

Producing Gari from Cassava

An illustrated guide for smallholder cassava processors

B. James, R. Okechukwu, A. Abass, S. Fannah, B. Maziya-Dixon,
L. Sanni, A. Osei-Sarfoh, S. Fomba, S. Lukombo



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Unleashing the power of cassava in Africa

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UPoCA

The project *Unleashing the Power of Cassava in Africa* (UPoCA) draws on prior research results to increase on-farm cassava productivity and value-added processing for markets in DR Congo, Ghana, Malawi, Mozambique, Nigeria, Sierra Leone and Tanzania. Funded by USAID, UPoCA aims to raise the incomes of smallholder groups by providing improved cassava varieties and developing their production and processing capacity, so they can produce cassava products at affordable prices. The project therefore contributes to national efforts to stimulate rural economic growth and, at the same time, benefits the urban poor.

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Introduction

Rapid urbanization throughout sub-Saharan Africa is currently being accompanied by a growth in demand for convenience foods. Cassava roots provide an ideal raw material for many of these types of food products, since they are easy to process and have a bland flavour. However, fresh cassava roots are bulky and costly to carry and, in addition, are likely to rot within a few days of harvesting.

Cassava roots contain cyanide, which is poisonous. Different varieties of cassava contain different amounts of cyanide. Roots that contain high amounts of cyanide normally taste bitter and should not be eaten raw, while the roots of 'sweet' varieties contain low levels of cyanide and can be eaten raw.

Cassava roots can be processed into several different products, which include gari, flour, bread and starch. Processing provides smallholder cassava producers with additional market opportunities, beyond simply selling the fresh roots. Once they have invested in suitable equipment, processing enables smallholders to increase their incomes, since they can demand a higher price for the value-added processed products.

Traditional methods of processing cassava roots can result in poor quality products that contain unacceptable levels of cyanide, as well as being contaminated by foreign matter and disease-causing agents. If people eat these kinds of products, they can suffer from acute cyanide poisoning, goiter, and a nerve-damaging disorder that makes them unsteady and unable to walk properly.

Proper processing converts fresh cassava roots into safer and more marketable products by:

- Reducing cyanide levels in the processed products
- Prolonging shelf life
- Reducing post-harvest losses of fresh cassava roots
- Avoiding contamination of the products and the environment



- Increasing the nutritional value of cassava (e.g., by adding grain legumes during processing)
- Increasing the market value of cassava
- Reducing transport costs.

Gari is one of many different kinds of food products that can be produced from fresh cassava roots. Gari is dry, crispy, creamy-white and granular. It is made from cassava roots that have been crushed into a mash, fermented and sieved into small pieces (known as grits). The grits are then roasted or fried to make the final crispy product. Gari is a popular food in West Africa and is fast becoming a marketable product.

Objectives of the guide

This pictorial guide focuses on building the capacity of smallholder farmers and food processors to produce gari as a business. The guide illustrates the equipment and skills needed to produce good quality gari. By following this guide, smallholder cassava processors will be able to respond to market opportunities and create a loyal customer base. Field agents who support value-added cassava processing will also find the guide useful for training.

