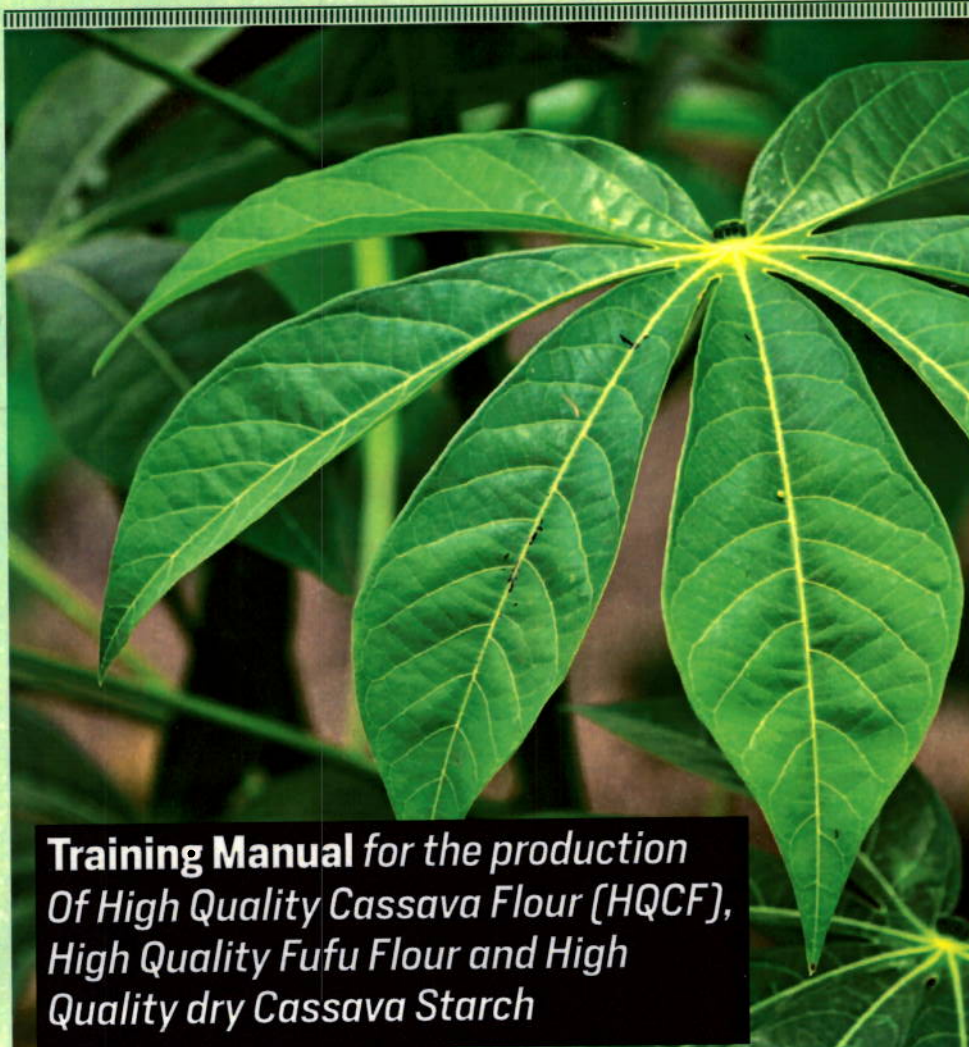


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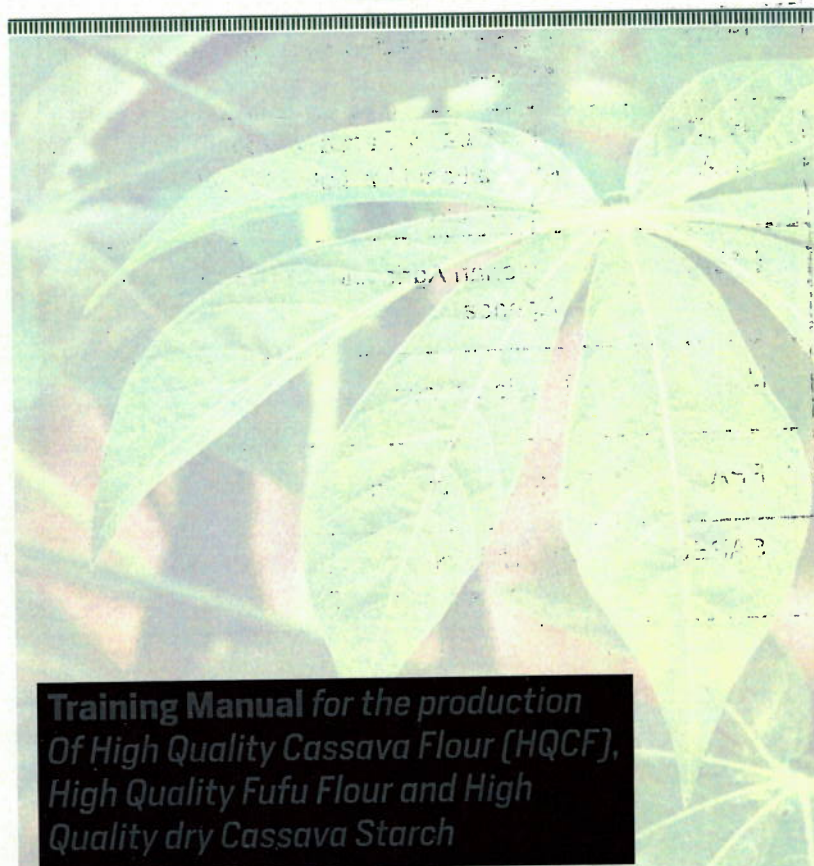
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**Training Manual for the production
Of High Quality Cassava Flour (HQCF),
High Quality Fufu Flour and High
Quality dry Cassava Starch**

MINISTRY OF AGRICULTURE LIBERIA

ITA



**Training Manual for the production
Of High Quality Cassava Flour (HQCF),
High Quality Fufu Flour and High
Quality dry Cassava Starch**

Acronyms

AFDB	African Development Bank
ECOWAS	Economics Community of West African States
FAO	Food and Agriculture Organization of the United Nations
FIRO	Federal Institute of Industrial Research Oshodi
HQCF IITA	High Quality Cassava Flour International Institute of Tropical Agriculture
LADA	Liberian Agricultural Transformation Agenda
MT	Metric Tonnes
PPA	Parts per million
SAPEC	Smallholder Agricultural Productivity Enhancement and Commercialization

TRAINING MANUAL
PROCESSING OF CASSAVA INTO HIGH
QUALITY CASSAVA FLOUR, DRY ODOURLESS
FUFU AND DRY CASSAVA STARCH
IN LIBERIA

PRODUCED BY:
ADETUNJI MEDINAT OLUWATOYIN
CONSULTANT (AfDB)
CASSAVA VALUE CHAIN

For Smallholder Agricultural
Productivity Enhancement and
