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GUIDELINES

FOR BEST PRACTICES OF CASSAVA PROCESSING EQUIPMENT FABRICATION

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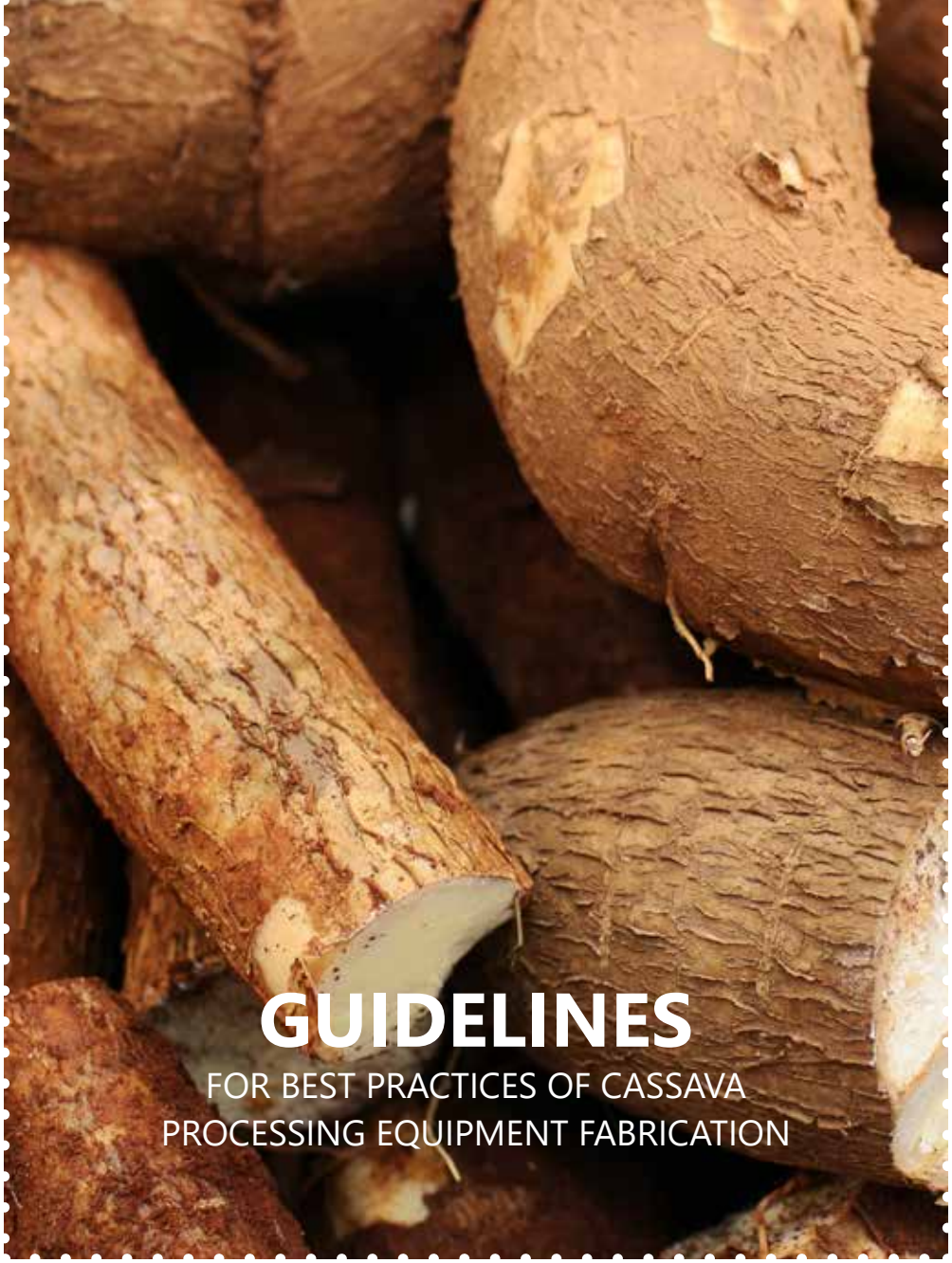

GUIDELINES

FOR BEST PRACTICES OF CASSAVA PROCESSING EQUIPMENT FABRICATION

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1. INTRODUCTION

The cassava sector in Ghana has seen substantial transformation in recent years, concentrating on the production of High-Quality cassava flour (HQCF), Industrial cassava flour, dried cassava chips, ethanol, starch, glucose syrup, cassava adhesive as industrial product, value-added household products including fufu, gari, kokonte, banku, agblema, tapioca, composite flour pastry products, gluten-free pasta, and livestock feed (FAO, 2022; Umeh, 2013).

In Ghana, the estimated total land under cassava production is over a million hectares, yielding an estimated 22.6 million metric tons of fresh cassava in 2021 (Acheampong et al. 2021). Additionally, over 70% of farmers in Ghana are engage in cassava production and 78% of total cassava production takes place in the southern and middle part of Ghana (FAO, 2022). Ghana was the third largest producer of cassava and the sixth-largest producer worldwide in 2017 according to Bayitse, Torniyie, Ferdinand and Bjerre (2017). Approximately 22% to 30% of the Agricultural Gross Domestic Product is contributed by cassava in Ghana as indicated by Acheampong et al. (2021). In 2018, cassava yield increased from 14t/ha in 2009 to 21t/ha (Acheampong et al. 2021). In a report by Acheampong et al. (2021), a partial budget analysis revealed that smallholder farmers have been more profitable over time, with their annual profits rising from GH644.32 (about US$ 111) in 2009 to GH5,243.27 (around US$ 904) in 2018. Thus, cassava serves as an important staple food addressing a number of Sustainable Development Goals (SDG) including SDG 1: No Poverty SDG 2: Zero Hunger and SDG 3: Good Health and Well-being. It also has great benefits for the economy, SDG 8: Decent Work and Economic Growth.

However, one major challenge affecting the processing of cassava into value-added products in Ghana is the lack of standardized processing equipment. Therefore, this seeks to provide guidelines for best practices in the fabrication of equipment required for cassava processing.

"Over 70% of farmers in Ghana are engaged in cassava production and 78% of total cassava production takes place in the southern and middle part of Ghana (FAO, 2022)".

These guidelines outline the risks associated with non-food grade materials employed in cassava equipment fabrication, as well as unsafe practices employed in cassava processing equipment fabrication. Further, the guidelines highlights some equipment required for cassava processing, input materials for standard cassava processing equipment, storage and transportation of equipment, safe operation of fabricated equipment, gender considerations, recommended occupational health and safety practices in the operation of equipment, maintenance schedule, DOs and DON'Ts, and general requirements for a standard equipment operational manual.

2. NON-FOOD GRADE MATERIALS IN CASSAVA EQUIPMENT FABRICATION

The fabrication of cassava processing equipment in Ghana is an age old activity. In the past, most of the fabricated equipment were simple and manually operated tools and processing aids. Today, equipment fabricated by Ghanaian artisans are more mechanical and autonomous and produce far better results in terms of efficiency and quality of output.

That above notwithstanding, some risks remain unresolved. Among these is the use of non-food grade materials. Major risks are associated with non-food grade materials such as mild and galvanized steel in cassava processing equipment fabrication. This situation results in chipping of material surfaces into cassava products during processing and leads to contamination of cassava products with heavy metals.

