

OPERATION MANUAL

Original in Portuguese  
Translated into English

**CASHEW PULP**  
**(Pasteurized and/or with Preservatives)**

IMPROVING CASHEW NUT POST HARVEST

TECHNOLOGIES IN TANZANIA

**TECHNICAL MANUAL**

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## 1. PRESENTATION

Industrializing cashew apples, specifically for the purpose of producing juice, jams, preserves, jelly and whole or diced dehydrated fruits, is a handy alternative to add value to products and generate income to cashew farmers in Tanzania due to the fact that they can be preserved for months without undergoing any undesirable changes, thus maintaining their organoleptic properties, such as aroma, taste, texture and color, besides, what is mostly important, their nutritional values are kept at high levels.

This product can be preserved by simply combining four factors: concentration of sugar, heating and vacuum sealing packaging. The fourth factor, both extremely important and indispensable for every food processing unit regardless of its size, refers to precautions related to Good Manufacturing Practices.

Using chemical additives to preserve cashew pulp is a widely applied method in Brazil, resulting in shelf life of around one year. Its use is recommended in the case of producing jams and dehydrated fruits. As for preserving pulp, freezing is a preservative method that preserves characteristics found in the fruit and makes it available during offseason periods. These processes allow farmers to have an alternative to using fruits that do not meet marketing standards for fresh products, or one whose prices are more advantageous.

This manual serves the purpose of catering for demands from small and medium-sized cashew farmers in Tanzania, related to producing **Cashew Pulp (pasteurized and/or with preservatives)** as an economic alternative capable of adding value to raw materials. The manual takes into account application of technology processes compatible with local situation of family-run agribusiness, as well as compliance with all food quality and safety requirements.

## 2. PRODUCT DEFINITION

Cashew pulp is a non-fermented, non-concentrated, non-diluted product with minimum total solids content from the edible part, obtained by crushing healthy and clean cashew apples (*Anacardium occidentale*, L.), which are crushed through suitable technology methods.

The product must be prepared with healthy, clean, parasite-free apples, not contaminated with animal or plant waste. It must not contain fragments of inedible parts of the fruit or substances not common to its normal composition.

With regard to producing pulp, cashews are received at the factory, weighed for payment and yields control purposes, and analyzed according to their quality properties, which include percentage of fermented apples, damages caused by pests and diseases, cleanliness, soluble solids content (Degrees Brix), pH and acidity.

Following suit, apples are washed in chlorinated water (50 ppm), manually sorted along a belt conveyor so that inadequate fruits are removed, and finally sent to a processing section.

Cashew pulp must have the following characteristics and composition:

Color: shades ranging from white to yellow;

Taste: specific to the fruit, slightly acidic and astringent;

Aroma: specific to the fruit.

Clarified Juice	Minimum
Soluble Solids (Degrees Brix)	10
pH	4.6
Total Acidity of Citric Acid (mg/100g)	0.3
Ascorbic Acid (mg/100g)	80
Total Sugars (mg/100g)	15
Total Solids (mg/100g)	10.5

Product label must inform its name and all other requirements comprised in specific labeling regulation.

### 3. STAGES IN THE PRODUCTION PROCESS

#### 3.1. Pasteurized frozen pulp

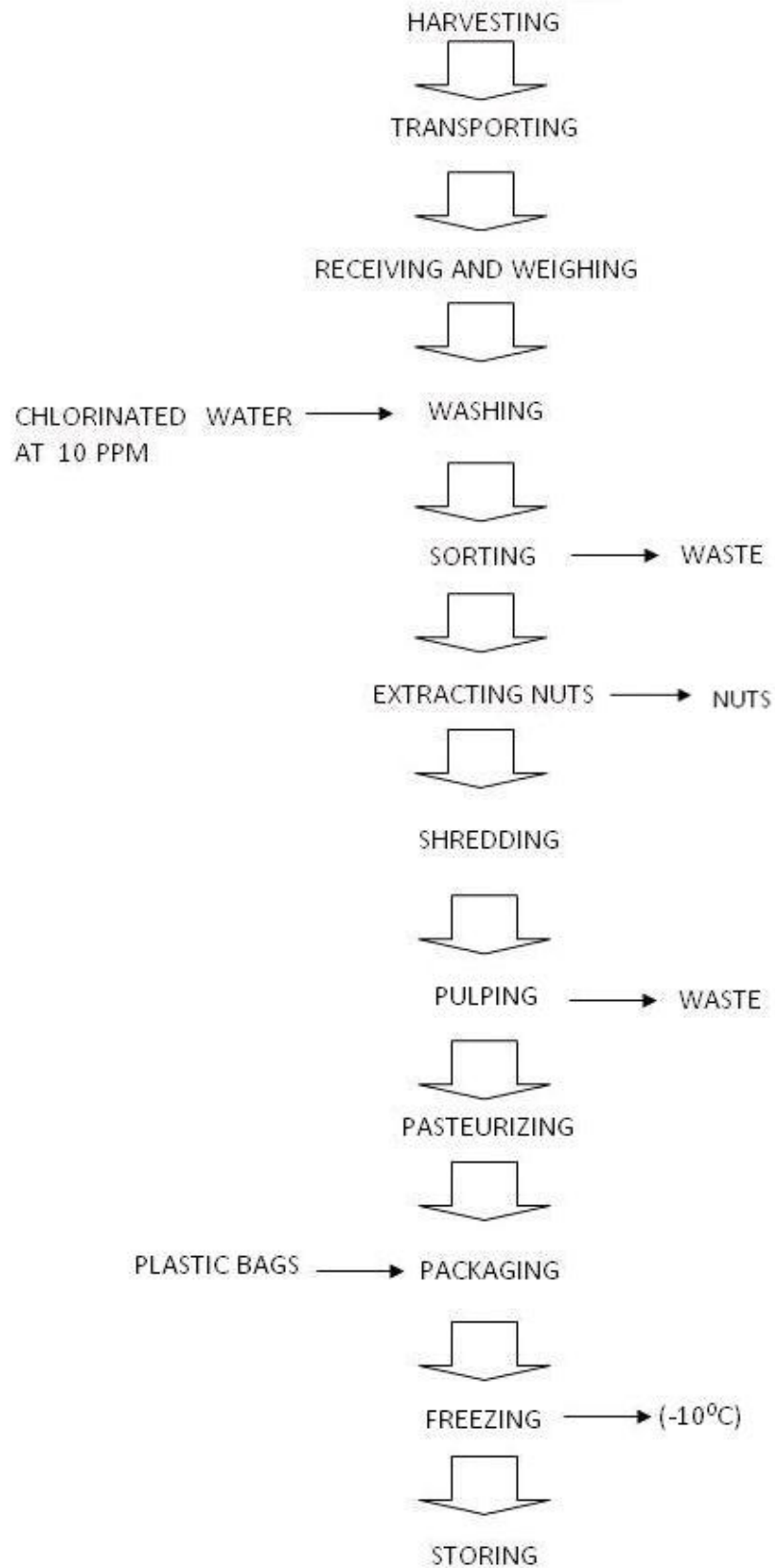


Figure 1 - Stages in processing frozen pulp.

