TRAINING MANUAL

FOR THE

PRODUCTION OF HIGH QUALITY CASSAVA FLOUR

Edited By
Nanam Tay Dziedzoave
Andrew Graffham(Dr.)
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NANAM DZIEDZOAVE, Food Research Institute, Accra.
ANDREW GRAFFHAM (Dr), Natural Resources Institute, U.K.
E. O. BOATENG, National Board for Small Scale Industries, Accra.

Contributors

Nanam Dziedzoave, Food Research Institute, Accra.
E. O. Boateng, National Board for Small Scale Industries, Accra.
Cletus Gyato, Food Research Institute, Accra.

Collated, Organised And Prepared For Printing By
E. O. Boateng
National Board For Small Scale Industries (NBSSI), Accra, Ghana.

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The collaborating institutions on the project are:

Food Research Institute (Ghana)

Forest Research Institute of Ghana

National Board for Small Scale Industries (NBSSI), Accra, Ghana

Natural Resources Institute (UK)

University of Ghana – Department of Nutrition and Food Science

Ministry of Food and Agriculture, Brong Ahafo Directorate, Ghana.

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1.0 INTRODUCTION

Cassava is an important food crop in Ghana. It is a popular food item and a major income earner for many Ghanaian farmers and households. Traditionally cassava is used mainly for food. Cassava roots are used for local staples like gari, fufu, ampesi, kokonte and banku.

Industrial uses of cassava are largely non-existent. The Industrial products which can be obtained from cassava are starch and cassava flour. Starch is a high value product, which can be used for many activities in industries.

High Quality Cassava Flour (HQCF) can also be used as an alternative for starch and other imported materials like wheat flour in a number of industrial undertakings. High Quality Cassava Flour can be used in the production of adhesives for paperboard manufacture, as an extender for plywood glues, as a source of starch in textile sizing and as a raw material for the production of glucose syrups, industrial alcohol and bakery products.The production of High Quality Cassava Flour is a process which requires a conscious adherence to good manufacturing practice (GMP) in order to obtain a product of desirable quality. Non-compliance to GMP will not produce the high-grade cassava flour needed by industry.

This production manual gives easy-to-follow steps in the preparation of High Quality Cassava Flour. The manual highlights on quality control, machinery and equipment requirements, their procurement and maintenance and potential markets for the product.

It is hoped that prospective entrepreneurs will find this manual handy and useful as they engage in this industrial activity whose market potentials are very promising.