Another major risk is the reaction of cyanide in cassava with the non-food grade material surface of the equipment to produce hazardous compounds.

This results in oxidation of the non-food grade material surface because of exposure to oxygen leading to electrochemical breakdown of the non-food grade material and ultimately resulting in release of hazardous compounds. This risk often arises when untrained technicians used in the fabrication of food processing equipment.

Another identified risk is the introduction of poisonous substances into cassava products during processing, when substandard (cheap) metals is used to fabricate cassava processing equipment. Additionally, painting or coating of food contact surfaces of food processing equipment with non-food grade paint to prevent corrosion and rusting may also introduce poisons into the final products.

A compilation of risks associated with non-food grade materials employed in cassava equipment fabrication, as well as unsafe practices employed in cassava processing equipment fabrication is presented in Annex 1.

"Today, equipment fabricated by Ghanaian artisans are more mechanical and autonomous and produce far better results in terms of efficiency and quality of output".

3. GENERAL GUIDELINES FOR CASSAVA PROCESSING EQUIPMENT

Cassava can be processed into various value-added products including High-Quality Cassava Flour, Industrial cassava flour, dried chips, ethanol, starch, glucose syrup, cassava adhesive as industrial products, fufu, gari, kokonte, banku, agblema, tapioca, composite flour pastry products, gluten-free pasta, and livestock feed. Various equipment are required for efficient and effective processing of cassava.

In order to safeguard product quality, food safety and human health, the general guidelines below have to be observed in the fabrication and manufacturing of cassava processing equipment.

3.1 Input materials for standard cassava processing equipment

- Food contact surfaces must be constructed using food grade stainless steel 316 and aluminium 1100. These may include plates, grinders teeth, hoppers, bolts and nuts, blades, washing troughs, stirrers, trays, slicing blades, rollers, blowers, cyclones and conveyers etc.
- Parts which do not come into contact with food including bolts and nuts, legs, etc., may be constructed using mild steel.
- Specially hardened and purposed plastics and wood may be used to construct both food contact and non-food contact parts.

3.2 Storage and Transportation of equipment

- During storage, equipment must be wrapped with plastic foil or other non-corrosive material to prevent dust and pests from entering or settling in the invisible parts.
- Equipment must be packaged separately by components in insulated wooden boxes to avoid breakage/damage during transportation.

3.3 Safe operation of fabricated equipment

- All equipment must be accompanied by an operational manual.
- They must be tested onsite.
- The buyer must be trained on safe operation and maintenance requirements before handing over.

3.4 Gender Considerations

- Equipment must be made easy to operate i.e. they must not require exertion of too much energy or effort or time to operate.
- For equipment that need continuous feeding, automated feeding system may be introduced.
- If manually fed, the weight of material needed to feed the equipment must not exceed 5kg/min.

- Whenever possible, machines should be motorized with visible ON and OFF buttons
- Equipment height must not exceed 3.5 ft and must not be too low. It must generally be positioned at waist level.

3.5 Recommended Occupational Health and Safety Practices in the operation of equipment

- Equipment must be operated under SOPs
- Operators must wear safety apparel (ie. lab coat, gloves, water-proof boots, goggles, face mask, head net).
- Equipment users must be advised to have a safety perimeter (red marking) around equipment.
- Unwell operators (feeling of drowsiness, drunkenness, severe headache, etc.) must not be allowed to operate an equipment.
- Avoid intake of barbiturates/narcotics before operating equipment.
- Avoid water entering into the electrical components.

3.6 Maintenance schedule

- Equipment maintenance should be routine (daily, weekly, monthly) and major (6-monthly, yearly).
- Daily cleaning with potable water, chlorinated water, mild food grade detergent, or drying cleaning with pneumatic compressor.
- Cleaning areas must be indicated in manual
- Major maintenance work may be carried out using food grade lubricants

3.7 DOs and DONTs

DOs: Operation of equipment should strictly follow the instructions in the operations manual

- Users must be advised to ensure regular cleaning,
- **DONTs:** Avoid metallic objects in contact with machine; avoid direct contact with machine during operation; avoid wet contact surfaces during operations; avoid water coming into contact with electric motor; avoid overloading/overworking equipment; avoid the use of phones in production area; avoid wearing ornaments during processing.

3.8 General requirements for a standard equipment operational manual

The operation and management of every equipment requires knowledge and skill to effectively operate it. This would help improve efficiency of the equipment, safe operation and ensure its longevity. To this end the following key points are recommended to be included in a standard manual for equipment operation in Ghana.

1. Qualified personnel should operate the equipment.

2. Equipment should be installed in a spacious area

3. Indicate power source of equipment (eg. electricity, engine, solar, biomass, etc.)

4. Identify power panel, ON and OFF, and emergency switch indicators

5. When powered by electricity, indicate phase, voltage and amps of equipment, voltage cut-out

6. When powered by solar, indicate wattage, voltage meter,

7. Operate under room temperature and required pressure

8. Daily cleaning with appropriate cleaning material (eg, potable water, mild detergent, ethanol, chlorine, etc.)

9. Floors should be designed with appropriate drainage systems

10. Equipment must not be operated in an unauthorized environment

11. Indicate operating temperature (or pressure) monitor on equipment

12. Use appropriate food-grade lubricants

13. Ensure safety guards installed on all revolving areas (eg. belts, motors, fans, pulleys, etc.)

14. Indicate routine checks on equipment (eg. bolts and nuts, spring ushers for vibrating parts, etc.)

15. Attach installation qualification (check-list) forms

16. Seek advice from qualified personnel before spraying

17. Safety of operator (appropriate working apparel of operator)

18. Replace damaged/worn-out parts immediately with appropriate spare-parts (and lubricate where required)

19. Regularly check equipment speed for normalcy

20. Emergency switch to shut down equipment.


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4. GUIDELINES FOR FABRICATION OF SPECIFIC CASSAVA PROCESSING EQUIPMENT

TUMBLING CLEANER

Specifications:

1. **Input materials:** All parts including bolts and nuts, pulleys, gears and legs may be constructed using mild steel, cast or hi-carbon steel

    - *Specially hardened plastics used for construction of strips.*

    - *If manually loaded, then loading hop per height should be reason able working height*

2. **Gender considerations:** make machine motorized with clearly defined ON and OFF buttons.