Commercialization (SAPEC PROJECT).
2017.

TRAINING MANUAL FOR THE PRODUCTION OF HIGH QUALITY CASSAVA FLOUR (HQCF),
HIGH QUALITY FUFU FLOUR AND HIGH QUALITY DRY CASSAVA STARCH

TABLE OF CONTENTS

Acknowledgement	4
Foreword	5
Introduction	6
Brief on Cassava Industry in Liberia	
Challenges of the Cassava Industry in Liberia	
Justification	
Objectives of the Training Manual	
Part 1: Cassava Processing Equipments	9
Part 2: High Quality Cassava Flour Processing	12
Brief on High Quality Cassava Flour	
Uses and composite levels	
Training Materials	
Training Equipments	
Processing Steps	
Quality Requirements	
Part 3: Production of Odourless Fufu Flour	16
Brief on Fufu, processing in Liberia	
Training Materials	
Training Equipments	
Processing Steps	
Quality Requirements	
Part 4: Production of Odourless dry Cassava Starch	18
Brief on High Quality dry Cassava Starch	
Training Materials	
Training Equipments	
Processing Steps	
Quality Requirements	

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FOREWORD

Cassava is one of the world's most important crops. It is the third-largest source of food carbohydrates after rice and maize. Cassava provides the basic diet for over half a billion people.

