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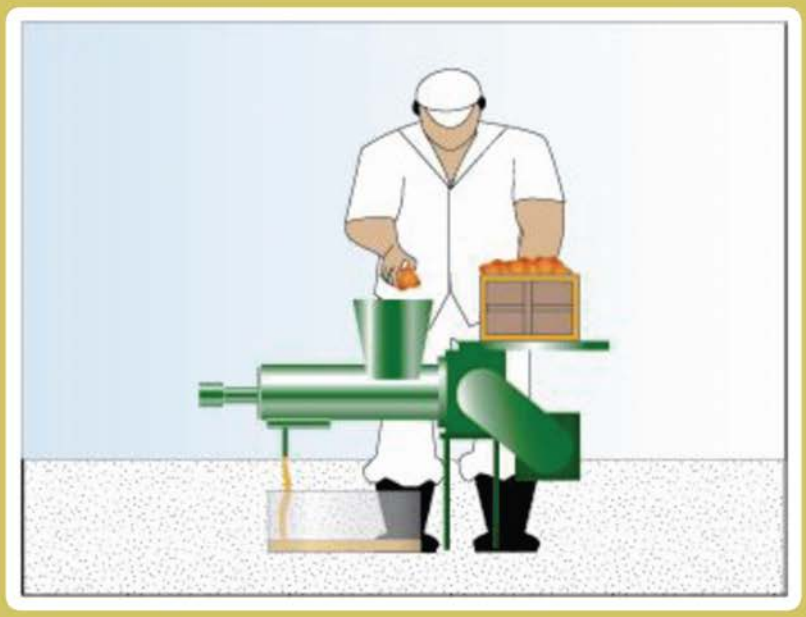
CASHEW APPLE CANDY

TECHNICAL MANUAL



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MINISTÉRIO DAS RELAÇÕES EXTERIORES

Embrapa

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Preface

The present manual has been elaborated by the Brazilian Agricultural Research Corporation (EMBRAPA) within the framework of a bilateral technical cooperation project for the strenghtening of cashew production in Tanzania. The project was financed by the Brazilian Cooperation Agency (ABC). Its translation to Kiswahili was a joint initiative between United Nations Industrial Development Organization (UNIDO) and the Brazilian Embassy in Dar es Salaam.

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 Apple Candy** 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

The paste is made by crushing, pulping and shredding cashew apples to which pectin and sugar are added, until a firm soft texture is obtained.

The product must be prepared with healthy cashew apples. It must not contain fragments of inedible parts of the fruit or substances not common to its normal composition.

For the purpose of producing paste, cashew apples must be received at the processing unit, weighed and sorted according to quality standards, such as dirtiness, soluble solids content (Degree Brix), pH and acidity, being discarded those apples having damages caused by diseases or pests.

The product must have the following characteristics and composition:

Color: shades ranging from light yellow to creamy;
Taste: specific to the fruit, sweet;
Consistency: firm with fibers
Aroma: specific to the fruit.

