

# Training Manual on Cashew Apple Processing



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**FruVaSe**

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## 1. Introduction to Fruits, Cashew Apples and their Benefits

### ❖ Fruit

- A fruit is an edible portion of the plant that develops from a flower and contains seeds.
- Example: Mango, orange, jackfruit, guava, cashew apple.
- Fruits are essential for health due to their content in vitamins, water, fibers, proteins, minerals, and sugars.
- It is recommended to consume at least 400g of fruits and vegetables per day, thus, approximately 200g of fruits per day.



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### ❖ Cashew Apple

- Cashew apple is a tropical fruit attached to the cashew tree and the nut on its terminal sides.
- Ripe and matured cashew apples are juicy, have a variety of size and color, and are easily detached from the tree.
- The color of apples are yellow, red, and orange (red-yellow).
- Cashew apples contain vitamins A and C, proteins, sugars, fibers, water, and minerals (calcium, potassium, phosphorus, zinc, etc.).
- It contains about five times vitamin C compared to mango, lemon, pineapple, and orange.
- High perishability and astringency of cashew apples limit its utilization.
- Value-added cashew apple products: jam, juice, wine, liquor, dried fruit, etc.



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Jam



Wine



Boxed Juice



Bottled Juice

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## 2. Post Harvest Handling of Cashew Apples

### ❖ Harvesting of Raw Cashew Apples from Orchards

- Indicators for the best harvesting time are color, firmness, and sweetness.
- In practice, harvesting takes place when apples are fully ripe, attain maximum size and show the typical color for their variety.
- In this stage, when touched, apples easily detach from the tree.
- Harvesting is to be done during hours when temperature is cool (morning or evening hours).
- Fruits may be hand harvested (slightly turn from side to side), if plant size allows it.
- Use a long rod with a bag in one end for fruits in upper branches.
-  Don't pick the fruits that fall on the ground or have cracks.



Long rod with a bag

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Cashew apples with cracks

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### ❖ Handling of Raw Cashew Apples

- To avoid damage and reduce contamination, apples are to be stored in layers inside plastic crates.
- Avoid to put large amount of apples in one crate, to avoid damage of apples during stacking of crates.
- Furthermore, keep the crates in the shade during harvest.



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Apples in a plastic crate



© Embrapa

Stacking of harvesting crates in a shade

## ❖ Receiving House (Washing, Sorting and Storage)

### • Why Washing the Cashew Apples

- Upon receiving, apples are washed to eliminate soil debris brought from the field.
- It serves the purpose of reducing heat which fruits have absorbed during handling.
- It also reduces microbial load on the surface of fruits brought from the field.

### • How Washing of Cashew Apples is Done

- Washing is done by using clean water (replace water at least thrice).
- Also 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.

**NOTE:** Clean harvest containers, processing plant machinery, cooling and storage facilities, and transit vehicles periodically with water, soap, and disinfectants.

### • Sorting and Storage

- After thorough washing, manual sorting is done to remove any damaged or decayed apples.
- If processing is to be done on the next day (s), then the fruits need to be stored in a refrigerator for short period (less than 2 days) or freeze at -20 °C for long period (3 months or more).

### 3. Processing of Fruits

#### ❖ Introduction

- In general, food processing is the act of transforming agricultural produce into food, or of one form of food into other forms.
- Example: Drying, fermentation, cooking (They will be described in detail below)
- Reasons for processing: preserve their quality, to increase palatability, convenience during consumption, and increase their market value.
- Also, through processing, fruits are made available for consumption during off-season.