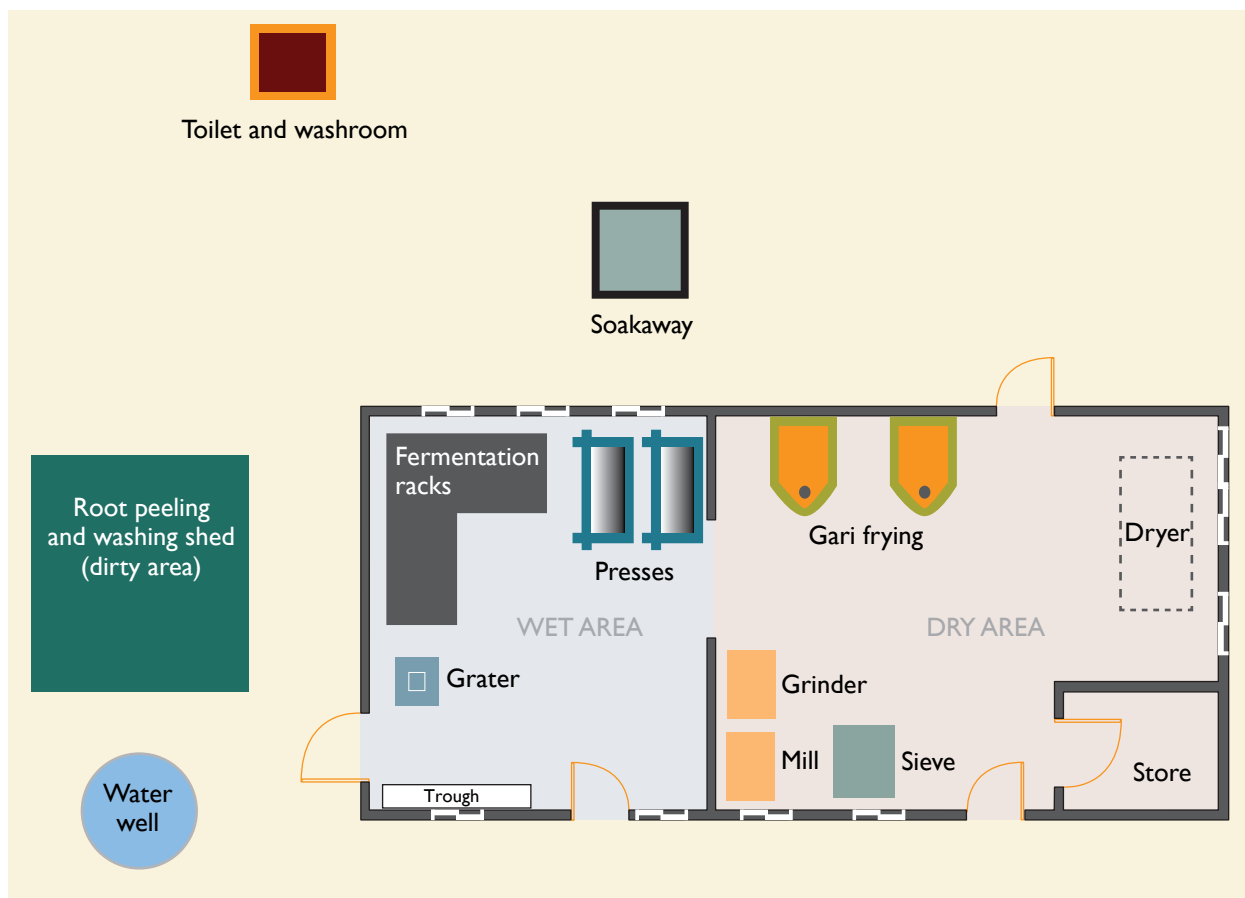
The guide uses photographs to explain the following topics, in a form that can be readily understood by both literate and illiterate cassava processors:

- Design of smallholder cassava processing centres or factories
- Selection of appropriate machines to improve the quality of products and expand market potential
- Techniques required to produce good quality gari
- Good hygiene practices.



The factory

Smallholder cassava processing centres or factories play an important role in national food industries and must maintain strict hygiene. This will become increasingly important as the number of cassava factories grows. Cassava processors are therefore advised to maintain good hygiene, not only to protect the health of their customers, but also to protect the reputation and future business of the processing industry.



Floor plan for a smallholder cassava processing factory

This floor plan illustrates a possible layout for a smallholder cassava processing factory. It can be modified according to the needs of the business:

- The size can be larger or smaller
- Different cassava processing pathways can be adapted into a single system, enabling the processor to produce a wide range of cassava products
- Changing rooms for workers can be located inside or outside the main building, but toilets should be separate
- The water source or well should be outside the main building
- The store should not be too large and only the processed cassava products should be stored there to minimise the risk of contamination.

The factory should be located away from the family's living quarters. It should have at least two separate doors, one for the delivery of raw materials and the others through which finished products are taken away. The walls can be made of reinforced mud or clay bricks (e.g., simveram bricks) or cement bricks. The floor should be made of concrete. There should be two separate areas of flooring: wet and dry.



Wet area

The wet area is where fresh cassava roots are made into wet cake or chips. The equipment and machines used for peeling, washing, grating roots into a mash and removing excess water are installed here. The floor and washing trough should be lined with ceramic floor tiles. These are easy to keep clean and will help the processors maintain good hygiene conditions.



