TRAINING MANUAL (DRAFT)

PROCESSING OF CASSAVA INTO GARI AND HIGH QUALITY CASSAVA FLOUR IN WEST AFRICA

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PREFACE

«REDUCTION OF POST HARVEST LOSSES BY THE DEVELOPMENT OF AGROBUSINESS IN AFRICA »

In order to increase incomes, to achieve food security and improve the social welfare of the population in the rural areas of Africa, many strategies and programs are being implemented and their main target is the improvement of the present economical situation and social indicators of Africa. The project for post harvest improvement of rice, cassava, sorghum/millet products in West Africa, which is a project lead by CORAF/WECARD, coordinated by the Songhai Regional Center and financed by USAID has this same preoccupation.

In the methodological plan for the concretization of priorities of the common vision among African countries and their technical and financial partners, we all agree that if we want agriculture to be the principal sector that stimulates economic growth, then agriculture has to go higher than just simple agricultural production and target the development of agribusiness and agro industries.

In fact, there is an umbilical cord which connects the matter of improvement of post harvest techniques to the development of agribusiness. We should note that agro processing contributes to food security by the following four main ways:

1. **Reduction of post harvest losses**: the estimates of this loss are about 30 percent in the case of cereals, 50 percent for root and tuber crops and up to 70 percent for fruits and vegetables.

2. **Extension of foodstuffs' preservation duration**: this enables the producers to take their products to urban areas where they can find the majority of the population who would buy their goods;

3. **Enhancement of products' value**: increase of producers' incomes, creation of employment

4. **Improving the quality**: assurance of food safety by setting up certification systems.

i. **CORAF's option about agribusiness promotion**

It is very important to note that, CORAF in its development strategic plan aims generally at diversifying sustainable agricultural growth in Africa.
The specific objective includes option for integrating the improvement of the productivity and the development of agribusiness. In fact, for the period of 2007 to 2016, CORAF aims at promoting sustainable agriculture and the diversification of agricultural markets.

The training manuals on the improvement of post harvest quality of rice and cassava products in West Africa, elaborated in the scope of this project, should be used according to a progression of their pedagogic objectives by insisting on the meaning of value chains. The main reason for the users of this manual must be for the invitation of the processors to three characteristics that make up the value chain:

1. **Ambition**, for the definition of production objectives that stops odd jobs
2. **Leadership**, so as to stop unexpectations and wastages of resources and make place for a strict management that guaranties profit making and competitiveness.

3. **Cooperation** so that the mutualization of forces or relative advantages of one and other would lead to a regional economic integration, widening of the market and at last the enhancement of beneficiaries incomes.

In other words, the gamble at the end of each training session with this manual should be to have changed:

- The food specialist, scientist, extension workers from their initial status of « inventor » to a status of « manager »

- The cassava or rice processor from their initial status of « promoter » to a status of « entrepreneur »

We can all see that the optimization of the technical expertise capitalized in this manual cannot be realized unless the trainer is knowledgeable in entrepreneurial because we all know that only an entrepreneur can train another entrepreneur and a mason another mason. So each trainer has to teach his trainees the ways of taking economic decision.

**Ways of promoting agribusiness by the manual:** teach the participants the mechanism of the ways of making economical decisions.

**The pedagogical orientation of this training session with these manuals must aim at guiding the listener to the necessity of:**
1. Searching for the valuing of agricultural products, the best strategies and alternatives that would optimize the resources which are to be used, we don’t have to process just because we have to process... the manual insists on the taking over of adapted technologies and on the mastering of processing procedures in conformity with the norms of quality and occupying a good position in the market.

2. Upgrading the firm with the new knowledge we’ve acquired into a large scale of production system.

As a result of this, the driving code from agribusiness requirement shows us the following chronological steps:

- A good definition of the comparative advantages and opportunities, good evaluation of the necessary needs, market segmentation and the outlining of the product and pricing strategies,
- Definition of the special offers and the distribution strategies
- Definition of competing strategies, analyses of the profitability of the operation.