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

3. STAGES IN THE PRODUCTION PROCESS

Cashew Apple Candy

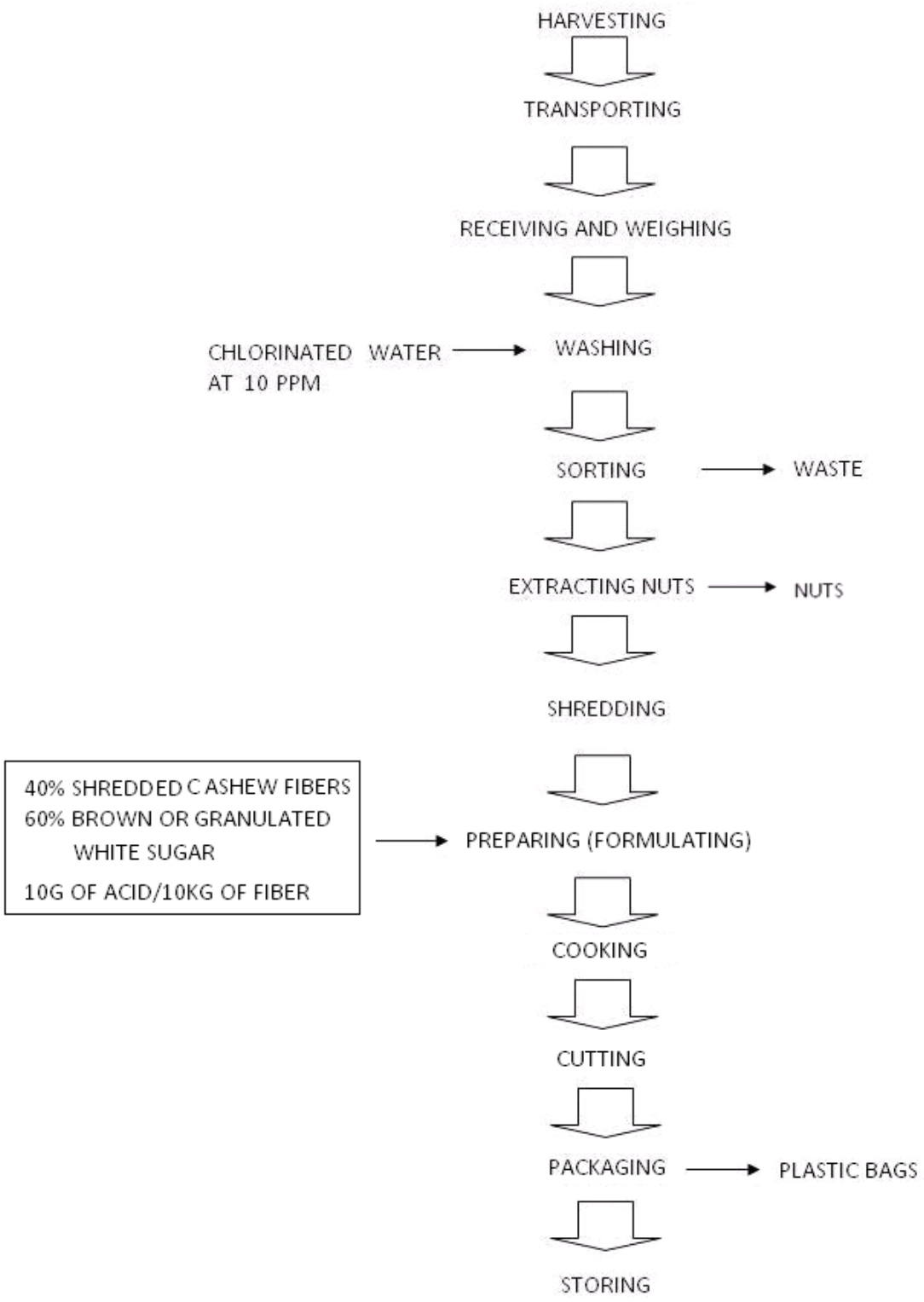

Figure 1 - Stages in processing candy from cashew apples

3.1. 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 harvest when they are fully ripe, when they have their best taste and aroma (maximum sugar content, lowest acidity and astringency). Because of such, 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 do 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 cashews 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, and 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.

3.2. 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 bellow 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.