2.0 PRODUCTION OF HQCF

2.1 Flow Chart

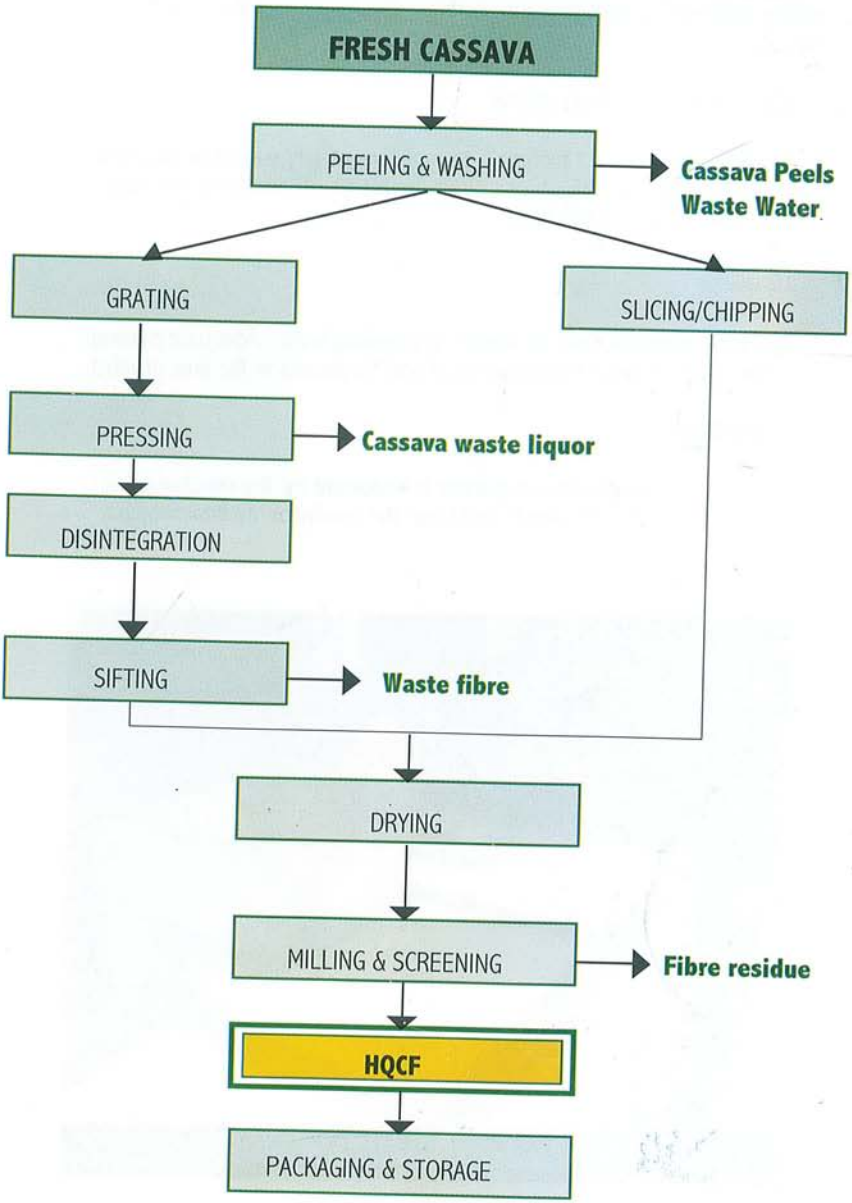


Fig. 1: Flow Chart For HQCF Production

2.2 Production Process

The processing of cassava into high quality cassava flour involves peeling, washing, grating/slicing/chipping, pressing, disintegration, sifting, drying, milling, screening, packaging and storage. The Flow Chart above summarizes the process.

2.2.1 *Raw Material Selection*

A well-matured (10-12 months) low moisture variety should be selected for processing, since this has a direct impact on product recovery rates and starch quality of the flour.

2.2.2 *Peeling*

Peeling is manually done by means of a peeling knife. Adequate peeling is necessary to avoid the presence of peel fragments in the final product.

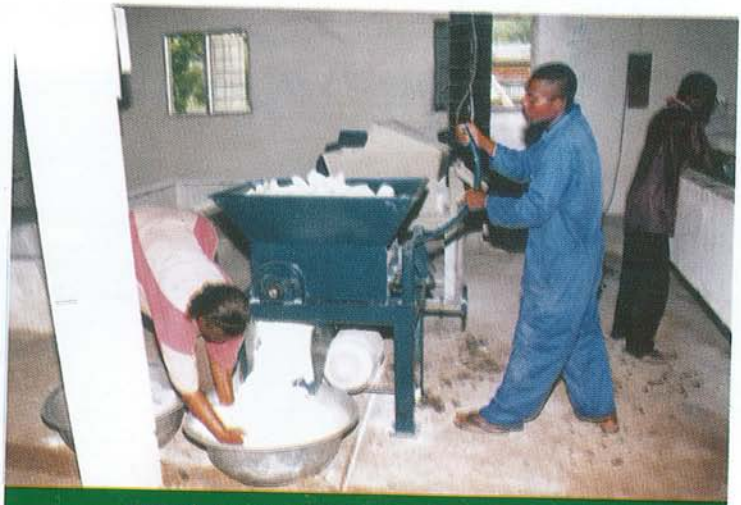
2.2.3 *Washing*

Thorough washing in clean tap water is important for the removal of all sand particles and dirt, which could mar the quality of the final product.

PICTURE OF PEELED CASSAVA BEING WASHED

2.2.4 *Grating*

Grating is carried out by means of a motorized cassava grater. Grating disintegrates the cassava tissue and frees up the moisture so that pressing can be done much easily.



PICTURE OF CASSAVA GRATER GRATING CASSAVA

2.2.5 *Pressing*

Pressing is principally a dewatering process, which is carried out either with a manual screw press or a hydraulic press. Pressing time should be kept at a reasonably short time to avoid fermentation of the grated mash. The purpose is first to remove enough moisture from the grated mash so as to facilitate drying. Inadequate pressing could lead to longer drying time resulting in fermentation with attendant undesirably high acid tastes in the product. Pressing also helps to get rid of much of the yellow colouring in cassava tissues thereby helping to improve the colour of the final product.