#### ❖ Types of Fruit Processing

- There are several types of fruit processing techniques, but the common ones are:
  - Drying/dehydration  
The main aim of drying is to reduce the moisture content of the fruit, and thus to inhibit the growth of fungi and bacteria. This could be done by using the sun, chemicals (sugar and salts), or electric driers.
  - Fermentation  
The growth of desirable bacteria and fungi in the fruit products inhibit the growth of other undesirable microbes either by increasing acidity, production of alcohol or other harmful chemicals to their competitors.
  - Heating/freezing  
Boiling of liquid fruit products at a particular temperature and time kills most of the fungi and bacteria, and thus preserve the products for extended period of time. On the other hand, freezing helps to inhibit microbial and food enzyme activities due to relatively low temperature.
  - Sugar addition  
By adding sugar, water is removed from the product and thus microbial growth can be inhibited. It is applicable in the preparation of products such as jams, jellies, or marmalades.

## ❖ Selected Technologies to Process Cashew Apples

- In this manual, processing of cashew apples into clarified juice and dried fruit is illustrated.
- Drying and juice processing offer many advantages in comparison to other processing methods such as wine, gin or jam processing. The benefits include;
  - the ease of preparation and storing,
  - reduction of saving in packaging,
  - cost-effective,
  - convenient,
  - widely acceptable products,
  - dried products could be stored for a long period and are of light-weight

### *Processing of Dried Cashew Apples*

#### • Requirements

- Clean, ripe cashew apples
- Water
- Table sugar (sucrose)
- Plastic containers
- Stainless steel pots and spoons
- Cutting board
- Stainless steel knife
- Personnel fittings (apron, headwear, and gloves)
- Thermometer
- Weighing scale
- Stove
- Driers (electrical or cabinet solar drier)