3. **Transportation:** packaged separately by components in insulated wooden boxes to avoid breakage/damage during transportation

4. **Safe operations:** The equipment must be accompanied by an operation manual. The manual must state specific capacity of equipment. Equipment must be tested onsite and buyer must be trained on safe operation and maintenance requirements before handing over. Belt and motor guards must be provided. Correct direction of rotation of motor/drum should be indicated with a sticker

5. **Occupational Health and Safety Practices:** Operate with SOPs; operators must wear safety apparel (ie. lab coat, gloves, water-proof boots, goggles, face mask, head net); ensure safety perimeter (red marking) around equipment, provide flow geometry (tilt angle) of machine especially during cleaning with potable water

6. **Maintenance schedule:** routine and major maintenance works must be carried out by qualified personnel using food grade grease and machine oil. Daily cleaning must be done with chlorinated water, mild food grade detergent

7. **After sales service:** regular motor checks, regular routine and major maintenance schedule by qualified fabricators

8. DOs and DONTs

DOs: Operation of the equipment should be strictly followed using the operations manual

DONTs: Avoid metallic objects in contact with machine; avoid direct contact with machine during operation; avoid wet contact surfaces during operations; avoid water coming into contact with electric motor; avoid overloading/ overworking equipment; avoid the use of phones in production area; avoid wearing ornaments during processing

WASHING TROUGH/SCREW CONVEYOR

Specifications:

1. **Input materials:** Stainless steel and plastic –type (food grade) Stainless steel – screw conveyor type Specialty hardened plastics for construction of strips
2. Bubbling system to improve cleaning.
3. Water filtration system
4. Variable drive to regulate rotational speed.
5. Base should be rounded with drain point.
6. Correct irection of rotation of motor/ augers should be indicated with a sticker
7. Gender-considerations: make machine motorized with clearly defined ON and OFF buttons. Equipment must be positioned at waist level
8. **Transportation:** packaged separately by components in insulated wooden boxes to avoid breakage/damage during transportation
9. **Safe operations:** The equipment must be accompanied by an operation manual. The manual must state specific capacity of equipment. Equipment must be tested onsite and buyer must be trained on safe operation and maintenance requirements before handing over.

10. **Occupational Health and Safety Practices:** Operate with SOPs; operators must wear safety apparel (ie. lab coat, gloves, water-proof boots, goggles, face mask, head net); ensure safety perimeter (red marking) around equipment, provide flow geometry (tilt angle) of machine especially during cleaning with potable water

11. **Maintenance schedule:** Ensure maintenance within 6 months of operation of equipment by qualified personnel using food grade grease and machine oil. Clean daily using chlorinated water, mild food grade detergent

12. **After sales service:** regular motor checks (noise, direction, speed, temperature), routine and major maintenance schedule by qualified fabricators, alignment checks for shaft and auger

13. **DOs and DONTs**

14. **DOs:** Operation of the equipment should be strictly followed using the operations manual Ensure regular cleaning,

15. **DONTs:** avoid metallic objects in contact with machine; avoid direct contact with machine during operation; avoid wet contact surfaces during operations; avoid water coming into contact with electric motor; avoid overloading/overworking equipment; avoid phones in production area; avoid wearing ornaments during processing

PEELING MACHINE

Specifications:

1. **Input materials**
   a. Abrasive material
   b. Hard brushes
   c. Stainless steel
   d. Bolts and nuts
   e. Electric motor

2. Rounded bottom with drain
3. Filtration system for water recycling
4. Variable speed drive
5. Gender-considerations:
6. If manually loaded, weight should be about 5kg/min.

7. If automated loading, then the weight should be at least 10kg/min

8. Make machine motorized with clearly defined ON and OFF buttons.

9. **Transportation:** packaged separately by components in insulated wooden boxes to avoid breakage/damage during transportation

10. **After sales service:** regular motor checks, regular routine and major maintenance schedule by qualified fabricators, alignment checks for shaft

11. **Safe operations:** Always use operational manual for safe operation of equipment

12. Daily, weekly, monthly, quarterly, half-yearly checks

13. Regular maintenance within 6 months of operation of equipment by qualified personnel using food grade grease and machine oil

14. Ensure daily cleaning using chlorinated water, mild food grade detergent

15. **DOs:** regular cleaning must be ensure; maintenance of machine: always operate machine using SOPs; processors must wear safety garments (ie. lab coat, gloves, water-proof boots, goggles, face mask, head net); ensure safety perimeter (red marking) around equipment

16. **DONTs:** avoid metallic objects in contact with machine; avoid direct contact with machine during operation; avoid wet contact surfaces during operations; avoid water coming into contact with electric motor; avoid overloading/overworking equipment; avoid phones in production area; avoid wearing ornaments during processing;

GRATER

Specifications:

1. **Input materials**

   a. Stainless steel hopper
   b. Stainless steel for the rotating drum
   c. Design of drum must allow for thorough cleaning, avoid trapping pieces of cassava
   d. Adjustable stopper (stainless steel)
   e. Plastic fibre for the controller/guide
   f. Stainless steel food contact areas
   g. Non-food contact areas – mild steel

2. **Gender-considerations:**
3. Motorized loading,
4. Make machine motorized with clearly defined ON and OFF buttons.

5. Appropriate direction of rotation of motor/ drum should be indicated with a sticker

6. **Transportation:** using insulated wooden boxes, ensure equipment components are packaged separately to avoid breakage/ damage during transportation

7. **After sales service:** ensure regular motor checks, regular routine and major maintenance schedule by qualified fabricators must be ensured

8. **Safe operations:** Always use operational manual for safe operation of equipment

9. Maintenance should be carried out within 6 months of operation of equipment by qualified personnel using food grade grease and oil

10. Daily cleaning using chlorinated water and mild food grade detergent

11. **DOs:** cleaning must be done regularly; maintenance of machine; always operate machine using SOPs; avoid directly inserting fingers into grating section; processors must wear safety garments (ie. lab coat, gloves, water-proof boots, goggles, face mask, head net); ensure safety perimeter (red marking) around equipment

12. **DONTs:** metallic objects in contact with machine must be avoided; avoid direct contact with machine during operation; wet contact surfaces during operations must be avoided; avoid water coming into contact with electric motor; avoid overloading / overworking equipment; avoid phones in production area; wearing ornaments during processing must be prohibited;

RASPER

Specifications:

1. **Input material**

   a. Food contact areas should be constructed with stainless steel
   b. Non-food contact areas (base)–mild steel

2. *Recommended purposely for starch and tapioca production

3. Gender-considerations:
4. Motorized loading
5. Make machine motorized with clearly defined ON and OFF buttons.

6. Appropriate direction of rotation of motor/ drum should be indicated with a sticker

7. **Transportation:** indication on boxes for purposes of orientation and ease of re-assembling, disassemble into insulated wooden boxes, ensure equipment components are packaged separately to avoid breakage/damage during transportation.

8. **After sales service:** ensure regular motor checks, regular routine and major maintenance schedule by qualified fabricators must be ensured.

9. **Safe operations:** Operational manual for safe operation of equipment should always be used.

10. Maintenance should be carried out within 6 months of operation of equipment by qualified personnel using food grade grease and oil.

11. Daily cleaning using chlorinated water and mild food grade detergent; remove rasper head covers and clean thoroughly

12. **DOs:** cleaning must be done regularly; maintenance of machine; always operate machine using SOPs; processors must wear safety garments (ie. lab coat, gloves, water-proof boots, goggles, face mask, head net); ensure safety perimeter (red marking) around equipment.