So if at least each participant leaves the training session with the conviction that he or she can optimize his firm by making it a real agribusiness center, then there will be no doubt that the training session done by using this manual has sowed seeds for agribusiness development. The following eleven questions can help us to act as an agribusiness promoter:

1. What am I suppose to change in my firm? (What are the problems in my firm)?
2. What am I losing by leaving the firm without improvement and what would I gain by making necessary improvement?
3. What kind of changes or improvements should I make?
4. What are my strong and weak points in relation to the changes I want to make, and what are the treats and opportunities?
5. Which objectives and results am I targeting by undertaking these changes?
6. What are the different possible alternatives and which are the best among them?
7. What are the priorities for the implementation of the improvement and according to which program?
8. What are the necessary means for implementing the innovation?
9. What are the expected fall outs of this innovation? After the innovation, would the situation be better than the old situation?

10. What are the reel risks and the chances of success in the concretization of these innovations?

11. Which indicators would enable me to supervise and to readjust during the implementation of the different stages of the project?

The implementation of these steps composed by 11 points can be done by the trainer as an exercise of economical decision making by what we call « partial budget » which is the analyses made together with the participants by knowing in the case of innovations in our firms, the additional charges and the subtracted products.

To sum up, this manual has to transform our poor population not only into producers and processors but also into wealth creators because, whether we like it or not it is clear that the success of Africa depends mostly on the capacity of his entrepreneurs and heads of enterprises to create and retain wealth through private enterprises.

Guy Médard LOUEKE,
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FOREWORD

The project, *Improving post-harvest quality and packaging of rice, sorghum/millet and cassava products to enhance marketability in West Africa* aims to put technological packages in the hands of cassava producers and processors as a means of increasing food availability and incomes. It is funded by the USAID, managed by CORAF/WECARD and coordinated by the Songhai Centre.

In cassava, the output of women cassava processing groups is reduced by 40% during the dry season as a result of drudgery vis-à-vis high labour cost in harvesting cassava roots. On the contrary, excessive glut and harvest losses occur at the peak of harvesting time. Additionally, the traditional pealing and grating methods of cassava into main products such as gari, flour and dough are grossly inefficient with low turnover, and sometimes injurious to health. A blend of 10% cassava flour with wheat flour is feasible. However, poor processing technology results in quality deterioration, storage losses and health hazards. Improvements and up-scaling of technologies for processing cassava into flour, gari and dough will ensure efficiency and reduction in post-harvest losses. The project is mobilizing the strengths, expertise and resources for post-harvest technology development and transfer in West Africa to demonstrate appropriate post-harvest technologies for adoption. Improved techniques for cassava processing into flour, gari and dough will be proven, alongside packaging and labeling technologies. The project seeks to strengthen capacities of the target groups to enable them adopt the techniques in cassava processing, whilst their access in the acquisition of simple processing equipment facilitated through relevant linkages to relevant institutions in the target countries, Senegal, Mali, Liberia, Nigeria and Ghana. The manual is an outcome of consultative effort involving key partners (agro-processing groups, particularly women, artisans, the respective NARIs, NGO/Extension and micro-credit institutions). The training needs of target groups, their constraints and existing opportunities for capacity strengthening were identified through a consultative scoping study involving the actors.

The manual development team reviewed existing manuals on processing technologies and updated them with new technologies and information available. It is anticipated that this will contribute to the reduction in cassava post-harvest losses and improve market quality to improve food security and increase incomes of cassava producers and agro-processors in West Africa.

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Introduction

Cassava is one of the most important root crops in Africa. Sixty percent of the population of sub-Saharan Africa (SSA) depends on cassava as a staple food crop. Through its production, marketing and processing, cassava provides a major source of household income, often for women and the very poor. NEPAD (2004) has identified cassava as a poverty-alleviation crop and has developed a market-orientated strategy for the sub-sector, based on the Global Cassava Development Strategy (GCDS). This choice is partly due to the recognized importance of the crop as a famine reserve, its production being relatively simple, demanding low agronomic inputs with little or no fertilization. Other advantages of the crop include: its efficiency in calorie production compared to other crops (accounting for 30% daily calorie intake in Ghana); its flexibility in planting and harvesting time, and drought-resistance. Cassava is reliable as a food source thus making it a crop of choice in Africa.