PICTURE OF A SCREW PRESS LOADED WITH GRATED MASH

2.2.6 *Disintegration*

This is best done by means of a motorized cassava grater. The objective is to reduce the pressed cake into fine grits so as to aid sifting and drying. Undisintegrated cake dries more slowly, whilst disintegrated cake dries faster and gives a better quality product.

2.2.7 *Sifting*

Sifting at this stage is necessary only in situations where no appropriate screening equipment is readily available. It is done by means of a manual rotary sieve, to remove as much fibre from the disintegrated dough before drying. It also helps to improve the smoothness of the product. When carried out in conjunction with screening of the milled flour, product quality may be improved but at the expense of product recovery rates.

2.2.8 *Slicing/Chipping*

This is a single alternative process for the four processes of grating, pressing, disintegration and sifting. It makes use of a manual or motorized slicer or chipper. It is a simpler alternative and has the advantage of yielding a product with a slightly higher starch content. But it compromises other quality requirements like colour, odour, and taste (pH, acidity) to a large extent. It is recommended for use only in the absence of a grater or other facilities for handling grated cassava. It should however never be used for cassava with high cyanide levels.

2.2.9 *Drying*

Drying may be carried out using a hot air mechanical dryer or a sun/solar dryer. Whichever option is chosen the loading density should not exceed 2.5 kg/m2 for mechanical drying and 1.5 kg/m2 for sun/solar drying. The lower the loading density the faster the drying process and the better the flour quality. For sun/solar-dried products a loading rate of 1.0kg/m2 is recommended to enable drying to be completed within a 6-7 hour drying period. Drying temperatures should be no higher than 60 degrees centigrade.

PICTURE SHOWING SUN/SOLAR DRYING OF CASSAVA GRITS

PICTURE SHOWING MECHANICAL DRYING OF CASSAVA GRITS

2.2.10 *Milling*

Dried chips are normally milled in a hammer mill or in a disc attrition mill to a fine particles size.

2.2.11 *Screening*

A motorized flour sifter fitted with a 250 um screen is used to sieve the flour in order to remove as much fibre from the product as possible in order to improve the smoothness of the flour.

PICTURE SHOWING MOTORISED FLOUR SIFTER IN OPERATION

2.2.12 *Packaging and Storage*

Bulk packaging of final product should be in polyethylene-lined polypropylene sacks. Unit packages should be done in polyethylene packaging material. Adequate packaging is necessary to avoid moisture uptake of HQCF during storage. Storage should be in well-ventilated rooms.

2.2.13 *Product Recovery Rate*

Depending on the maturity of the cassava, the variety used for processing and the initial moisture content of the cassava product recovery rates would range between 13-19%. A recovery rate of 18% should be aimed at.

3.0 QUALITY REQUIREMENTS FOR HQCF, PLANT SANITATION AND FACTORS IMPACTING DIRECTLY ON QUALITY

3.1 Quality Specifications

Good quality cassava flour should be white in colour, odourless, bland to taste and very smooth to the feel. It should also be free from extraneous matter including peel fragments and sand particles. The table below lists some objective standard specifications. These are however to be considered more as regulatory standards rather than mandatory standards.

Objective Standard Specifications for HQCF

Quality Parameter	Specification	Unit processes and other factors impacting on Quality specification
Moisture (%)	8-10	Slicing/Grating, Drying, packaging and storage
Colour: L*	>99	Slicing/Grating, pressing and drying
a*	<8	
b*	<[-4]	
C	<8	
h*	>92	
Taste: Acidity (%)	<0.25	Slicing/Grating, pressing, drying, packaging and storage
pH	6-7	
Average particle size (um)	115-120	Milling, screening and sifting
Starch (%)	>70	Slicing/Grating and drying
Extraneous Matter (specks/100cm^2)	<10	Peeling and washing
Pasting Temperature (C)	<74	Drying
Viscosity (BU)	>750	Drying

3.2 Plant Sanitation and Personal Hygiene

- Regular Cleaning and Disinfection of Processing Hall and Equipment are very essential for quality maintenance.
- Regular Cleaning of Products storeroom is also needed to prevent insect infestation of products.
- Production staff should adhere to basic rules of personal hygiene to prevent microbial contamination of end products.
- The wearing of nose masks, head gears and hand gloves especially during milling, screening and packaging is essential for the health of staff as well as prevention of product contamination with extraneous matter, like hair fragments etc.