Dry area

The dry area is where finished cassava products are made from wet cakes or chips. The dry section houses machines used for breaking and sieving wet cakes, roasting wet cake particles into gari, drying and milling. The final products are packed and stored here too. The dry area can be tiled, but this is not essential.



Machines and equipment

Different machines and types of equipment are used for the different stages and types of processing. Table 1 lists the types and capacity of some machines commonly used to produce gari from cassava. Before buying equipment, the processor should find out about the product qualities required by the market, to ensure they produce the most suitable product.

Table 1: Equipment for producing gari

Name/function	Capacity	Key features required and common problems
Cassava root peeler	2 tonnes/hour	Manual or motorised; labour intensive
Motorised grater	2 tonnes/hour	Robust frame; stainless steel grating drum/blades; chute; this is an essential item in cassava factories, requires regular cleaning and maintenance
Wooden fermentation racks	Number of bags held depends on length and strength of racks	Robust frame to prevent breakage and collapse; requires periodic cleaning to remove starch layers and dirt
Presses for de-watering cassava mash	Number of bags held depends on size of press	Robust frame; needs to be serviced occasionally
Manual or mechanical sifters	0.2 tonnes/day for manual and 1 tonne/day for mechanical sifter	Hole size varies according to grade of gari; manual sieve needs careful handling to prevent holes becoming too large
Improved gari roasting bays	3–6 kg per load, depending on size of tray	Stainless steel material for roasting tray; galvanised steel chimney pipes; tiled roasting bays; poorly installed bays tend to crack and allow smoke to enter the processing factory
Grinder	250 kg powder/hour	Standard stainless steel grinding surfaces
Bag stitching machine	1 bag/minute	Single stitch or double stitch; regular maintenance required; needs a 2 KVA generator to supply power
Weighing scale	100 to 150 kg capacity	Simple to use; needs cleaning and occasional re-setting
Impulse sealer for polythene sachets	100 packs/hour	Simple to use; needs a 2 KVA generator; heating element may need to be replaced at regular intervals



A motorized grater used to crush cassava roots into a wet mash



A hydraulic press used to remove excess water from cassava mash



An automatic gari roaster is ideal for producing large volumes of gari



The buyer should check that all cassava processing machines have stainless steel surfaces where they are in direct contact with the cassava roots. If these parts are made from mild steel, they will rust quickly and contaminate the gari.

Skills

For most cassava varieties, a processor can expect to produce 1 tonne of gari from 4 tonnes of fresh cassava roots. For cassava varieties or clones with a high dry matter content (e.g., variety TME 419), a processor can expect to produce 1 tonne of gari from 3 tonnes of fresh cassava roots. Processing cassava roots into gari takes several steps, and processors need to develop their skills in each of the following:

- Peeling and washing cassava roots
- Grating cassava roots into mash
- De-watering and fermenting mash into wet cake
- Sieving wet cake into grits and roasting grits into gari
- Bagging and storing the gari
- Maintaining good hygiene compliance.



Step 1: Peeling and washing cassava roots

Freshly harvested cassava roots are covered with soil and dirt and some may be damaged or rotten. Only healthy roots (without rot or other damage) should be transported to the factory. At the factory, the roots are peeled to remove the outer brown skin and inner thick cream layer and washed to remove stains and dirt. The water source should be checked regularly to ensure it is not dirty or contaminated.

Items needed :



Fresh, undamaged cassava roots



Source of clean, good quality water



Means of transporting the roots to the factory



Set of assorted clean containers



Clean, sharp knives



Plastic scourer

Peeling



Select fresh cassava roots without rot or damage. Use a sharp knife to peel the roots and remove the skin. Remove any damaged or woody parts from the roots.



Do not shave the roots because you will cut off too much and reduce the amount of gari produced

Washing



Wash the peeled roots in clean water



Do not use water from open and unprotected sources, since this could introduce contamination



Gently scrub the roots with the scourer to remove pieces of unpeeled skin and dirt

Make sure the washed roots are clean with no spots

Step 2: Grating cassava roots into mash

Cassava roots are traditionally grated into a mash or pulp as part of the process to remove cyanide and make the roots safe to eat. Traditional cassava graters are usually made from perforated metal sheets. These rust quickly and are difficult to keep clean. They are also very slow and labour intensive to use.

