



**TOGETHER**  
*for a sustainable future*

## OCCASION

This publication has been made available to the public on the occasion of the 50<sup>th</sup> anniversary of the United Nations Industrial Development Organisation.



**TOGETHER**  
*for a sustainable future*

## DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as “developed”, “industrialized” and “developing” are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

## FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

## CONTACT

Please contact [publications@unido.org](mailto:publications@unido.org) for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at [www.unido.org](http://www.unido.org)

# CASHEW PRESERVE TECHNICAL MANUAL



UNITED NATIONS  
INDUSTRIAL DEVELOPMENT ORGANIZATION

B R A S I L



ABC Agência Brasileira  
de Cooperação  
MINISTÉRIO DAS RELAÇÕES EXTERIORES



JULY 2013

## Table of Contents

Preface.....	ii
1. PRESENTATION .....	1
2. PRODUCT DEFINITION .....	1
3. STAGES IN THE PRODUCTION PROCESS .....	2
3.1. HARVESTING .....	3
3.2. TRANSPORTING.....	3
3.3. RECEIVING AND WEIGHING.....	5
3.4. WASHING AND SORTING .....	5
3.5. EXTRACTING NUTS .....	7
3.6 CUTTING AND POLISHING .....	8
3.7. COOKING IN SYRUP .....	8
3.8. DRAINING.....	9
3.9. FILLING.....	9
3.10. ADDING SYRUP.....	10
3.11. AIR REMOVAL OR EXHAUSTION.....	10
3.12. THERMAL TREATMENT AND SEALING.....	11
3.13 COOLING AND LABELLING .....	11
3.14 STORING .....	11
4. GOOD MANUFACTURING PRACTICES - GMPs.....	11
5. BASIC EQUIPMENT AND UTENSILS FOR CASHEW PRESERVE PRODUCTION .....	13
6. BIBLIOGRAPHY .....	15

## **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 strengthening 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.

This manual serves the purpose of catering for demands from small and medium-sized cashew farmers in Tanzania, related to producing **Cashew Preserves (in syrup)** 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 preserve in syrup is a product obtained from the cashew apple, in whole or in pieces, with or without its skin, cooked in water and sugar, packaged into hermetically sealed jars or cans that undergo an appropriate heat treatment. The product will be called “preserve”, preceded by the name of the fruit and followed by the expression “in syrup”. For example: cashew preserve in syrup.

The product must be prepared with healthy, clean, parasite-free cashew apples, not contaminated with animal or plant waste. We might add to the product invert sugar or glucose. The syrup covering the fruits must have a concentration ranging from 30 to 65 degrees Brix. Free space in the containers (jars and cans) shall not exceed 10% of their height.

