KWARA STATE POLYTECHNIC

DESIGN AND FABRICATION OF CASSAVA GRATING MACHINE

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CERTIFICATION

The undersigned certify that this project report titled; **DESIGN AND FABRICATION OF CASSAVA GRATING MACHINE** prepared by **ALEGE SAHEED BABATUNDE** with matriculation number **HND/23/MEC/FT/0168** meets the requirement for the award of Higher National Diploma (HND) in the Department of Mechanical Engineering, Kwara State Polytechnic, Ilorin, and approved for its contribution to knowledge and literacy presentation.

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DEDICATION

This project report is dedicated to Almighty God, the Most Beneficent and Merciful, who has protected me throughout the duration of this academic programme. It is also dedicated to my parents. May Almighty God grant them peace in this life and the hereafter for their unwavering financial and moral support.

ACKNOWLEDGMENT

My sincere gratitude goes to Almighty God, who created me for His glory and granted me protection, knowledge, and life throughout this program. May His name be glorified forever, Amen.

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I extend my appreciation to the entire staff of the Department of Mechanical Engineering, as well as all other individuals who contributed, in one way or the other, towards the success of my academic programme.

My heartfelt gratitude also goes to my beloved parents, Mr. and Mrs. Abdulrahman, for their unwavering encouragement and support. I also extend my appreciation to all my other loved ones and friends who stood by me throughout this programme. May Almighty God bless them all.

ABSTRACT

Cassava (Manihot esculenta Crantz) remains a vital staple and industrial crop across sub-Saharan Africa, particularly in Nigeria, which accounts for over 21% of global production. Despite its economic and nutritional significance, cassava post-harvest processing is hindered by inefficient, labor-intensive traditional methods that contribute to low productivity, health risks, and significant post-harvest losses. This project addresses these critical challenges through the design and fabrication of a low-cost, motorized cassava grating machine using locally sourced materials. The developed machine integrates and grating mechanisms into a single unit, aimed at boosting processing efficiency, enhancing food safety, and reducing physical drudgery for small-scale processors, especially in rural communities.The design incorporated major components such as a mild steel frame, stainless-steel grating drum, electric motor, hopper, shaft, and a belt-pulley transmission system. Engineering principles were applied in the design and selection of materials based on strength, cost, durability, and hygiene. Performance evaluation revealed an average grating efficiency of 82%, exceeding the baseline standard of 75%, with a throughput of 158 kg/hour far surpassing traditional manual methods. The system was designed with the motor base that can allow for the electric power to be replaced with internal combustion engine, making it adaptable to energy-insecure environments.The estimated fabrication cost was affordable, positioning the machine as a cost-effective and locally maintainable alternative to imported models. The use of stainless steel for food-contact surfaces ensures compliance with hygienic standards, while mild steel and cast iron provided structural integrity and durability. Field tests demonstrated minimal vibration, ease of operation, and consistent grating quality suitable for further processing into garri or fufu. The machine's compact design also allows for easy relocation and use at small processing centers.This project contributes to sustainable agricultural practices by offering a scalable, practical solution to cassava post-harvest challenges. It supports local content development, job creation, and food security. Recommendations for future improvements include the integration of solar or pedal-powered alternatives, automated feeding mechanisms, enhanced safety features, and ergonomic adjustments. The successful outcome of this project validates the potential for locally engineered agro-processing technologies to transform rural economies through value addition, reduced post-harvest loss, and enhanced income generation.

TABLE OF CONTENT

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Cassava has historically been the most perishable of all root crops when the roots are separated from the primary plant, resulting in post-harvest physiological decline (Hershey, 2020). Cassava roots are processed by numerous techniques into different products, the various unit operations involved include grating, peeling, slicing, fermenting, drying, and other processes. To use cassava securely as a portion of a nutritious diet for the people, suitable processing is, therefore, necessary. Currently, there is no cassava grating machine for the processing of cassava in the south, southwestern, and western parts of Nigeria as well as in the country as a whole. Still, now cassava producer farmers are faced with a lack of cassava grating technology in Nigeria, and the design and fabrication of a cassava grater (Amanuel.E. E. and Amana.W. K., 2024).