Solar drier



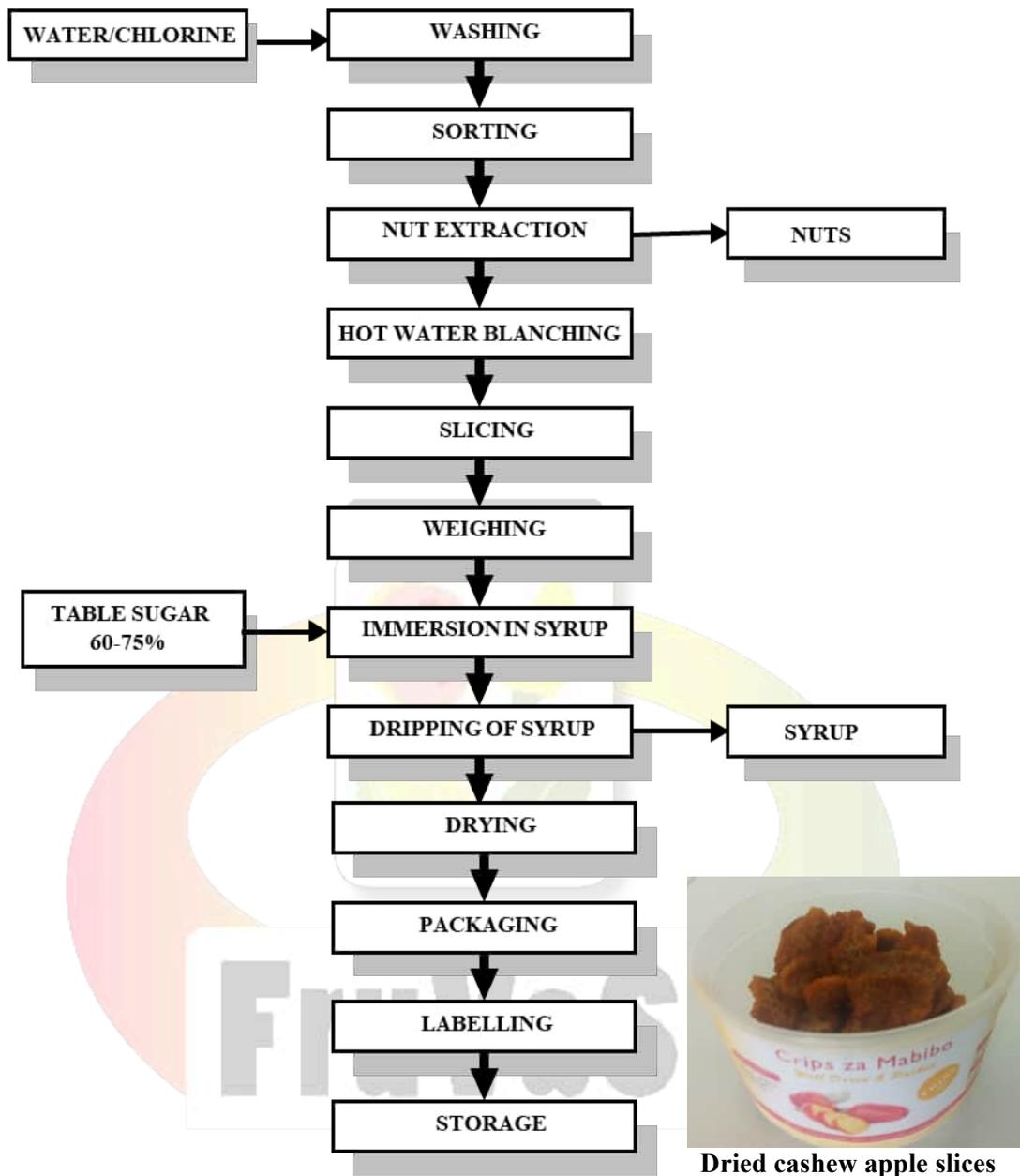
Electrical drier

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- **Processing Methods**

- Prepare sucrose solution (60-75%) as follows; for 70% sucrose solution, dissolve 70 g of sucrose in every 30 mL of water. Use warm water to dissolve sucrose completely.
- Remove the nuts from the thoroughly washed cashew apples.
- Dissolve the apples in water (hot water blanching) at 100 °C for 5 minutes to reduce astringency.
- Remove both ends of cashew apples to reduce astringency.
- Cut the apple transversely into approximately 1 cm in thickness using a sharp stainless steel knife.
- Immerse cashew apple slices into the sucrose solution at a ratio of 1 part of fruit sample to 4 part of syrup.
- Leave slices in the syrup for 12 - 24 hours.  
**NOTE:** The longer (more than 16 hours) you left slices in the syrup, the sweeter the slices become.
- Remove fruit slices from the syrup, drain, and rinse with running water and place on absorbent paper to reduce excess surface moisture.
- Then, put the slices on a drier.
  - If solar drier is used, drying should start in the morning and products removed in the evening to avoid gaining of moisture. The length of drying depends on the sun's strength and type of a drier used.
  - If electrical drier/oven is used, temperature is set at 60 °C. The length of drying depends on whether it has a fan or not. For instance, the electrical drier shown above has a fan and thus can dry fruits or vegetables for 2 – 3 hours.
- Finally, dried cashew apple slices are removed, packed (air tight), labelled, and stored.



**Flow Diagram of Dried Cashew Apple Slices Processing (Source: Drawn by Authors)**

- Suggested pre-packages for dried cashew apple slices (various plastic materials)



- Dried cashew apple slices can be stored at both ambient or refrigeration temperature.
  - If good manufacturing practices are followed, dried products could retain quality for more than six months without refrigeration.
  - Added sugar, low moisture, and good packaging prolong the shelf life.
- Dried cashew apples are subject to spoilage from fungi and bacteria if contamination happens.
  - If packaging materials are tightly sealed, the entry of air, moisture, and microbes could be prevented, hence preserve the quality.
  - Without artificial preservatives, the shelf life of cashew apple juice is very short compared to dried apples.
  - Observable indicators of spoilage include: off-odor, off-flavor, color change, fermentative odor.