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

### 3. STAGES IN THE PRODUCTION PROCESS

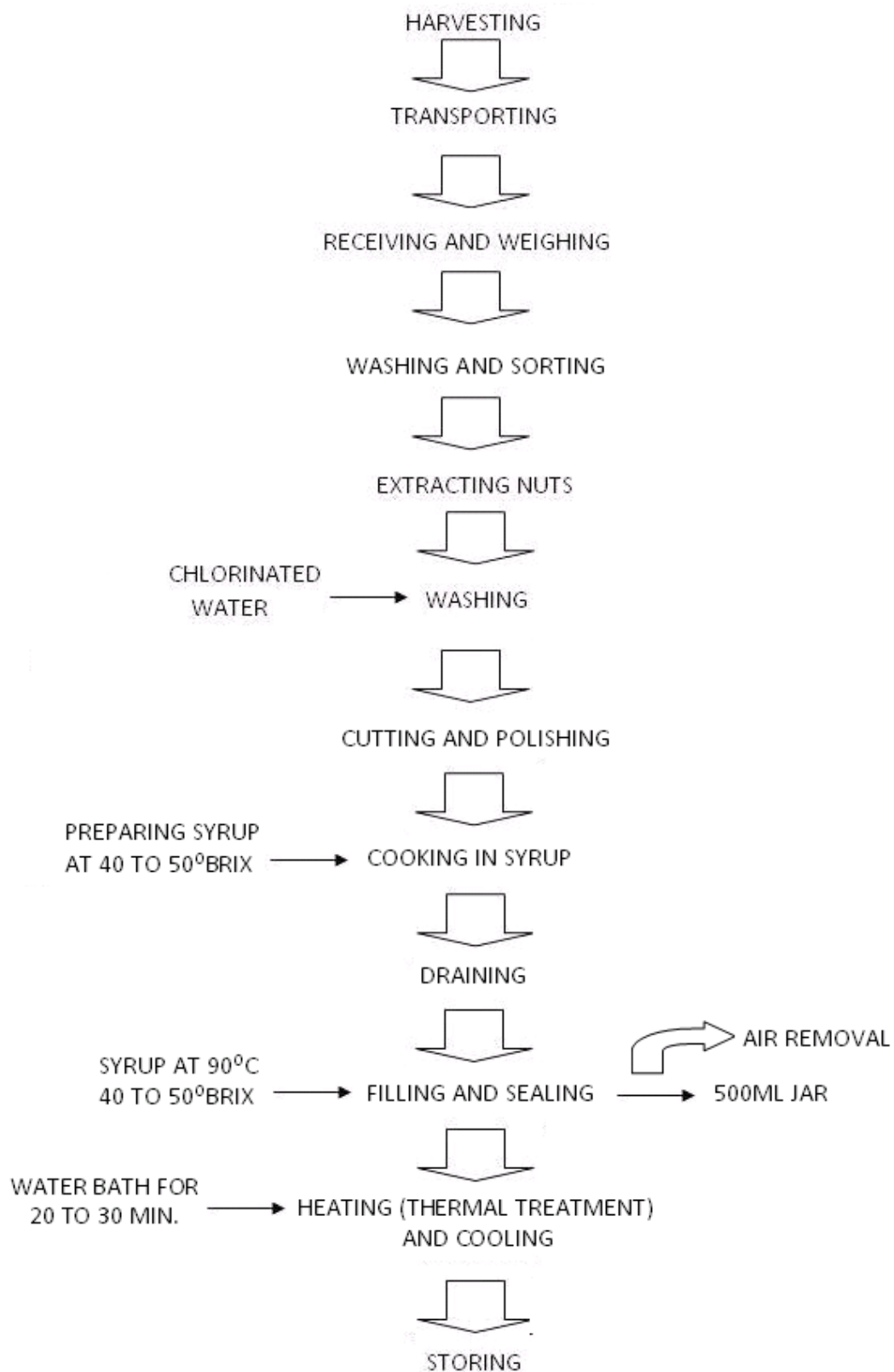


Figure 1 - Stages in processing cashew preserve in syrup.

### 3.1. HARVESTING

Cashew apples become useless for consumption 48 hours after detaching from the trees and reaching the ground. Therefore, fruits must be hand harvested on a daily basis. Also, harvesting is to be done during hours when temperatures are milder (Fig.2). Harvesting takes place when cashews are fully ripe, healthy and very firm. When directly picked ripe off the ground, fruits must neither be soiled in sand or soil matter, and nor be contaminated with microorganisms (mold and bacteria).



Figure 2 – Appropriate harvesting of cashews.