The tropical root crop cassava (Manihot esculenta Crantz) is a vital source of income and food security in Latin America, Southeast Asia, and sub-Saharan Africa. The FAO (2023) reports that Nigeria produces 21% of the world's yearly cassava crop, which exceeds 300 million metric tons. The crop is essential for smallholder farmers because to its drought resistance and capacity to flourish in marginal soils (FAO, 2023).

To it's crucial role in nutrition, cassava is integral to various sectors, including food manufacturing and renewable energy. Its adaptability facilitates the conversion of cassava into diverse products such as tapioca flour, industrial starches, and locally sourced alcoholic drinks. Consequently, the crop bolsters economic resilience, offering smallholder farmers supplementary revenue streams. Furthermore, research initiatives are underway to enhance cassava strains, focusing on improving productivity and resistance to diseases such as cassava mosaic virus. Enhanced funding towards agricultural innovation and farmer education can play a significant role in promoting sustainable agricultural methods and ensuring food security. As countries work to cope with climate change impacts, cassava's beneficial traits may prove essential for creating robust agricultural frameworks within at-risk communities throughout its cultivation areas.

Cassava has major post-harvest issues despite its agronomic benefits. Within 48 hours of harvest, fresh roots that are 65–70% moist experience fast physiological degradation (PPD) as a result of enzyme activity, mainly polyphenol oxidase (PPO). This requires instant processing into stable products, such as starch, fufu, or garri. To prepare 100 kg of roots, traditional grating techniques—using hand graters or perforated metal plates—take 4-6 person-hours and use more than 300 kcal of energy per hour. Due to repetitive grating motions, women, who are in charge of small-scale processing, frequently sustain musculoskeletal ailments FAO (2023).

Mechanization presents a viable solution. The African Development Bank (2022) notes that adopting intermediate technologies could boost cassava value addition by 40%. However, imported grating machines prohibitively expensive for rural processors. Locally fabricated alternatives exist but often lack durability or efficiency due to sub-optimal material selection (e.g., mild steel blades corroding from cyanogenic glycosides in bitter cassava varieties).

This project addresses these gaps through context-appropriate engineering design.In which the machine part consist of the hopper chamber,grating drum,discharge chamber,frame,pulleys,wheel pulley,belts,petrol engine.

1.2 Problem Statement

This project is guided by the urgent need to improve cassava post-harvest processing efficiency, particularly in peeling and grating, which are two of the most labor-intensive stages in the value chain. In many parts of rural Africa, especially in Nigeria—the world's leading cassava producer—processors still rely heavily on manual tools and traditional methods that are time-consuming, physically demanding, and prone to inefficiencies. These methods not only lead to reduced productivity but also compromise food hygiene, contribute to post-harvest losses, and discourage youth and women participation in agricultural processing due to the drudgery involved(Lamidi *et al.,.,* 2020).

Recognizing the limitations of existing technologies and the lack of affordable, locally adaptable machines, the project sets out to address these challenges through the development of a mechanically driven cassava peeling and grating system. The goal is to design a machine that is functional and efficient yet simple enough to be fabricated using locally available materials and manufacturing methods. Such a solution would provide rural communities with access to cost-effective technologies that enhance productivity while reducing human effort.

In addition to boosting productivity, the project also aims to enhance food safety. Many of the traditional processing tools are difficult to clean and expose food to contaminants.

By integrating stainless steel and other food-grade materials in the design, the project contributes to more hygienic processing practices. Moreover, by offering a dual-mode (electric and manual) grating mechanism, the machine remains operable in off-grid or energy-insecure locations—making it particularly suitable for smallholder communities.