### 3.2. Chemically preserved pulp

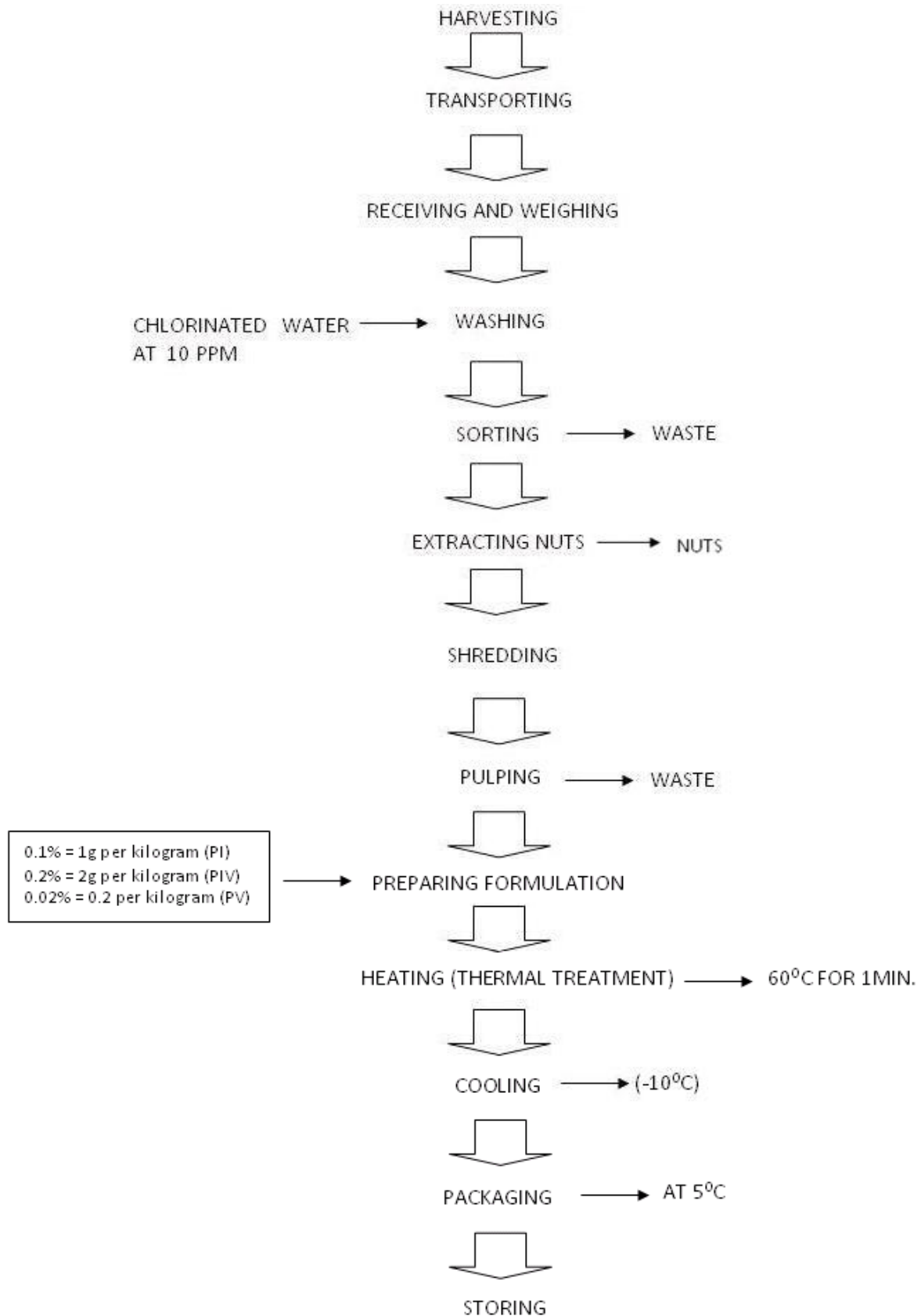


Figure 2 - Stages in processing frozen pulp.

### **3.1. PASTEURIZED FROZEN PULP**

#### **3.1.1. HARVESTING**

Indicators for the best harvesting time of cashew apples are color, firmness and composition. Nonetheless, in practice, harvesting takes place when apples are fully grown, in other words, at their maximum size, when they are still firm and sporting the typical color for their variety or clone.

In this stage, when touched, apples easily detach from the tree. Moreover, due to cashew's being climacteric (ripening does not continue after harvested), apples need to be harvested when they are fully ripe, when they have their best taste and aroma (maximum sugar content, lowest acidity and astringency). Therefore, harvesters must walk the orchard every day, during production season, for the fact that ripe apples spontaneously detach from the tree, thus becoming useless for consumption.

Harvesting is to be done during hours when temperatures are milder.

For correct harvesting procedures, fruits are to be slightly turned from side to side so that they detach from the panicle branch. In case apples are a bit hard to be harvested, such fact evidences early ripening stages, unsuitable for harvesting. So as to avoid contaminating apples, harvesters must keep their nails clean.

Cashews are to be stored in layers inside harvesting plastic crates or containers (Figure 2). In case an excessively large amount of cashew is placed in a crate, fruits in upper layers may damage the ones in the bottom. Also true, the ones on top layers may be damaged by the crate immediately stacked on top of them, when crates are piled up.

For industrial purposes, fruits may be hand harvested, if plant size allows it, or if it is possible to use a long rod with a bag in one end. Nevertheless, using long rods without bags or shaking branches to harvest cashews is not advisable, because they may damage apples and make flowers and unripe fruits to fall, besides the fact that they do not always allow reaching ripe apples in the top of taller trees.

For the purpose of producing juice, cashew apples must be completely healthy and ripe, with soluble solids content preferably between 10.5 and 11.5, and must not be the sour type. Their color may be red or yellow, no requirements related to this regard. Fruits must neither be soiled in sand or soil matter, nor be contaminated with microorganisms (mold and bacteria) when directly picked ripe off the ground.



Figure 2 - Harvesting cashew apples and storing them in adequate crates.

### 3.1.2. TRANSPORTING

Cashews are to be transported to the family-run agribusiness unit in adequate harvesting crates, which must be not so deep so as to avoid many layers inside, a fact that could result in smashed fruits, damaged texture and loss of juice. In general, such crates can hold up to 17.6 liters, in other words, 8kg to 9kg of fruits, measuring 0.5m x 0.22m x 0.16m.