Cassava is a perishable commodity with a shelf life of less than 3 days after harvest. Processing provides a means of producing shelf stable products (thereby reducing losses), adding value at a local rural level and reducing the bulk to be marketed (Phillips et al., 2005). As urban population expand, the demand for more convenience and shelf-stable foods increases. Some cassava foods, such as Gari, tapioca, and attieke, are highly prized by urban populations, and these have managed to retain their markets. Imported food products are important urban foods but there is still a high demand for traditional foods, although they are often considered less acceptable because of concerns of quality and safety (Sanni et al., 2007).

In Africa, cassava is currently utilized for two main purposes: human food and industrial usage. Estimates for the percentage of cassava used for industrial utilization range from 5 to 16% while the rest used directly for human consumption. Most of cassava's industrial utilization is for animal feed. About 10% of its industrial demand consists of high quality cassava flour used in biscuits and other confectioneries, dextrin, pre-gelled starch for adhesives, and starch for pharmaceuticals and seasonings.

Failure to adequately develop post-harvest and marketing systems for cassava has for many years, limited the contribution of the crop in economic growth and poverty reduction. There have been pockets of very innovative technical research works towards, understanding the mechanisms of cyanogens reduction during processing (Sanni and Jaji, 2003; Aerni, 2004), development of cassava processing equipment and of the commercial/industrial applications of cassava (Westby et al., 2001). In spite of the extensive research activities on cassava, there seems to be wide variation with no control on the processing of cassava within and among the countries of the sub-region. There is therefore the need to have a document containing standardized procedure in processing.
the products and empower processors and other stakeholders for commonality in quality and competitive market.

**Constraints of Gari and HQCF processing**

Gaps in knowledge contribute to a number of problems/constraints in cassava processing. These include low multiplication rates because of vegetative propagation, and labor intensive production and processing.

Fresh cassava is highly perishable, with a shelf life of less than 3 days. Hence, processing which provides a means of producing shelf stable products for value addition is important. The root is also very bulky, (containing about 70% moisture), making processing close to the supply source economical.

Other identified problems include traditional processing methods, which give poor/low product yields; current practices of use of mixed varieties in processing create problem in product quality consistency; finished product safety not guaranteed as a result of non-availability of standards, poor product packaging and storage, and low productivity as a result of no to low use of modern equipment. Most of the equipment needed for processing cassava into Gari and HQCF are being produced in West Africa but the right materials (e.g. Stainless steel) are not used in manufacturing some of them. The efficiencies of the peeling machines need to be improved upon with respect to the peeling loss incurred and inability to completely peel the roots. All these problems could result in non-competitiveness of the products in the global market.

**Justification**

The vision for cassava is that it will spur rural industrial development, helping to raise incomes for producers, processors and traders while contributing to national food security, by a shift from cassava as principally a subsistence food crop to an industrial crop for export trade.

One of the approaches to achieve this goal is to have a document, in form of a manual which addresses cassava product standards in terms of production, processing, storage and distribution. The manual can be used by cassava stakeholders in the sub-region to consistently produce good quality products with competitive advantage in the global market.

Currently, available manuals on cassava processing are mainly found in Nigeria and Ghana but the manuals only address recipes of the countries' based products, which may
or may not be found in other West African countries. There is dearth of information for trainers on cassava processing in the sub-region; this therefore gives room for fluctuation in product quality hence, lack of competitiveness in global market. Having a manual for trainers in West Africa for cassava processing would go a long way in improving the enterprise.

This training manual intends to give guidelines in cassava processing for Trainers namely, extension workers, NGOs, cooperatives and other cassava stakeholders who would use it to empower processors, farmers at the grassroots and also those in small to medium scale cassava enterprise.

**Objectives of the training manual**

1. To standardize Gari and HQCF processing technologies in West Africa

2. To develop a manual for training cassava stakeholders on processing and packaging of good quality and safe cassava products (Gari and HQCF) for competitive market in West Africa

**Development of the training manual**

The training manual development was part of the mandate of the CORAF project. The project identified and brought together cassava processing experts from Nigeria, Ghana, Togo and Benin who are from relevant ministry sectors, research and academic institutions. The team made use of experience, information gathered from literature and existing practices to put together this manual for use among cassava stakeholders in West Africa for improved practices and productivity.