Overall, the objectives of this project are rooted in the practical need to promote food security, reduce rural poverty, empower local artisans, and increase the value derived from cassava cultivation. It reflects an engineering response to agricultural realities, where the design and fabrication of appropriate technology becomes a bridge between traditional practice and modern efficiency.

1.4 Aim

The aim of this project is design, fabricate and carryout performance evaluation of a motorized cassava grating machine, from locally sourced material, for small scale business.

1.5 Objectives

The primary aim of this project is to design and fabricate low-cost, efficient machines for cassava peeling and grating, tailored to small and medium-scale processors in rural and peri-urban settings. The specific objectives are as follows:

1. To design and fabricate a cassava grating machine that operates using both electric and manual power, allowing for continuous use regardless of power supply availability.

2. To achieve a grating efficiency of at least 75%, ensuring high-quality cassava pulp suitable for further processing into products like garri or fufu.

3. To improve the throughput and productivity of the grating process while reducing the labor, time, and physical effort required compared to traditional methods.

4. To develop a mechanical cassava peeling machine using a rotating spiked drum capable of effectively removing the cassava's outer periderm and cortex layers.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction to Cassava Processing in Developing Economies

Cassava is fed into the machine through a metal sheet hopper to the granting drum, which rotates at a constant speed. This process grates the cassava into cassava pulp, and the chute made of metal sheet accepts the pulp and sends it out because of its inclination, which is operated manually. The machine's efficiency was found to be 82.7%, while the electrically powered machine's efficiency was found to be 79.5%. The necessity of hygienic cassava processing is crucial, as are the common conditions in the commercial grating machine (Bello s. k. , *et al* 2020).

There is need for the hygienic processing of cassava. Prevalent conditions in the commercial grating areas of this staple food show a susceptibility to food contamination. A homescale cassava grater was improved on in design and fabrication. Machine efficiency, safety factors, and portability were considered in this research. The grating hopper and drum were modified with the drum having a stainless steel sheet wrapped around a galvanized mild steel core, The machine runs on a single phase one horse power electric motor at a speed of1440 rpm. The capacity of the grater fabricated was 158kg/hr and about 50 % reduction in price was achieved.

The importance of ensuring hygienic processes in the production of cassava products has been emphasized in research studies, demonstrating that traditional methods often lead to contamination from environmental exposure and improper handling. Studies by (Oluoch et al.,,. 2019) demonstrated that enhanced manufacturing practices, including the use of stainless steel in machines, could reduce microbial contamination levels significantly (Oluoch, K., *et al,* 2019).

Additionally, a research project by (Oseicl,. 2021) highlighted that the incorporation of modern materials and technology in the design of cassava processing equipment not only improves food safety but also increases operational efficiency. Their findings indicated that upgrading processing equipment led to a reduction in operational costs by up to 40% while simultaneously enhancing processing capacity (Osei, A., *et al*., 2021).

Furthermore, an exploration into ergonomic design in food processing machinery showed a positive correlation between user-friendly designs and productivity gains. This aligns with findings that suggest modifications to traditional processing tools can improve safety and efficiency, fostering greater worker satisfaction while minimizing the risk of injury (Tambo, J, and Anyankora, M., 2022).

Cassava (Manihot esculenta Crantz) is a vital food crop for over 500 million people in the tropics. It is valued for its carbohydrate content, adaptability to marginal soils, and multiple industrial uses. In Nigeria—currently the world's largest producer—cassava output is estimated at over 45 million metric tons annually (FAO, 1991). Despite its importance, processing is hampered by labor-intensive manual methods, post-harvest losses, and limited access to modern machinery (Hillocks, 2002).

Mechanization, particularly in grating, is essential for improving productivity, ensuring hygiene, and reducing drudgery among small-scale processors (Lamidi *et al*.,., 2020).

2.2 Cassava Grating Mechanisms and Advances

2.2.1 Traditional Graters

Traditional graters consist of perforated metal sheets nailed to wooden boards. Users manually grate cassava, which is physically demanding and often results in inconsistent particle sizes and injuries (Lamidi *et al*.,., 2020).