## Processing of Cashew Apple Juice

### • Requirements

- Clean, ripe cashew apples
- Water
- Gelatine or sago
- Plastic buckets
- Stainless steel pots and spoons
- Basins
- Stainless steel knife
- Cutting board
- Cotton cloth
- Apron, headwear, and gloves
- Hand refractometer (optional)
- Weighing scales (0-200g, greater than 1Kg)
- Volumetric instruments (5mL, 1L)
- Stove
- Fruit presser (hydraulic press or screw-type extractor)



Scale (2-300Kg)

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Scale (0-200g)

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Hydraulic presser

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Screw-type presser

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### • Processing Methods

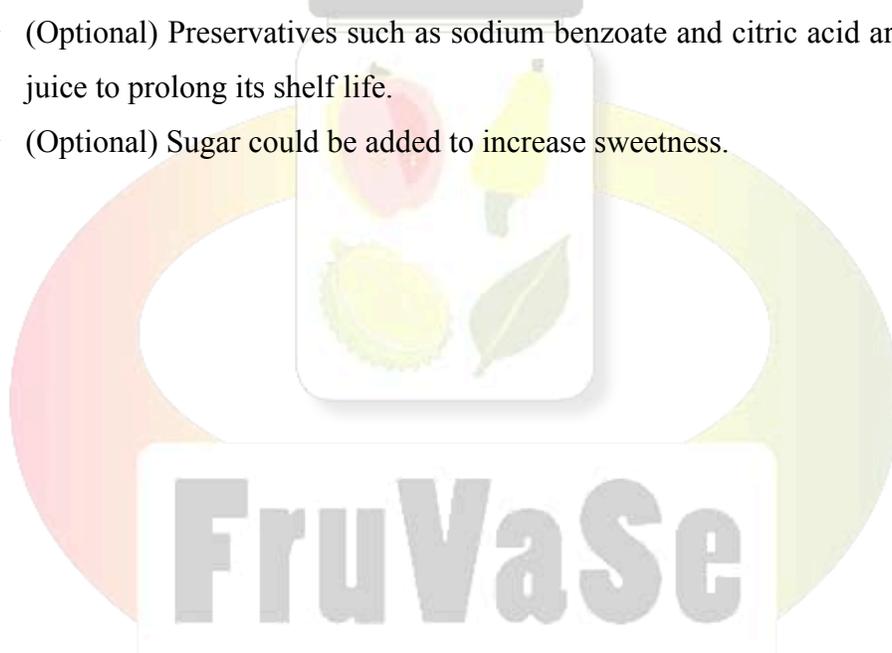
- After thorough washing of apples, remove the cashew nuts.
- Remove both ends of cashew apples to reduce astringency
- Chop the apples in small pieces for easy juice extraction.
- Extract the juice by using either hydraulic press or screw-type machine. Hands can also be used.
- Filter the cloud juice with a clean cotton cloth. Repeat at least twice.