**Structure of the training manual**

The manual focuses on two common products from cassava in West Africa, which are Gari and High quality cassava flour. Each of the products is described with detailed processing using flow charts and diagrams for the trainers’ use. Each product identifies training needs, people, equipment, etc for trainer’s use. It therefore contains all that the trainers need to empower cassava processors and other stakeholders at all levels to produce good quality and safe products.
CHAPTER 1: Training on *gari* processing

Background Information

*Gari* is a partially gelatinized (by toasting), free-flowing granular flour with a slightly fermented flavor and sour taste. In West Africa, it is the most consumed and traded of all food products made from cassava roots. It is consumed either soaked in cold water or stirred in boiling water to make a stiff paste and consumed with choice soup. *gari* can be yellow (if fortified with red palm oil) or white, although *gari* from bio-fortified cassava is gaining popularity now. Seventy percent (70%) of cassava processed as human food is *gari* (Oduro et. al., 2000). Its wide consumption is attributed to its relatively long shelf life and its easy preparation as a meal.

There are variations in the *gari* produced within the sub-region in terms of physical, chemical and sensory qualities. However, the processing method used in this manual captures all variations as much as possible. It also emphasizes precautions on unit operations that have implications on finished product quality and safety.

A trainer on *Gari* processing should familiarize the trainees on the following;

- Training objective
- Training needs

**Training objective:**
To empower trainees to produce good quality and safe *Gari* for consumption and/or commercialization

**Training Needs**
The trainer must have a checklist, which contain the following

1. **Materials**
   a) Raw material-Cassava roots
   b) Basins for washing and packing washed roots
   c) Clean washing water
   d) Clean stainless knives for peeling
   e) Clean sacks for fermenting cassava mash
   f) Sieve/sifter
   g) Fuel for toasting/roasting/Garifying; (fire wood, charcoal or cooking gas)
   h) Packaging materials for finished product
   i) Clean cloth or used sacks for washing
2. Equipment

j) Cassava grater
k) Cassava press
l) Gari toaster/Gari roaster/Garifyer
m) Sealing and stitching machines
n) Weighing scale
o) Mechanical sifter (for medium to large scale processing)
p) Fermenting trough

The trainer should ensure that all the above are available before the training.

Fig. 1  Process Flow Chart for Gari from Cassava roots
Cassava roots: Use fresh cassava roots harvested 10-12 months after planting. The fresh roots must be healthy without rot and well handled from farm.

Note: (Educate farmers, processors and marketers to stick to a particular variety for a particular product; they should be familiar with their varieties and discourage the use of mixed varieties in processing)

Sorting: Select healthy roots from the lot for processing. Discard the unwholesome roots.

Peeling: Peel with clean stainless steel knives and remove woody tips. Ensure that the rind is completely removed and avoid excessive waste of roots.

Mechanical peelers are available in medium to large scale processing.

Note: sorting and peeling can be done simultaneously in small scale processing.

Fig. 2: Peeling
**Washing:** Wash peeled roots in clean water at least twice to remove pieces of peel, sand and other dirts. Clean cloth and used sack can also be used to facilitate washing.

**Grating:** Grate roots properly in clean stainless steel grater to obtain uniformly smooth mash. The grated mash must be uniformly smooth without lumps. In case of non-uniform mash, grate again until smooth mash is obtained. The smoothness of the mash determines the quality, yield and market value of the finished *Gari*.

![Fig. 3: Grating](image)

**Fermenting:** Put cassava mash into a clean sack and tie. Allow to stand in a fermenting trough for 2-4 days. Arrange sacks in such a way that there is no contact with sand or dirts that can contaminate the mash. Allow free sipping of water from the sacks.
There are variations in fermentation period within and among countries. However, fermentation should not be less than 2 days (to allow development of the characteristic sour taste of Gari).