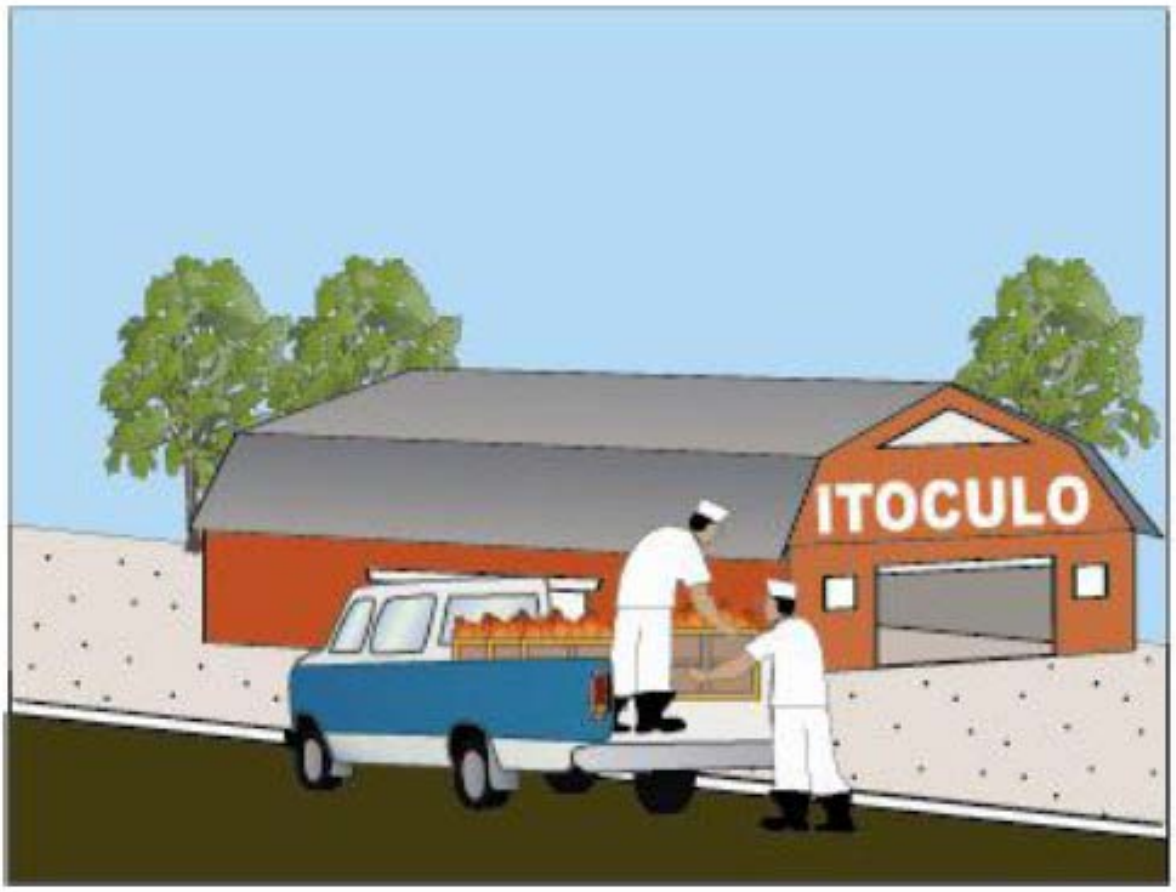

Figure 3 – Transporting cashews to the factory.

3.3. 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.

3.4. 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).

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

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).