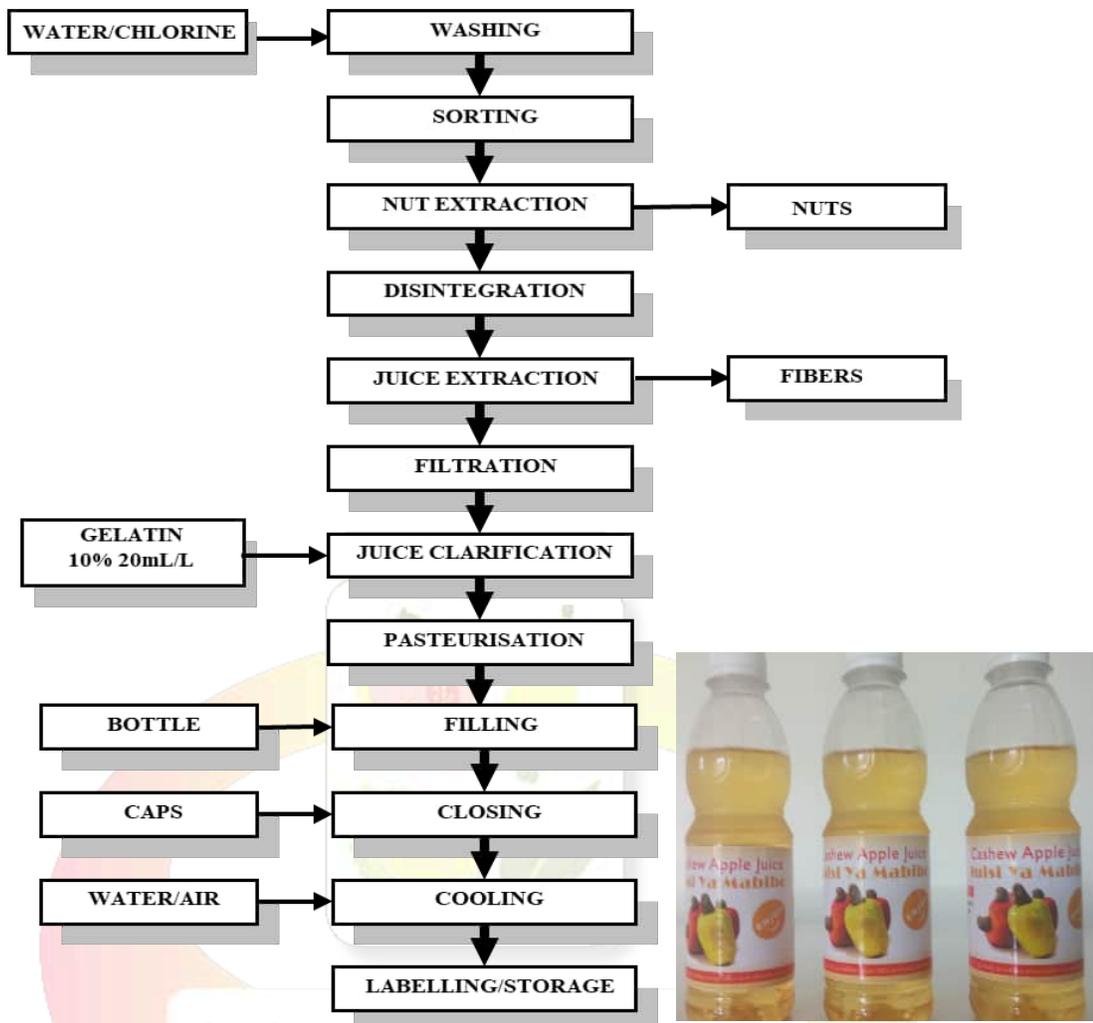


Hands pressing of fruits

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- Mix the juice with 10% (10g gelatine in 100 ml water) gelatine at the ratio of 20 mL per 1 L of juice. Shake the mixture vigorously and leave it to settle for 10 to 16 hours.
- Decant slowly the clarified juice into a clean container and discard the bottom layer.
- Filter the clarified juice with a clean cloth in case some of the suspended solids are observed.
- Pasteurize the clarified juice at 100 °C for 5 minutes.
- If glass bottles are used, then pour the hot juice into them. If plastic bottles are utilized, allow the juice to cool in a covered pot before filling the bottles.
- (Optional) Preservatives such as sodium benzoate and citric acid are added to the juice to prolong its shelf life.
- (Optional) Sugar could be added to increase sweetness.





Cashew Apple Juice

Flow diagram of cashew apple juice processing (Source: Drawn by Authors)

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- Suggested packages for cashew apple juice (All pictures © Embrapa)



**Glass bottles**



**Plastic bottles**



**Cardboard**

- Cashew apple juice could be stored at ambient conditions, refrigerated, or frozen.
  - Without artificial preservatives, the shelf life of juice without refrigeration or freezing is very short (mostly not more than three months).
  - If juice is pasteurized inside the sealed glass bottles, longer shelf life may be achieved.
- Cashew apple juice is subject to spoilage from fungi and bacteria if contamination happens.
  - If packaging materials are tightly sealed, the entry of air, moisture, and microbes could be prevented, hence preserve the quality.
  - Without artificial preservatives, the shelf life of cashew apple juice is very short compared to dried apples.
  - Observable indicators of spoilage include: off-odor, off-flavor, color change, fermentative odor, and cloudy juice.