![Figure 4: Fermentation](image)

*(Please ask your trainees for common practice with respect to this and follow what is acceptable to them. In cases of fermentation of less than 2 days, please educate and discourage the practice. Also prolonged fermentation, beyond 3 days, should be discouraged to ensure adequate starch content in the product.)*

**NOTE**: “The practice of processing cassava roots which have been stored overnight into Gari without fermenting the mash should be discouraged”

**Pressing**: The fermented mash in sacks is pressed to remove as much moisture as possible. Pressing is completed when water is no longer dripping from the sacks. If dewatering is not complete, there would be lumps during toasting which reduces quality and yield of gari. The pressing time depends on the efficiency of the press and moisture content of the mash.

Sacks should not be used for too long to prevent bursting during pressing. In some cases of light sacks or over-use of sacks, it is advisable to double the sacks.
Note: Currently, there are different types of press with different capacities and efficiencies.

The press and the pressing area should be kept very clean with good drainage system for safe disposal of the effluent to avoid environmental pollution and public health hazards.

![Fig. 5: Pressing](image)

**Cake breaking/Sifting or Sieving:** Cake breaking is done using clean hands followed by sifting with non-rusting sifter into clean basin. Sifter made of stainless steel material is preferable.

![Fig. 6: Sifting](image)
**Toasting/Roasting/Garifying:** Toast and stir constantly in a large, shallow cast-iron pan over fire, with a piece of gourd or a wooden paddle until the Gari is dried through hand feel. This may take 20-30mins depending on the heat source and quantity of sifted cake.

The finished product (Gari) is usually recognized from the color change from white to cream (for non-palm oil fortified Gari) and crispy hand feel of the grains/particles.

Toasting can also be done mechanically using an automated Garifyer or other improved Garifyer made of stainless steel material and with firewood or charcoal as the heat source.

![Fig. 7: Toasting](image)

**Cooling:** The toasted Gari should be collected into a clean basin and spread on a raised platform lined with clean polythene material or white cloth to cool to room temperature.

**Sieving:** Sieve to obtain granules of uniform size.

**Packaging:** Pack desired quantities in polythene bags and/or sacks, seal or stitch as appropriate. Properly label the packages according to the standards of national regulatory agencies. Gari should be packaged in clean, insect- and moisture-proof materials that guarantee the wholesomeness of the product and the retention of its nutritional, physical and sensory qualities. The packaging should not impart any toxic substance or undesirable odor/flavor to the product. This product could be packaged in polypropylene sacs lined with thin polythene material for bulk sales, or in smaller bags (paper, polythene/polypropylene) as unit packages for retail market. The unit packages could be arranged into secondary packages of cardboard boxes.
In labeling, the following information about the product should be provided:

- The common name and/or brand name
- Name of the manufacturer or packer
- Batch or code number
- Net mass (in metric units)
- Date of manufacture
- Country of origin
- Expiry date
- Preparation, nutritional and storage information should be attached.
- Other information required by the national regulatory agencies.

**Storing:** Store in a cool, dry, well ventilated, insect and rodent free store/enclosure.

**Processing environment**

The trainer should emphasize the need for clean processing environment at the training for product safety and public health.
CHAPTER 2; Training on high quality cassava flour (hqcf) processing

Background Information

High quality cassava flour (HQCF) is a fine flour produced from wholesome freshly harvested cassava (10-12 months after planting) and rapidly processed roots. HQCF is an unfermented, smooth, odourless, white or creamy flour, bland with no gluten. Commercial production of HQCF is relatively new in Africa. As a result of increase in the price of wheat in the international market and unfavourable exchange rates in West Africa, high quality cassava flour (HQCF) was introduced and is now gradually gaining popularity in the sub-region.

HQCF has contributed appreciably to cassava industrial revolution especially in Nigeria and Ghana (Sanni et al, 2009), with enormous potentials in the other countries within the sub-region. The product has been found to be suitable for making a variety of pastries, whole or in the composite forms (cakes, cookies, doughnuts and breads) and convenience foods. It is also an acceptable raw material for the manufacture of industrial items such as textiles, plywood, paper, etc. (Dziedzoave et al, 2006). The processing of cassava roots into HQCF as a primary industrial raw material has the potential to jump-start rural industrialization, increase market value of cassava and improved famers' earnings and their livelihoods.