Mechanized graters are needed to produce a sufficient quantity of cassava mash to meet market demands and standards. Smallholder processors therefore need to learn how to use and maintain these machines.



Items needed:

Washed and spotless roots in a clean container



Do not process roots that are rotten or damaged





Items needed (continued):

A motorised grater with a stainless steel grating drum. Petrol or diesel to power the grater.



The grating drum and all food contact areas should be made from stainless steel



Do not use grater drums made from mild steel; these will rust and contaminate the processed product



Clean woven polythene sacks to hold the cassava mash after grating

Grating



Load the grater with washed roots while the engine is running to crush the roots into a mash



Do not use your bare hands to push the cassava roots against the grating drum as this may cause injury



Collect the mash in a clean bowl and then pour the mash into a clean polythene sack



Wash the sacks after use, dry and store them in a clean dry place
Wash them again before using the next time

Step 3: De-watering and fermenting mash into wet cake



De-watering and fermenting complete the process of removing cyanide from the cassava mash. This is done traditionally by using stones or logs as weights to press excess water out of the bags of cassava mash. The bags are then left to drain and ferment for a few days. As with traditional graters, these methods are slow and unhygienic, and are therefore not suitable for a cassava processing business. Several improved methods are available.

Items needed:



A fermentation rack



A hydraulic press (left) or screw press (right) (here they are on display outside the factory)

Bagged cassava mash can be left on the fermentation rack for one or more days before de-watering. Alternatively, the bags of cassava mash can be pressed for the required number of days, during which time the mash will ferment. At the end of the fermentation period, the mash will become a firm, wet cake.

Fermentation periods of longer than one or two days will produce very sour products. Consumer tastes and preferences will therefore determine the length of the fermentation period.

Always de-water the cassava mash in the wet area of the factory, using one of the following methods:



Load the bags of cassava mash on to the fermentation rack and allow the milky water to drain freely from the bags. At the end of the fermentation period, remove the bags of mash from the rack and press them with a hydraulic press or screw press.



Load the bags directly on to a hydraulic press. Lift and press the jack handle up and down until it becomes hard to move. Repeat the process several times each day until no more water comes out of the bag to produce a firm wet cake.



You can also de-water the mash using a screw press. Turn the handle clockwise to force water from the bag.

When a press is used on the bare ground the waste water will not drain away properly and the area will get dirty. The bags of cassava mash could also become contaminated by the dirt.



When water stops dripping from the bags and the surface of the bag is still moist, you can remove the firm wet cake from the press



Ensure sufficient water has been removed, otherwise the gari will form into lumps during roasting. But, if too much water is removed, the gari will not cook properly during roasting, becoming floury instead.

Step 4: Sieving wet cake into grits and roasting grits into gari

Gari is made by sieving the wet cake into small pieces – known as grits – and then roasting or frying the grits in a hot frying tray or pan to form the final dry and crispy product. Gari is normally white or cream, but will be yellow when made from yellow cassava roots or when fried with palm oil. It is important to make sure the taste and smell is acceptable to local consumers. Yellow cassava roots and palm oil are rich in vitamin A and therefore make nutritious gari.

The product should be free from mould, insects (dead or alive), dirt and any other material that could be hazardous to health.

Gari is usually classified by its particle size:

- Extra-fine: passes through 0.25 mm to 0.5 mm aperture sieve
- Fine: passes through 0.5 mm to 1 mm aperture sieve
- Coarse: passes through 1 mm to 1.25 mm aperture sieve
- Extra coarse: passes through 1.25 mm to 2.0 mm aperture sieve.

Items needed:



A gari sieve made from stainless steel mesh



A gari roasting bay with a shallow stainless steel tray or a moulded aluminium pot. The tray should be mounted on simveram or mud bricks rather than cement bricks, since these are more heat efficient. The tray should have a tiled surround so the area can be kept clean.

Breaking and sieving



Remove the cassava wet cake from the bag



Break the wet cake into small pieces (grits) using a grater or a sieve with an aperture size of 1.5–2.0 mm. This can also be done by hand.