The current national annual cassava production is 1.5million metric tonnes, on an average of 0.5 ha land holding per smallholder farmer and a yield of between 6-10mt/ha (a considerably low yield) as compared to 15 to 25 MT/ha in other cassava producing countries in West African sub-region and in some parts of the world. However, Liberia has a huge potential for cassava production for both domestic food consumption as well as export if the value chain is developed to meet the global standards. Cassava is commonly used in Liberia as food in form of "depah", "Fufu" and sauce from the leaves. Therefore, industrial use of cassava is limited or non-existent.

However, the Government of Liberia, through the Ministry of Agriculture, set a goal to diversify its economic base through agriculture and on the basis of commodities of comparative advantage, with the private sector as the major driver of the initiative. The Ministry of Agriculture, through the World Bank and African Development Bank funded "Smallholder Agriculture Productivity Enhancement and Commercialization" (SAPEC) Project, prioritized cassava, rice and vegetables as its major commodities. The Ministry of Agriculture embarked on full-scale value chain approach to develop the cassava sector. The Ministry also empowers farmers, processors, marketers and end users through capacity building, training and provision of inputs. The aim is to develop the skills of the processors in the value addition of cassava to produce high quality cassava flour (HQCF), dry odourless Fufu, high quality dry cassava starch, amongst others. Processors will also be supported with modern equipments to ensure sustainability of the industry.

This training manual will educate the trainees on the step-by-step process for producing various cassava derivatives to the best quality and standards to meet both domestic and international market demands.

Dr. Moses M. Zinnah
Minister of Agriculture
Republic of Liberia

INTRODUCTION

Background

The government of Liberia, using the initiative of Liberian Agricultural Transformation Agenda (LATA) is currently transforming the agricultural landscape of the country to meet both the food needs of the people, create jobs and wealth. This is also aimed at transforming agriculture from subsistence to business approach. This initiative is therefore germane especially having survived both the two civil wars and the recent Ebola Virus epidemic. With over 60% of the population of the 4.1 million people living in poverty i.e. under 1 dollar per day, agriculture portends the panacea for the economic revival.

The Smallholder Agricultural Productivity Enhancement and Commercialization (SAPEC) project under the Ministry of Agriculture is focusing on accelerated food production and value addition to ensure domestic food security, better livelihoods and for import substitution to enhance foreign exchange earnings through export. Cassava is one of the agricultural commodities of Liberia, together with rice makes more than up 50% of the country's agricultural GDP.

Cassava is a root crop which has its origin from Latin America as far back as 2000B.C. It is regarded as the most important staple food in Africa and the third most important source of calories in the tropics, (FAO, 2013) it is known as 'Manihot' in Latin America, it is called 'Manioc' by the Francophone, and 'Yucca' in Spanish. It is regarded as the crop of the poor and mostly cultivated on marginal land. However, cassava has grown in importance to become the 21st century crop and described as having transformed from the food of the poor to a multipurpose crop that responds to the Priorities of developing countries, to trends in the global economy and to the Challenges of climate change (FOA, 2013).

While the total world's production of Cassava stands to be 276.7 million MT in 2013 (FOASTAT, 2013), over half of the production is grown in Africa i.e 140.9 million MT, with major producers as Nigeria, Democratic Republic of Congo and others like Liberia, Ghana, Tanzania e.t.c

The following are some of the products that can be derived from Cassava

- High Quality Cassava Flour, (HQCF) for bread and other confectionaries
- Sweeteners (glutamate, fructose, maltose, glucose)
- Other food items such as Gari, Fufu, Depah, etc
- Cassava Chips (Livestock feeds)

Problems of the Cassava Industry in Liberia

The cassava industry in Liberia is faced with several challenges, among which are the following:

1. Poor inputs distribution
2. Lack of mechanization system for production
3. Poor rural infrastructure for ease of movement of goods and services in and out of farm
4. Absence of latest technology for processing
5. Poor market systems and infrastructure
6. Poor or absence of market information system
7. High cost of production which affects the cost along the value chain
8. General low productivity of the crop
9. Poor credit facilities and access to credit
10. Poor agricultural funding by government
11. Poor policy support.
12. Duplication of efforts and intervention
13. Lack standard laboratory for quality check of products
14. Proper packaging & branding of products
15. Absence of Post-harvest disciplines in Liberia higher institutions