4.0 EQUIPMENT REQUIREMENTS AND MAINTENANCE

4.1 Types Of Equipment, Capacity And Source

TYPES OF EQUIPMENT	CAPACITY	SOURCE			
		FRI	AGRICO	AGBEMSKOD	ENTESEL
a. Cassava grater (drum grater with stainless steel grating compartment)	750-800kg/hr	*			
Cassava grater without stainless steel	750-800kg/hr			*	
Disc grater	500-600kg/hr		*		
Cassava grater (mobile)	400-600kg/hr				*
b. Cassava slicer	800-1ton/hr	*			*
c. Cassava press (screw press)	800kg/hr	*			
Cassava press (screw press)	400-500kg/hr		*	*	
Cassava press (Hydraulic)	400-600kg/hr		*		
d. Cassava dough Sieving machine	500-800kg/hr	*	*		
e. Electric dryers Electric dryers Diesel fuel/kerosine Solar tent Solar tent Drying platforms (concrete floors)	500kg/batch 1 ton/batch 2 tons/batch 500kg/batch 1 ton/batch	* * * * * *			
f. Crushers		*			
g. Milling machine Plate attrition Hammer mills		 *		 * *	
h. Flour sifters (Centrifugal flour sifter)	300-500kg/hr	*			
i. Diesel engines	6-8 H.P.		*		

4.2 Equipment Operation And Maintenance

The major equipment required include:

- Cassava grater/slicer
- Screw/Hydraulic press
- Sieving machine
- Mechanical/solar tent dryers
- Milling machines: (plate attrition/hammer mill)
- Sifting machine

Other minor equipments include:

- Bag sealer
- Heat sealing machine
- Weighing scale
- Peeling knives/tools
- Plastic bowls and containers

Routine maintenance checks should be carried out at the first use of each equipment each day. Periodic maintenance checks should be carried out at least once in every two weeks.

4.2.1 *Cassava Grater*

Operation

- Place a receptacle/container at the outlet chute of the grater to receive the grated dough.
- Start engine/electric motor and allow it to achieve operating speed
- Pour cassava into hopper, and activate the leaver upwards and downwards to grate the cassava (moving the leaver upwards allows cassava into the grating compartment and moving the leaver downwards puts pressure on the cassava against the grating surface thus grating the cassava).
- Apply smooth uniform pressure during the downwards movement of the leaver
- Stop engine/electric motor when grating is completed.

Maintenance

Daily Maintenance

- Check foundation bolts and bearing bolts for loseness and tighten if necessary.

- Check engine/electric motor for soundness using the manufacturer's recommmendations as specified in the operator's manual. (E.g fuel, oil, etc.).
- Clean grating machine before and after work every day. Wash the hopper and the grating compartment thoroughly with water.
- Check belt tension for looseness and adjust if necessary. Loose and flappy belts reduce efficiency and can cause serious injury when they fly out.

Periodic Maintenance

- Grease the grating surface periodically, at least once a month when in every day operation.
- Check the grater bearings periodically and replace when worn out (use stainless steel grating surface).
- Follow the manufacturer's recommendations as specified in the operator's manual for routine maintenance of the engine/electric motor.

4.2.2 *Cassava Presses*
Manual Press

Operation

- Turn the press screw anticlockwise with the aid of the short press bar. Lever to raise The press plate to a suitable height.
- Clean the press; wash the bottom and press plate with water.
- Remove the door of the pressing chamber by unscrewing the four wing nuts.
- Stack grated cassava in mini polypropylene sacks of 30-40kg and tie the opened ends.
- Place the loaded (sacks) on the bottom plate through the opened door. Arrange in two rows, one sack on top of the other. Rows must have even heights.
- Close the door and tighten the wing nuts securely.
- Apply load pressure on the dough with the press plate by turning the press screw clockwise. Use the short press bar lever first and as the resistance increases use the long press bar.