13. **DONTs:** metallic objects in contact with machine must be avoided; avoid direct contact with machine during operation; avoid directly inserting fingers into rasper section; wet contact surfaces during operations must be avoided; avoid water coming into contact with electric motor; avoid overloading/overworking equipment; avoid phones in production area; wearing ornaments during processing must be prohibited

SLICING MACHINE

Specifications:

1. **Input material**
2. Stainless steel plate.
3. Bolts and nuts of stainless steel.
4. Stand and non-food contact areas should be made of mild steel square pipes/angle irons.
5. Adjustable cutting blade to give varied thickness.
6. *Preferable slicing thickness.
7. Gender-considerations Motorized loading.
8. Make machine motorized with clearly defined ON and OFF buttons.
9. Appropriate direction of rotation of motor/ drum should be indicated with a sticker.
10. **Transportation:** package electrical components separately from mechanical parts into insulated wooden boxes to avoid breakage/damage during transportation
11. **After sales service:** regular motor checks should be ensured, regular routine and major maintenance schedule by qualified fabricators must be ensured.
12. **Safe operations:** Always use operational manual for safe operation of equipment.
13. Maintenance should be carried out within 6 months of operation of equipment by qualified personnel using food grade grease and machine oil.
14. Daily cleaning using chlorinated water and mild food grade detergent and clean thoroughly.
15. **DOs:** cleaning must be done regularly; regular maintenance of machine; always operate machine using SOPs; processors must wear safety garments (ie. lab coat, gloves, water-proof boots, goggles, face mask, head net); ensure safety perimeter (red marking) around equipment.
16. **DONTs:** metallic objects in contact with machine must be avoided; avoid direct contact with machine during operation; avoid directly inserting fingers into blade section; wet contact surfaces during operations must be avoided; avoid water coming into contact with electric motor; avoid overloading/overworking equipment; avoid phones in production area; wearing ornaments during processing must be banned;

CHIPPING MACHINE

Specifications:

1. **Input materials**

   a. *Stainless steel for blades must be*

2. Bolts and nuts of stainless steel.

3. Stand and non-food contact areas should be made of mild steel square pipes/angle irons.

4. Adjustable cutting blade to give varied thickness.

5. **Gender-considerations:** Motorized loading.

6. Make machine motorized with clearly defined ON and OFF buttons

7. Correct direction of rotation of motor/ drum should be indicated with a sticker.

8. All machines should have replaceable parts.

9. **Transportation:** package electrical components separately from mechanical parts into insulated wooden boxes to avoid breakage/damage during transportation.

10. **After sales service:** regular motor checks should be ensured, regular routine and major maintenance schedule by qualified fabricators must be ensured.

11. **Safe operations:** Always use operational manual for safe operation of equipment

12. Maintenance should be carried out within 6 months of operation of equipment by qualified personnel using food grade machine oil and grease.

13. Daily cleaning using chlorinated water and mild food grade detergent must be carried out.

14. **DOs:** cleaning must be done regularly; regular maintenance of machine; always operate machine using SOPs; processors must wear safety garments (ie. lab coat, gloves, water-proof boots, goggles, face mask, head net); ensure safety perimeter (red marking) around equipment.

15. **DONTs:** metallic objects in contact with machine must be avoided; avoid direct contact with machine during operation; avoid directly inserting fingers into blade section; wet contact surfaces during operations must be avoided; avoid water coming into contact with electric motor; avoid overloading/overworking equipment; avoid phones in production area; wearing ornaments during processing must be banned.

FERMENTATION TROUGH/ TANKS

Specifications:

1. **Input materials**

   a. *Food contact areas use stainless steel plates*

   b. *Bolts and nuts use stainless steel material*

   c. *Rounded base with drain point*

2. **Gender-considerations:** Automated filling of tanks; ensure dedicated pump with clearly defined ON and OFF buttons to fill and discharge tank.

3. **Transportation:** Tank should be disassembled into smaller curved components, padded separately and placed in insulated wooden boxes.

4. **After sales service:** regular checks to ensure tank is leakage free; regular routine and major maintenance schedule by qualified fabricators must be ensured.

5. **Safe operations:** Always use operational manual for safe operation of equipment.

6. Maintenance should be carried out quarterly by qualified personnel to seal leakages.

7. Practice non-destructive testing to ensure effective welding.

8. Daily cleaning using chlorinated water and mild food grade detergent must be carried out.

9. **DOs:** cleaning must be done regularly; regular maintenance of machine; always operate machine using SOPs; processors must wear safety garments (ie. lab coat, gloves, water-proof boots, goggles, face mask, head net); ensure safety perimeter (red marking) around equipment.

10. **DONTs:** metallic objects in contact with machine must be avoided; avoid direct contact with machine during operation; avoid water coming into contact with pumps; avoid phones in production area; wearing ornaments during processing must be barred.

DOUBLE SCREW PRESS

Specifications:

1. Input materials
2. Mild steel for all parts
3. Internally lined top and base with stainless steel plate.
4. **For threaded screw:** square thread, 2 threads / inch.
5. Consider ergonomics during fabrication and reasonable working height to enhance operation
6. Equipment not gender-friendly because of screw manual turning of screw.
7. **Transportation:** equipment can be packed in insulated wooden box during transportation.
8. **After sales service:** regular routine and major maintenance schedule by qualified fabricators must be ensured.
9. **Safe operations:** Always use operational manual for safe operation of equipment.
10. Maintenance should be carried out within 3 months of operation of equipment by qualified personnel using food grade grease and machine oil.
11. Daily cleaning using chlorinated water and mild food grade detergent
12. **DOs:** cleaning must be done regularly; maintenance of machine; always operate machine using SOPs; processors must wear safety garments (ie. lab coat, gloves, water-proof boots, goggles, face mask, head net); ensure safety perimeter (red marking) around equipment.
13. **DONTs:** metallic objects in contact with machine must be avoided; avoid direct contact with machine during operation; wet contact surfaces during operations must be avoided; avoid overloading equipment; avoid phones in production area; wearing ornaments during processing must be forbidden.

HYDRAULIC JACK PRESS

Specifications:

1. **Input materials**

   a. Mild steel
   b. Internally lined with stainless steel
   c. Torque of 50T jack

2. **Gender-considerations:** easily operated jack, does not require much human effort to operate

3. **Transportation:** equipment can be packed in insulated wooden box during transportation

4. **After sales service:** biannual maintenance schedule by qualified fabricators must be ensured

5. **Safe operations:** Always use operational manual for safe operation of equipment

6. Maintenance should be carried out regularly by qualified personnel using food grade grease and machine oil

7. Daily cleaning using chlorinated water and mild food grade detergent

8. **DOs:** cleaning must be done regularly; always operate machine using SOPs; processors must wear safety garments (ie. lab coat, gloves, water-proof boots, goggles, face mask, head net); ensure safety perimeter (red marking) around equipment

9. **DONTs:** metallic objects in contact with machine must be avoided; avoid direct contact with machine during operation; avoid overloading equipment; avoid phones in production area; wearing ornaments during processing must be prohibited

MOTORIZED HYDRAULIC PRESS

Specifications:

1. **Input materials**
   a. Mild steel (includes bolts and nuts
   b. Internally lined with stainless steel thickness
   c. Collecting trough – stainless steel
   d. Strong framework – mild steel thickness
2. Preferably, framework must be constructed using I-beam
3. Consider load to be dewatered in order to select hydraulic cylinder, pump and piston
4. **Gender - considerations:** requires minimum effort to operate
5. **Transportation:** disassemble motor from main framework and package separately, equipment can be packed in insulated wooden box during transportation
6. **After sales service:** biannual maintenance schedule by qualified fabricators must be ensured
7. **Safe operations:** Use operational manual always for safe operation of equipment
8. A quarterly maintenance schedule must be adhered to by qualified personnel using food grade grease and machine oil
9. Daily cleaning using chlorinated water and mild food grade detergent
10. **DOs:** cleaning must be done regularly; always operate machine using SOPs; processors must wear safety garments (ie. lab coat, gloves, water-proof boots, goggles, face mask, head net); ensure safety perimeter (red marking) around equipment
11. **DONTs:** metallic objects in contact with machine must be avoided; avoid direct contact with machine during operation; avoid overloading equipment; avoid phones in production area; wearing ornaments during processing must be prohibited

DECANTER

Specifications:

1. **Input materials**

   a. Stainless steel for food contact areas

   b. Use mild steel for other parts

   c. Valves (stainless steel) placed on sides of tank at various heights and lengths

2. **Gender-considerations:** requires minimum effort to operate

3. **Transportation:** disassemble and package motor separately for transportation, main body must be packed in insulated wooden box during transportation

4. **After sales service:** quarterly maintenance schedule adhered to by qualified fabricators must be ensured

5. **Safe operations:** Use operational manual always for safe operation of equipment

6. A quarterly maintenance schedule must be adhered to by qualified personnel using food grade grease and machine oil

7. Daily cleaning using chlorinated water and mild food grade detergent

8. **DOs:** cleaning must be done regularly; always operate machine using SOPs; processors must wear safety garments (ie. lab coat, gloves, water-proof boots, goggles, face mask, head net); ensure safety perimeter (red marking) around equipment

9. **DONTs:** metallic objects in contact with machine must be avoided; avoid direct contact with machine during operation; avoid overloading equipment; avoid phones in production area; wearing ornaments during processing must be prohibited

MECHANIZED GARI ROASTER

Specifications:

1. **Input materials**
2. Mild steel plate internally lined with stainless
3. steel vessel
4. Mechanical arm (stainless steel) to break lumps
5. Automated stirring
6. Loading mechanism to ensure regular feeding,
7. load in portions
8. Automatic temperature regulation
9. Heat source must be devoid of contamination
10. Liquified Petroleum Gas (LPG), biomass, etc.
11. **Gender-considerations:** requires minimum effort to operate, provision of smoke exhaust
12. **Transportation:** disassemble and package motor separately for transportation, main body must be packed in insulated wooden box during transportation
13. **After sales service:** quarterly maintenance schedule adhered to by qualified fabricators must be ensured

14. **Safe operations:** Use operational manual always for safe operation of equipment

15. A quarterly maintenance schedule must be adhered to by qualified personnel using food grade grease and machine oil

16. Daily cleaning using chlorinated water and mild food grade detergent

17. **DOs:** cleaning must be done regularly; always operate machine using SOPs; processors must wear safety garments (ie. lab coat, gloves, water-proof boots, goggles, face mask, head net); processors must wear heat-resistant aprons; ensure safety perimeter (red marking) around equipment

18. **DONTs:** metallic objects in contact with machine must be avoided; avoid direct contact with machine during operation; avoid directly inserting fingers into roasting drum; avoid overloading equipment; avoid phones in production area; wearing ornaments during processing must be prohibited

CABINET DRYERS

Specifications:

1. **Input materials**

   a. Outer body – mild steel
   b. Inner lining– stainless steel/aluminium
   c. Filter for inlet air - cotton
   d. Trays – stainless steel/aluminum/plastic
   e. Trolleys – stainless, with stainless wheels
   f. Extractor/blower – mild steel/aluminum (low to medium speed)

2. Sensors – humidity, temperature, moisture

3. Insulation – fibre glass

4. **Gender-considerations:** requires minimum effort to operate, time and temperature settings make operation easier, trays should be placed on trolleys for ease of movement

5. **Transportation:** disassemble and package motor and trays separately for transportation, main body must be packed in insulated wooden box during transportation

6. **After sales service:** biannual maintenance schedule should be followed by qualified fabricators must be ensured

7. **Safe operations:** Use operational manual always for safe operation of equipment

8. A quarterly maintenance schedule must be adhered to by qualified personnel using food grade grease and machine oil

9. Daily (internal) cleaning using dry cleaning Quarterly cleaning using chlorinated water and mild food grade detergent

10. **DOs:** cleaning must be done regularly; always operate machine using SOPs; processors must wear safety garments (ie. lab coat, gloves, water-proof boots, goggles, face mask, head net); processors must wear heat-resistant aprons; ensure safety perimeter (red marking) around equipment

11. **DONTs:** metallic objects in contact with machine must be avoided; avoid overloading equipment; avoid phones in production area; wearing ornaments during processing must be prohibited; avoid placing water close to electrical components

BIN DRYER

Specifications:

1. **Input materials**

   a. Outer body – mild steel insulated
   b. Inner lining – stainless steel / aluminum
   c. Extractor/blower – mild steel / aluminum (low to medium speed)
   d. Insulation material – fiber

2. Sensors – humidity, temperature, moisture

3. Extractor (low to medium speed, with damper) placed above the food samples

in the drying chamber to regulate air flow and reduce heat loss.

4. Gender friendly with the introduction of automated loading and distribution system.

5. **Gender-considerations:** requires minimum effort to operate, time and temperature settings make operation easier.

6. **Transportation:** disassemble and package motor, heat exchanger and trays separately for transportation, main body must be packed in insulated wooden box during transportation.

7. **After sales service:** biannual maintenance schedule should be followed by qualified fabricators must be ensured.

8. **Safe operations:** Use operational manual always for safe operation of equipment.

9. A monthly maintenance schedule must be adhered to by qualified personnel using food grade grease and machine oil

10. Daily cleaning using chlorinated water and mild food grade detergent.

11. **DOs:** cleaning must be done regularly; always operate machine using SOPs; processors must wear safety garments (ie. lab coat, gloves, water-proof boots, goggles, face mask, head net); processors must wear heat-resistant aprons; ensure safety perimeter (red marking) around equipment

12. **DONTs:** metallic objects in contact with machine must be avoided; avoid overloading equipment; avoid phones in production area; wearing ornaments during processing must be prohibited; avoid placing water close to electrical components

FLASH DRYER

Specifications:

1. Input materials

a. Feeding unit – stainless
b. Blower – stainless steel
c. Drying ducts – stainless steel
d. Cyclone- stainless steel
e. Supports/framework – mild steel
f. Bolts and nuts – stainless steel
g. Heat exchanger – mild steel, stainless, aluminium, brass, coper

h. **Recommended heat source:** LPG / diesel / Steam / biomass

2. Gender-friendly with the introduction of automated feeding system

3. **Gender-considerations:** requires minimum effort to operate, time and temperature settings make operation easier

4. **Transportation:** all different components (blower, cyclone, discharge, feeding, heat exchanger, burner) should be packaged separately and transported in insulated wooden boxes

5. **After sales service:** biannual maintenance schedule should be followed by qualified fabricators must be ensured

6. **Safe operations:** Use operational manual always for safe operation of equipment