Justification

The training on Cassava processing became necessary because of the urgent need to improve the state of cassava industry in Liberia and the technical knowledge of processors in order to have value added products that is market driven. The industry is at very low level in Liberia compared to countries like Nigeria and Ghana. Earlier interventions had more emphasis placed on production than processing. Hence, many processing activities were limited to Gari, Depah, Wet Fufu, while little is done in Higher value products such as High Quality Cassava Flour (HQCF) odourless fufu, cassava starch as well as Tapioca. Among the 6 medium scale processors identified in Liberia, none of them has the required recommended modern processing equipments. The available drying alternative identified was cabinet dryers owned by Falama Incorporated and Liberia Business Incubator Centre.

Most processing activities were mainly done using very crude and rudimentary equipments/ technology. In many instances, grating were done using hand grater which sometimes bruised the hands and introduce blood into the product, thereby creating health issues. It was observed that processing were done mostly under very unhygienic condition.

It therefore became imperative to undertake the bridging of the knowledge gap and improve capacities to meet the global competitiveness.

At the village level, lack of basic infrastructure hinders the production of quality products that is fit for the food market e.g. lack of water for proper washing of the roots.

The training is important for the sustainability of the cassava industry in Liberia as it will help to maintain the supply chain and prevent issues of cyclic glut.

Training the processors will encourage more uses of cassava and improve the marketing of cassava roots, thereby strengthening the value chain and improving the income of actors along the chain.

Objectives

To improve the technical knowledge of processors on the production of high quality cassava products mainly High Quality Cassava Flour (HQCF), High Quality Fufu Flour and High Quality dry Cassava Starch.

The manual will serve as Handbook for processors and other users for both production of value added products and knowledge of the standards and quality.

Part1.

Cassava Processing Equipments

Grater is used in grating peeled and washed cassava roots. The cassava roots are ground into mash. A stainless steel grater is recommended to ensure quality of product and food

CASSAVA GRATER



Jack Press

Presser is used in dewatering the grated cassava mash before drying or roasting in the case of Gari. Sometimes the press serves as fermentation rack for fermented Gari. There is traditional press made of wood and ropes, common in the rural communities and equally effective but highly susceptible to dirty and other impurities. The modern recommended pressers are Hydraulic press or Jack press.

Gari or drying into cassava flour

Pulverizer or Sifter –is used to loosen pressed cassava mash which is known as 'cake' to allow for parching/toasting/roasting gari and drying. There are both local and improved versions but local is more common. It is made from bamboo or plastic net materials



Manual Cassava mash Sifter

Drying- drying is done in various form depending on the available capital and the environmental suitability. There are flash dryers, cabinet dryers, tube dryers, solar dryers and sun energy amongst others. The product must be dried to the recommended moisture content of 10% (SON 2005).



FLASH DRYER



SUN DRYING



CABINET DRYER



SUN DRYING

Dry Hammer Mill:

It is used to mill the dry products into fine powder. Milling allows the product to come out in the desired particle size as required by the end users/market



MECHANICAL SIFTER

Sieving Machine:

Used to sieve HQCF and other flour products. This is to remove fibres and other unwanted materials to obtain fine flour, according to the specifications of the off takers. Can be done manually with local sieve or mechanical siever.

TRAINING MANUAL FOR THE PRODUCTION OF HIGH QUALITY CASSAVA FLOUR (HQCF),
HIGH QUALITY FUFU FLOUR AND HIGH QUALITY DRY CASSAVA STARCH

Part2

HIGH QUALITY CASSAVA FLOUR PROCESSING

Brief on High Quality Cassava Flour

High Quality Cassava Flour (HQCF) is non-fermented flour derived from fresh cassava roots. The flour is produced within 24 hours of harvesting the cassava roots to ensure freshness and prevent fermentation.

Uses - It is used solely or as composite flour for bread and other confectioneries, such as cakes, doughnuts, chin-chin and meat pie e.t.c.






