Making sweet potato chips and flour in Kenya

Sweet potato is a popular food in many parts of Eastern Africa. It is a drought, hardly and can grow in marginal areas, thus contributing to improved food security. The young leaves and vines can be consumed as vegetables or fed to livestock.

During bumper harvests, farmers often sell sweet potatoes at throw-away prices. Losses after harvesting are high due to perishing. In some communities in Eastern Africa, sweet potatoes are preserved for the dry season by sun-drying to make amukeke – dried sweet potato chips. The dried chips are boiled and mashed with beans, milled or pounded to make flour, which can be mixed with either millet or cassava flours to make stiff porridge.

Some facts about dried sweet potato chips and flour

- Any sweet potato variety can be dried to make chips, which can then be milled into flour
- Dried sweet potato chips can be stored for up to six months when packaged in airtight, strong, black plastic bags
- Sweet potato flour is used to make doughnuts and pancakes
- Flour made from the chips can also be used to make high-value flours by mixing with millet, maize or soybean flour. These mixed flours are used to make porridge and baby foods, which are easily digestable.
- Some bakeries are already using new flour mixes to make bread and cakes
- The poultry feed industry is showing interest in using orange-fleshed chips in their feeds to improve yolk colour and vitamin A content of eggs.

Requirements for making sweet potato chips and flour

- Mature sweet potato roots. On average, 4 kg of fresh sweet potato roots give about 1 kg of dried sweet potato chips
- A clean area, ideally a room with raised working surfaces, such as tables – not on the ground
- Large plastic containers, preferably 10 to 20 litre buckets with lids
- Supply of clean water
- Ideally, a manual or motorized sweet potato chipper for chopping or slicing
- Raised open platform for air drying, or ideally a solar dryer placed in a clean area in full sunshine.
Procedure for making sweet potato chips and flour

Step 1: Choosing the roots
- Use any sweet potato variety
- The roots should be undamaged and mature - here to four months for the early maturing varieties and five to six months for the late maturing varieties.

Ste 2: Washing
- Wash the sweet potatoes in clean water in large buckets, changing water as frequently as required
- Alternatively, you can ash the roots in a sweet potato drum washer when processing large quantities to speed-up the process
- Do not peel the roots because the peel is rich in nutrients

Step 3: Draining
After washing, drain by placing the sweet potatoes on a raised, perforated rack.

Step 4: Chipping or slicing
- Chip the washed sweet potatoes to uniform size (3-6 mm thick)
- You can slice them manually with a sharp knife or use a manual or motorized chipper to speed-up the process.

Step 5: Drying
- Sweet potato chips should be evenly spread on a raised platform, preferably on a clean black plastic sheet, to sun dry under maximum sunshine for about six to eight hours – it is best to do this during the hot, dry season
- To ensure high quality chips, solar dryers can be used. A modified solar dryer, called a hybrid solar dryer has an additional source, such as charcoal and can be used to dry chips.
- Chips should be dried until they are brittle
- If drying in the open, cover chips with netting to keep off flies and birds
- Pack chips or continue processing to flour

Step 6: Milling
Mill dried chips to flour using a hammer mill (village “posho” mill)
Step 7: Packaging and labeling

- Pack dried chips or flour in strong (thick gauge) black polyethylene bags. Flour can be packaged in 2 kg packs for distribution to shops and other retail outlets.
- Label product to state source, date of manufacture and expiry date (after six months).
- Place bags of dried chips or flour in card board cartoons to protect them from light.

Step 8: Storing

- Store in a cool, dry place off the ground, preferably on pallets or raised surfaces.
- Flour can be stored for six months.

CASE STUDY

Table 1. Production costs for sweetpotato dried chips and flour in Soroti/Uganda (UShs)

<table>
<thead>
<tr>
<th>Items</th>
<th>Cost/unit</th>
<th>Unit</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweetpotato roots (120 kg)</td>
<td>5500</td>
<td>8.33</td>
<td>45815</td>
</tr>
<tr>
<td>Cleaning &amp; trimming roots (labour)</td>
<td>700</td>
<td>3</td>
<td>2100</td>
</tr>
<tr>
<td>Washing water (100 L)</td>
<td>50</td>
<td>10</td>
<td>500</td>
</tr>
<tr>
<td>Washing tools</td>
<td>9800</td>
<td>0.1</td>
<td>980</td>
</tr>
<tr>
<td>Washing &amp; brushing (labour)</td>
<td>700</td>
<td>4</td>
<td>2800</td>
</tr>
<tr>
<td>Slicing tools</td>
<td>1000</td>
<td>0.1</td>
<td>100</td>
</tr>
<tr>
<td>Slicing (labour)</td>
<td>700</td>
<td>5</td>
<td>3500</td>
</tr>
<tr>
<td>Drying*</td>
<td>1000</td>
<td>2</td>
<td>2000</td>
</tr>
</tbody>
</table>