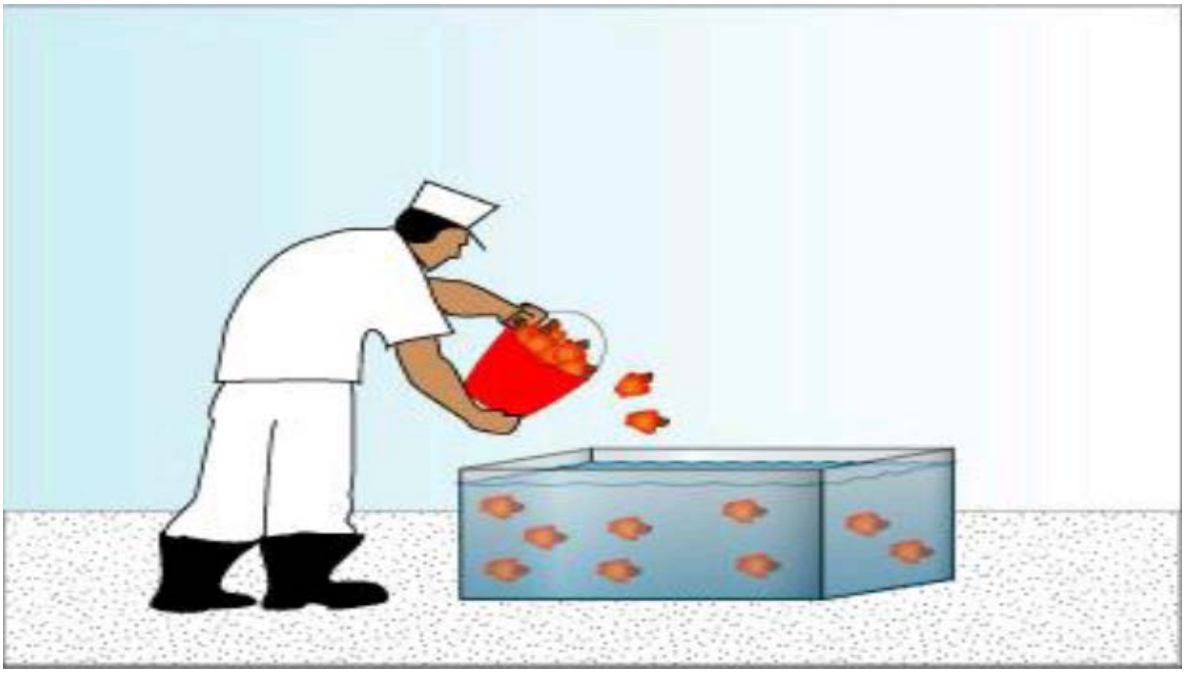

Figure 4 - Washing of cashews in chlorinated water.

3.5. 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.

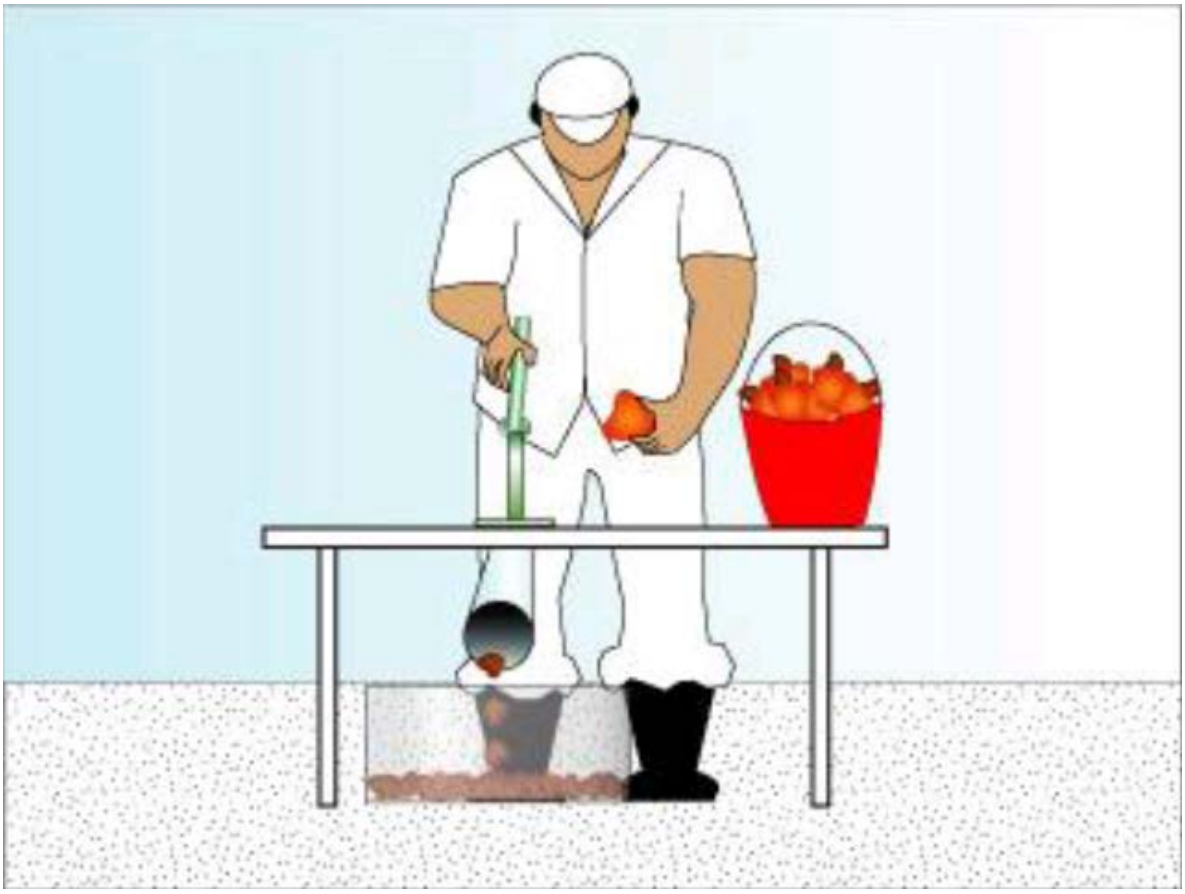

Figure 5 – Extraction of nuts from cashew apples.

