniform cutting process ensures consistent juice yield and better product quality, emphasizing the importance of mechanization in the cutting stage.

S. R. Patil et al. [4] This research discussed kokum fruit characteristics and various value-added products derived from it. The authors noted that a lack of proper machinery limits large-scale processing in rural areas, suggesting that an affordable and efficient cutting machine would help small-scale processors increase productivity and reduce post-harvest losses.

A.M. Jagtap et al. [5] The study explored kokum fruit utilization and processing steps. It pointed out that due to manual cutting, production speed and uniformity are compromised. The authors suggested that mechanization could significantly enhance cutting precision and product quality while saving time and labour.

3. PROBLEM STATEMENT

Kokum (scientific name: Garcinia indica) is an important fruit crop widely grown in the coastal regions of Maharashtra, Goa, and Karnataka. It is commonly used for preparing food products such as kokum syrup, beverages, and dried kokum (amsul). Before these products can be made, the kokum fruit must be properly cut and the seeds must be removed. In many small-scale processing units and rural areas, this cutting process is still carried out manually using knives or simple hand tools.

The traditional method of cutting kokum fruits is time-consuming and requires a large amount of manual labor. Workers have to cut each fruit individually, which reduces the overall productivity when processing large quantities of kokum during the harvesting season. In addition, manual cutting may result in uneven sizes of kokum pieces, which can affect the quality of the final processed product. Another important issue is the safety of workers, as continuous use of sharp knives may lead to hand injuries and fatigue.

Due to these problems, farmers and small-scale industries face difficulties in processing kokum fruits efficiently and economically. The lack of a suitable and affordable machine for kokum cutting increases labor costs and slows down the production process. Therefore, there is a need to design and develop a **semi-automatic kokum cutting machine** that can improve the speed and uniformity of cutting while reducing manual effort. The machine should be simple in construction, safe to operate, cost-effective, and suitable for small-scale food processing units. Such a machine will help increase productivity, reduce labor dependency, and improve the overall efficiency of kokum processing0

4. OBJECTIVES OF PROJECT

1. To ensure uniform and precise slices for better product quality.
2. To reduce labor dependency and operational costs.
3. To improve worker safety by minimizing manual knife use.
4. To minimize post-harvest losses and wastage of kokum fruits.

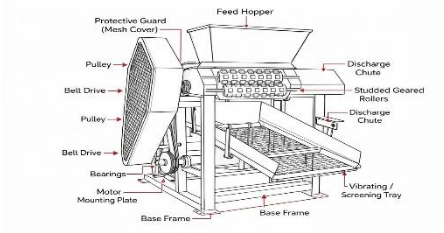

Fig. 2- Skematic Diagram Of Machine

5. WORKING OF KOKUM CUTTING MACHINE

The working principle of this industrial crushing machine is based on **mechanical reduction** through high-torque shearing and gravity-assisted filtration.

i. Material Intake

The process begins at the **Feed Hopper**, where raw material is introduced into the system. Gravity directs the material downward toward the primary processing zone.

ii. Power Transmission

A motor (not fully shown, but indicated by the **Motor Mounting Plate**) provides the initial rotational energy. This energy is transferred via the **Belt Drive** and **Pulleys** to the **Main Shaft**. This belt-and-pulley system allows the machine to convert high-speed motor rotation into the high-torque rotation necessary for crushing heavy materials.

iii. Cutting and Crushing Mechanism

Inside the **Cutting / Crushing Chamber**, the mechanical reduction occurs:

- **Rotational Shearing:** The **Studded Geared Rollers** (attached to the cutting shafts) rotate against each other or against static components.
- **Size Reduction:** The studs or "teeth" on the rollers grip, tear, and crush the material, breaking it into smaller fragments.

iv. Discharge and Screening

Once the material is processed, it exits through the **Discharge Chute**:

- **Primary Sieve:** Smaller particles fall through an internal sieve directly onto the **Vibrating / Screening Tray**.
- **Final Filtration:** The vibrating motion of the tray further sorts the material. Fine particles pass through the mesh of the tray, while any remaining larger debris is moved toward the final discharge point for collection or re-processing.

v. Safety and Stability

Throughout operation, the **Protective Guard** ensures that operators are shielded from the moving belt drives. The entire process is stabilized by the **Base Frame**, which is bolted to the floor to absorb the significant vibrations generated by the crushing action.