Crates are to be carefully placed onto the vehicle and never thrown onto it. When stacking crates one must ensure ventilation between them and that crates never touch fruits in other crates immediately below them.

The driver must be instructed to avoid speeding up and bumping, because it is precisely in this stage where most mechanical damages happen.

Exposing cashews to sunlight or high temperatures after harvesting causes them to lose water due to transpiration and increased respiration rate, resulting in reduced life cycle of products. As the result of such, apples lose luster, firmness and become sweeter. Crates must be stacked in the shade before they are transported and be taken as fast as possible to the family-run agribusiness unit (Figure 3). Mechanical damages are among the leading causes of post-harvest losses of cashew apples, and hence they are to be very carefully handled.

When cashews fall to the ground they may get useless for processing, the same situation



may happen when inadequate harvesting crates are used, ones with rough surfaces and cutting edges, which may damage fruits. Any damage is an opening wound for decomposer microorganisms.

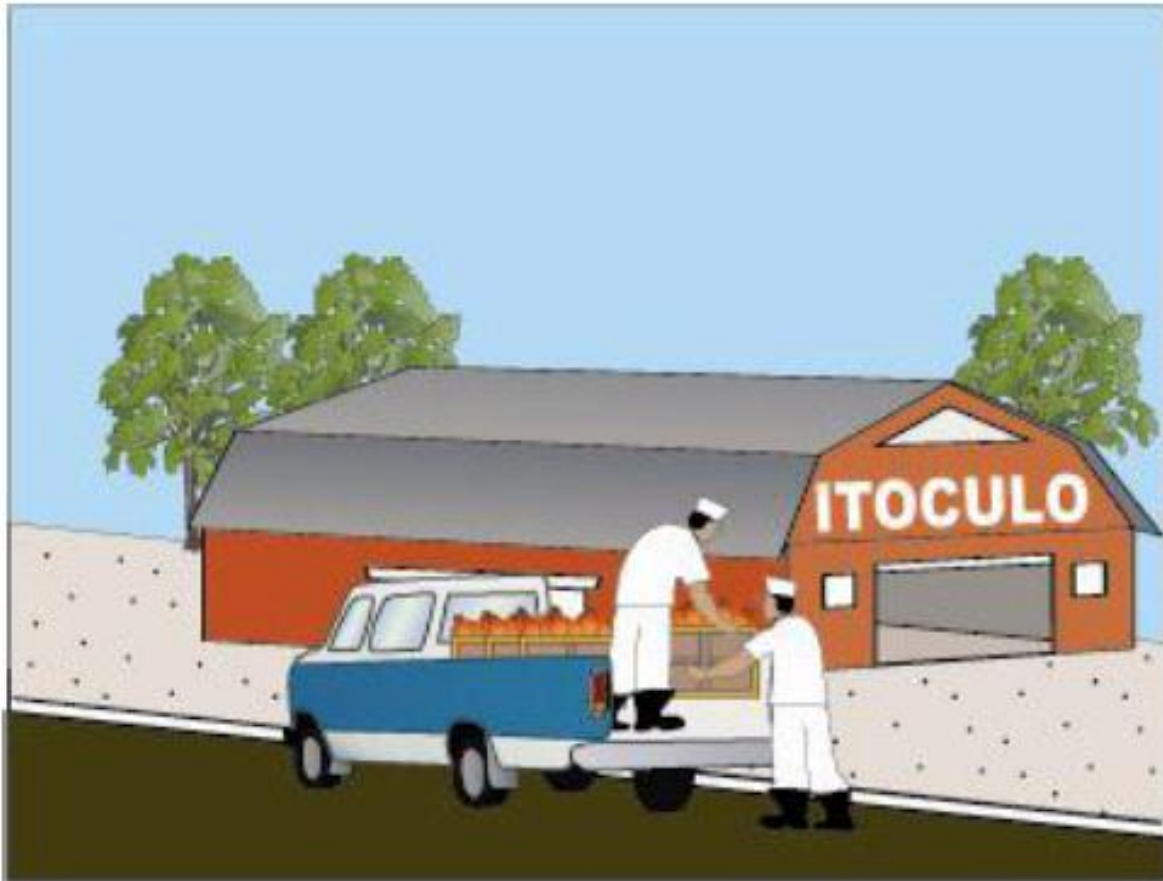


Figure 3 – Transporting cashews to the factory.

### **3.1.3. RECEIVING AND WEIGHING**

Products are received in a place near the pre-washing zone, where they are weighed on a platform scale, with the purpose of providing means for payment and calculation of end product yields. The amount of raw material must be such to avoid interruptions in the production process.

Fruits must be stored in cool or well ventilated places. Crates or containers must be washed and dried before they are taken back to the field, because they may get dirty or carry mold, which speed up the deterioration process of fruits during transportation and storage.

### **3.1.4. WASHING**

This stage aims at eliminating impurities brought from the field that may contaminate raw materials and result in problems related to equipment wearing out during the process. Washing also serves the purpose of reducing heat fruits have absorbed since they were

harvested up to the moment they were received in the factory.

When cashews are brought from the field, they generally have high microbial load, due to their storage in crates, which are normally contaminated because of contact to the ground, handling, etc. Washing is aimed at reducing the microbial load on the surface of fruits and is done by sinking fruits in sodium hypochlorite solution, or bleach, from 15 to 20 minutes, in a concentration of 200 ppm (0.02%) of active chlorine (Table 1).

<b>AMOUNT OF WATER For 100 liters of water</b>	<b>SODIUM HYPOCHLORITE (with 8% of active chlorine)</b>	<b>BLEACH (colorless and odorless)</b>
	<b>250ml</b>	<b>800ml</b>

Table 1 - Formulation of chlorinated water to wash cashews.

This concentration may be obtained by adding an average amount of 250ml of sodium hypochlorite (with 8% of active chlorine) or even 800ml of bleach (odorless) to 100 liters of water, in a tank lined with tiles or epoxy, or even made of stainless steel (Figure 4).