3.6. SORTING

After washed, 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.

3.7. 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-milimiter opening, so that fibers are removed from the pulp. However such using such device is optional in the production of cashew apple candy. In most factories, only the shredder is used, which leaves more fiber mass in the raw material, granting better texture to the end product.

In case a shredder is not available to break cashew fibers, the operation can be done manually; using stainless steel knives to evenly dice apples, from which juice will be squeezed, leaving partially dried fiber behind. It is advisable to spare such juice to be added during the cooking phase of this processing.

Some factories making cashew products, such as *cajuína*, for instance, produce paste from fibers extracted during crushing (Figure 6), which is not used to produce *cajuína*. Most probably, such partially dried material will not produce good quality cashew apple candy. Nonetheless, in case raw materials are lacking, it is advisable to use such supply and add 20% of whole cashew juice during the preparation (formulation).

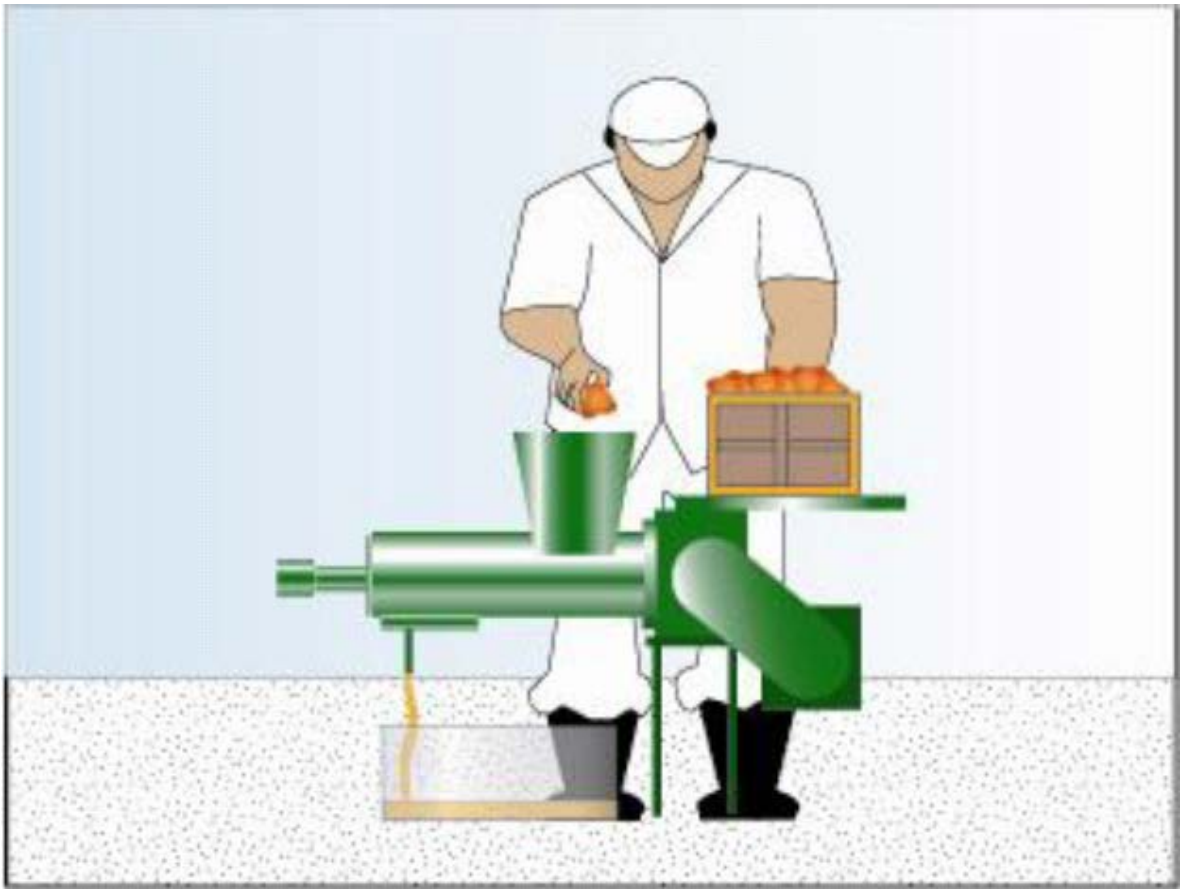

Figure 6 – Obtaining fibers to produce cashew apple paste

3.8. PREPARING (FORMULATING)

Candy made from cashew apples is similar to other fruit pastes, such as those made from papaya, guava, banana, etc. The key is balancing ingredients used in its preparation.