7. A monthly maintenance schedule must be adhered to by qualified personnel using food grade grease and machine oil

8. Daily cleaning using high pressured air from compressor

9. **DOs:** cleaning must be done regularly; always operate machine using SOPs; processors must wear safety garments (ie. lab coat, gloves, water-proof boots, goggles, face mask, head net); ensure safety perimeter (red marking) around equipment

10. **DONTs:** metallic objects in contact with machine must be avoided; avoid overloading equipment; avoid phones in production area; wearing ornaments during processing must be prohibited; avoid placing water close to electrical components; do not pour water into feeding system

DRUM DRYER

Specifications:

1. **Input material**
   a. Food contact areas- stainless steel
   b. Bolts and nuts – stainless steel
   c. Source of heat - steam
2. Steam boiler required
3. Gender-friendly with the introduction of automated feeding system; requires minimum effort to operate, time and temperature settings make operation easier
4. **Transportation:** package equipment in insulated wooden box
5. **After sales service:** biannual maintenance schedule should be followed by qualified fabricators
6. **Safe operations:** Use operational manual always for safe operation of equipment
7. A monthly maintenance schedule must be adhered to by qualified personnel using food grade grease and machine oil
8. Daily cleaning using high pressured air from compressor
9. **DOs:** cleaning must be done regularly; always operate machine using SOPs; processors must wear safety garments (ie. heat resistant aprons, gloves, water-proof boots, goggles, face mask, head net); ensure safety perimeter (red marking) around equipment;
10. **DONTs:** metallic objects in contact with machine must be avoided; avoid overloading equipment; avoid phones in production area; wearing ornaments during processing must be prohibited; avoid placing water close to electrical components; do not pour water into feeding system

SOLAR DRYER

Specifications:

1. House (Walk-in)
   a. Perspex roofing (mica), Poly carbonate, glass

2. Cabinet
   a. Perspex roofing, Poly carbonate, glass
   b. Radiant stones to increase temperature

3. Hybrid
   a. Solar panels + batteries + charge controller
   b. Resistors + blower
   c. Biomass energy source
   d. Direct sunlight

4. Trays should be sizable – aluminium / stainless steel

5. Gender-friendly with the introduction of automated feeding system

6. Transportation: package equipment in insulated wooden box, and package Perspex sheets separately

7. **After sales service:** biannual maintenance schedule should be followed by qualified fabricators

8. **Safe operations:** Use operational manual always for safe operation of equipment

9. Daily cleaning using high pressured air from compressor

10. **DOs:** cleaning must be done regularly; always operate machine using SOPs; processors must wear safety garments (ie.lab coat, gloves, water-proof boots, goggles, face mask, head net); ensure safety perimeter (red marking) around equipment;

11. **DONTs:** avoid leaving food samples in dryer overnight; avoid overloading equipment; avoid phones in production area; wearing ornaments during processing must be prohibited; avoid placing water close to electrical components; do not pour water into feeding system

LONG CHAIN DRYER

Specifications:

1. **Input material**

   a. Mild steel for NFC areas
   b. Chain – stainless steel

2. LPG / Biomass energy source

3. Gender-friendly with the introduction of automated feeding system

4. **Transportation:** all different components (loading, discharge, legs, drying chamber) should be packaged separately and transported in insulated wooden boxes

5. **After sales service:** biannual maintenance schedule should be followed by qualified fabricators

6. **Safe operations:** Use operational manual always for safe operation of equipment

7. Daily cleaning using high pressured air from compressor

8. **DOs:** cleaning must be done regularly; always operate machine using SOPs; processors must wear safety garments (ie. heat-resistant aprons, gloves, water-proof boots, goggles, face mask, head net); ensure safety perimeter (red marking) around equipment;

8. **DONTs:** avoid overloading equipment; avoid phones in production area; wearing ornaments during processing must be prohibited; avoid placing water close to electrical components; do not pour water into feeding system.

VIBRO SIFTER

Specifications:

1. **Input materials**
   a. Food contact areas -stainless steel
   b. Bolts and nuts of stainless steel make
2. Mechanical vibrator/Vibrator motor
3. Select correct sieve size for right particle size.
4. Gender-friendly with the introduction of automated feeding system.
5. **Transportation:** all different components (loading, discharge, framework, vibration chamber) should be packaged separately and transported in insulated wooden boxes
6. **After sales service:** biannual maintenance schedule should be followed by qualified fabricators
7. **Safe operations:** Use operational manual always for safe operation of equipment
8. Daily cleaning using high pressured air from compressor
8. **DOs:** cleaning must be done regularly; always operate machine using SOPs; processors must wear safety garments (ie.lab coat, gloves, water-proof boots, goggles, face mask, head net); ensure safety perimeter (red marking) around equipment;
10. **DONTs:** avoid overloading equipment; avoid phones in production area; wearing ornaments during processing must be prohibited; avoid placing water close to electrical components; do not pour water into feeding system.

HAMMER MILL+CYCLONE

Specifications:

1. **Input materials**

   a. Hammers (swing/fixed) - stainless steel
   b. Cyclone – stainless steel
   c. Sieve material - stainless
   d. Food contact areas - stainless steel
   e. Non-food contact areas (legs, motor seat) –mild steel
   f. Aspirator

2. **Gender-considerations:** Introduction of automated feeding system; machine should have clearly defined ON and OFF buttons.

3. **Transportation:** disassemble into insulated wooden boxes, ensure equipment components (hopper, cyclone, milling chamber, holding bin) are packaged separately to avoid breakage/ damage during transportation.

4. **After sales service:** ensure regular motor checks, biannual maintenance schedule by qualified fabricators must be ensured.

5. **Safe operations:** Operational manual for safe operation of equipment should always be used.

6. Daily cleaning using chlorinated water and mild food grade detergent; remove hammers and clean thoroughly.

7. **DOs:** cleaning must be done regularly; maintenance of machine; always operate machine using SOPs; processors must wear safety garments (ie. lab coat, gloves, water-proof boots, goggles, face mask, head net); ensure safety perimeter (red marking) around equipment.

8. **DONTs:** metallic objects in contact with machine must be avoided; avoid direct contact with machine during operation; avoid directly inserting fingers into hammer section; avoid water coming into contact with electric motor; avoid overloading/overworking equipment; avoid phones in production area; wearing ornaments during processing must be prohibited;

PIN MILL

Specifications:

1. **Input materials**

   a. Pins- stainless steel
   b. Food contact areas - stainless steel
   c. Sieve material - stainless
   d. Non-food contact areas (legs, motor seat) – mild steel

2. Use pneumatic blower and cyclone to achieve dust-free operation

3. **Gender-considerations:** use of motorized loading

4. Machine must have clearly defined ON and OFF buttons.

5. **Transportation:** disassemble into insulated wooden boxes, ensure equipment components are packaged separately to avoid breakage/damage during transportation

6. **After sales service:** ensure regular motor checks, biannual maintenance schedule by qualified fabricators must be ensured using food grade grease and machine oil

7. **Safe operations:** Operational manual for safe operation of equipment should always be used

8. Daily cleaning using chlorinated water and mild food grade detergent; remove pins and clean thoroughly

9. **DOs:** cleaning must be done regularly; maintenance of machine; always operate machine using SOPs; processors must wear safety garments (ie. lab coat, gloves, water-proof boots, goggles, face mask, head net); ensure safety perimeter (red marking) around equipment

10. **DONTs:** metallic objects in contact with machine must be avoided; avoid direct contact with machine during operation; avoid directly inserting fingers into pin section; avoid water coming into contact with electric motor; avoid overloading/ overworking equipment; avoid phones in production area; wearing ornaments during processing must be prohibited.

