Amla
Emblica officinalis

Bael
Aegle marmelos

Ber
Ziziphus mauritiana Lam.

Jackfruit
Artocarpus heterophyllus Lam.

Lapsi
Choerospondias axillaris (Roxb.) Burtt et Hill

Persimmon
Diospyros kaki L.

Tamarind
Tamarindus indica L.

Sugar apple
Annona squamosa

Technical Manual for Small-Scale Fruit Processors

DFID Department for International Development

FRP FORESTRY RESEARCH PROGRAMME

UTFANET

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ICUC does not take any responsibility for the outcome of recipes and for any accidents or damage caused by the use of equipment as recommended in this training manual.

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Foreword

Fruits for the Future is a programme initiated and implemented by the International Centre for Underutilised Crops (ICUC) in partnership with local stakeholders. It is funded by the Forestry Research Programme (FRP) of the UK Department for International Development. Project outputs are aimed at increasing incomes from smallholders' lands thereby contributing to improved livelihoods.

In February 2002, ICUC organised an Asian regional consultation in Bangkok on the Fruits for the Future programme. The meeting discussed the present status of underutilised fruit tree species in Asia and identified constraints limiting their greater utilisation. A major constraint is the lack of accessible practical information, particularly on post-harvest handling, processing and marketing locally, nationally and regionally. The meeting recommended the establishment of a pilot project to assemble information on post-harvest handling, processing and market chains, and to develop mechanisms for the dissemination of this information to village processors, small traders, entrepreneurs and others. It also recommended that research projects on post-harvest handling, processing and marketing of underutilised fruits should be developed. A survey on processing and marketing of fruits in 5 countries of Asia was carried out to address the initial recommendations of the meeting. The results were reported to DFID-FRP and further funds were assigned to support resource centres for appropriate training at the village level through workshops and dissemination of information. This manual and associated large posters have been developed to serve those needs.

The manual has been prepared by Elke Peiler of ICUC in consultation with Sue Azam-Ali, other members of ICUC and the national partners of five targeted countries in Asia. It is intended to be a source of technological background information on post-harvest handling, processing, storage, packaging, hygiene and for business skills development appropriate to the conditions of village processors and small-scale enterprises. It contains individual modules that link together key aspects of selected underutilised fruit production.

The manual will be translated by the local partners into the following languages: Bengali, Hindi, Kannada, Marathi, Nepalese, Sinhalese and Vietnamese. For greater effectiveness in reaching small-scale fruit processors, DFID-FRP and ICUC encourage any user of the manual to adapt it to specific local conditions and to translate it into other local languages.

The manual complements scientific monographs dealing with specific fruit species and their associated manuals for extension officers and popular fact sheets issued by ICUC. I hope the manual will prove useful for the village level use, for small traders and that it will encourage small entrepreneurs to promote the products of the selected fruit species.

Nazmul Haq
Director, ICUC

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Glossary

Ascorbic acid	vitamin C.
Astringency	a drying sensation in the mouth.
Ayurvedic preparations	ayurvedic treatments are primarily dietary and herbal. Ayurvedic medicine claims to be the traditional medicine of India.
Baume	a scale for specific gravity, used to determine sugar syrup concentrations.
Blanching	heated rapidly in boiling water or steam, held for a known time and then cooled quickly to near room temperature. Blanching is used to destroy enzymes and some micro-organisms.
Blender	a mixer with whirling blades that mixes, chops or liquefies foods.
Brine solution	a strong solution of salt and water used for pickling.
Brix	measurement of the sugar content.
Calcium chloride	a soluble salt.
Carbon dioxide (CO_2)	a colourless, odourless, non-poisonous gas that results from fossil fuel combustion and is a normal constituent of ambient air.
Cashflow	the cash remaining in a month when all cash inflows are subtracted by all cash outflows.
Caustic soda	common name for sodium hydroxide, e.g. used for unblocking drains.
CAZRI	Central Arid Zone Research Institute at Jodhpur, India.
cm (= centimetre)	unit of length in a metric system, equal to 10 millimetres.
Concentrating	boiling off water in liquid foods to increase the solids content and to preserve the product.
Cultivar	a race or variety of a plant that has been selected intentionally and maintained through cultivation.
Citric acid	an organic acid which is naturally occurring in citrus fruits and used to adjust the pH of products.
Dehydrating	removing water from a product.
Density	the mass of a substance in a unit volume.
Dry ice	solidified carbon dioxide.
Ethrel	a chemical (ethephon) which is used as a plant growth regulator and for the removal of the astringency of persimmon fruits.
Ethyl alcohol	same as ethanol or alcohol.
Ethylene gas	a plant growth-regulating gas, naturally produced in ripening fruits, responsible for promoting ripening.
Fermentation	is a process whereby beneficial bacteria are encouraged to grow. These bacteria increase the acidity or alcohol content of a food and therefore prevent the growth of spoilage and food poisoning bacteria.
Fumigate	treat with fumes, with the aim of disinfecting or eradicating pests.
Fungicide	a substance or chemical that kills fungi.
g (= gram)	basic unit of mass in the metric system, 1,000 grams equal 1 kilogram.
Gauge	a standard measure used to determine the thickness of films.
Growth regulator	a natural or chemical substance that changes the shape and appearance of the plant, stops or starts plant growth, prevents flowering and other functions.