Total costs (dried chips) 57795
Yield in dried chips (Kg) 295.5
Production cost/Kg dried chips (UShs) 195.6

<table>
<thead>
<tr>
<th>Items</th>
<th>Cost/unit</th>
<th>Unit</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milling</td>
<td>400</td>
<td>15</td>
<td>6000</td>
</tr>
<tr>
<td>Packaging</td>
<td>560</td>
<td>5</td>
<td>2800</td>
</tr>
<tr>
<td>Yield in flour (Kg)</td>
<td></td>
<td></td>
<td>286</td>
</tr>
<tr>
<td>Total costs (flour)</td>
<td></td>
<td></td>
<td>66595</td>
</tr>
</tbody>
</table>

Production cost/Kg flour (UShs) 232.8
2. Calculation of Sweetpotato Flour Production Costs

2.1. Needs and costs of flour processing equipment

We are talking about the production of sweet potato flour in rural area at the village level. The hand chipping of roots is a traditional technology and only requires a knife. However, the operation is perillous and accidents of fingers cut or injured often occur. The way the operation is currently done needs a lot of improvements and a hand chipper machine can get it easier and rapid done and ensure the sanitation of the dried product.

Water is scarce when the sun drying is suitable, and the food sanitation is a crucial step in marketing. An investment in a 200-L jerry can/household is desirable. The sun drying is usually done on rocks, and on cleaned surfaces and covered by dried cow dung etc. The dried product is always in contact with soil and dust, and would not necessarily meet the basic hygienic requirements of urban foods. A training of farmers in general sanitation of dried roots, and use of local available material such as mats to avoid direct contact of chips with soil would improve the sanitation aspect of the end product.

The milling would be done in local hammer mills and the packaging is a must to improve the transportation of the product to urban areas.

2.2. Cost of raw material

The schema of the technological process of the figure 1 indicates the sweet potato flour processing requires only roots and water.

Roots. Prices of fresh sweet potato roots vary from 200 to 350 Ksh/bag of 120 Kg in areas surrounding Soroti.

Water. Water is another important ingredient in sweet potato flour processing. Due to its multiple uses (washing & cleaning) in the process of slices dehydration, an important quantity of that liquid is necessary. Potable water is used in the processing dried chips for cleaning the fresh roots and utensils. Roots should be washed in potable water to eliminate surface impurities and make the drying process more effective. In case of any doubt regarding the portability of water, the last is made potable using chlorides. The adequate concentrations of chlorine in water should be 3 to 5 ppm of free chlorine (for 1000 L of water use 3 to 5 g of Na hypochlorite)

Energy. There is no cost related to energy because the sun drying is involved. The cost appearing in Table 2 is for night watching of drying material.

2.3. Transport cost

The transport of raw material at the village level does not require any extra cost.

2.4. Storage cost

Packing and flour storage would require the plastic bags. One plastic bag, size 20 X 24, gauge 200, suitable for packing and storage of flours costs 2.4 Ksh (about 45 Ushs). The loss during the grinding was estimated at 3% of the weight of dried sweet potato chips.
2.5. Profitability

Sweet potato dried chips or flour are not currently traded off on food markets surrounding Soroti Trading Center (Uganda). However, sweet potato flour is home made in each household and used alone or in mixture with sorghum or finger millet to process local bread called “atapa”. According to information collected from farmers and agricultural extension service in Soroti, the price of a 120-Kg bag of fresh sweet potato (variety Kenya) varies between 4,000 Ushs and 7,500 UShs at the farm gate, where drying is supposed to be taking place. The Table 1 suggests that the production cost of a kilogramme of sweet potato flour would fluctuate between Ushs 183.1 and 291.1. The cost of production was 233 UShs/Kg of sweet potato flour when the study was being conducted, which can be reasonably traded off at Ushs 300. That price can highly compete with wheat flour (traded at 750 UShs/Kg), maize flour (400 UShs/Kg), cassava (300-350 Ushs/kg), millet flour (400-500 UShs) in Soroti and Kampala.