- Press intermittently allowing 5-10 minutes after every pressure to enable the dough to drain. (Continuous pressure or excessive pressure(without allowing liquid to drain may burst the sack).
- Feel with fingers to check for hardness of dough, as an indication of a well-dewatered dough.
- When pressing is complete remove the door and remove the pressed dough for further drying.

Maintenance

Routine Maintenance

- Clean machine before and after the day's work. Wash the bottom and press plates amply with water.

Periodic Maintenance

- Check foundation bolts for looseness and tighten when necessary.
- Check the screw and nut for dryness and grease when necessary. (Greasing may last over six months)

Hydraulic Presses

Routine Maintenance

- Clean machine before and after work.
- Clean metallic cages that hold the dough everyday after work.

Periodic Maintenance

- Check threaded (screw) joints of gauges, plugs etc for leaks and tighten if necessary.
- Check main cylinder and piston for leaks and replace seals and rubber caps when necessary. This work needs a specialist attention.
- Check the hydraulic tubes for leaks due to cracks and replace if necessary.

4.2.3 *Sieving Machine*

Operation

- Place receptable/container at the outlet to recieve sieved dough.
- Turn the driving wheel via the handle clockwise slowly about 50 revs per min

N/B: When sieving bigger volumes of dough, it may be necessary to stop the sieving process from time to time and clean the sieving drum to avoid clogging of the sieving mesh.

Maintenance

Routine Maintenance

- Thoroughly clean machine everyday before and after use.
- Remove trapped fiber from sieving drum and sieving mesh.

Periodic Maintenance

- Check sieving mesh for damage and replace if necessary.
- Check bearings for dryness and grease when necessary, greasing may take six months to repeat.

4.2.4 *Cassava Slicer*

Operation

- Set/adjust the blades to the correct size slices/chips needed.
- Place a receptable/container at the outlet of the slicing machine.
- Start motor/engine.
- Feed cassava through the feed inlet.
- Stop motor/engine when slicing is finished.

Maintenance

Routine Maintenance

- Clean and grease bearings at least once a month.
- Check belt tension before slicing and adjust if necessary.

Periodic Maintenance

- Check and grease bearings at least once a month.
- Follow the routine servicing of the motor/engine as prescribed by the manufacturer.

4.2.5. *Dryers*

Electrically Operated Dryers

Operation

- Spread cassava dough thinly in trays in the drying chamber.
- Set the correct drying temperature 50-60 C (where necessary).
- Set the correct drying time (where necessary).
- Start drying machine.
- Periodically check temperature readings to ensure proper functioning of the dryer.
- Check product for thorough dryness when the dryer goes off.
- Allow the product to cool.
- Remove the product from the dryer.

Maintenance

Routine Maintenance

- Clean dryer before & after use.
- Check electrical connections and make sure they are tight and sound.

Periodic Maintenance

- Check and service electrical motors according to the manufacturer's recommendations.
- When fans are belt driven, check belt tensions and adjust if necessary.
- Check bolts securing fans and tighten if necessary at least once a week.

Fuel Operated Dryers

Maintenance

- Check the fuel delivery system, Clean and service atomizers at least once a week during operation or as specified by the manufacturer.
- Check the drying chamber periodically and make sure exhaust fumes are not leaking into the drying chamber.

4.2.6 *Solar Tent Dryers*

Maintenance

- Check polyethylene sheets for damage and replace when necessary.
- Check the nylon mesh for damage and replace when necessary.
- Keep underneath and around the solar tent clean and free from under-growth.
- Apply wood preservative to wooden frame structure.
  min. while feeding gradually the disintegrated dough through the hopper.
- After sieving stop the machine.

4.2.7 *Milling Machines*

Plate Attrition Mill

Operation

- Pour dried and crushed cassava into hopper.
- Place a receptacle/container at the outlet of the machine to receive the milled flour.
- Start motor/engine.
- Manually feed the milling chamber with product from the hopper.
- Adjust the moveable disc to obtain fine milling but make sure the plates are not too tight together. Too tight plates causes wear of plates into the milled product.
- Stop machine after milling.