PACKAGING MACHINE

Specifications:

1. **Input materials**

   a. Food contact areas- stainless steel
   b. Other parts – mild steel
   c. Bolts and nuts – stainless steel

2. Form fill and seal (FFS)

3. Jumbo packaging

4. Gender-friendly with the introduction of automated feeding system

5. **Transportation:** all different components (loading, discharge, framework, filling chamber) should be packaged separately and transported in insulated wooden boxes

6. **After sales service:** biannual maintenance schedule should be followed by qualified fabricators

7. **Safe operations:** Use operational manual always for safe operation of equipment

8. Daily cleaning using high pressured air from compressor

9. **DOs:** cleaning must be done regularly; always operate machine using SOPs; processors must wear safety garments (ie.lab coat, gloves, water-proof boots, goggles, face mask, head net); ensure safety perimeter (red marking) around equipment;

10. **DONTs:** avoid overloading equipment; avoid phones in production area; wearing ornaments during processing must be prohibited; avoid placing water within the packaging area and close to electrical components; do not pour water into feeding system.

WASTE BINS/TANKS

Specifications:

Input material

1. Plastic/stainless steel/aluminum
2. Introduce trolley system
3. Gender-friendly
4. **Transportation:** transported as whole
5. **Safe operations:** Use operational manual always for safe operation of equipment.
6. Daily cleaning using chlorinated water
7. **DOs:** cleaning must be done regularly; always operate machine using SOPs; processors must wear safety garments (ie. lab coat, gloves, water-proof boots, goggles, face mask, head net).
8. **DONTs:** avoid overloading equipment; avoid ruminants from coming into contact; avoid phones in production area; wearing ornaments during processing must be prohibited; do not pour water into waste bin.

WASTE WATER RECEPTACLE

Specifications:

Input material

1. Sludge pond
2. Dug-out pit
3. Covered to avoid contamination
4. Gender friendly
5. **Transportation:** transported as whole
6. Utilize waste bin trucks to dislodge occasionally
7. **DOs:** processors must wear safety garments (ie.lab coat, gloves, water-proof boots, goggles, face mask, head net), ensure safety perimeter is adhered to; fenced to avoid accidents.
8. **DONTs:** avoid spillage or overflow; avoid rodents and ruminants from coming into contact.
9. overloading equipment; avoid phones in production area; wearing ornaments during processing must be prohibited; do not pour water into waste bin.


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7. CONCLUSION AND RECOMMENDATION

The expansion of the cassava sector demands improvement of processing equipment on all fronts. This places a demand on all stakeholders to ensure that food safety and public health are not compromised for economic benefits.

This guidelines document is therefore expected to show the way by creating the awareness of equipment fabricators, cassava processors and other stakeholders and chart a path towards continuous improvement in cassava processing equipment fabrication in Ghana. Cassava fabricators are encouraged to use this guideline to fabricate standard cassava processing equipment for the cassava industry.

This guideline is also recommended as a training tool ensure the manufacture of standard cassava processing equipment in Ghana.

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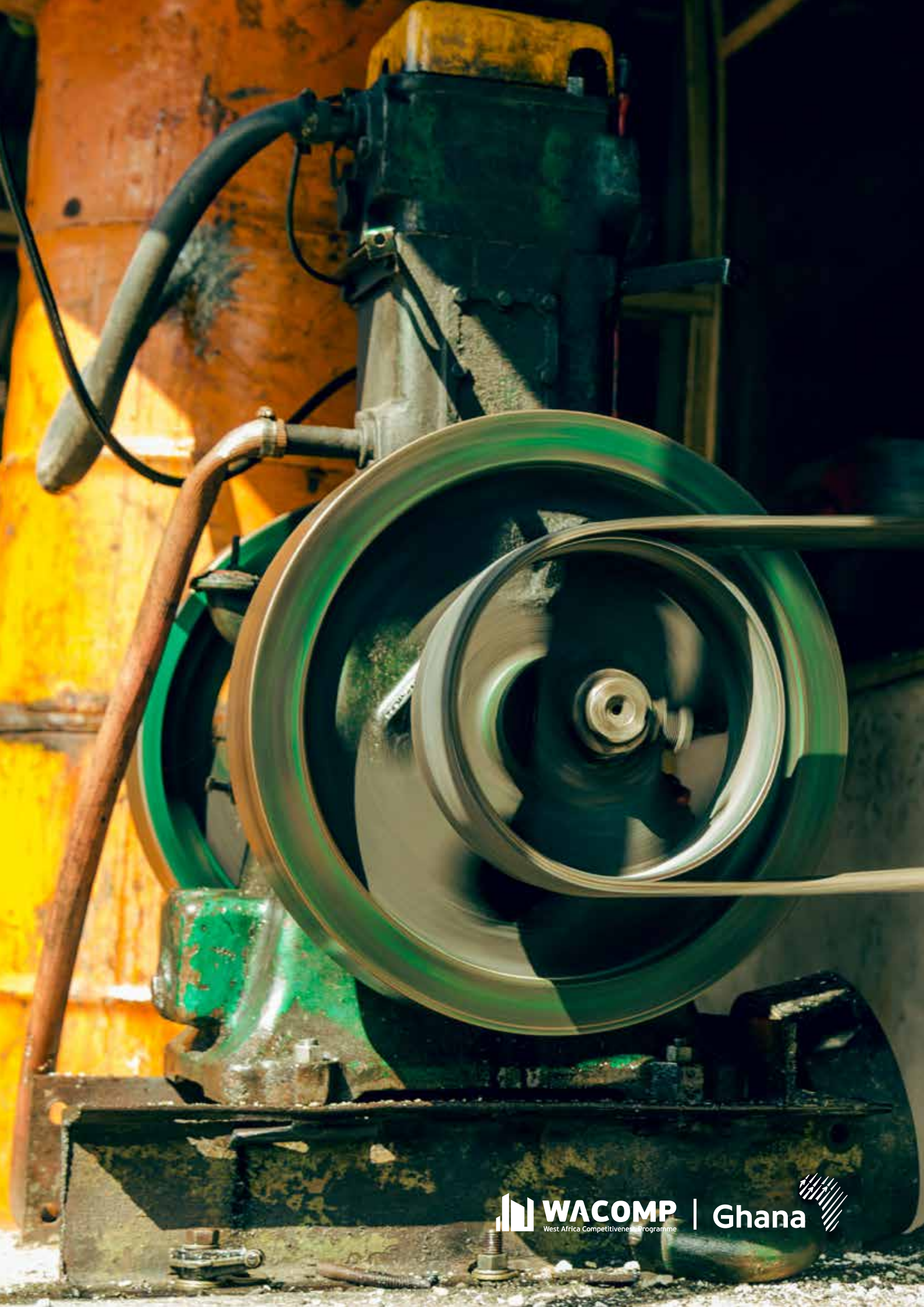
Annex 1: Cassava processing equipment fabricated in Ghana