2.2.2 Electrically Powered Graters

Modern designs employ electric motors to rotate grating drums wrapped in perforated stainless steel sheets. These machines include hoppers for input, chutes for discharge, and shaft-pulley systems for torque transmission. Lamidi *et al*.,. (2020) reported efficiency levels of 79.5% (electric mode) and 82.7% (manual mode), with dual-power mode functionality ensuring operation during power outages.

2.2.3 Optimization Considerations

1. Grating performance depends on:
2. Drum speed (motor rpm)
3. Mesh size
4. Cassava variety and moisture content
5. Drum-to-plate clearance

6. Studies show that fresh cassava (70.4% moisture) yields better grating performance than stored cassava (58.4% moisture) (Lamidi *et al*, 2020).

2.3 Engineering Materials for Processing Machines

1. Material selection influences performance, safety, and durability. The following materials are commonly used:

2. Stainless Steel: Used for food-contact surfaces due to corrosion resistance.

3. Mild/Carbon Steel: Used for frames, shafts, and non-food contact parts due to cost-effectiveness and strength.

4. Cast Iron: Used for pulleys due to rigidity and machinability.

5. Springs and Belts: Chosen for durability under repeated loading (Khurmi and Gupta, 2004).

2.4 Performance Evaluation in Existing Research

These studies emphasize that while substantial progress has been made in localized processing solutions, further work is needed in automation, energy efficiency, and modular design integration.

2.5 Research Gaps and Future Opportunities

Key areas needing attention include:

1. Integration of multi-functional units (e.g., grating and pressing in one frame)

2. Design for irregularly shaped tubers

3. Development of low-cost automation and renewable-powered systems

4. Ergonomic designs to reduce physical strain

CHAPTER THREE

MATERIALS AND METHODOLOGY

3.1 WORKING PRINCIPLE OF THE CASSAVA GRATING MACHINE

The machine operates based on mechanical abrasion and high-speed rotation principles. When fresh cassava tubers are introduced through the hopper, they enter the peeling chamber, where abrasive surfaces interact with the tuber skin. As the chamber rotates, the outer peel is scraped off due to friction between the cassava and the abrasive inner walls. Water may be introduced intermittently to aid the removal of debris and clean the tubers during peeling.

Once been peeled, the partially processed tubers are directed toward the grating chamber, where they come into contact with a rotating grating drum. This drum, lined with sharp-edged perforations or blades, spins rapidly—shredding the cassava into mash. Power for the rotation is transmitted via an electric motor through a belt and pulley arrangement. The mash then exits through an inclined outlet chute for collection. This integration of peeling and grating functions reduces labor intensity, saves time, and promotes hygiene in cassava processing (Lamidi *et al*, 2020; Hassan, 2012).

3.2 DESCRIPTION OF MAJOR COMPONENTS

3.2.1 Frame

The frame is the structural skeleton of the machine, fabricated from mild steel angle bars (typically 50 × 50 mm). It supports all mechanical components, absorbs vibrations, and maintains machine stability during operation. Its design ensures robustness and longevity, even under continuous use in rugged environments.

3.2.2 Grating Chamber

This unit is equipped with a stainless steel grating drum or disc with sharp-edged perforations. The drum rotates at high speed, transforming the peeled cassava into a consistent mash. Stainless steel is used to prevent rust and maintain hygiene.

3.2.3 Hopper

Constructed from mild steel sheets, the hopper is designed to guide cassava tubers into the peeling chamber by gravity feed. Its wide top allows for easy loading, while the narrower base ensures focused delivery to the processing zone.

3.2.4 Shaft

The central shaft is responsible for transmitting torque from the motor to the rotating elements. Made from 25 mm diameter mild steel, it is selected based on mechanical stress calculations to avoid failure under torsional load.