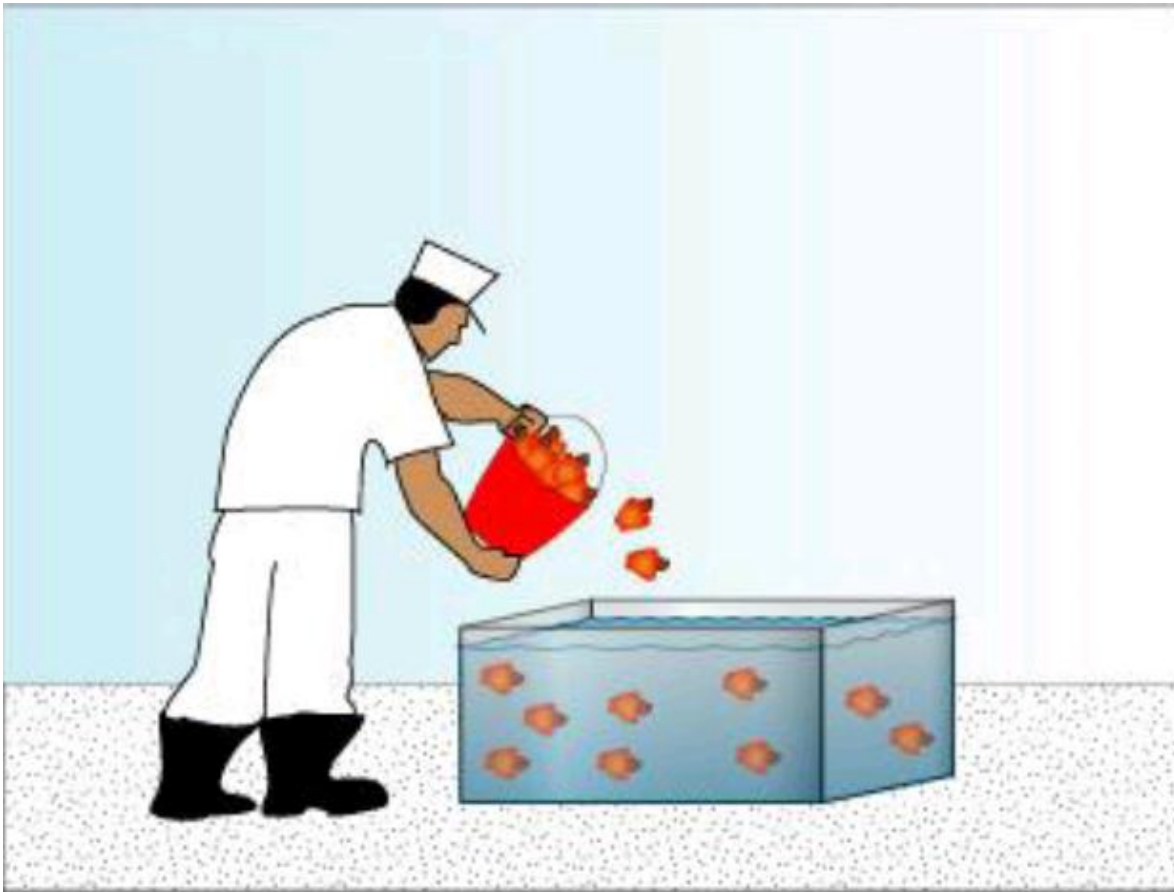


Figure 4 - Washing of cashews in chlorinated water.

### 3.1.5. EXTRACTING NUTS

This procedure can be done in two different ways. The first one refers to using a nylon string wrapped around the point where the nut is joined to the apple, which is then pulled up to the point the nut is cut loose without any tearing to the apple.

Another method is based on using a small manually-operated device to extract the nuts by means of a clear cut in the point where the nut is joined to the apple. If this operation is done by turning the nut around, tears in the apple will expose the flesh to microorganisms, resulting in decreased quality and loss of juice during washing and sanitization procedures.

Figure 5 shows the correct way of extracting nuts from cashew apples so as to avoid tearing or breaking the insertion point.

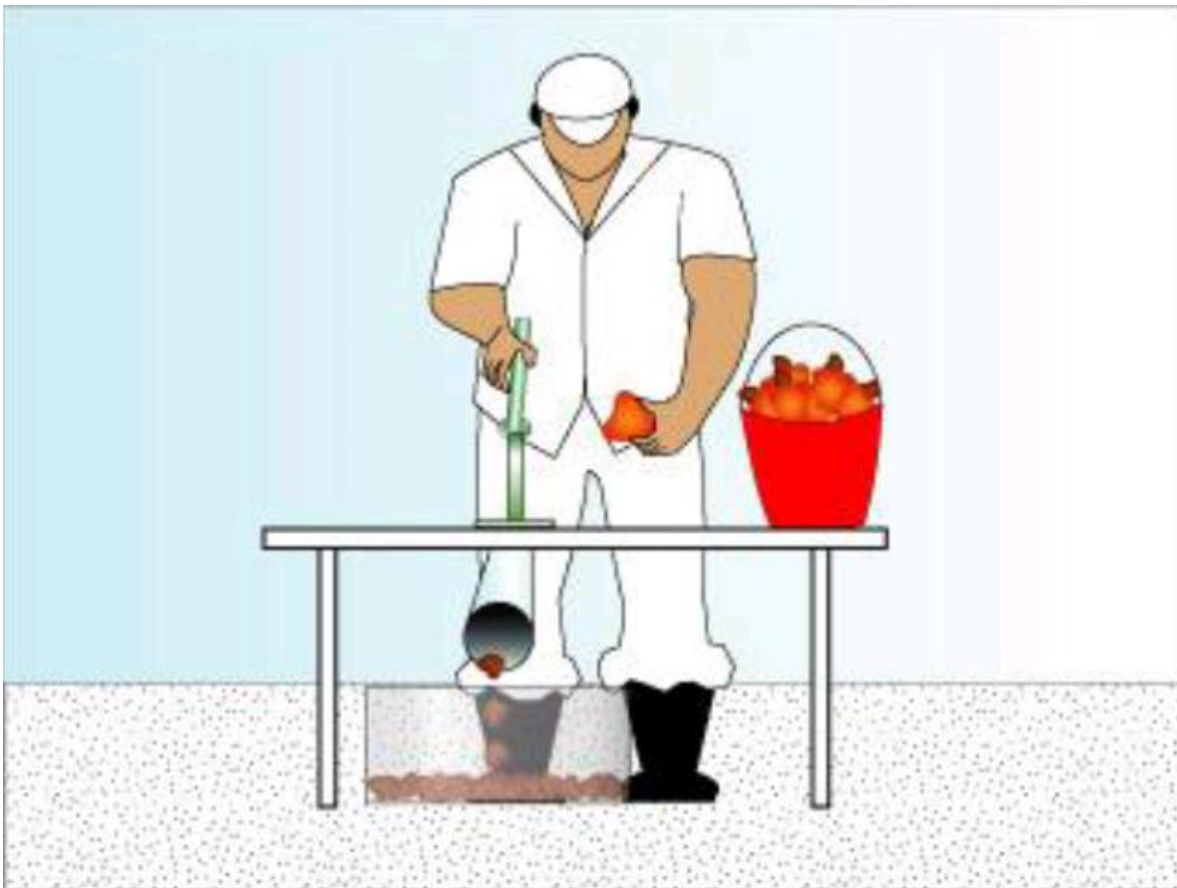


Figure 5 – Extraction of nuts from cashew apples.