Since cashew fibers lack components which can make it consistent and firm, as pectin for instance, in preparing the paste it is necessary to use ingredients that result in a product with reduced amounts of sucrose or cane sugar.

Some manufacturers add 10% of commercially available pectin or use other types of fruit with high pectin content, such as banana, up to the maximum amount of 25% of the mixture. It is also possible to use albedo from passion fruit peel to induce good cooking stage as candy is prepared.

If the candy is intended to be sold to consumers with higher purchasing power, it is advisable to add ground cashew nuts up to an amount of 10% of the mixture.

Nevertheless, this manual is focused on making cashew apple candy the traditional way, employed by most processing units, in which only partially dried cashew fibers are used, to

which cane sugar is then added.

Cashew apples, packaged in bags made of synthetic fibers, are to be crushed in a hydraulic press, until they are partially dried. This procedure is quick and the juice extracted may be used for other purposes.

After partially removing the juice, apples are evenly cut, and the area around the point in which the nut is attached to the apple are discarded.

The recipe to produce thirty 200g candy bars made from cashew apples is the one informed bellow:

Ingredient	Qty.
Cashew fiber (kg)	05
Sugar (kg)	10
Acid* (g)	05
Pectin (g)	40

*The acid is to be dissolved in 5ml of water.

3.9. COOKING

After preparing the recipe, the mixture in put in a pot and cooked.

The pulp and part of the sugar are put in the pot. Part of the sugar is spared and mixed to pectin, in the proportion of one part of pectin to five parts of sugar. Then, cooking is started. When the thickening is well into progress, it is time to add the sugar and pectin mixture, which was previously dissolved in water. Cooking continues. Toward the end of the thickening process, the acid dissolved in water is to be added and the cooking process continues up to the moment the paste gets loose from the pot.

This procedure is to be carried out in a ventilated and sanitized place, according to all due requirements, particularly with regard to personal safety. Cooking is generally done without covering the pot, with an automatic or manual stirrer, depending on the amount to be produced. It is advisable to use a rounded stainless steel pot, 40cm deep and 75cm in diameter, which makes it easier to watch the cooking stage, thus preventing overcooking and burning. When pots are not covered, it is advisable to use a skimmer to remove any impurities from the pulp and the sugar. To stir the mixture, one can use stainless steel or wooden stirrers, at least 60cm in length. In some situations, longer stirrers may grant more safety to operators; however more strength is required to move them.

3.10. COOKING STAGE

Afterward, the pot is taken away from the burner and, using a wooden spoon, the mixture is to be beaten until the paste stage is achieved, normally after five minutes.

In order to know if the mixture has reached a stage to be taken from the burner, the spoon technique is used. It consists of getting a small amount from the mixture being cooked and using a plate with water to check its consistency, to see if it sticks to the bottom or not. Another cue indicating that the candy stage has being achieved is the formation of sugar crystals on the border of the pot or on the upper layer of the mixture.

Nonetheless, the safest procedure to know the correct stage is to use a refractometer. In general, as to candies, right cooking stage is comprised between 70 and 72^{o} Brix.

If the mixture does not get the desirable consistency in five minutes after being removed from the burner, it is necessary to put it back on the burner and add and amount of sugar or cashew apple candy, to be determined by the operator, until the right stage is obtained.

3.11. CUTTING

After the right cooking stage is obtained and the mixture cools down, it is placed on tables on which wooden or stainless steel molds, measuring 80 to 100cm in length with partitions for 5 bars weighing from 200 to 300g, have been previously arranged. This procedure is carried out by getting amounts straight from the pot and putting them into the molds, using a spatula to smooth the surface and remove and extra amount from the mold. Another way of doing it would be pouring all the mixture from the pot onto the table, producing a layer as thick as the intended paste size, which is then molded. In this case, it is advisable to use stainless steel molds, which are thinner and more suitable for the process.