6. DESIGN CALCULATIONS

i. Input Parameters

First, we establish the known variables.
Power (P) = 1 hp ≈ 0.746 kW
Motor Speed (N1) = 1440 RPM (Typical 4-pole motor)
Machine Speed (N2) = 240 RPM (Assumed for 6:1 reduction)
Service Factor (Fs) = 1.2 (Normal duty for agricultural machinery)

Design Power:

$Pd = P \times Fs$

Pd = **0.895 kW**

Design Power is 0.895 KW.

ii. Pulley Diameters

To achieve the speed reduction, we calculate pulley diameters.

Small Pulley (d) = 50 mm (standard value chosen)

Large Pulley (D)

$D = d \times (N1 / N2)$

D = **300 mm**

Diameter od Pulley is 300 mm.

iii. Belt Selection and Velocity

For a 0.75 kW motor, an **A-section V-belt** is suitable.

Belt Velocity (v)

$v = (\pi \times d \times N1) / (60 \times 1000)$

v = 3.76 **m/s**

This value is well below the maximum safe V-belt speed of 25 m/s.

iv. Center Distance and Belt Length

For a compact machine, choose center distance:

$D < C < 3(D + d)$

Assume:

C = **360 mm**

Pitch Length (L)

$L = 2C + (\pi/2)(D + d) + (D - d)^2 / (4C)$

L = **44.28 mm ~ 46 mm**

Standard belt length selected:

46 mm or 48 mm A-section belt

v. Arc of Contact and Tension

Angle of Wrap (θ)

$\theta = 180 - 2 \times \sin^{-1}((D - d) / (2C))$

θ = **139.36°**

Convert to radians:

$\theta = 139.36 \times \pi / 180$

θ = **2.43 rad**

Tension Ratio

Using friction coefficient $\mu = 0.3$

Half groove angle $\alpha = 20°$

$T1 / T2 = e\verb|^|(\mu\theta / \sin \alpha)$

T1 / T2 = **8.42**

vi. Final Belt Tension

Net Driving Force

$T1 - T2 = (P \times 1000) / v$

T1 − T2 ≈ **198.4 N**

Using

T1 = 19.8 T2

Solving:

T1 = **225 N**

T2 = **26.7 N**

Final Results

Small Pulley Diameter = **50 mm**

Large Pulley Diameter = **300 mm**

Centre Distance = **360 mm**
Belt Length = **46 mm**
Belt Type = **A-Section V-belt**
Tight Side Tension (T1) = **225 N**
Slack Side Tension (T2) = **26.7 N**

7. CONCLUSION

The kokum cutting machine makes the cutting process much easier compared to doing it by hand. It saves time, reduces physical effort, and produces slices that are neat and uniform. Because of this, the quality of the final product improves, and the process becomes more hygienic. Overall, the machine is very helpful for farmers and small businesses as it increases efficiency and reduces wastage.

Another advantage of the machine is that it allows a larger quantity of kokum to be processed in less time. Cutting kokum manually can be slow and tiring, especially during the harvesting season when there is a large amount of fruit to process. By using the machine, workers can complete the task faster with less strain. The slices are also more consistent in thickness, which helps them dry more evenly and maintain better quality.

The machine is also simple to operate and does not require complicated maintenance. This makes it suitable for use in rural areas and small processing units where advanced equipment may not always be available. Since the work becomes easier and faster, farmers and small entrepreneurs can manage their production more effectively.

In the long run, using a kokum cutting machine can help improve productivity and reduce manual labor. It supports farmers and small businesses by making the processing of kokum quicker, cleaner, and more reliable, while also helping them meet market demand more easily.

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