## 4. Packaging and Labelling of Products

### ❖ Purpose of Packaging Materials

- To hold the foods, keep them clean and secure without leakage until they are used.
- To protect food against dirt, microbes, moisture, light, etc. along distribution chain.
- To give convenient handling throughout the production, storage and distribution including easy opening, dispensing, disposing and recycling.
- To enable the consumer to identify the food, and give instructions so that the food is stored and used correctly.

### ❖ Selection of packaging materials

- There are different types of packaging materials that are intended for different purposes.
- Example: metal containers, glass, paper and cardboard, flexible plastic films, low density polyethylene (LDPE).
- Different criteria are considered when choosing a suitable package. These include:
  - Nature of the product; liquid (juice, jam, wine) or solid (fresh-cut/dried fruits).
  - Eco-friendly and legally compliant.
  - Security and durability; the amount of protection needed will of course depend on the fragility of the product.
  - Affordability and easy to use.
  - Widely availability.

### ❖ Labelling of pre-packages

- Labelling includes any written, printed or graphic matter that is present on the label.
- The following information shall appear on the label of packaging material:
  - The name of the food; indicate the true nature of the food.
  - List of ingredients.
  - Net contents by weight or volume.
  - Name and address of the manufacturer, packer or distributor.
  - Lot/batch identification.

➤ Date marking and storage instructions.



Example of key information to be included on a food label (Source: Drawn by Authors)

## 5. Marketing of Food Products

### ❖ Finding the Market for Your Products

There are a multitude of methods by which you can sell your processed food products. These include;

- Selling to friends and neighbors
  - This is the best place for new processors to start marketing their products.
  - It is an easy way to start direct sales, but it does have some drawbacks.
  - It requires a lot of work to contact people to sell your products. Yet, if the quality of products is high and liked in your area, the number of consumers might easily increase through word of mouth.
  - Also, because these are your friends and neighbors, they may expect to get a lower price as a friendly bonus.
  - You must remind them that for your business to be sustainable, you must make a profit.
- Farmers' markets
  - These places are perfect for direct marketing.
  - The biggest advantage of selling at a farmers' market is that you'll find many consumers in one place.
  - It is much easier to sell a little bit of produce to a lot of customers than a lot of produce to a few customers.
  - If you have something new and different from the rest of the market, provide taste samples to the customers.
  - Recipes featuring your produce are also a good marketing strategy.
  - The major disadvantages to farmers' markets are cost and time.
- Shows and fairs
  - A booth at trade shows and community events can promote your product and increase your sales.
  - These booths are a good way to tap into local markets, appealing both to brand-new customers and to people who have already heard about your products but never tried it.

- Have cards or flyers available with maps to show interested people how to find you.
- Grocery and health-food stores
  - These can be good outlets for your products, but you will be selling them wholesale.
  - You must produce many products at once to make up for your reduced income and increased time and travel.
- Online (Whatsup, Facebook and Instagram)
  - It is also another affordable way to advertise and sell your processed products.