Maintenance

Routine Maintenance

- Clean milling machine before and after work every day. It would be necessary to open the milling chamber and clean chamber and plates thoroughly with dry cloth. Plate must be dry and free from oils and fats.
- Check/prepare electric motor/engine for work according to the manufacturer's recommendations

Periodic Maintenance

- Check driving belt tension and adjust when necessary.
- Check driving belt(s) for wear. Replace worn, weak or torn belt(s).
- Check foundation bolts of machine and motor /engine for looseness and tighten when necessary.
- Check bolts and nuts on machine especially those securing the grinding discs and tighten when necessary.
- Check grinding discs for wear and sharpen when necessary.
- Replace worn out, weak and cracked discs.

Hammer Mill

Maintenance

Routine Maintenance

- Clean machine before and after work every day. Clean milling chamber, milling screen and hammers thoroughly with dry cloth.
- Check driving belt(s) tension and adjust when necessary.

Periodic Maintenance

- Check belt(s) for wear. Replace worn, weak and torn belt(s).
- Check milling screen. Replace worn and damaged screen. Use only fine milling screen.

- Check hammers for wear and replace when necessary.
- Check foundation blots for looseness and tighten if necessary.
- Check all bolts and nuts on machine especially those securing the hammers for looseness and tighten accordingly.

4.2.7 *Flour Sifter (Sifting Machine)*

Operation

- Set the feed gate from the hopper to a required suitable opening.
- Install the right mesh sieve basket in the machine.
- Check and make sure the sieve mesh is well stretched and taut and it is tight on the sieve basket.
- Place receptacles/containers at the appropriate openings to receive flour and fiber.
- Start motor/engine.
- Pour in flour into hopper and sift.
- Avoid overloading of machine (as this result in damage to the sieving mesh).
- Periodically open the inspection gate to ensure the basket is not overloaded.
- Stop motor when sifting is completed.

Maintenance

Routine Maintenance

- Clean sifter everyday before and after work with clean dry cloth.
- Remove the sieve basket and clean the machine thoroughly (Flour left in machine results in weevil's breeding/infesting the machine).
- Clean sieve basket and avoid crumpling of sieve meshes. (Crumpling reduces the life of the mesh.)
- Check the belt tension and adjust when necessary.

Periodic Maintenance

- Check the bearings for dryness and grease when necessary, bearings can last for more than three months after greasing (2000 hrs).
- Check foundation bolts for looseness and tighten when necessary.
- Check mesh for damage tear etc. Replace with 250-micron mesh.

5.0 ECONOMICS, PROFITABILITY AND MARKETING OF THE PRODUCTION OF HQCF

The profitabity of HQCF production as discussed in this section is based on feasibility studies previously undertaken to examine the financial viability or otherwise in the production of High Quality Cassava Flour in both rural and urban areas. Generally the profitability or otherwise of HQCF production, depends to a large extent on the location of the enterprise, the scale of production and the source of power for operating equipment.

5.1 Location of HQCF Producing Enterprise

An enterprise engaged in the production of HQCF should ideally be located in a cassava growing area or near it. This is so because of the bulkiness of the raw cassava and its perishability due to its high moisture content. A business enterprise processing HQCF, which, for purposes of proximity to the market centre is located in an urban area, should preferably be processing high quality cassava chips/grates obtained from smaller cassava processing plants located in the cassava growing areas, rather than processing fresh cassava.

5.2 Access to utilities and other facilities

Business enterprises producing cassava flour or chips in the rural area should have access to clean water. This is very crucial in producing both high quality cassava chips and flour. Access to electricity for use by machinery and equipments is essential but in some cases diesel-powered machinery can be used in the rural areas. Electricity is very necessary in urban production or large-scale production in rural areas.

5.3 Finance

Financial requirements for producing HQCF in rural and urban areas vary due to the nearness or otherwise to raw materials or utilities and the varying costs of transportation, labour etc.Total project costs ranged from ¢64 million (¢32m fixed assets, ¢32m working capital) for rural production to ¢176 million (¢50m fixed assets, ¢126m working capital) for urban production. (Note: Prices or costs of services and goods used in this chapter were based on those prevailing in Ghana in the first quarter of 2002.).