Training Materials- the following are required for the production of HQCF:

Stainless steel knives for peeling,
Large basins for washing,
Clean water, sieves,
Packaging materials,
Clean sacks for dewatering or pressing the grated cassava mash

Training Equipments-

Craters,
Pressers,
Dryers Such as Flash dryer, cabinet dryer, Rotary dryer, Solar
dryer or Sun drying platform,
Scale for weighing roots
Sealing Machine
Hammer mill
Sieving machines

Steps involved in the production of High Quality Cassava Flour (HQCF)

SORTING	Good and healthy roots, free of insect bites or bruise should be selected.	 <p>Sorting of harvested roots</p>
WEIGHING	Take initial weight of the roots to determine the quantity of final product and for product yield calculation	 <p>Weighing scale</p>
PEELING	Should be done with clean stainless steel knives. The woody-ends should be cut off and fibres in the middle removed to avoid high fibre products and ensure effective milling.	 <p>Peeling</p>
WASHING	Should be done thoroughly with clean water and clean sponge/cloth To remove dirt, sands and other	 <p>Washing of peeled roots</p>
GRATING	Should be done with stainless steel machine to avoid heavy metal contamination	 <p>Grating</p>

PRESSING	Done with mechanical press (screw or hydraulic jack). Can also be done using local materials (wood) but care must be taking to avoid impurities and contaminants.	
DRYING	Can be done with flash dryer, solar dryer or sun drying on raised platform.	
		Sun Drying
MILLING & SIFTING	Should be done using stainless steel machines. The dry product Is milled and sieved to obtain fine product. Some hammer mills do sieving simultaneously.	
		Flash Dryer
COOLING	The milled product is allowed to cool before packaging in order to avoid caking.	
PACKAGING	Packaging is done using recommended materials for storage or preservation. Use materials that will not Alter the taste or colour of the product.	

Packaging - The final product must be packed and stored for the market or for keep. The packaging must be airtight to avoid moisture and contaminants getting into product.

Clean packaging materials that meet food safety standards must be used and kept away from insects and pests




High Quality Cassava Flour



Sealing Machine: is used to close the packaging materials to avoid air or moisture getting into the product. There are table sealing machine for small plastic packs and other hand and industrial sewing machines for jute and other big bags. There are also automatic sealing machines and band sealers for supermarket packs designed in various shapes and sizes



Labelling	The label must contain the detailed product information such as the product name, the production and expiry dates, composition of the content and the net weight of the product.	
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Quality requirements for HQCF according to CODEX STAN 176-1995. CODEX

PARAMETER	REQUIREMENT
Moisture Content % (m/m) max	10.0
Crude Fibre % (m/m) max	2.0
Sulphated ash m/m (dry product) max	0.6
Total acidity % (m/m) max	1.0
Hydrocyanic acid and its glycosides measured as hydrocyanic acid (dry form) max % (parts per million)	10
Starch content % m/m	65-70

Recommended Percentage Substitution Level

PASTERIES	SUBSTITUTION PERCENTAGE
BREAD	10-20%
BISCUITS	5-50%
CAKES	50-100%
PIES/ROLLS	20-50%
DOUGHNUTS	50-100%
CHIN-CHIN	25 - 100%

Sanni et al., 2005

Part3

PRODUCTION OF ODOURLESS FUFU FLOUR

Brief on Fufu processing in Liberia

Fufu is a common food item consumed in Liberia. It is produced and sold generally in wet form. The product is poorly produced with high content of fibres, peels, shafts and other extraneous materials. The roots, sometimes is soaked for longer time than necessary, thereby leaving the final product with strong odour and discolouration. The consumer is also left with the task of removing these unwanted materials and pounding the product to required consistency of texture. This is the commonest method of making fufu in Liberia unlike other West African Countries where the dry odourless fufu flour is widely known and accepted.

Training Materials:

Stainless steel knives for peeling
large basins for washing and
soaking.
Clean water
Sieves
Packaging materials
Clean sacks for dewatering
Cassava roots

Training Equipments:

Graters
Pressers
Dryers Such as Flash dryer, cabinet dryer, rotary dryer, solar
dryer or Sun drying platform
Scale for weighing tubers
Sealing Machine