### 3.1.6. SORTING

After washing, cashews are then placed on a sorting table, preferably made of stainless steel, from which workers remove rotten, unripe and imperfect fruits. Small imperfections and rotten spots must be removed using stainless steel knives. In order to have a quality end product, a thorough sorting of raw materials must be carried out by skilled workers, capable of removing uneven fruits. It is best to use fruits in adequate ripening stage, free of contamination, rotten spots, physical damages, torn surface and smashed parts. It is

important to have good lighting in the place this procedure is carried out.

### **3.1.7. SHREDDING**

After selected, cashews are then shredded, aiming at increasing yields. For such purpose, apples are put in a shredder which tears fruits without ripping their fibers. This operation is recommended for famers who do not have a continuous press. The juice extracted must be put into clean containers, made either of plastic, glass, aluminum or stainless steel, never made of iron. In the beginning of the process, apples are torn in a shredder. Afterward they are taken to a unit equipped with a horizontal pulper with stainless steel mesh and a 0.5-milimeter opening, so that fibers are removed from the pulp.

### **3.1.8. PULPING**

It is the process used in extracting cashew pulp from fibers (Figure 6). Depending on the type of fruit chosen, pulping must come after shredding, in a shredder or industrial blender, as it is done in the case of cashews. In this stage, pulpers (made of stainless steel and equipped with sieves with different size holes) are the most common devices used. Sieves may be changed according to the type of fruit being processed.

This process consists in putting cashews (whole, diced or even shredded fruits) into a pulper. The pulp must be collected in clean buckets (made of stainless steel or PVC) in the lower part of the equipment, whereas solid waste is collected up from the front part. Some fruits, like guava, require repeating the pulping process a second time using sieves with smaller holes, in order to thin the pulp, thus granting better characteristics to it. There is equipment on the market made of two or three parts allowing pulping and thinning to be done in a continuous way. Before packaging the product and freezing it, samples of pulp are to be taken for microbiological and physical-chemical analysis.

Yields, in terms of amounts of pulp produced in relation to amounts of fruit used, vary according to the type of fruit and pulping conditions.

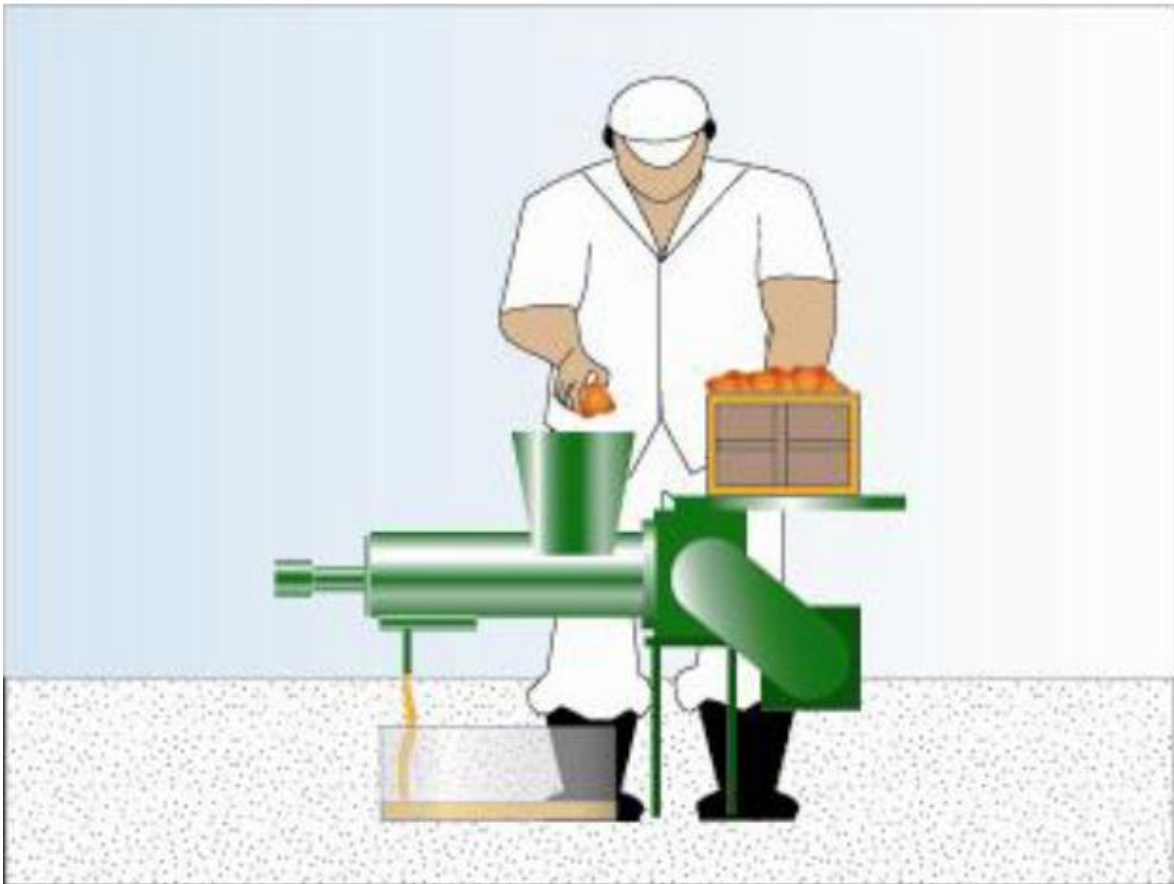


Figure 6 – Pulping cashew apples

### 3.1.9. PASTEURIZING

After pulping, which consists in removing fibers from cashew apples in a horizontal pulper equipped with a 0.5-millimeter stainless steel sieve, pulp is pumped to a pasteurizing unit (tubular-shaped pasteurizer), where it is heated up to 92°C for two minutes and then cooled down to 6 °C, with the purpose of eliminating pathogens and stabilizing microbial load in the pulp. After pasteurization, pulp is then packaged, first in 100-gram heat sealed polystyrene bags in pneumatic packagers, and later frozen at -30°C in fast freezing tunnels. Bags containing frozen pulp are then packaged into new containers (with four or five units) and then taken to -20 °C storage rooms until they are marketed.

### 3.10. PACKAGING AND SEALING

Cashew pulp is normally packaged in horizontal hand-operated or mechanical fillers, equipped with a metering device, which allow packaging the product according to desired presentation (Figure 7), in a container with dimensions as required by the consuming market. For household use, it is advisable to use 100-mililiter to 200-mililiter containers, which is enough to prepare from one to two liter of juice.