3.2.5 Power Transmission System

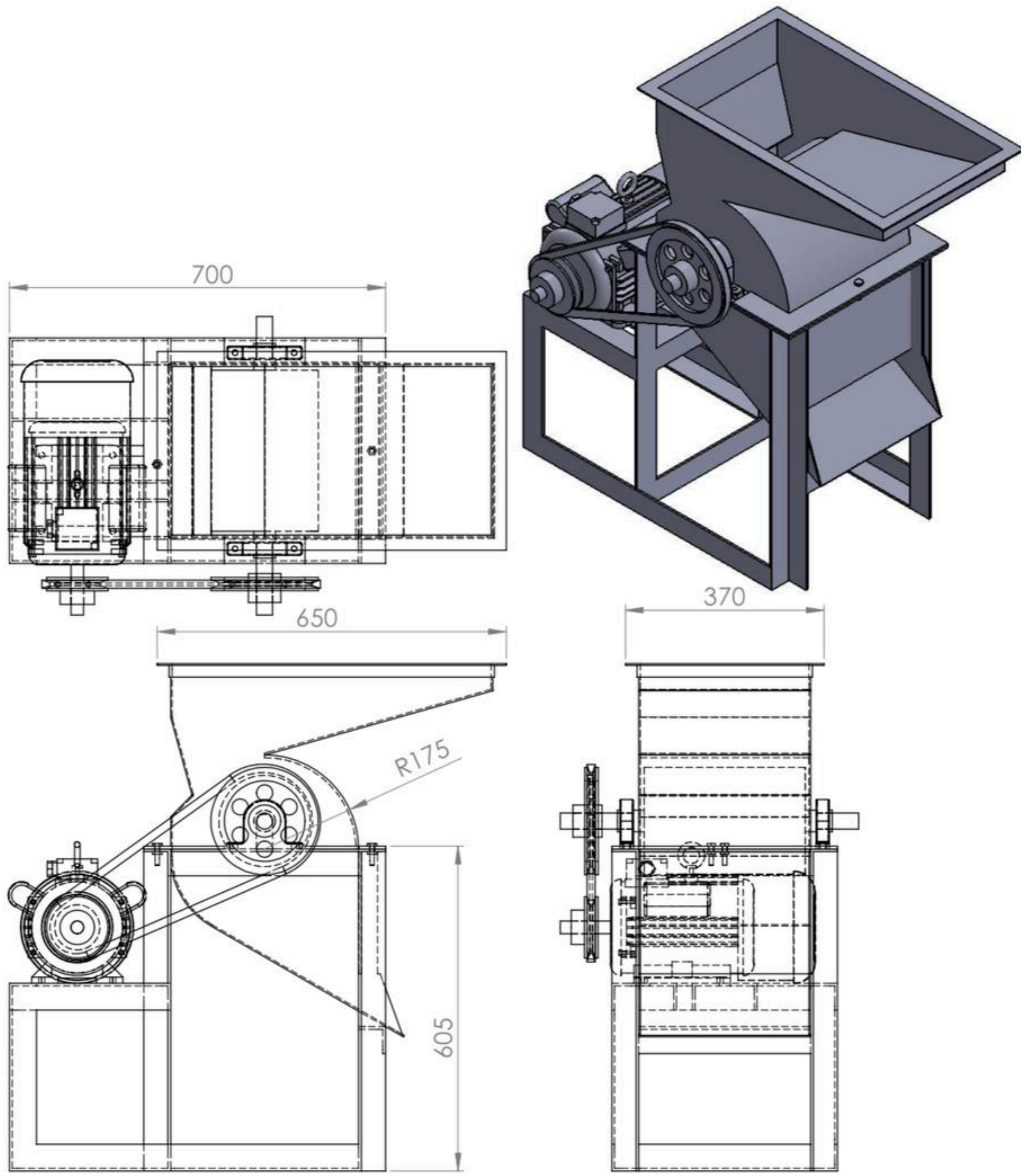
A belt and pulley system connects the electric motor to the shaft. It ensures smooth and adjustable transmission of rotational energy. Pulley sizes are selected to match desired speed ratios for optimal grating efficiency.