Sieve the pieces of wet cake to remove any fibrous material

Roasting



Clean the surface of the roasting tray and smear it with a thin layer of edible oil (e.g., palm oil or cooking oil)



In the improved gari roasting bay, fuel wood, wood shavings, charcoal or other readily available suitable material is lit through a fireplace on the outside of the factory wall, away from direct contact with the processor



The fire heats the stainless steel tray sitting on a raised platform above the fireplace inside the factory, providing the heat for roasting the gari

Heat the tray and load it with a batch of grits. Stir the batch with a wooden spatula. The gari is ready when it turns into dry, creamy granules.



Smoke generated from the fire underneath the tray escapes through a galvanized steel chimney pipe to the top of the roof



Collect the gari from the roasting pan when it is dry, leaving a small amount of gari in the tray. This helps to roast the next batch.



If the fire is not hot enough, the gari will not cook properly and will become white (bottom of picture). If it is too hot, the gari will burn (top right). The gari at top left was cooked correctly.



Traditional gari roasting bays expose processors to direct heat, smoke and fumes. Over the long term, this may affect the health of the processor and their family.



Do not use a mild steel tray for roasting gari. This will rust and contaminate the gari.



Step 5: Bagging and storing the gari



Remove the gari from the roasting tray and spread it thinly on a raised platform in the open air to cool and dry. Several batches can be put on the cooling tray.



Sieve the gari with a standard size sieve to produce fine granules, which are collected in a plastic bowl



Large granules (on the left) should be broken into smaller granules (on the right)



Use a grinder to break the large granules into smaller ones



When the gari granules are all the same size, pour the gari into a plastic lining inside a woven polythene sack

Do not use a woven sack without the plastic lining because the gari will absorb moisture and lose its crispiness; it will also become mouldy and unsaleable



Weigh the sack of gari to make sure it is the correct weight, as required by the market: e.g., 25 kg, 50 kg or 65 kg. Seal the sack manually or with a bag sealer (if available) to keep the gari clean and fresh during storage.



Pile the sacks on pallets or a raised platform and keep them in a cool, dry place; the gari will keep for up to a year in these conditions

Hygiene compliance

Maintaining good hygiene is vital for the health of the customers and the processors, as well as to build and maintain the processor's reputation, encourage repeat business and grow sales.

Personal and factory hygiene



All staff must maintain good personal hygiene, especially when handling finished products. This includes cleaning machines thoroughly before and after use.

Keep your fingernails short and clean

Do not allow people with long or dirty fingernails to work inside the factory



Clean the grater by pouring water into the hopper while the engine is running for a few minutes



Do not leave the grater dirty; always clean it before and after use, otherwise the dirt will contaminate the next batch of gari



Dress in clean clothing, wear a head scarf or cap and remove all jewellery. Wash your hands thoroughly with soap before starting work, after meal breaks and especially after using the toilet.

The wet area of the factory should be tiled for easy cleaning. Wash the floor of the factory at the end of every day with plenty of water and ensure the water flows into a soakaway, not straight onto the ground outside the factory. Clean cobwebs and dust from the inside of the roof, windows, walls and corners once a week.

Environmental hygiene



Gather all cassava peels. When dried, they can be fed to livestock, e.g., goats and pigs. Cassava peels can also be used as a mulch to control nematodes in vegetable plots and as part of the substrate used to produce edible mushrooms.



Do not throw cassava peels on waste dumps. They will rot and create a bad smell as well as attracting flies and germs.



Collect the milky wastewater from the fermentation bags in a bowl placed underneath the fermentation rack or by the side of the press. Starch in the milky wastewater will collect at the bottom of the bowl and can be collected, cleaned, then sold as a useful by-product.



Do not leave cassava peels and other waste at the processing site as this creates a dirty environment



Alternatively, channel the water into in a soakaway just outside the factory



Do not allow the wastewater to flow straight onto the ground next to the factory; this will make the surroundings dirty and promote the spread of germs



Summary

To build a successful gari production business, you need to:

1. Check out the factors that matter most to your prospective customers, e.g., taste, smell, colour, price, pack sizes.
2. Treat your processing centre or factory as a part of the national food industry, which means keeping it clean and ensuring all staff maintain strict personal hygiene, as well as disposing of waste materials properly.
3. Select and use appropriate processing equipment, making sure all equipment has stainless steel surfaces where it is in contact with the cassava. Keep all equipment clean and in good working order.
4. Choose cassava varieties with a high dry matter content, since these will produce more gari.
5. Learn improved techniques and develop your skills in each of the gari production steps.



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