So as to cater for institutional demands, it is advisable to package pulp in bags capable of holding more than one kilogram. It is also possible to supply pulp in vacuum sealed hard plastic buckets when the product is to be sent to wider markets or places distant from the production unit.

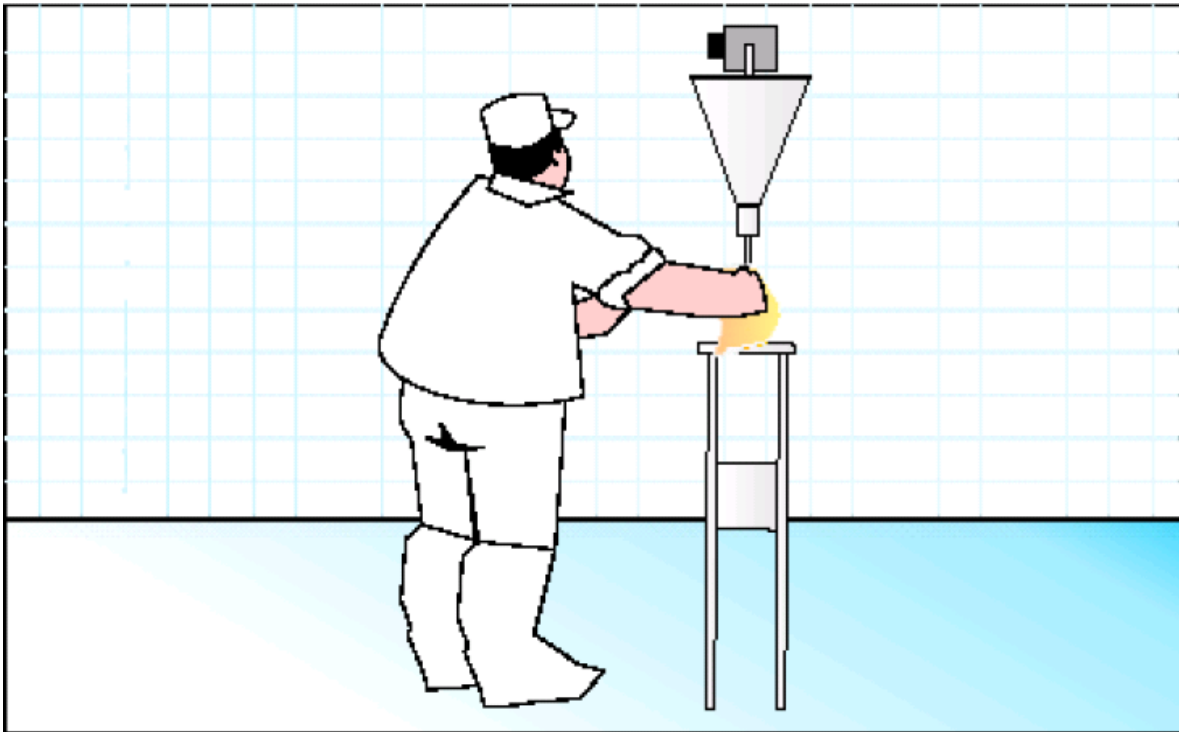


Figure 7 – Hand-operated filling system for cashew pulp

In case pulp is packaged in plastic bags, it is advisable to use hand-operated machines (Figure 8), equipped with paddle and hand-activated sealer. Some of these machines may come with an automatic mechanism for larger amounts and a device to print production and expiry date.

After pasteurized, pulp must be packaged; first in 100-gram heat sealed polystyrene bags in pneumatic fillers.



Figure 8 – Hand-operated sealer for cashew pulp

### 3.1.11. FREEZING

Freezing (Figure 9) is an operation to be done immediately after pulp is packaged. Quickness in performing this procedure favors preservation of the original characteristics of fruits, thus granting quality to the end product.

In this stage, it is possible to use chillers, with cold air flow, or household freezers (less advisable).

It is important to be attentive to freezer or chiller holding capacity. One must not fill them up to the total recommended amount, because it could block cold air flow and such scenario would eventually result in an inefficient freezing procedure.

Freezing is done in  $-20^{\circ}\text{C}$  fast freezing tunnels. Bags with frozen pulp are put in new containers (with four or five units) and sent to storage rooms at  $-10^{\circ}\text{C}$  until they are marketed.



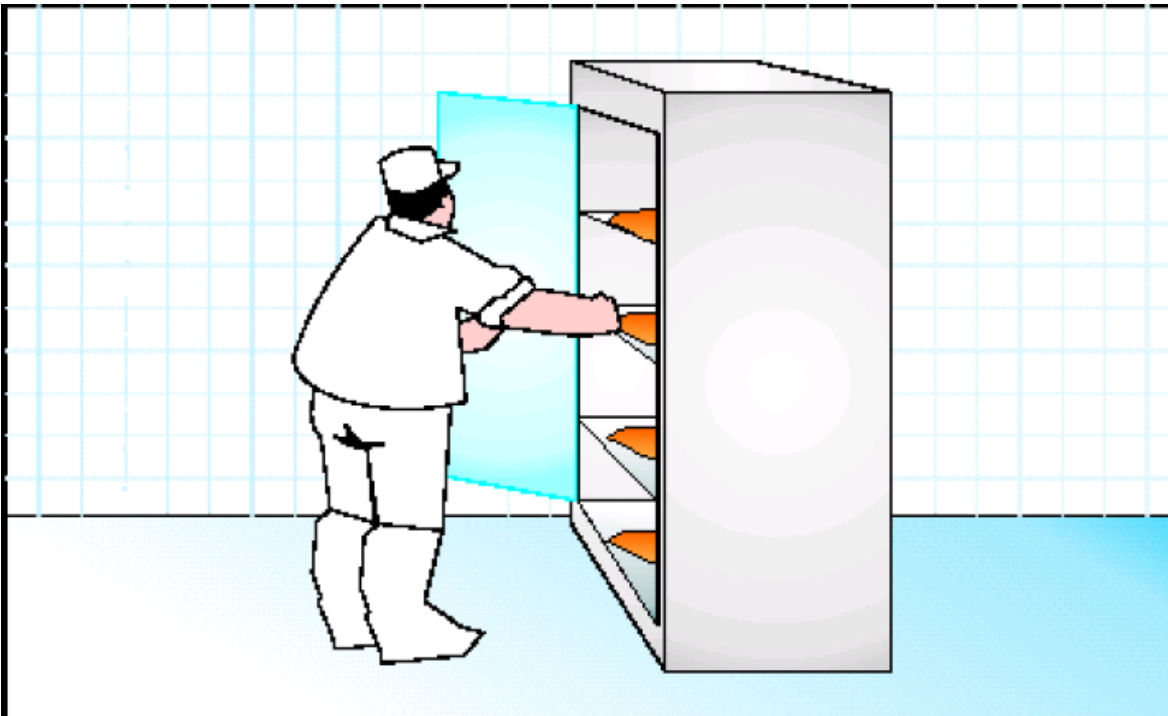


Figure 9 – Freezing processed fruit pulp

### 3.12. STORING

Pulp must be kept frozen until it is consumed. Recommended storage temperature, in chillers, varies from  $-18^{\circ}\text{C}$  to  $-22^{\circ}\text{C}$ . Household freezers, with inside temperature ranging from  $-8^{\circ}\text{C}$  to  $-10^{\circ}\text{C}$ , can also be used. However, in this last case, products are to be marketed faster, because shelf life is shorter.