Governments of some cassava-growing nations are making efforts to promote competitive production and processing of cassava into industrial raw materials for import substitution and foreign exchange earnings (Dziedzoave et al, 2005). To achieve this, policies and laws are being put in place to promote market diversification and expanded utilization of HQCF.

A trainer on HQCF processing should familiarize the trainees on the following;

- Training objective
- Training needs

Training objective

To empower trainees to produce HQCF for domestic and commercial use.

Training Needs
The trainer must have a checklist, which contain the following
1. **Materials**
   a. Raw material - Cassava roots
   b. Basins for washing and packing washed roots
   c. Clean washing water
   d. Clean stainless knives for peeling
   e. Packaging materials for finished product
   f. Clean cloth or used sacks for washing
   g. Clean sacks for dewatering
   h. Black polythene sheet for sun-drying

2. **Equipment**
   i. Cassava grater
   j. Cassava press
   k. Dryer (mechanical, solar)
   l. Milling machine
   m. Sealing and stitching machines
   n. Weighing scale
   o. Mechanical sifter
   p. Slicer/Chipper
   q. Elevated Platform for solar drying

The trainer should ensure that all the above are available before the training.
CASSAVA ROOTS

Sorting/Peeling

Washing

Grating

Pressing

Cake breaking/Sifting

Drying

Milling/Sifting

HQCF

Cooling

Packaging

Storing

Chipping/Slicing

Fig8: Flow Chart for production of HQCF from Cassava roots
**Cassava roots:** Use fresh cassava roots harvested 10-12 months after planting. The fresh roots must be healthy without rot and well handled from farm. The roots should be processed within 12 hours after harvesting.

**Note:** Educate farmers, processors and marketers to stick to a particular variety for a particular product, they should be familiar with their varieties and discourage the use of mixed varieties in processing.

“Processors should be enlightened to process roots which are not older than 12 months. This helps to improve their yields and meet industrial standards for starch and fiber”

**Sorting:** Select healthy roots from the lot for processing. Discard unwholesome roots.

**Peeling:** Peel with clean stainless steel knives and remove woody tips. Ensure that the rind is completely removed to ensure low fiber and white color of the finished product. Avoid excessive waste of roots during peeling.

Mechanical peelers are available in medium to large scale processing.

**Washing:** Wash peeled roots thoroughly in clean water to remove pieces of peel, sand and other dirt. Pieces of clean cloth and used sack can also be used to facilitate washing.

**Grating:** Grate roots properly in clean stainless steel grater to obtain uniformly smooth mash.

The grated mash must be uniformly smooth without lumps. In case of non-uniform mash, grate again until smooth mash is obtained. The smoothness of the mash determines the quality, yield and market value of the finished HQCF.

**Pressing:** The mash is loaded into sacks and pressed to remove as much moisture as possible. Pressing is completed when water is no longer dripping from the sacks. Complete dewatering facilitates drying. Pressing should be done immediately after grating to avoid the onset of fermentation. The pressing time depends on the efficiency of the press and moisture content of the mash.

Sacks should not be used for too long to prevent bursting during pressing. In some cases of light sacks or over-use of sacks, it is advisable to double the sacks.
Note: Currently, there are different types of presses with different capacities and efficiencies.

The press and the pressing area should be kept very clean with good drainage system for safe disposal of the effluent to avoid environmental pollution and public health hazards.

**Cake breaking/Sifting or Sieving:** Cake breaking is done using clean hands followed by sifting with non-rusting sifter into clean basin. It can also be done by placing the pressed cake back into the grater and disintegrate for drying. Sifter made of stainless steel material is preferable.

**Chipping/Slicing:** This unit operation should be used for processing only low cyanide cassava varieties (cassava containing less than 100mg/Kg HCN_{eq}). It makes use of a manual or motorized slicer or chipper. In manual chipping the roots should be thinly sliced to facilitate the drying process.

It is a simple operation with the advantage of yielding a product with slightly higher starch content but compromises other quality requirements like color, odor and taste to a large extent if drying is not done rapidly.

It should not however be used for cassava with high cyanide content (more than 100mg/Kg HCN_{eq}) because the process does not afford sufficient contact between endogenous enzyme (linamarase) and cyanogens for effective detoxification of the product.