5.4 Raw Material and Processing Supplies Requirements

- Fresh cassava (10-12 months maturity).
- Good quality water.
- Polypropylene sacks.
- Polyethylene lining.

5.5 Cleaning/Sanitation/Protective- Materials

- Liquid detergent.
- Disinfectant.
- Gloves.
- Overalls.
- Nose masks.
- Head gears.

5.6 Labour Requirements

Needed workforce will be:

- **Skilled Technician**: to operate machinery for chipping/grating milling and bagging.
- **Labourers:** to dry chopped/grated cassava and bag flour.
- **Casual Labour:** to peel and wash fresh cassava depending on daily output.
- **Owner/Manager**: to manage the business accounts or marketing officer can be hired depending on the scale of production.

The size of labour force will depend on the level of production.

5.7 Production Levels and Costs

The suggested organization of production is as follows:

- 7 months per year for rural production of chips and flour.
- 10 months per year for urban processing of chips into flour.
- 20 to 22 days per month (rural areas).
- 20 days per month-(urban area)

Rural Area:

The cost estimates for production at the rural area were based on the following:

- Structure/building- ¢7,000,000.
- Machinery and equipment.
- Repairs and maintenance- 5% on equipment costs.
- Raw materials: 65-80 tons of fresh cassava at ¢400,00 per ton(not stable).
- Labour: owner, 2 technicians, 3 labourers and required daily casuals. Add 25% Social Security and medical costs.
- Utilities: diesel and petrol for chipper/ slicer and engine for mill, water and electricity (alternative).
- Transport.
- Administrative.
- Peeling: ¢30,00 per tonne.
- Packaging materials: ¢30,000/ton of flour/chips.

- Interest rate on loan: 20% per annum.
- Depreciation: 10% on machinery and 5% on building.
- Working Capital: Depends on owner's resources and what financial organizations will provide.
- Taxes: District assembly and Internal Revenue Service (IRS) taxes.
- Insurance: 2% on fixed assets.

Urban Area:

- Building: owned or rented.
- Machinery and equipment.
- Repairs and maintenance- 5% on equipment cost.
- Raw materials: 40 tons of cassava chips per month at ¢3million/ton.
- Labour: owner, 2 technicians, 1 procurement officer, 1 accounts officer and 3 labourers. Add 25% Social Security and medical costs.
- Utilities: Electricity (Kwh per month) and water.
- Transport: Depends on source of raw materials and volume of production
- Administrative.
- Packaging materials: ¢30,000/ton of flour produced
- Interest rate on loan: 20% per annum.
- Insurance: 2% on fixed assets.
- Depreciation: 10% on machinery and 5% on building.
- Taxes: Local and Internal Revenue Service.

Assumptions:

The calculations on production and finances are to be based on the following general assumptions stated below:

- Production will be on 7 months (rural area) and 10 months (urban area) in a year.
- Constant level of production for a 5-year period.
- Revenue, raw material costs, transport costs, labour cost, packaging material costs and utilities are projected over the years by 20%.
- Other costs are projected at 15% annually.
- Normal losses of 1% are assumed for cassava chips and HQCF.
- The project will attract tax of 25% of gross profit.
- Depreciation is on straight-line basis.

5.8 Sales Revenue:

The price of a kilo of HQCF should be competitive to that of wheat flour. But if the price of HQCF is slightly about that of wheat flour and HQCF is readily available consumers are prepared to buy it at that price.Financial analyses have shown that HQCF priced at ¢3,500/kilo as against wheat flour of 3,000/kilo at that time gave reasonable net profit over the projected five-year period. The Return on Investment (ROI) ranged from 30% to over 100% over the period depending on the production level and on the location of the plant.

5.9 Financial viability of HQCF production

From the analysis stated above an entrepreneur (a small-scale one) who intends to go into production of HQCF should critically examine the availability and costs of raw materials (fresh cassava) and the market price for the product. A HQCF producing enterprise located in a cassava growing area with large acreage of high yielding cassava farms resulting in cheaper fresh cassava prices will be able to produce profitably with the prudent management of other production costs. Since there is a large unmet demand ready to absorb any quantity of HQCF at a competitive price relative to imported wheat flour the efficient use of factors of production as stated earlier by an entrepreneur will be very rewarding.