In this stage, it is also important to be attentive to the amount of products inside chillers or freezers, so as to avoid overloading and prevent air from properly flowing between walls and in-between bags. The basic rule of stock movement must be applied with regard to inflow and outflow of products: first product in, first product out, due to expiry date.

It is important to keep pulp in freezing conditions throughout distribution, marketing and consumption stages, in order to ensure quality to the product.

Most common packaging materials are 100-mililiter or 1000-mililiter polystyrene plastic bags. After packaging this bags are heat sealed (Figure 8), by means of a hand-operated sealer and then frozen.

The following information must be printed on the package label:

- Name: (type of fruit) pulp;
- Amount in grams (g);
- Date of production;
- Expiry date;
- Expressions: 100% (in case additives were not used);



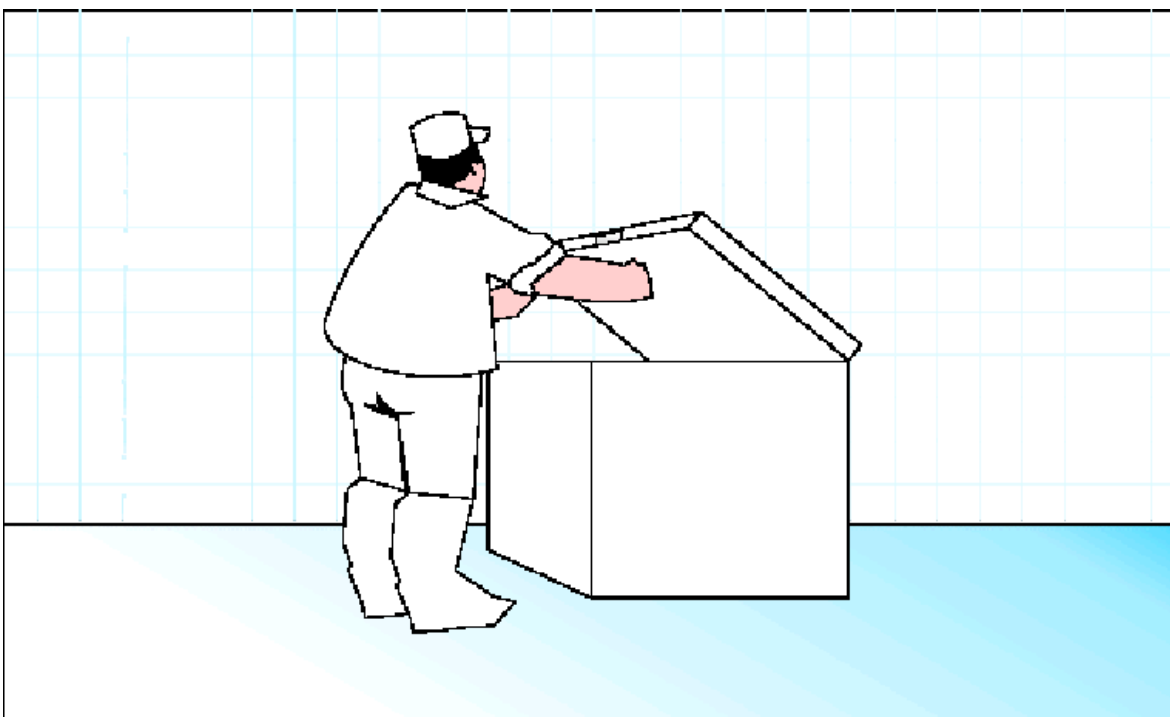


Figure 10 – Storing cashew pulp in a freezer

### 3.2. CHEMICALLY PRESERVED PULP

Harvesting, transporting, receiving, weighing, washing, sorting, shredding, and pulping stages are also the same ones used and described for pasteurized frozen cashew pulp.

In order to produce chemically preserved pulp, chemical additives are used according to amounts regulated in legislation, with the purpose of keeping pulp in adequate preservation conditions to last for 12 months, depending on preparation procedures employed.

For the formulation of cashew pulp it is advisable to use benzoic acid or sodium benzoate (PI) to the maximum amount of 0.1%, sorbic acid or sorbates (PIV) to the maximum amount of 0.2%, and sulfur dioxide (PV) or byproducts that result in SO<sub>2</sub> to the maximum amount of 0.02%. Sulfur dioxide is only to be used in processing operations in which products are pasteurized and cooled before the chemical is added (Figure 11).

0.1% = 1 gram per kilogram
0.2% = 2 grams per kilogram
0.02% = 0,2 gram per kilogram

Pulp must be heated in an open pan at the temperature of 95°C for minutes.

Hot pulp at 85 to 90 °C is to be put in 18-kilogram tins, which are to be immediately sealed. Further on, tins are to be placed upside down for three minutes. Before tins are filled with pulp, they are to be thoroughly cleaned and sterilized with boiling water.