### 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 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).

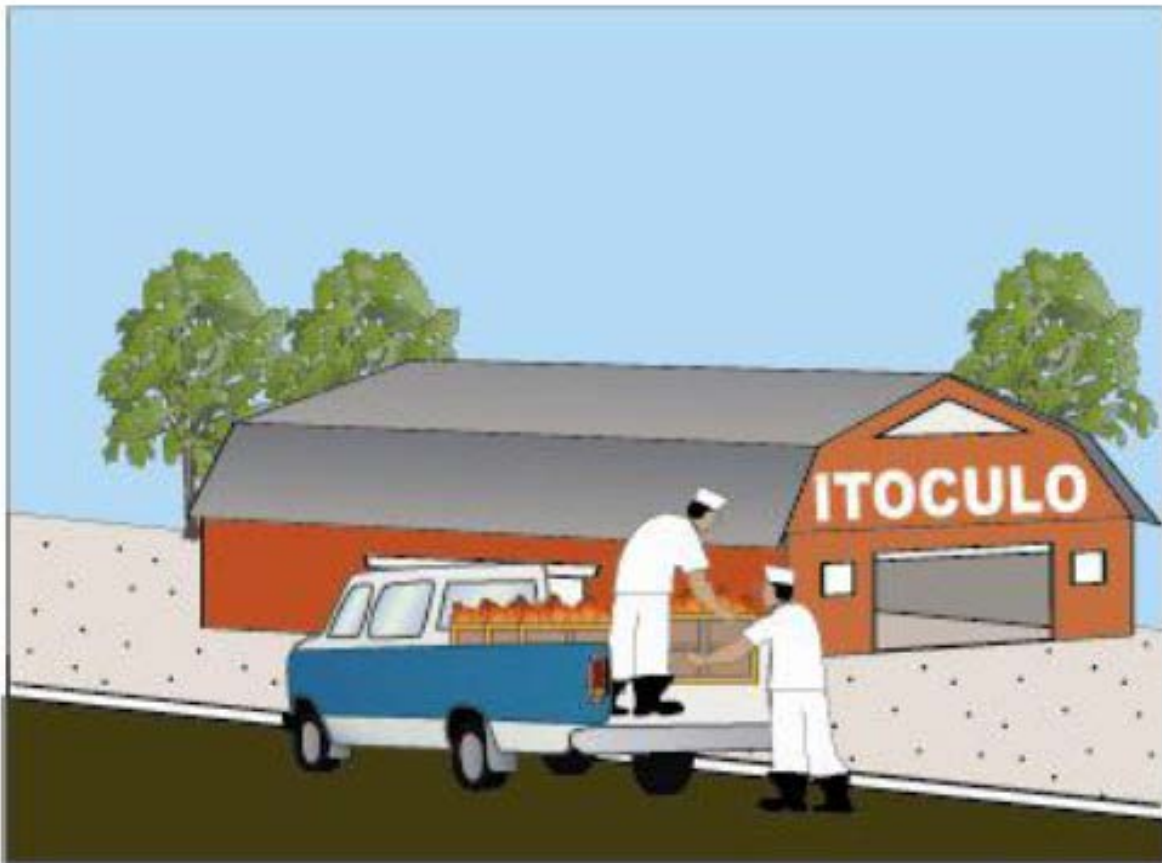


Figure 3 – Transporting cashews to the factory.

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 become inappropriate 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.



### **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 final 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 AND SORTING**

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). 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 in epoxy, or even made of stainless steel (Figure 4).