Item No.	Cassava Processing Equipment	Key materials employed in cassava equipment manufacturing	Risks associated with non-food grade materials employed in cassava equipment fabrication	Unsafe practices employed in food processing equipment fabrication.
1.	Grater	• Hopper (Stainless Steel), • Blade (Stainless Steel), • outlet (Stainless Steel). • Base (Mild/Galvanized steel), • leg (Mild/Galvanized steel)	Chipping of material surface into cassava product during processing; Contamination of cassava by heavy metals because of chipping of equipment contact surface	The use of untrained technicians in the fabrication of food processing equipment. Use of substandard (cheap) metals to fabricate food processing equipment. Coating of contact surface of food processing equipment with non-food grade paint to prevent corrosion and rusting. Use of non-food grade materials and unapproved materials as contact surfaces for food processing
2.	Press (Jack/screw)	• FCA (Stainless steel) • NFCA (Mild steel) • Some fabricators use Galvanized/mild steel 100%	Chipping of material surface into cassava product during processing; Contamination of cassava by heavy metals because of chipping of equipment contact surface	The use of untrained technicians in the fabrication of food processing equipment. Use of substandard (cheap) metals to fabricate food processing equipment
3.	Hydraulic press	• FCA (Stainless steel) • NFCA (Mild steel) • Some fabricators use Galvanized/mild steel 100%	The heavy weight of wet cassava can fracture or weaken non-durable non-food material over a long period of continuous loading; partial dewatering of wet cassava dough	The use of untrained technicians in the fabrication of food processing equipment. Use of lightweight materials to fabricate equipment meant for processing heavy or high-density food materials
4.	Decanter	• FCA (Stainless steel) • NFCA (Mild steel)	Poor resistant of food contact surface of equipment to rubbing	The use of untrained technicians in the fabrication of food processing equipment.

		• Some fabricators use Galvanized/mild steel 100%	of sand particles against it resulting in metallic dust particles mixing with the cassava slurry during cassava starch processing	Use of substandard (cheap) metals to fabricate food processing equipment
5.	Gari fryer (Roasting pan)	• Stainless drum or cylinder • All other parts mild steel • Some also use mild steel 100%	Reaction of cyanide in cassava with the material surface to produce hazardous compounds; Oxidation of the material surface because of exposure to oxygen leading to electrochemical breakdown of the material	The use of untrained technicians in the fabrication of food processing equipment. Use of non-food grade materials and unapproved materials as contact surfaces for food processing Use of substandard (cheap) metals with high corrosion and oxidation tendency to fabricate food processing equipment.
6.	Dryers	• FCA (Stainless steel) • NFCA (Mild steel) • All parts (Galvanized metal)	High cost of maintaining fabricated equipment because of frequent breakdown of equipment due to heavy weights of cassava, corrosion, and oxidation of material contact surfaces	The use of untrained technicians in the fabrication of food processing equipment Use of substandard (cheap) metals to fabricate food processing equipment
7.	Vibration sieve	• FCA (Stainless steel) • NFCA (Mild steel) • Some fabricators use Galvanized/mild steel 100%	Chipping of material contact surface into cassava product due to abrasion of contact surface during processing	The use of untrained technicians in the fabrication of food processing equipment. Use of substandard (cheap) metals to fabricate food processing equipment
8.	Hammer mill	• Hopper (Stainless Steel), • Blade (Stainless Steel), • Outlet (Stainless Steel).	Chipping of material contact surface into cassava product during processing; Oxidation of the material surface because of	The use of untrained technicians in the fabrication of food processing equipment.

		• Base (Mild steel), • Leg (Mild steel) • Some fabricators also use stainless steel 100% • Some fabricators also use galvanized steel 100%	exposure to oxygen leading to electrochemical breakdown of the material ending in rusting of contact surface of miller hopper	Use of non-food grade materials and unapproved materials as contact surfaces for food processing Coating of contact surface of food processing equipment with non-food grade paint to prevent corrosion and rusting.
9.	Bin dryer	• FCA (Stainless steel) • NFCA (Mild steel) • All parts (Galvanized metal)	Corrosion of material surface due to contact with water resulting in production of poisonous chemicals into cassava during processing; Oxidation of the material surface because of exposure to oxygen leading to electrochemical breakdown of the material	The use of untrained technicians in the fabrication of food processing equipment. Use of substandard (cheap) metals to fabricate food processing equipment
10.	Washing trough	Stainless steel 304	Corrosion of material surface due to contact with water resulting in production of poisonous chemicals into cassava during processing	The use of untrained technicians in the fabrication of food processing equipment. Use of non-food grade materials and unapproved materials as contact surfaces for food processing Use of substandard (cheap) metals with high corrosion and oxidation tendency to fabricate food processing equipment
11	Peeling machine	Stainless steel 304	Difficulty in cleaning material surfaces leading to contamination of cassava by residual products during processing	The use of untrained technicians in the fabrication of food processing equipment. Use of non-food grade materials and unapproved materials as contact surfaces for food processing

1.	Slicing machine	Stainless steel 304, mild steel	Difficulty in cleaning material surfaces leading to contamination of cassava by residual products during processing	The use of untrained technicians in the fabrication of food processing equipment. Use of non-food grade materials and unapproved materials as contact surfaces for food processing
2.	Chipping machine	Stainless steel 304	Difficulty in cleaning material surfaces leading to contamination of cassava by residual products during processing	The use of untrained technicians in the fabrication of food processing equipment. Use of substandard (cheap) metals, non-food grade materials and unapproved materials as contact surfaces for food processing
3.	Fermentation trough/tanks	Aluminium/ carbon steel/ stainless steel	Inability to withstand processing conditions such as high heat and high temperature can result in explosion and cause harm	The use of untrained technicians in the fabrication of food processing equipment. Use of substandard (cheap) metals to fabricate food processing equipment
4.	Flash dryer	Stainless steel/ mild steel	High cost of maintaining fabricated equipment because of frequent breakdown of equipment due to heavy weights of cassava, corrosion, and oxidation of material contact surfaces	The use of untrained technicians in the fabrication of food processing equipment Use of substandard (cheap) metals to fabricate food processing equipment
5.	Packaging machine	Stainless steel	Rusting of contact surface due to oxidation	The use of untrained technicians in the fabrication of food processing equipment Use of substandard (cheap) metals to fabricate food processing equipment
6.	Waste bins/tanks	Steel	Rusting of contact surface	The use of untrained technicians in the fabrication of food processing equipment
				Use of substandard (cheap) metals to fabricate food processing equipment
7.	Wastewater tanks	Steel	Rusting of contact surface	The use of untrained technicians in the fabrication of food processing equipment Use of substandard (cheap) metals to fabricate food processing equipment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GUIDELINES

FOR BEST PRACTICES OF CASSAVA
PROCESSING EQUIPMENT FABRICATION

GUIDELINES

FOR BEST PRACTICES OF
CASSAVA PROCESSING EQUIPMENT
FABRICATION

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