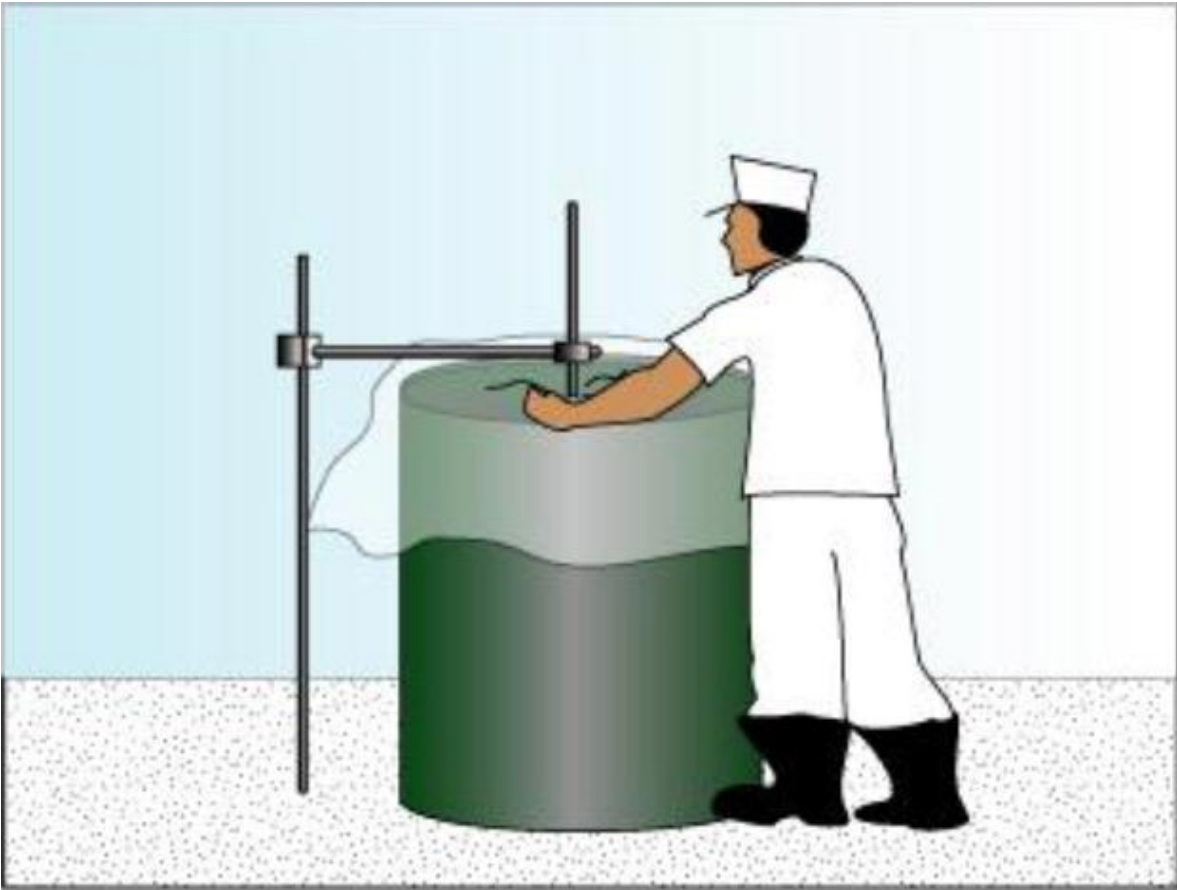


Figure 11- Preparing preserved pulp

Cooling pulp tins can be done under cold water sprays or by sinking tins in tanks with running water. Water for cooling purposes must be chlorinated in the ratio of 10ml of bleach to 100 liters of water. The product needs to be quickly cooled down to the temperature of 40°C.

Each tin must be identified with a label with the product name and production date.

Pulp must be stored in dry and well ventilated places, at room temperature.

#### **4. EQUIPMENT AND UTENSILS**

Equipment and utensils necessary to process frozen cashew pulp are the following:

- Brick tanks lined with tiles or made of stainless steel for washing procedures;
- Sorting tables (made of stainless steel);
- Preparation tables (made of stainless steel);
- Tables for packaged pulp;
- Scales;
- Shredder or industrial blender (made of stainless steel);
- Industrial stove to heat preserved pulp;
- Heat sealer or plastic bag sealer;
- Chiller or freezer;
- Buckets, knives, stirrer, waste baskets and plastic crates.

## **5. GOOD MANUFACTURING PRACTICES - GMPs**

Good Manufacturing Practices (GMPs) are basic requirements to make products not harmful to consumers. GMPs comprise construction projects for buildings and facilities, hygiene and sanitization plans and even storage conditions and distribution. Companies producing fruits abide by Good Manufacturing Practices regulated in specific laws.

Every production unit must have a Good Manufacturing Practices manual available, a document with the company's letterhead, containing all the information about procedures of Good Manufacturing Practices adopted in the factory. Major measures related to Good Manufacturing Practices are listed below:

### **Facilities**

- Production unit must be located in a place free of smoke and dust;
- The building must be solid, providing enough space for all production stages and constructed in such a way to avoid contamination of end product by raw materials;
- Floor and walls must be washable and drains are necessary to avoid water from lodging;
- Windows must have insect screens installed;
- Production unit must be well lit and ventilated;
- Light bulbs must be protected against breakage and explosion;
- Bathrooms must not be directly communicable with the production area.

### **Personal Hygiene**

- Workers must always wash hands before entering the production area and begin processing activities, after handling contaminated materials, and immediately after using bathrooms;
- The place to wash hands must have: running water, soap, paper towel, and pedal-activated plastic garbage can;
- Nails must be always clipped and never polished;
- Hair must be always protected under caps;
- It is not allowed to wear rings, bracelets, earrings, necklaces, watches, wedding rings, and others, because such jewelry may contaminate food;
- It is recommended to avoid anti-hygienic practices in the production area: smoking, sneezing, coughing, spitting, and others;
- Every worker involved in production activities suffering from any kind of food-borne disease or any infectious disease must be compulsorily sent away from the production area;
- When workers have open wounds or cuts they must be instructed not to handle food, unless the injury is protected under waterproof material, therefore not posing a risk to contaminate food;
- Uniforms must be made of light colored fabric and be clean at all times.

### **Pest Management**

- Facilities must be closed in such a way not to allow the entrance of pests such as flies, birds, rodents and others;
- Garbage must never build up, so as to avoid pests; it must be taken out at least once a

- day or whenever necessary and its container must be cleaned after every disposal;
- Every pulp producing unit must have in place an efficient and continuous pest management plan. The processing unit and its vicinities must be regularly inspected, aiming at reducing the risk of contamination to the lowest levels possible;
  - Extermination measures comprise treatment with authorized chemicals and/or biological substances, as well as physical barriers, which are to be applied under the guidance of skilled professionals, that is, companies or institutions accredited for such purpose, deeply knowledgeable of the risks those substances pose to health;
  - Before using any chemical, one must be cautious enough to cover all equipment and utensils to avoid contamination. After the necessary time for its effect, facilities are to be completely cleaned before production is resumed, so as to eliminate any residues;
  - In the event of hiring an outsourced company, it must have an operating license issued by the relevant institution and provide an expert with educational background and/or experience in the field to be in charge of overseeing services hired.

### **Water Quality**

- Water that comes in contact with food must be suitable for human consumption;
- Water tanks, cisterns and other water storage containers must be covered, free of cracks and cleaned every six months, at least.

### **Cross contamination**

- It is not allowed to let pets into the production area;
- It is necessary to correctly sanitize equipment, utensils and molds used in the cashew processing unit;
- Chemicals and cleaning products must be stored away from packaging materials and ingredients used in the production process;
- Ingredients and packaging materials must be stored under conditions that prevent them from getting damaged or contaminated. Products must be kept on pallets and away from walls so as to allow appropriate cleaning of storage facilities. Stock turnover must be ensured, with compliance to the principle of First One In, First One Out.

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