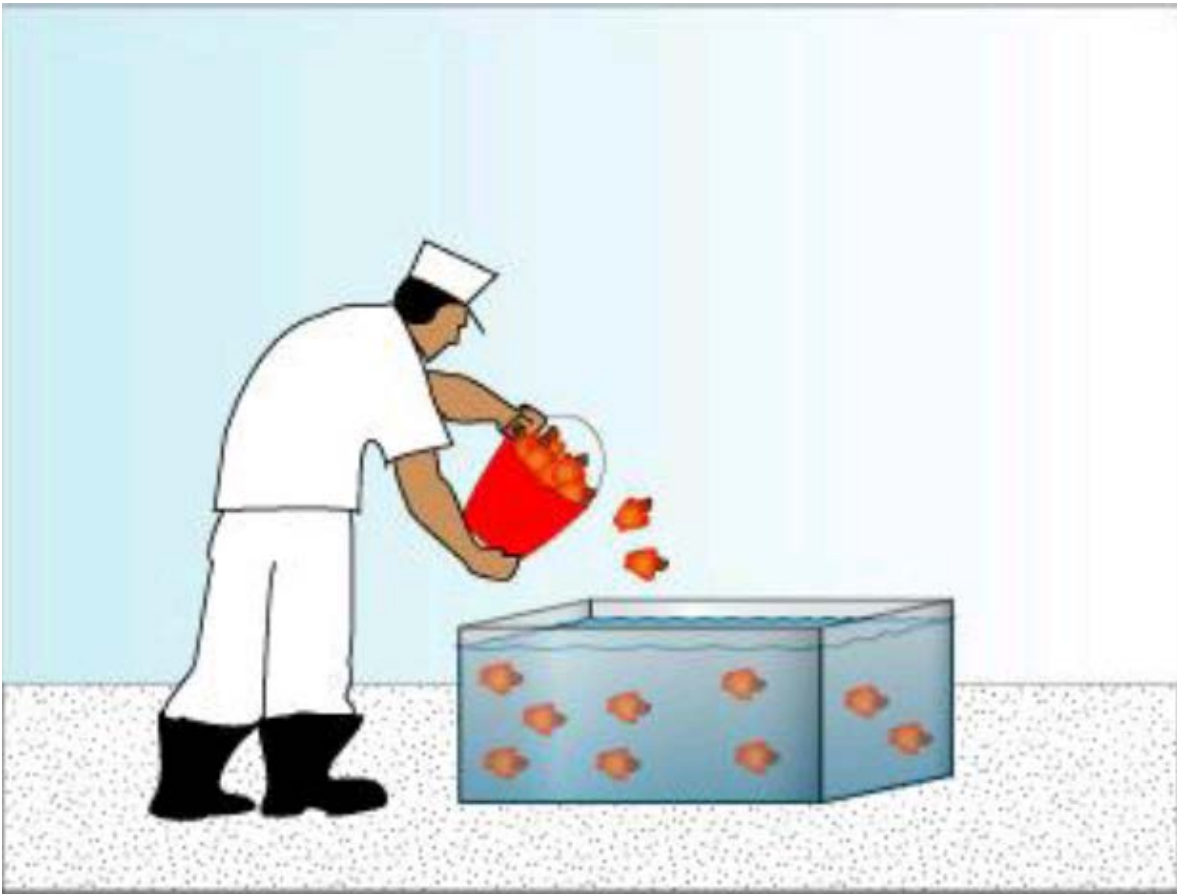


Figure 4 - Washing of cashews in chlorinated water.

After being washed, the fruits are placed on a sorting table, preferably made of stainless steel, from where workers in charge of performing this procedure will remove rotten, unripe and damaged fruits. Small imperfections and rotten spots must be removed using stainless steel knives. It is recommended that selected fruits present a uniform size, which improves the visual aspect of the fruit during commercialization.

<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.