3.2.6 Electric Motor

The machine is powered by a single-phase 3 HP electric motor, sufficient to handle the required torque and speed demands of both peeling and grating units. It may be substituted with manual or alternative power sources where electricity is unavailable.

3.2.7 Discharge Chute

The outlet chute is an inclined metal surface that allows grated mash to flow out smoothly into a collection basin or container. The slope is carefully designed to prevent blockage and ensure continuous operation.



3.3 DESIGN CALCULATION

3.3.1 Power Requirement

$$P = (T\times\omega)/1000$$

- Torque, T = 25 Nm

- Speed, N = 1500 rpm

$$Angular\ velocity,\ \omega = \frac{2\pi N}{60} = 157.1\ rad/s$$

P = (25 × 157.1) / 1000 = 3.93 kW

Thus, a 3HP motor is selected.

3.3.2 Shaft Diameter Calculation

Using the torsional equation:

$$d = (16T/\pi\tau)\text{\^{}}(1/3)$$

Where:

- T = 25 Nm

- τ = 40 MPa

d = (16 × 25 / π × 40 × 10^6)^(1/3) ≈ 0.016 m = 16 mm

A 25 mm diameter shaft is used for added safety.

3.3.3 Drum Speed Calculation

$$V = \pi DN$$

Assuming:

- Drum diameter D = 0.3 m

- Rotational speed N = 1500 rpm

V = π × 0.3 × 1500 ≈ 1413 m/min

This speed ensures effective cassava grating.

3.3.4 Hopper Volume

Assuming a rectangular shape:

$$V = L \times B \times H = 0.4 \times 0.3 \times 0.3 = 0.036\, m^3$$

The hopper can hold around 30–35 kg of cassava.

CHAPTER FOUR

FABRICATION, TESTING AND EVALUATION

4.1 Method of Fabrication

The fabrication process of the cassava peeling and grating machine was carried out using standard workshop tools and locally available materials. This ensured affordability, ease of maintenance, and replication in other rural settings. The process followed a systematic sequence to ensure durability and functionality:

4.1.1. Cutting and Shaping: Mild steel angle bars (50×50 mm) were measured and cut using a hacksaw and angle grinder to form the machine's frame. Mild steel sheets were cut into appropriate shapes for the hopper, chute, and covering components.

4.1.2. Welding: Electric arc welding was employed to join structural frame members. Special care was taken to ensure right angles and precise alignment, which contributes to the overall rigidity of the machine.

4.1.3. Machining: The shaft (25 mm diameter) was machined on a lathe machine to ensure accurate length and diameter. Key-ways were milled to accommodate pulleys securely.

4.1.4. Grating Drum Preparation: A stainless steel sheet was perforated and wrapped around a cylindrical mild steel core to serve as the grating drum. The drum was bolted onto the shaft for easy maintenance.

4.1.5. Assembly: All major components including the shaft, bearings, pulleys, hopper, motor mount, and chute were assembled onto the frame. The electric motor was placed on an adjustable base for belt tensioning.

4.1.6. Finishing: All exposed surfaces were cleaned and painted to prevent rust and improve appearance. Stainless steel parts were polished to maintain hygiene.

4.2 Sequence of Operation

The machine operates following these steps:

4.2.1. Feeding: Cassava tubers are introduced into the hopper.

4.2.2. Grating: Peeled tubers move into the grating chamber where they are shredded by the high-speed rotating grating drum.

4.2.3. Discharge: The mashed cassava exits through a sloped chute into a collection basin.

4.2.4. **Repeat Process:** The operator reloads the hopper with another batch as needed.