Steps Involved in the Production Of High Quality Odourless Powder Fufu

SORTING	Selection of good and healthy roots, free of insect bites and bruises to obtain high quality final product
WEIGHING	Take initial weight of the roots to determine the quantity of the final product
PEELING	Should be done with clean stainless knives. The woody ends should be cut off and fibres in the middle removed to avoid high fibre products and ensure effective milling.
WASHING	Should be done thoroughly to remove dirt, sands and other impurities.
SOAKING	Soaked for 3-4 days. But first change water 48 hours, then change water daily till the 3 rd or 4 th day, depending on when it is soft enough to pulp
PULPING/ REMOVAL OF FIBRE	The softened roots is pulped by hand in a clean basin or with the use of grating machine. Water is added to the pulp and wet sieved to remove fibre and other particles.
SEDIMENTATION	Allow pulp to settle
DEWATERING/ PRESSING	Water is drained off and the pulp is further dewatered by packing into bags and placed under presser.
PULVERISING	The cake is broken down into tiny particles using local sifter or a pulverizer or grater.
DRYING	Can be done with mechanical dryer, solar dryer or sun drying on raised platform.
MILLING/SIFTING	The dry product is milled and sieved to obtain a finer particle size. Some hammer mills do the sieving simultaneously.
COOLING	The Fufu is allowed to cool before packaging to avoid moisture trapped in the packed product which may develop mould
PACKAGING	Packaging is done using recommended materials for storage and preservation. Use materials that will not alter the taste or colour of the product

Part4

PRODUCTION OF ODOURLESS DRY CASSAVA STARCH

Brief on High Quality dry Cassava Starch

Cassava starch is an important product from cassava roots. Cassava starch is a major constituent of cassava roots and it is produced from fresh unfermented cassava roots by grating, wet sieving, sedimenting and decanting to obtain a white semi solid slurry. Starch can also be obtained from dry cassava chips. It is the most marketed product in the international market of cassava derivatives. Starch is used as industrial raw materials in pharmaceutical, confectionery, food and textile industries amongst others. The production of cassava starch is low in Liberia and marketing of the product is limited to local uses. Most hotels and end users in Liberia import corn starch for their use. The cassava starch has high potential if the production is enhanced and the quality is ensured.

Training Materials-

Stainless steel knives for peeling,
Large basins for washing,
Clean water,
Sieves, fine muslin cloth for sieving,
Packaging materials and
Cassava tubers.

Training Equipments-

Graters,
Dryers such as Flash dryer, cabinet dryer, Rotary dryer, Solar dryer or
Sun drying platform,
Scale for weighing tubers,
Sealing machine

Steps involved in the production of high quality odourless dry starch

SORTING	Selection of good and healthy roots, free from insect bites or bruises.
WEIGHING	Take initial weight of the tubers to determine the quantity of the final product
PEELING	Should be done with clean stainless knives. The woody ends should be cut off and fibres in the middle removed to avoid high fibre products and ensure effective milling.
WASHING	Should be done thoroughly to remove dirt, sands and other impurities
GRATING	Should be done with stainless steel machine to avoid iron particles and other metal impurities.
ADD WATER/PULP/SIEVE	The grated tubers is pulped by hands in a clean basin, water is added to sieve it.
SEDIMENTATION/WATER CHANGE	The sieved product is allowed to settle. Clean water is used to clean the coloured slurry layer to obtain a clear white starch cake.
DEWATERING	The cake is packed into bags and pressed to further drain the water.
PULVERISING	Can be done with mechanical dryers such as flash dryer, tube dryer. Can also be done using solar dryer or sun drying on raised platform.
DRYING	Can be done with mechanical dryer, solar dryer or sun drying on raised platform
MILLING/SIFTING	The dry product is milled and sieved to obtain a finer particle size. Some hammer mills do sieving simultaneously
COOLING	The starch is allowed to cool before packaging to avoid moisture trapped in the packed product which may develop mould
PACKAGING	Packaging is done using recommended materials for storage and preservation. Use materials that will not alter the taste or colour of the product.

Quality Requirements for Starch according to CODEX

PARAMETER	REQUIREMENT
Moisture Content % (m/m) max	10.0
Crude Fibre % (m/m) max	2.0
Sulphated ash m/m (dry product) max	0.6
Total acidity % (m/m) max	1.0
Hydrocyanic acid and its glycosides measured as hydrocyanic acid (dry form) max (parts per million)	10
Starch content % m/m	65-70

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