### 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.

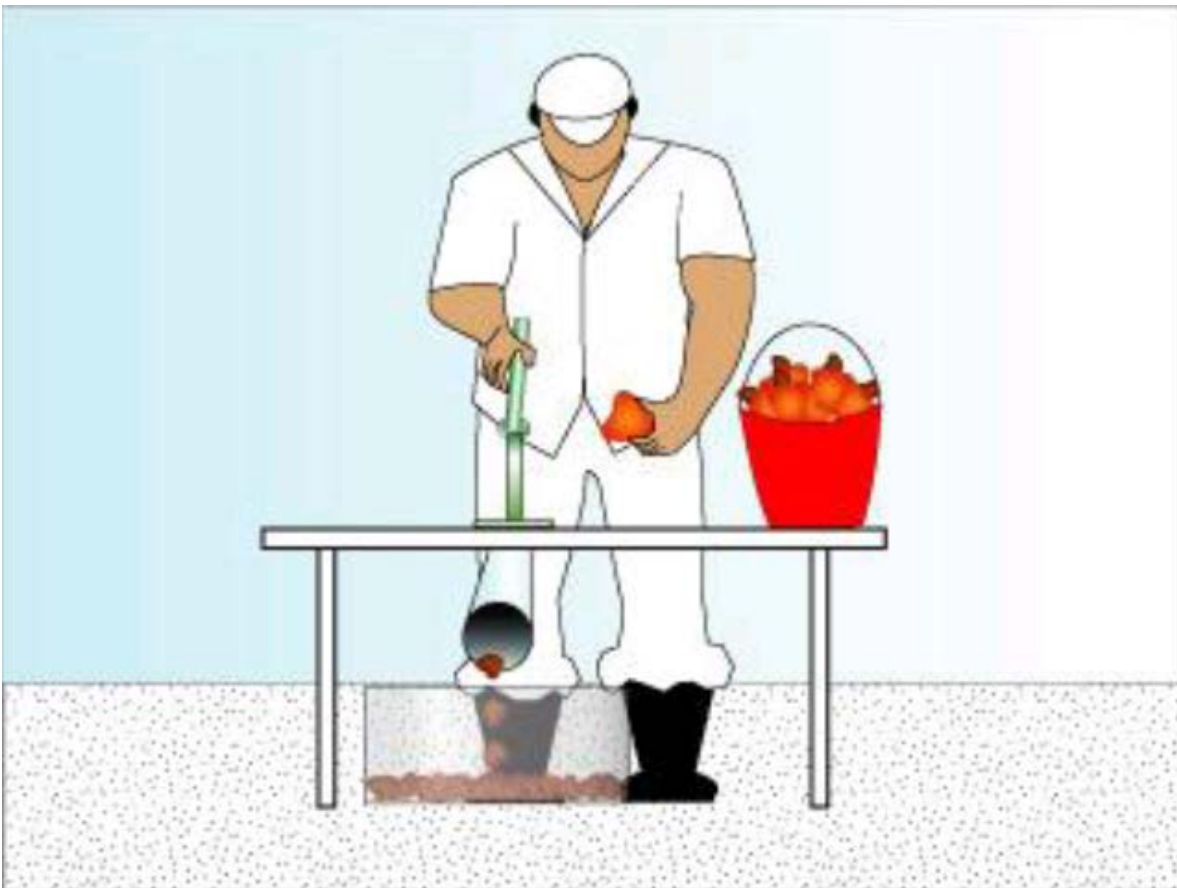


Figure 5 – Extraction of nuts from cashew apples.

### 3.6 CUTTING AND POLISHING

The purpose of this procedure is to improve the visual aspect of the cashew apple by removing black spots, green edges and inserted floral peduncles when preserves are made with whole fruits. Also, depending on the size of the fruit, the procedure aims to cut it into strips, chunks or pieces and remove its peel when deemed necessary. Knives and other utensils used in this process must be made of stainless steel.

### 3.7. COOKING IN SYRUP

#### Preparation of the syrup

The syrup is also called liquid topping and is used to fill up the empty spaces between the fruits and the container, facilitating heat transmission, air removal and enhancing fruit flavor. The syrup is prepared separately, with water and pure granulated sugar, with proportional levels capable of reaching the required range of Brix degrees, which is from 30 to 65°. The addition of sugar to the water must follow the sugar concentration desired in the syrup (Table 3). The mixture shall boil until fully dissolved. If granulated sugar is used instead of refined sugar, the syrup must be filtered using a clean cloth so as to remove impurities.

° Brix	Grams of sugar/ liters of water
10	112
20	250
30	429
40	668
50	1000
60	1500
70	2334

Table 3 – Proportions for syrup preparation

#### Cooking in syrup

As shown in Figure 6, we will add prepared fruits to the hot syrup (40% sugar concentration or 40° Brix) and leave them between 15 to 30 minutes. Exact cooking time will be estimated according to the desired texture you want to obtain from the fruit.



Figure 6 – Cooking cashews in syrup

### 3.8. DRAINING

After they're cooked, the fruits are separated from the syrup using a sieve or a skimmer, making it possible to weight the amount of fruits to put in the package.

### 3.9. FILLING

Place a standardized amount of fruit inside the glass container and fill it with hot syrup (90°C). As much as possible, the container shall be filled with the solid constituent. Attention shall be given in order not to damage the fruits. The amount of fruit shall be equivalent to at least 60% of the weight of water necessary to completely fill the container. In other words, in a container with capacity for 500g of water, at least 300g of drained fruit shall be added.

### 3.10. ADDING SYRUP

The syrup is added manually or with the use of a syrup dispenser. When adding the syrup, its temperature shall not be lower than 75°C. Syrup must attain a 40 to 50% sucrose or Brix concentration and be added of 0,25% of citric acid.