Regardless of the method, it is recommended to wait about 30 minutes before molding, and do the “flip-over” procedure with the purpose of evenly drying the paste. Some factories add diced or ground cashew nuts on top of the paste to increase its value.

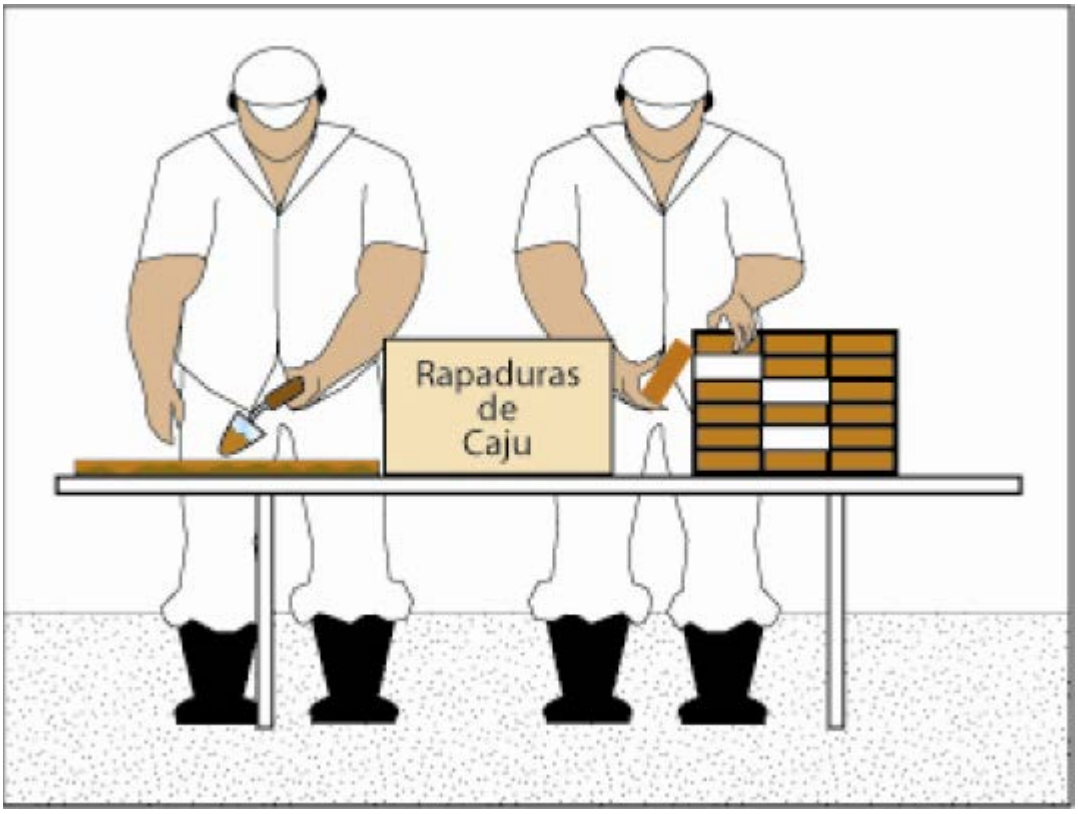

Figure 7 – Molding cashew apple candy

3.12. PACKAGING

Cashew apple candies are to be packaged in high density plastic bags, which are closed in a heat sealer, labeled and stored in a dry and well ventilated place.

It is advisable to package the candy in plastic bags. It is possible to use a manually operated machine (Figure 8), equipped with pedal and sealer. Some of these machines are automatic so as to cope with larger amounts. Moreover, some times they are even equipped with a device to brand production and expiry dates.