*Fig. 9: Sifting*
**Drying:** Dry the disintegrated/sifted cake in a dryer to reduce moisture level to acceptable level according to national regulatory standards. Sun drying, use of mechanical or solar dryer can be employed to reduce the moisture.

Sun-drying should be carried out by spreading the sifted mash or the chips on an elevated platform covered with a black polythene sheet. The black polythene facilitates drying by absorption of solar heat and the elevated platform prevents dust and other dirt from contaminating the drying product.

*“The trainer should strongly emphasize the need to dry the pressed mash and the chips rapidly to prevent fermentation which would impart unacceptable flavor to the pastries produced from the HQCF”*

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**Fig. 10 A:** Sun drying on raised platform

**Fig. 10 B:** Sun drying
Milling: Milling is done to obtain fine textured flour using hammer mill or disc attrition mill.
CHAPTER 3: Packaging/Labeling

Pack desired quantities of HQCF in polythene bags and/or sacks, seal or stitch as appropriate. This avoids absorption of moisture of the flour from the environment. Properly label the packages according to the standards of national regulatory agencies.

HQCF should be packaged in clean, insect- and moisture-proof materials that guarantee the wholesomeness of the product and the retention of its nutritional, physical and sensory qualities. The packaging should not impart any toxic substance or undesirable odor/flavor to the product. This product could be packaged in polypropylene sacs lined with thin polythene material for bulk sales, or in smaller bags (paper, polythene/polypropylene) as unit packages for retail market. The unit packages could be arranged into secondary packages of cardboard boxes.

In labeling, the following information about the product should be provided:
- The common name and/or brand name
- Name of the manufacturer or packer
- Batch or code number
- Net mass (in metric units)
- Date of manufacture
- Country of origin
- Expiry date
- Preparation, nutritional and storage information should be attached.
- Other information required by the national regulatory agencies.
**Storing:** Store in a cool, dry, well ventilated, insect and rodent free store/enclosure.

**Processing environment**

The trainer should emphasize the need for clean processing environment at the training for product safety and public health.

**Food uses of HQCF**

As mentioned earlier, there are various uses of HQCF in the food industry; HQCF is useful in the convenience or fast food industry for making a variety of pastries at 100% level of substitution for wheat or as a composite of wheat flour particularly for bread making. It is very acceptable as a raw material in the food and beverage industry for the manufacture of biscuits, noodles, baby foods, alcoholic drinks, etc, and as a binding or thickening agent in soups/sauces.

Standard recipes for production of HQCF-based pastries have been developed in some countries within the sub-region. Hundred percent substitution for wheat flour is possible in the production of a large number of HQCF-based confectioneries but greater quantities of bakery fats and other texture enhancing ingredients would also be required for the preparation of acceptable products.

**Table 1: Percentage HQCF substitution in pastries**

<table>
<thead>
<tr>
<th>Pastries</th>
<th>Substitution level (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bread</td>
<td>10 – 20</td>
</tr>
<tr>
<td>Biscuits</td>
<td>5 – 50</td>
</tr>
<tr>
<td>Cakes</td>
<td>50 – 100</td>
</tr>
<tr>
<td>Pies/Rolls</td>
<td>20 – 50</td>
</tr>
<tr>
<td>Doughnuts</td>
<td>50 – 100</td>
</tr>
<tr>
<td>Chin-chin</td>
<td>100</td>
</tr>
</tbody>
</table>
Fig. 13: Example of Label
IMPACT POINTS ON PROCESSING GARI AND HQCF

The following table presents a summary of the points the trainer should emphasize to ensure production of good quality, safe and marketable gari and HQCF.

