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**Fiche technique n°05 : Fabrication de l’amidon à base du manioc**

**PROCESSING CASSAVA INTO HIGH-QUALITY CASSAVA STARCH**



amidon

**PROCESSING CASSAVA INTO HIGH-QUALITY STARCH**

1. **Introducti*on***

Starch is one of the most abundant substances in nature,a renewable and almost unlimited resource. Starch can be produced from grain or root crops. It is mainly used as food, but is also readily converted chemically, physically, and biologically into many useful products. Cassava starch has many remarkable characteristics, including high paste viscosity, high paste clarity, and high freeze-thaw stability, which are advantageous for many industries.

Cassava starch is produced primarily by wet milling of fresh cassava roots but in some countries such as Thailand, it is produced from dry cassava chips. Starch is the main constituent of cassava. About 25% starch may be obtained from mature, good quality tubers. About 60 % starch may be obtained from dry cassava chips and about 10 % dry pulp may be obtained per 100 kg of cassava roots.

Fresh tubers are processed during any season and dry chips during the off-season in some countries. Extraction of starch from fresh cassava roots can be divided into five main stages: preparation (peeling and washing), rasping/pulping/grating, purification (starch washing), dewatering and drying, and finishing (milling and packaging).

For cassava, the process of starch extraction is relatively simple as there are only small amounts of secondary substances, such as protein, in the roots. Age and root quality are critical factors that determine the harvesting or selection of cassava roots for starch extraction. Cassava roots need to be processed almost immediately after harvest, as the roots are highly perishable and enzymatic processes accelerate deterioration within 1-2 days. A first-rate quality starch can be obtained from cassava using only water, and this makes the processing of cassava starch and flour particularly suitable for developing countries and rural industries.

***II-Different uses of Cassava starch?***

Cassava starch has varied uses in different industries such as Food, Paper, Textiles, Adhesives, Beverages, Confectionary, Pharmaceuticals and Building materials.

***Advantage of cassava starch over others***

* High level of purity ;
* Excellent thickening characteristics;
* A neutral (bland) taste;
* Desirable textural characteristics;
* A relatively cheap source of raw material containing a high concentration of starch (dry-matter basis) that can equal or surpass the properties offered by other starches (maize, wheat, sweet potato, and rice).

Cassava starch is also:

* Easy to extract using a simple process (when compared to other starches) that can be carried out on a small-scale with limited capital;
* Often preferred in adhesive production as the adhesives are more viscous, work more smoothly, and provide stable glues of neutral pH;
* Has clear paste.
	1. **REQUIREMENTS FOR PROCESSING CASSAVA STARCH**
* Cassava roots (plant or buy cassava roots with high starch content);
* Water for washing utensils, tubers and starch
* Space (you need space for peeling and washing of tubers, installation of grating machine, washing and pressing of starch, drying and milling);
* Equipment (knives, bowls, mill, grater, sieves, press, drying surface, bags, etc);

**NB:It might not be necessary to acquire a grating machine since there are mobile chippers that can be hired and used within a day.**

* 1. **PROCEDURE FOR PROCESSING HIGH-QUALITY STARCH**

The following steps are required for the processing of cassava starch:

**Step 1: Rootselection**

Harvest or buy healthy, mature and firm freshly harvested cassava roots. These should have no bruises. The flesh of the roots should be white and have no cracks and few fibrous roots.

**Step 2: Peeling**

Peel the roots and remove the stalk, woody tips and any fibrous roots using a sharp knife. Failure to peel properly will result in off-colour in the final product.

**NB:** Cassava peel (after drying) can be used for animal feed or composting – so do not waste it!

**Step 3: Washing**

Wash peeled cassava roots with clean water to remove any dirt (including sand, soil, leaves or other impurities).

**Step 4: Grating**

Use a simple perforated iron sheet or mechanical grater to grate cassava roots into a fine mash.

**Step 5: Settling and Purification of Starch**

The quality of the starch produced depends to a great extent on the proper performance of these operations, which comprise settling in successive tanks, settling on flour tables, and the action of modern separators. Each operation can be used alone or carried out in different combinations. They all result in a more or less concentrated suspension of starch in pure water. Several washing sessions in water is necessary before allowing to settle and the water drained.

Step 6: Pressing

Pack the wet starch into a clean bag, such as a jute or sisal sack that will allow extra water to drain. Press the sack using a screw press or hydraulic jack to remove excess water until the starch is crumbly.

Allow to stand for 2-3 days while pressing every morning and evening to continuously keep the bag tight.