5.10 Potential markets for HQCF

The potential industrial markets for HQCF are:

- Adhesives for paperboard production
- Extenders for plywood glues
- Starches for textiles
- Sugar syrups for confectionery industries
- Industrial alcohol
- Alternative flour to wheat flour in bakery products.

Trails conducted in some plywood and paperboard industries have demonstrated the potential of HQCF as an extender for urea formaldehyde glues used in the plywood industry or as an adhesive when blended with various chemicals. High Quality Cassava Flour has been used wholly or combination with wheat flour in various bakery products, which have enjoyed wide acceptance by the general public and is being adopted by some professional bakers and caterers.

Table2 gives a summary of the potential market for HQCF.From the table the market potential for HQCF is about 452,000 tonnes per annum as indicated by the current consumption of imported alternatives by entrepreneurss in the plywood, paperboard and confectionery in the bakery industry.

Under the project, one-day awareness/information seminars were held in Takoradi, Kumasi and Accra in the first half of the year 2001 to promote the production and use of HQCF. A total of one hundred and ninety-nine (199) participants attended these seminars. The participants included industrialists who expressed their readiness to purchase large quantities of HQCF that can be produced by entrepreneurs. At present large quantities of imported wheat flour are used by these industries and HQCF will serve as a good substitute.

It must be noted that, high demand for HQCF is conditioned by the following success indicators:

- Producing to meet quality specifications
- Maintaining quality
- Reliability of supply (in terms of quantity)
- Timeliness of delivery
- Price competitiveness.

CONCLUSION

It has been amply demonstrated that High Quality Cassava Flour has a high potential as an industrial commodity. The raw material for HQCF is readily available in some rural areas with the possibility of increasing the acreage under cultivation under right economic conditions.

It is hoped that existing or prospective food processors or entrepreneurs will find this manual very helpful into this area of business. By using good quality raw material, quality-based production methods and prudent business practices, entrepreneurs will find the production of HQCF as a profitable business alternative.

Industrial Options for High-Grade Cassava Flour

Industry	Current Product	Locally produced cassava-based alternative	Quality requirements	Market potential (Tonnes of fresh cassava)
Plywood	Imported wheat flour	High-grade cassava flour	**High**- finely milled (0.25mm) white flour, low fibre, not fermented, with high paste viscosity and stability.	17,000-34,000 tonnes
Paperboard	Imported glue, based on maize starch.	Adhesive made from high-grade cassava flour	**High**- As for plywoood	21,000 tonnes
Textiles	Imported and locally produced maize starch, imported Cassava starch.	High-grade cassava flour	**High**- finely milled (0.25mm) white flour, low fibre, no odour or taints and not fermented, with high paste viscosity and stability.	17,00 tonnes
Sugar Syrup	Mostly Imported Sugars	High-grade cassava flour	**High**- As for textiles, but paste viscosity and stability are not important.	251,000 tonnes
Industrial Alcohol	Mostly imported with small amount of local production.	High-grade cassava flour converted to sugar, then fermented and distilled to produce 96% industrial ethyl alcohol.	**High**- As for sugar syrups.	56,000 tonnes
Bakery Products	Imported Wheat flour	High grade cassava flour	**High**- Similar to textiles.	90,000 tonnes*
Total Market requirement (Tonnes fresh cassava)				**452,000-469,000 tonnes**

Assuming 10% replacement of important wheat flour with high-grade cassava flour.

Further Information

For further information contact the following addresses:-

NAME OF ORGANISATION	TYPE OF INFORMATION
1. Food Research Institute	General information on all aspects of production including machinery and euipment and utilization in various bakery products. Adhesives for paperboard (corrugated).
2. Ministry of Food and Agriculture - Crop Post Harvest Division. Sunyani.	General information on HQCF production including solar drying utilization in bakery products.
3. National Board for Small Scale on Industries	Business plans in the establishment small-scale enterprises. Advisory services and training in the management of small-scale enterprises.
4. Natural Resources Institute	General information on all aspects of HQCF production and utilization in food and non-food uses. Starch production and utilization.
5. Forest Research Institute of Ghana	General information on the physical and chemical properties of cassava and its uses as binder in adhesive mixture and use as adhesive. Adhesives for multi-wall paper.