<table>
<thead>
<tr>
<th>Activities</th>
<th>Impact points</th>
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<tbody>
<tr>
<td>1. Unit operations</td>
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</tr>
<tr>
<td>Raw material selection</td>
<td>Process only roots harvested 10-12 months after planting</td>
</tr>
<tr>
<td>Peeling</td>
<td>Peel wholesome roots properly using non-rusting knives</td>
</tr>
<tr>
<td>Washing</td>
<td>Wash peeled roots thoroughly</td>
</tr>
<tr>
<td>Grating</td>
<td>Grate washed roots properly using a grater made of non-rusting material.</td>
</tr>
<tr>
<td>Fermenting (Gari)</td>
<td>Ferment mash for a minimum of 2 days and a maximum of 3 days</td>
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<tr>
<td>Chipping/Slicing (HQCF from low cyanide cassava)</td>
<td>Chip/slice the washed roots thinly</td>
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<tr>
<td>Pressing (HQCF)</td>
<td>Press immediately after grating</td>
</tr>
<tr>
<td>Toasting/Roasting</td>
<td>Toast/roast the sieved mash to low moisture content</td>
</tr>
<tr>
<td>Drying (HQCF)</td>
<td>• Dry pressed mash immediately after sieving/cake breaking</td>
</tr>
<tr>
<td></td>
<td>• Commence drying of chips immediately after chipping/slicing</td>
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<tr>
<td></td>
<td>• Dry the mash or chips to low moisture content on a raised platform covered with black polythene sheets.</td>
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<tr>
<td>Packaging</td>
<td>Package products in well-labeled, insect- and moisture-proof material that would not impart any toxic substance or undesirable odor/flavor to them</td>
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<tr>
<td>2. Hygiene observance</td>
<td>• Personal and environmental hygiene should be strictly observed.</td>
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<td></td>
<td>• Processing equipment should be washed/cleaned before and after use.</td>
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</tbody>
</table>


REFERENCES


## Appendix 1

### Some National standard specifications for Gari and HQCF

<table>
<thead>
<tr>
<th>Edible flour</th>
<th>Gari</th>
<th>Produits</th>
<th>Pays</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>65-70%(min)</td>
<td>10%(max)</td>
<td>Nigeria</td>
</tr>
<tr>
<td>Fiber</td>
<td>2%(max)</td>
<td>1.3%(max)</td>
<td>Ghana</td>
</tr>
<tr>
<td>Starch</td>
<td>10%(max)</td>
<td>2.0%(max)</td>
<td>Togo</td>
</tr>
<tr>
<td>Cyanide</td>
<td>0.6%(max)</td>
<td>0.6 - 1.0%</td>
<td>Benin</td>
</tr>
<tr>
<td>Fiber</td>
<td>2.0%(max)</td>
<td>2.0%(max)</td>
<td>Code Alimentaire</td>
</tr>
<tr>
<td>Ash</td>
<td>0.6%(max)</td>
<td>1.0%(max)</td>
<td></td>
</tr>
<tr>
<td>Cyanide</td>
<td>10mg/Kg (max)</td>
<td>2.0mg/Kg (max)</td>
<td></td>
</tr>
<tr>
<td>Total acidity</td>
<td>0.6 - 1.0%</td>
<td>0.6 - 1.0%</td>
<td></td>
</tr>
</tbody>
</table>

- **Edible flour**: Moisture: 65-70\%(min), Fiber: 2\%(max), Starch: 10\%(max), Cyanide: 0.6\%(max), Ash: 0.6\%(max), Total acidity: 0.6 - 1.0\%.

- **Gari**: Moisture: 10\%(max), Fiber: 1.3\%(max), Starch: 2.0\%(max), Cyanide: 0.6 - 1.0\%.

- **Produits**: Moisture: 10\%(max), Fiber: 1.3\%(max), Starch: 2.0\%(max), Cyanide: 0.6 - 1.0\%.

- **Nigeria**: Moisture: 10\%(max), Fiber: 1.3\%(max), Starch: 2.0\%(max), Cyanide: 0.6 - 1.0\%.

- **Ghana**: Moisture: Non disponible, Fiber: 2.0\%(max), Starch: 2.0\%(max), Cyanide: 0.6 - 1.0\%.

- **Togo**: Moisture: 11-13\%, Fiber: 2.5\%(max), Starch: 2.65\%(max), Cyanide: 0.6 - 1.0\%.

- **Benin**: Moisture: 10-12\%, Fiber: 2.0\%(max), Starch: 2.0\%(max), Cyanide: 0.6 - 1.0\%.