### 3.11. AIR REMOVAL OR EXHAUSTION

Cook the full glass containers in boiling “bain-marie”(water bath) and place the lids on top of the jars. Do not close the jars and allow hot air to come out. Leave it for 5 to 10 minutes. Water in the containers shall reach  $\frac{3}{4}$  height. Put either a cloth or a wood pallet at the bottom of the glass containers in order to prevent breakage during this operation.

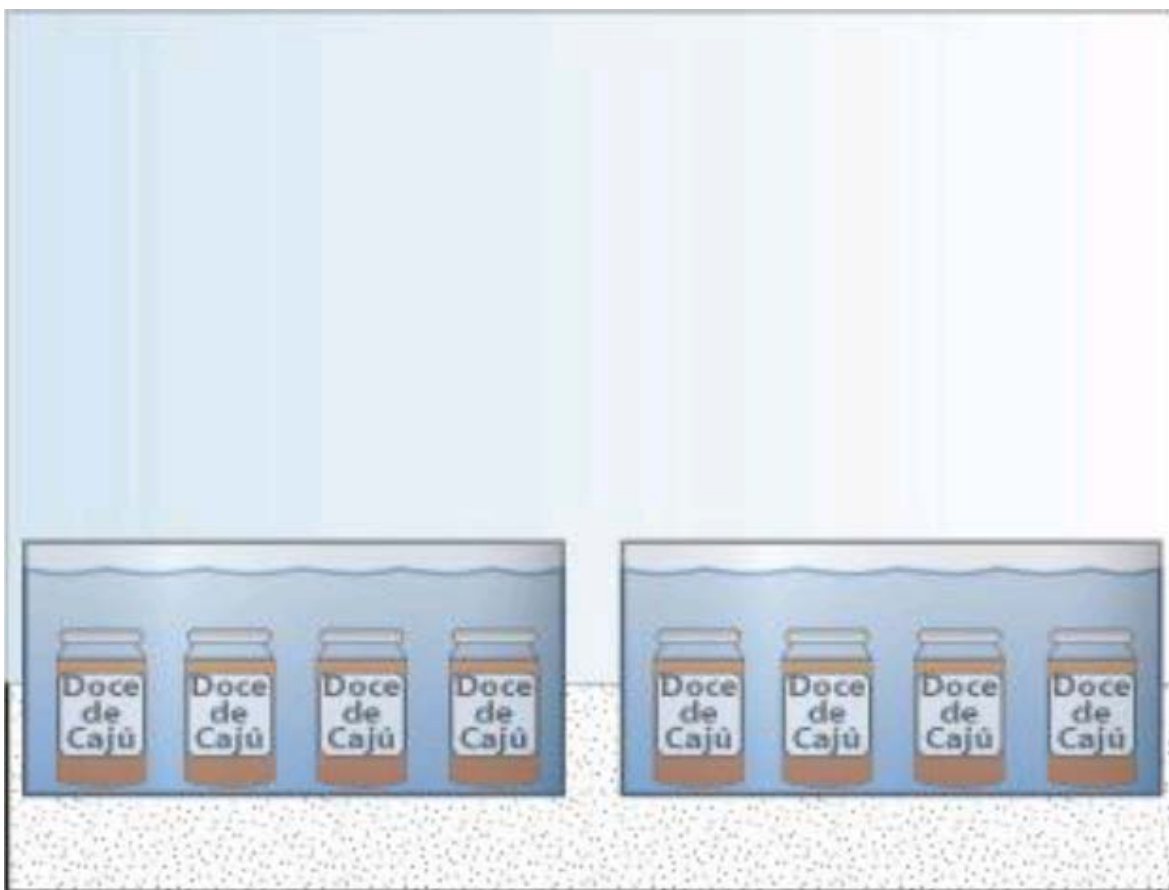


Figure 7 – Thermal treatment in water bath

Exhaustion can be facilitated by introducing a spatula into the recipient and passing it on the edges of the container or between the fruits to create space for the air to come out. This procedure must be done during the water bath (bain marie) and prior to sealing the containers.