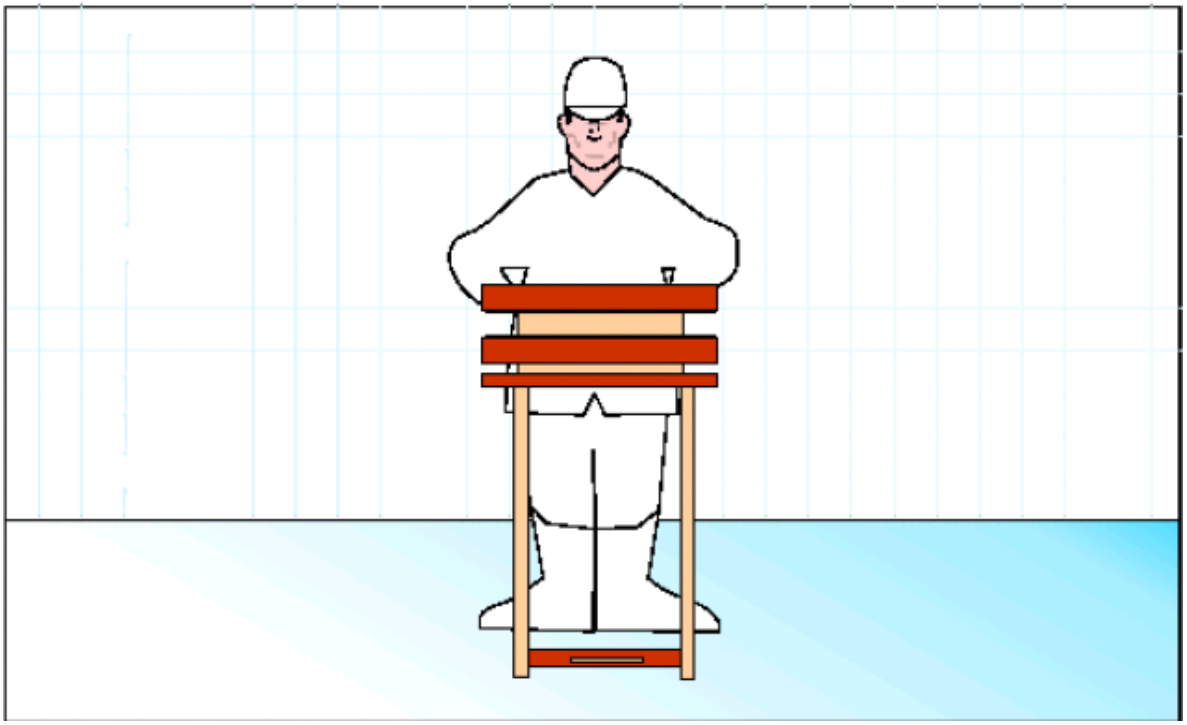

Figure 8 – Manually operated sealer for cashew apple candy

3.13. STORING

After packaged, candies are to be stored in card board boxes holding 24 bars and then placed in well ventilated places, with low levels of moisture, light and heat. In general, they have shelf life of six months.

The following information is to be printed on the label:

- Product name: cashew apple candy;
- Amount in grams (g);
- Production date;
- Shelf life.

4. EQUIPMENT AND UTENSILS

Equipment and utensils necessary to make paste from cashew apples:

- Brick tanks lined with tiles or epoxy paint, according to the production capacity, for the washing and sorting of apples; vented plastic crates for immersion and handling of raw materials in water during washing;
- Stainless steel tables for sorting, finishing and packaging of products;
- Stainless steel table to mold paste bars;
- Press for juice extraction, the expeller type or even the hydraulic type. Expeller

presses result in more yields, in terms of making the fullest use possible of juice (around 70% of the juice). However they must be used in such a way to allow medium pressure, leaving some juice in the bagasse to minimize problems related to high contents of tannin.

- Stainless steel cooking pot with capacity to hold 50kg for cooking and "whitening" raw materials;
- Industrial gas stove with 2 burners, hose and valve;
- Wooden framed shelves with stainless steel or Formica tops for paste bars to be cooled down and inputs and products to be stored;
- Abbé refractometer with reading scope up to 80^{o}Brix;
- Thermometer;
- pH-meter or pH strips;
- Wooden or stainless steel molds;
- Scale with holding capacity of 10kg;
- Shredder or industrial blender (made of stainless steel);
- Heat sealer or plastic bag sealer;
- Buckets, knives, stirrer, waste baskets and plastic crates;
- Assorted materials to be used in the processing.

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 cashew apple paste 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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IMPROVING CASHEW NUT POST HARVEST TECHNOLOGIES IN TANZANIA

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