#### ❖ **Ways to Make Your Product Attractive to Customers**

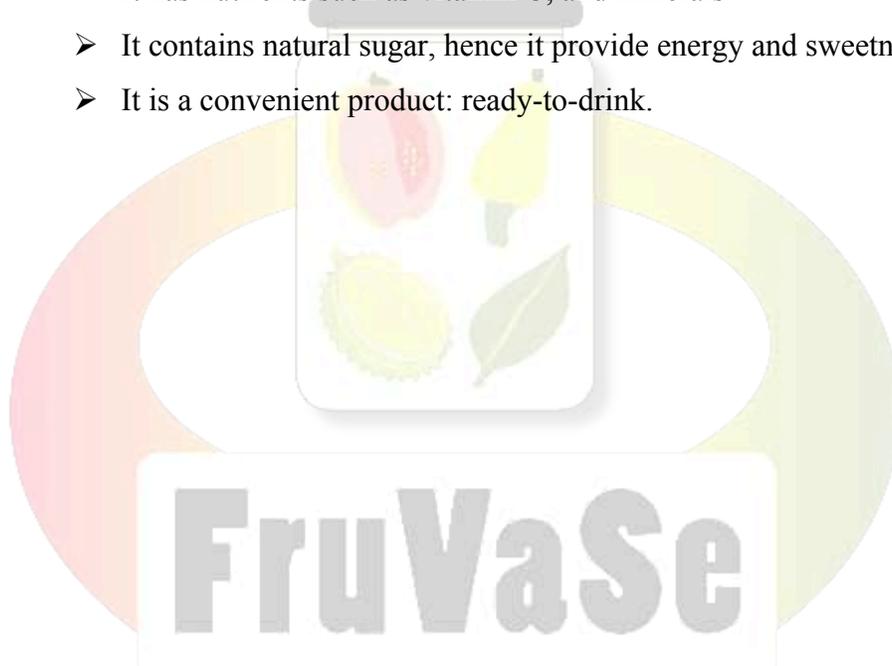
- Find an attractive and convenient packaging material.
- Create an attractive label with all the information required by customers.
- Find a good recipe/ attributes (taste, colour, aroma, nutritional value, quantity, etc.) for your targeted customers.

#### ❖ **Marketing Aspects of Dried Cashew Apple Product**

- Market for dried products
  - It is easy to find dried fruit products in the market, even local ones.
  - Example: dried banana, dates, mangoes, and grapes.
  - Dried cashew apples is an exceptional and a new product.
  - Customers of this product are many except for diabetics.
- Selling points include:
  - Made from cashew apples.
  - It has nutrients such as vitamin C, minerals, sugar and dietary fibers.
  - It is a convenient product: ready-to-eat, eaten anywhere, and can be mixed with other foods such as milk, porridge, and fruit juices.

## ❖ Marketing Aspects of Cashew Apple Juice

- Market for juices
  - This is a very familiar product in the market and at home.
  - Example: Mango juice, pineapple, orange.
  - Cashew apple juice is exceptional and a new product.
  - Customers of cashew juice are many, of different age, gender, profession, and health status.
- Selling points include:
  - Made from cashew apples
  - It has nutrients such as vitamin C, and minerals
  - It contains natural sugar, hence it provide energy and sweetness
  - It is a convenient product: ready-to-drink.



## 6. Good Manufacturing Practices (GMPs)

### ❖ Personal Hygiene Practices

- All working personnel at the facility should;
  - Come to work clean.
  - Keep fingernails trimmed and clean.
  - Don't wear fingernails polish, false eyelashes, nails, etc.
  - Avoid touching body parts. If hands become contaminated, wash them.
  - Don't eat, drink, smoke, or spit or use medication in any of food related areas.
  - Don't bring personal items to the food production or storage areas including keys, tobacco, phones, candy, etc.



Trimming of nails



False eyelashes

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### ❖ Hand Washing Practices

- Proper hand washing is critical in preventing the spread of microorganisms.
- All personnel must wash their hands thorough and frequently.

#### *Hand washing procedure*

- Please follow the illustrated steps during hand washing



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### ***Hand Washing Frequency***

- All personnel must wash their hands:
  - when starting or return to work
  - after using the washroom
  - after handling/touch ingredient, utensil, pre-package and food contact surfaces
  - after handling raw cashew apples
  - before putting on gloves
  - after handling garbage or waste bins
  - every time hands become contaminated

### **❖ Clothing, Footwear and Headwear**

- All personnel must wear clean clothing to prevent contaminations. These rules must be followed:
  - Come to work in clean clothing.
  - Put on your apron, gloves or uniform before start working.
  - Keep designated work clothing clean and in good repair (no holes, loose threads, loose buttons, etc.)
  - Wear clean non-slippery shoes inside the facility.
  - Do not wear designated clothing outside the production facility.
  - Wear designated clothing for each different operation in the plant to avoid cross contamination.