GLOSSARY

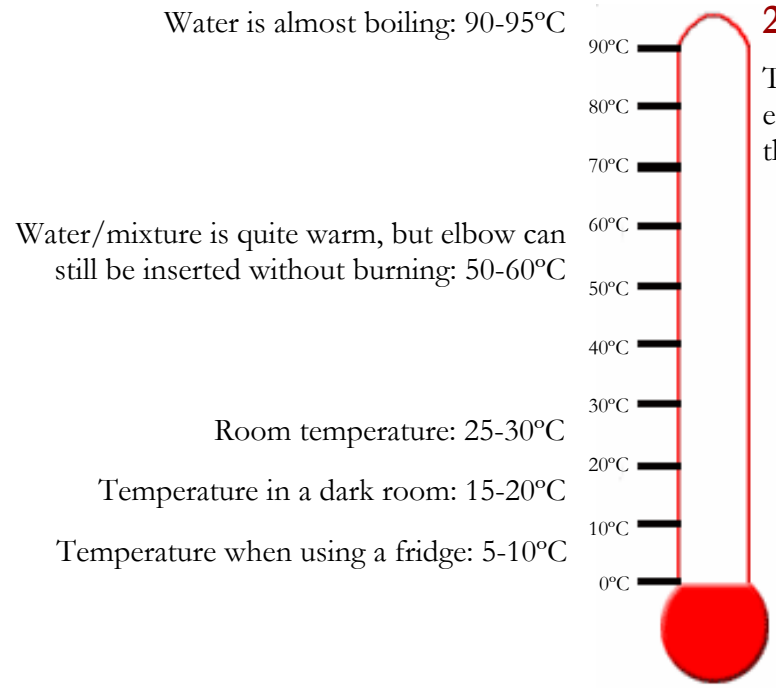
Hygrometer	an instrument used for measuring relative humidity.
ICAR	Indian Council of Agricultural Research.
kg (= kilogram)	unit of mass in a metric system, equal to 1,000 grams.
m (= metre)	unit of length in a metric system, equal to 100 centimetres or 1,000 millimetres.
mg (= milligram)	unit of mass in a metric system. 1,000 milligrams equal 1 gram.
ml (= millilitre)	unit of volume in a metric system. 1,000 millilitres equal 1 litre.
mm (= millimetre)	unit of length in a metric system. 1,000 millimetres equal 1 metre.
l (= litre)	unit of volume in a metric system, equal to 1,000 millilitres or 1,000 cubic centimetres (cm^3).
NGO	non-governmental organisation.
Oxygen (O_2)	a colourless, odourless, tasteless gas that makes up 21% of our air.
Pasteurising	is a process of heat treatment to kill bacteria and help to maintain low levels of bacteria within fruit products without major changes in the chemistry of the food.
Pectin	is a component found naturally in fruits and can be extracted and used in food processing to form the characteristic gel in jams/jellies.
Pectin degrading enzyme	proteins which facilitate the degradation of pectin. They are used for the extraction and clarification of fruit juices.
pH	scale for measuring acidity. The pH scale runs from 0 to 14. Values below 7 are acid (sour taste), values above 7 are alkaline (bitter taste).
Polypropylene	a clear glossy film with a high strength and puncture resistance. It has a moderate permeability to moisture, gases and odours.
Polythene	a film with a reasonable barrier to moisture, but a relatively high gas permeability.
Potassium metabisulphite	preservative, can be added during the processing of dried fruits, jam, fruit leathers, juices, beverages and others to preserve the colour and to extend the shelf-life.
ppm (= parts per million)	a unit of concentration. One ppm is 1 part in 1,000,000. The common unit mg/l is equal to ppm.
Preservatives	chemicals, such as sodium or potassium metabisulphite which are added to the fruit products to prevent the growth of micro organisms and to extend the shelf-life.
Pulper	a piece of equipment which is used to pulp fruits to a puree by pushing it through a mesh by a rotating paddle.
Refractometer	an instrument which is used to measure the sugar concentration of products.
Relative humidity	a measure of the amount of water in the air. It is expressed in a percentage of how much moisture the air could possibly hold.
Shelf-life	the amount of time a product can be expected to remain consumable.
SO_2	sulphur dioxide. A gas which is produced by either burning sulphur or by dissolving sodium metabisulphite in water. It acts as a preservative.
Sodium carbonate	raising agent.
Sodium hypochlorite	a chemical compound which is used as a disinfectant. Household bleach usually contains 3 to 6% sodium hypochlorite.
Sodium metabisulphite	see preservative.
Specific gravity	the ratio of the weight of a specific volume of a substance to the weight of the same volume of pure water at 4°C.
Total soluble solids content	total of all the soluble solids dissolved in water (sugar, salt, protein, acids, etc.).
UAS	University of Agricultural Sciences at Bangalore, India.