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**Step 7: Drying**

The sun is the cheapest source of heat.All small mills and many medium-size factories resort to this kind of drying despite the problems and the risk of contamination involved. The flour cake left after draining in the sedimentation tank or on the flour table is scooped up and after crumbling (sometimes with the aid of coarse matting or a wire screen) is spread out on basketwork trays about 1m in diameter. Each tray is covered with as much of the wet product to contain about 0.5 kg of dry starch. The trays may be placed on the ground, but preferably should be laid on racks 1 m above the ground. In this way, besides direct radiation, the heat reflected from the ground aids drying while the circulation of air is ensured on both sides of the layer of flour.

It is preferable to begin the drying process soon after sunrise so that in fair weather and a dry atmosphere it can be completed in one day. Often, however, this does not suffice, and before sundown the trays are stacked up on the factory premises.

The shortcomings of sun drying can be overcome by other methods such as oven, drum, tunnel and pneumatic driers depending on the size of the production unit.

**Step 7: Bolting and Milling**

This is done to obtain a homogenous product. During bolting, fibers and other had materials are removed and the starch flour that emerges is smooth and free flowing.

**Step 8: Storing and Packaging**

The finished starch should he stored in a dry place, preferably on a board floor or in bins where it can be mixed in order to obtain a uniform lot. Before storing, the starch is sieved to assure lump-free uniform particles. It is usually packaged in gunny sacks for shipment, but multiwall paper bags are becoming more popular.

The procedure of processing cassava roots into starch is presented as follows:

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|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **CASSAVA STARCH PRODUCTION** |  |  |  |  |  |  |  |  |  |
|  | **Type:** |  |  |  | **VARIETY** |  |  |  | **QUANTITY** | **1000 Kg** | **YIELD** | **250Kg flour/1000 Kg Cassava** |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | **Operations** | **unit cost** | **Quantity** | **Unit price**  | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** | **Total cost** |
|   |   |   |   |   | **First week** | **35 Weeks** | **Total** |   |   |   |   |   |
| I | INVESTMENT COST |   |   |   |   |   |   |   |   |   |   |   |
| **1.1** | **land and infrastrures** |  |  |  |  |  |  |  |  |  |  |  |
|   | Store(7x9m) | U  | 0 | 2500000 | 250000 | 0 | 250000 | 0 | 0 | 0 | 0 | 250000 |
|   | first expense cost | forfait | 1 | 40000 |   | 0 | 40000 | 40000 | 40000 | 40000 | 40000 | 240000 |
|  | **Sub total** |  |  |  | **250000** | **0** | **250000** | **0** | **0** | **0** | **0** | **250000** |
| **1.2** | **Material and équipments** |  |  |  |  |  |  |  |  |  |  |  |
|   | Hammer Mill | U | 1 | 200 000 | 200000 | 0 | 200000 | 20000 | 20000 | 20000 | 20000 | 280000 |
|   | Cassava Mill | U | 1 | 150000 | 150000 | 0 | 150000 | 30000 | 30000 | 30000 | 30000 | 270000 |
|   | Wheelbarrow | U | 2 | 20000 | 40000 | 0 | 40000 | 20000 | 20000 | 20000 | 20000 | 120000 |
|   | Construction of drying surface  | U | 1 | 100 000 | 100000 | 0 | 100000 | 10000 | 10000 | 10000 | 1000 | 140000 |
|  | **Sub total** |  |  |  | **490000** | **0** | **390000** | **80000** | **80000** | **80000** | **71000** | **550000** |
| **1.2.2** |  **Small equipment materials** |  |  |  |  |  |   |  |  |  |  |  |
|   | Sieve | U | 2 | 5000 | 10000 | 0 | 10000 | 10000 | 10000 | 10000 | 10000 | 50000 |
|   | Bassin | U | 4 | 5000 | 20000 | 0 | 20000 | 20000 | 20000 | 20000 | 20000 | 100000 |
|   | Cutlass | U | 2 | 2500 | 5000 | 0 | 5000 | 5000 | 5000 | 5000 | 5000 | 25000 |
|   | Knives | U | 8 | 1500 | 12000 | 0 | 12000 | 12000 | 12000 | 12000 | 12000 | 60000 |
|   | Bags (fermentation and pakaging) | U | 20 | 300 | 6000 | 6000 | 12000 | 12000 | 12000 | 12000 | 12000 | 60000 |
|   | 20L Buckets  | U | 4 | 1500 | 6000 | 0 | 6000 | 3000 | 3000 | 3000 | 3000 | 18000 |
|  | **Sub total** |  |  | **15800** | **59000** | **6000** | **65000** |  |  |  |  |  |
|  |  **Total investment** |  |  |  | **799000** | **6000** | **775000** | **131000** | **131000** | **131000** | **122000** | **1206500** |
|   |   |   |   |   |   |   |   |   |   |   |   |   |
| **II** | **EXPLOITATION CHARGES** |  |  |  |  |  |  |  |  |  |  |  |
| **2.1** | **Inputs** |  |  |  |  |  |   |  |  |  |  |  |
|   | Cassava | KG | 1000 | 50 | 50000 | 1750000 | 1800000 | 1800000 | 1800000 | 1800000 | 1800000 | 9000000 |
| **2.2** | **LABOUR** |  |  |  |  |  |   |  |  |  |  |  |
| 2.2.13 | Water  | L | 2000 | 0 | 350 | 12250 | 12250 | 12250 | 12250 | 12250 | 12250 | 61250 |
| 2.2.16 | Labour (peeling and washing) | H/j (mandays) | 10 | 1500 | 15000 | 525000 | 540000 | 540000 | 540000 | 540000 | 540000 | 2700000 |
|   | Labour (Grating) | H/j (mandays) | 1 | 1500 | 1500 | 52500 | 52500 | 52500 | 52500 | 52500 | 52500 | 315000 |
|   | Labour (Chiping) | H/j (mandays) | 1 | 2000 | 2000 | 68000 | 70000 | 70000 | 70000 | 70000 | 70000 | 350000 |
|   | Labour (drying and bagging) | H/j (mandays) | 5 | 1500 | 7500 | 262500 | 270000 | 270000 | 270000 | 270000 | 270000 | 1350000 |
|   | Fuel for grating  | litres | 12 | 600 | 7200 | 252000 | 259200 | 259200 | 259200 | 259200 | 259200 | 1296000 |
|  | **Sub total** |  |  |  | **83550** | **2922250** | **3003950** | **3003950** | **3003950** | **3003950** | **3003950** | **15072250** |
|   | finance cost (18% of 80% of total investment + exploitation charges)  |   |   |   | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|  | **Total charges** |  |  |  | **83550** | **2922250** | **3003950** | **3003950** | **3003950** | **3003950** | **3003950** | **18599400** |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | **DEPRECIATION** |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| **DESIGNATION** | **unit cost** | **lifespan** | **Depreciation** | **Total depreciation** |
|  |  |  |  |  | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** | **Year 6** | **Year 7** |
| Hammer Mill | 200000 | 5 | 40000 | 40000 | 40000 | 40000 | 40000 | 40000 | 40000 | **280000** |
| Cassava Mill | 150000 | 5 | 30000 | 30000 | 30000 | 30000 | 30000 | 30000 | 30000 | **210000** |
| Wheelbarrow | 20000 | 3 | 13334 | 13334 | 13334 | 13334 | 13334 | 13334 | 13334 | **93338** |
| Drying sur face | 100000 | 10 | 10000 | 10000 | 10000 | 10000 | 10000 | 10000 | 10000 | **70000** |
| Sieve | 25000 | 2 | 12500 | 12500 | 12500 | 12500 | 12500 | 12500 | 12500 | **87500** |
| Bassin | 10000 | 2 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | **35000** |
| Cutlass | 2500 | 1 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | **35000** |
| Knives | 1500 | 2 | 750 | 750 | 750 | 750 | 750 | 750 | 750 | **5250** |
| Bags (fermentation and pakaging) | 300 | 1 | 6000 | 6000 | 6000 | 6000 | 6000 | 6000 | 6000 | **42000** |
| 20L Buckets  | 5000 | 2 | 2500 | 2500 | 2500 | 2500 | 2500 | 2500 | 2500 | **17500** |
| Plaque signaletique | 10000 | 5 | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | **14000** |
| **Total** | **524300** |  | **127084** | **127084** | **127084** | **127084** | **127084** | **127084** | **127084** | **889588** |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | **SUMMARY OF CHARGES** |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | **Designation** | **Amount** | **Total** |  |  |
|  | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** |  |  |
|  | Total depreciation charges |   |   | 127084 | 127084 | 127084 | 127084 | 127084 | **635420** |  |  |
|  | Total exploitation charges |   |   | 3003950 | 3003950 | 3003950 | 3003950 | 3003950 | **15019750** |  |  |
|  | **Total charges (1)** |  |  | **3131034** | **3131034** | **3131034** | **3131034** | **3131034** | **15655170** |  |  |
|  | **Total cumulated charges**  |  |  | **3131034** | **3131034** | **3131034** | **3131034** | **3131034** |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| **A III** | **GROSS PRODUCT** |  |  |  | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** | **Total** |  |  |
| 3.1 | Cassava starch production for 35 weeks | Kg | 8750 | 500 | 4375000 | 4375000 | 4375000 | 4375000 | 4375000 | 21875000 |  |  |
|   | Total product | Kg | 8750 | 500 | 4375000 | 4375000 | 4375000 | 4375000 | 4375000 | 21875000 |  |  |
|   | Total cummulated |   |   |   | 4375000 | 8750000 | 13125000 | 17500000 | 21875000 |  |  |  |
|  | **Turnover (2)** |  | **17500** |  | **4375000** | **4375000** | **4375000** | **4375000** | **4375000** |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| **A IV** | **FINANCES RESULTS** |  |  |  | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** | **Total** |  |  |
| 4.1 | gross margin (1) | F CFA |   |   | 1371050 | 1371050 | 1371050 | 1371050 | 1371050 | 6855250 |   |  |
| 4.2 | profit  |   |   |   | 1243966 | 1243966 | 1243966 | 1243966 | 1243966 | 6219830 |   |  |
| 4.3 | promotor salary |   |   |   | 360000 | 360000 | 360000 | 360000 | 360000 | **1800000** |  |  |
| 4.4 | Cost/ Benefit analises |   |   |   | 0,40 | 0,40 | 0,40 | 0,40 | 0,40 |   |   |  |
| 4.5 | production cost  | F CFA/kg |   |   | 39 | 39 | 39 | 39 | 39 |   |   |  |
| 4.6 | Man power handworkers valorisation | F CFA |   |   |   |   |   |   |   |   |   |  |
|   | gross margin with depreciation |   |   |   | 1498134 | 1498134 | 1498134 | 1498134 | 1498134 |   |   |   |