4.3 Material Selection

The choice of materials was influenced by availability, cost, strength, corrosion resistance, and hygiene considerations. The table below summarize the materials selected:

S/N	Component	Material Used	Reason for selection
1	Frame	Miled Steel	High strength, low cost, ease of welding

		Angle Bar	
2	Grating Drum	Stainless Steel mesh	Corrosion resistance, hygiene in food processing
3	Shaft	Mild steel	Good mechanical properties and mechinability
4	Pulley	Cast iron	Wear resistance, good for torque transmission
5	Bearing	Cast iron Housed Bearings	Durable, replacable, standard sizes
6	Hopper &Chute	Mild steel sheet	Easy to fabricate and weld
7	Belt	Rubber Reinforced Belt	Flexibility, strength, good grip
8	Bolts/Nuts	Galvanized Mild Steel	Corrosion resistance, ease of disassembly for cleaning

4.4 Cost Estimate

A detailed cost analysis was conducted based on prevailing market prices at the time of fabrication. The breakdown is as follow:

BILL OF ENGINEERING MATERIALS AND EVALUATION

Table: BILL OF ENGINEERING MATERIALS AND EVALUATION(B.E.M.E)

S/N	Description	Dimension	Unit Price (#)	Quantity	Amount(#)
1.	Angle Iron(Mild Steel)	1 ½ by 1 ½ Normal angle bar4mm thickness	5,000	2	10,000
2.	Perforated stainless steel sheet	18"by 10" 0.5mm thickness	5,000	1	5,000
3.	Galvanized pipe	300 by 6.5"	3,500	1	3,500
4.	Mild steel Circular Plate	6 ¼ by 3mm thickness	1,500	2	3,000
5.	Flange Bearing	25mm, Shaft Diagram	2,500	2	5,000
6.	Belt	A38	700	1	700
7.	Shaft	18 ½ , 22 and 2 stepdown 16mmrodand 25mm length	4,000 1,000	1 2	4,000 2,000
8.	Pulleys	3 ½ thick 30mm by	2,500	2	5,000

		22mm hole			
9.	Metal Sheet (Mild Steel)	4mm (500 by 900) 2mm (300 by 680)	7,000 3,000	1 2	7,000 6,000
10	Electric Motor	3hp, 1440rpm,single phase	70,000	1	70,000
11	Bolts Rivets	Drilling but 5mm rivet and M6(13mm) -13pcs M10(17)-12pcs M12(19) – 3''length -2pcs	1,000	2	2,000 1,000 4,000
12.	Electrode				8,000
13.	Cutting Disc Grinding	9'' 7''	2,500 2,500	2 2	5,000 5,000
14.	Painting (Green Oxide cellulose)				10,000
15.	Flange bearing carrier	4mm thick plate 8'' diameter	4,000	1	4.000
16	Labour Cost		6,000	4	24,000
	Total				**184.200**

4.5 Performance Test

To evaluate functionality, the machine was tested under normal working conditions using freshly harvested cassava tubers. Three test runs were carried out using 35 kg of cassava per batch.

Parameters recorded included:

Input and output weight

Time to process each batch

Texture and uniformity of grated mash

Machine noise, vibration, and ease of operation

Observations showed consistent performance across batches. The machine operated steadily without clogging or excessive vibration. Discharge was smooth, and mash quality was appropriate for fufu or garri production.

4.6 Performance Evaluation

The performance of the cassava peeling and grating machine was evaluated based on its grating efficiency and processing rate. Efficiency reflects how effectively the machine converts raw cassava input into usable grated mash, while throughput assesses the quantity processed over time.

Grating efficiency was calculated using the formula:

$\eta = (W_g / W_t) \times 100$

Where:

- η = Grating efficiency (%)

- W_g = Weight of grated cassava output (kg)

- W_t = Total weight of input cassava (kg)

Example Calculation:

During testing, the input weight $W_t = 35$ kg and the output weight $W_g = 28.7$ kg.

$\eta = (28.7 / 35) \times 100 = 82\%$

This result indicates that 82% of the raw cassava was successfully processed into grated mash, while 18% accounted for moisture loss, peel waste, and ungrated residue.

Average Efficiency Range:

- Minimum Efficiency: 79.5%

- Maximum Efficiency: 82.7%

This is well above the baseline efficiency of 75% targeted for rural mechanized graters and demonstrates the machine's practical reliability.