### **3.12. THERMAL TREATMENT AND SEALING**

Tighten the screw lids well and completely submerge the glass containers in water bath for the following times:

- 15 minutes for a ½ liter jar
- 30 minutes for a 1 liter jar
- 1 hour for a 2 liter jar

### **3.13 COOLING AND LABELLING**

This step takes place immediately after thermal treatment and sealing and has the purpose of promoting the circulation of cold water in the containers that underwent thermal treatment. Cooling is performed in room temperature from 25 to 38°C, which is also the temperature that allows handling of the jars.

After drying, containers must be labeled informing product type, name of the manufacturer, net weight (that of the fruit without the syrup), manufacturing date and expiry date and compulsory nutritional information.

### **3.14 STORING**

The final product must be properly packed in cardboard boxes and stored in a dry, ventilated environment and room temperature shall be of 38°C maximum.

## **4. 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 as to avoid contamination of final 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 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.

## **5. BASIC EQUIPMENT AND UTENSILS FOR CASHEW PRESERVE PRODUCTION**

- 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;
- Conic or cylindrical bottom-shaped tank with a suitable size to facilitate decantation of the juice for preparation of the syrup. Most suitable sizes vary according to the capacity of the plant to be installed. However, its height must be two times greater or more than the diameter size. It must also be equipped with an outflow valve in the lower part of the cone.
- Manual or semi-automatic capsule filling machine for closing the jars. It can be easily manufactured, and it does not have to be made of stainless steel. The equipment has multiple uses and purchase prices can be significantly cheap.

- Water-bath tank. It is an equipment with heater and installation for cold –water influx for cooling after the thermal processing. The tank must contain at least two grated steel sheet buckets to water-bathe the jars.
- Sorting tables (made of stainless steel).
- 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. Such presses are made of AISI-304 stainless steel with structure made of carbon steel, equipped with electric motor and speed reducer.
- Stainless steel depulper with three-phase/single-phase electric engine 2cv, capacity range from 200 to 1000 kg/h.
- Stainless steel kettle, with 50 kg capacity and perforated basket for pre-cooking or blanching of raw material and syrup preparation.
- Two-burner industrial oven with hose and gas valve.
- Wood shelves with stainless steel or Formica tops for cooling of preserves and storage of supplies and final product.
- Horizontal freezer with a 400 liter capacity for conservation of the cashew pulp.
- Abbe refractometer with reading scope up to 800Brix;
- Thermometer;
- pH meter or pH strips;
- Plastic containers;
- Steel knives of various sizes;
- Miscellaneous processing materials

## 6. BIBLIOGRAPHY

CAJU. Pós-colheita/editor técnico Ricardo Elesbão Alves; Embrapa Agroindústria Tropical (Fortaleza, CE). – Brasília: Embrapa Informação Tecnológica, 2002. 36p.; (Frutas do Brasil; 31).

DA SILVA NETO, R. M. & PAIVA, F. A de. Processamento de doce de caju. Teresina: SEBRAE/PI, 2003. 46p.

DA SILVA NETO, R.M. Inspeção em indústria de beneficiamento da castanha de caju visando a implantação das boas práticas de fabricação. (dissertação de mestrado). Fortaleza: Departamento de Tecnologia de Alimentos. Universidade Federal do Ceará, 2000.128p.

JACKIX, M.H. Doces, geléias e frutas em calda. Campinas: Editora da UNICAMP: São Paulo: Ícone, 1988. (Coleção ciência e tecnologia ao alcance de todos: Série tecnologia de alimentos).

SOCIEDADE BRASILEIRA DE CIÊNCIA E TECNOLOGIA DE ALIMENTOS São Paulo. Manual de boas práticas de fabricação para indústria de alimentos. São Paulo, 1990. 27p. (SBCT. Publicações Avulsas, 1).

# IMPROVING CASHEW NUT POST HARVEST TECHNOLOGIES IN TANZANIA

Prepared by:  
Francisco Fábio de Assis Paiva,  
Researcher at Brazilian Agricultural Research Corporation - Embrapa