V-Cost-Benefit Analysis for Cassava Starch Production from one ton (1000 kg) of cassava

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Item** | **Unit Cost** | **Number** | **Total Cost**  | **Depreciation (years)** | **Amount per year** |
| Cassava Mill | 150 000 | 1 | 150 000 | 5 | 30 000 |
| Wheelbarrow | 20 000 | 2 | 40 000 | 4 | 10 000 |
| Construction of drying surface | 100 000 | 1 | 100 000 | 10 | 10 000 |
| Sieve | 5 000 | 2 | 10 000 | 2 | 5 000 |
| Hammer Mill | 200 000 | 1 | 200 000 | 5 | 40 000 |
| Basin | 5 000 | 4 | 20 000 | 2 | 10 000 |
| Cutlass | 5 000 | 2 | 10 000 | 2 | 5 000 |
| Knives | 1 500 | 8 | 12 000 | 1 | 12 000 |
| Bags (Fermentation and packaging) | 300 | 10 | 3 000 | 1 | 6 000 |
| 20L Buckets | 1 500 | 4 | 6 000 | 1 | 6 000 |
| **Total** |  |  |  |  | **134 000** |
| **Running Cost** |  |  |  |  |  |
| **Item** | **Quantity** | **Unit Cost (FCFA)** | **Cost (FCFA)** | **Cost per year (35 weeks of production)** |  |
| Cassava | 1 000 kg | 50 | 50 000 | 1 750 000 |  |
| Water | 2 000 L | 0.35 | 350 | 12 250 |  |
| Transportation | 1 | 10 000 | 10 000 |  10 000 |  |
| Labour (peeling and washing) | 10manday | 2 000 | 20 000 | 700 000 |  |
| Labour (Grating) | 1 | 2 000 | 2 000 | 70 000 |  |
| Labour (drying and bagging) | 5manday | 2 500 | 12 500 | 437 500 |  |
| Fuel for grating | 12 L | 600 | 7 200 | 252 000 |  |
| **Total Cost** | **3 231 750** |  |
| **Total Expenditure for one year** |  |  |  |  | **3365 750** |
| **Income** (35 weeks of production) | 8750 kg | 500 |  |  | **4 375 000** |
| **Benefit for one year** |  |  |  |  | **1 009 250** |
| **Benefit per production cycle** |  |  |  |  | **28 835,71** |
| **Production cost for 1kg Starch** |  |  |  |  | 384.6571 |