**Apron**



**Glove**



**Shoes**

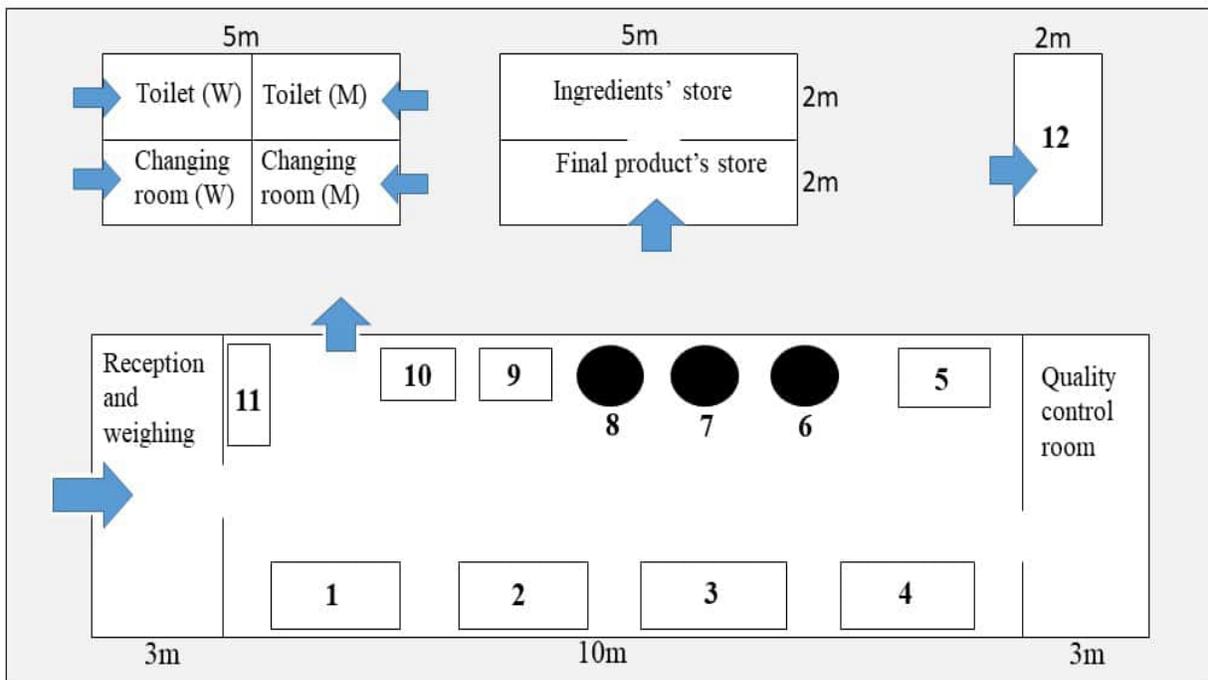


**Headwear**



### ❖ Processing Factory Design

- The building shall be designed and maintained in a manner appropriate to:
  - The nature of the processing operations to be carried out.
  - The potential sources of contamination from the plant environment.
- Internal layout shall be designed, constructed and maintained to reduce the traffic and facilitate Good Hygiene Practices and Good Manufacturing Practices.
- The building shall provide adequate space with a unidirectional flow of the materials, personnel, and physical separation of the raw from the processing areas.
  - Separation includes barriers, physical separation or sufficient distance to minimize the risk of cross contamination.
- Facilities used to store ingredients, packaging, and products shall provide protection from dust, condensation, drains, waste, pests, etc.
- All materials shall be stored off the floor on palettes, away from the wall and from ceilings to facilitate cleaning, inspection and pest control activity.



1: Selection/grading, 2: Washing/disinfection, 3: Peeling/slicing, 4: Juice extraction/filtration, 5: Juice clarification, 6: Refrigerator, 7: Electrical drier, 8: Autoclave/pasteurizer, 9: Sealer/capper, 10: Packaging and labelling, 11: Double dishwasher, 12: Boiler room/solar driers.

**Simple internal layout of cashew apple processing plant (Source: FAO, 1997)**

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