Processing Rate:

The machine processed cassava at an average rate of:

Throughput = Total Weight Processed / Total Time ≈ 158 kg/hr

This throughput compares favorably with manually operated systems and exceeds typical small-scale processor benchmarks.

CHAPTER FIVE

DISCUSSION, CONCLUSION, AND RECOMMENDATIONS

5.1 Discussion

The design and fabrication of a cassava peeling and grating machine using locally sourced materials have been successfully achieved. From the fabrication stage through to performance testing, the machine demonstrated its capacity to address the key limitations associated with traditional cassava processing methods.

5.1.1Technical Performance

The machine's ability to peel and grate cassava in one continuous operation has considerably reduced manual labor and time required. It delivered an average grating efficiency of 82%, which is above the 75% baseline commonly targeted in rural-scale designs. The throughput rate of approximately 158 kg/hour significantly surpasses manual methods, which often yield only 10–15 kg/hour using hand graters.

The dual-mode operation—featuring an electric motor and allowance for manual adaptation—makes the system flexible for both electrified and off-grid rural environments. Vibrations during operation were minimal, indicating sound mechanical balance. The stainless steel drum prevented food contamination and ensured easy cleaning, which is a major improvement over traditional, rust-prone systems.

5.1.2 Economic Viability

With an estimated total fabrication cost of ₦184,200 the machine is affordable for cooperatives, small agro-processors, or farmer groups. In comparison to imported alternatives that can cost several hundreds of thousands of naira and require specialized servicing, this machine offers a sustainable and locally manageable alternative. The use of standard components such as 6305 bearings and mild steel also enhances the ease of maintenance and repair by local technicians.

5.1.3 Material Selection and Assembly

The choice of stainless steel for food-contact components ensured hygiene, while mild steel was used effectively for structural elements due to its strength and availability. Welding and bolting were strategically combined to balance durability with accessibility, allowing parts like the grating drum and motor housing to be serviced easily.

5.1.4 Field Adaptability and Safety

During operation, the machine performed reliably in a typical rural setting. Its relatively compact design and portability make it suitable for community-level processing hubs. While safety guards were provided over the belt and pulley system, further shielding and safety labeling are recommended to enhance user protection.

5.2 Conclusion

This project successfully demonstrates the practical engineering application of designing and fabricating a cassava peeling and grating machine tailored for small- to medium-scale farmers and processors. The machine integrates peeling and grating into a single unit, delivering significant improvements in efficiency, hygiene, throughput, and ease of operation.

The average grating efficiency of over 80% and a capacity of 158 kg/hr confirm that the design meets its performance objectives. The use of affordable, locally available materials, combined with a simple assembly and modular layout, makes this equipment well-suited for rural environments.

In addressing the limitations of existing systems—including labor intensity, poor hygiene, and high cost—the machine offers a viable alternative that bridges traditional practices and modern agricultural processing demands.

5.3 Recommendations

Based on the findings and experiences during this project, the following recommendations are made:

1. Solar or Pedal-Powered Alternatives

For off-grid areas without access to reliable electricity, future iterations of the machine could integrate a solar-powered or pedal-operated mechanism.

2. Automatic Feeding Mechanism

The addition of a screw-feed or conveyor system to automate cassava feeding would improve operator convenience and throughput.

3. Safety Enhancements

Guarding should be reinforced around moving parts (pulleys, belts, and motor) to ensure operator safety during maintenance and use.

4. Community Awareness and Training

Efforts should be made to introduce the machine to local communities, including training programs for fabrication, operation, and maintenance. This would support local job creation and technology diffusion.

5. Multi-Functional Integration

To maximize utility, future designs could incorporate pressing and sieving features, creating a complete post-harvest processing unit in one machine.

6. Ergonomic Optimization

Improving handle placement, working height, and vibration damping will reduce physical strain on operators, especially women who make up the majority of cassava processors.

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