Weights and Measures

1. Measuring sizes

The ruler inserted in the right margin on the back of this Technical Note can be used for measuring, for example, the length of fruits during grading operations or the thickness of the pulp layer when preparing fruit leather.

2. Estimating temperatures



The indications on the left can be used to estimate temperatures when there is no thermometer available.

3. Measuring ingredients

A simple cup, teaspoon (tsp) or tablespoon (tbs) can be used to measure the ingredients needed to process fruits when there is no scale available. However, the correct weighing out of raw materials and ingredients is critical for the quality of the product and the success of the business. The table below can be used to translate the weight of different ingredients into simple measurements.

1 cup = 250 ml

1 teaspoon (tsp) = 5 ml

1 tablespoon (tbs) = 15 ml

Ingredients	Weight of 1teaspoon full (tsp)*	Weight of 1table-spoon full (tbs)**	Weight of 1 cup***
Salt	7.0 g	21.0 g	350 g
Sugar	6.0 g	18.0 g	300 g
Black pepper (ground)	2.5 g	7.5 g	
Cumin (ground)	2.5 g	7.5 g	
Turmeric (ground)	2.5 g	7.5g	
Chilli (ground)	2.5 g	7.5 g	
Coriander (ground)	2.0 g	6.0 g	
Pectin	3.5 g	10.5 g	
Citric acid	7.0 g	21.0 g	
Sodium metabisulphite	6.5 g	19.5 g	

* levelled tsp ** levelled tbs ***levelled cup

4. Measuring relative humidity

Relative humidity can be measured with an instrument called hygrometer. When there is no hygrometer available, it can be measured as follows:

Equipment required

- 2 thermometers
- 1 rubber band
- 1 cup of room temperature water
- 1 paper towel

Difference between dry bulb and wet bulb temperatures	Relative humidity
None	100%
0.5ºC	96%
1.0ºC	93%
1.5ºC	89%

1. Select 2 thermometers reading the same temperature.
2. Wet the paper towel in a cup of water.
3. Wrap the wet paper towel around the bulb of one of the thermometers and fix it there with a rubber band. Wait for 5 minutes.
4. Record the temperatures measured by the 2 thermometers and subtract them to get the difference.
5. Use the table on the right to estimate the relative humidity.

5. Measuring the moisture content of dried fruit products

Fruit leather, for example, should be dried until it has a final moisture content of about 15-20% and with experience, you will know when the leather has the correct "feel". To determine the correct end point, it is necessary to do a few trial runs. Once you have established a good product, as long as the recipe and drying conditions remain the same from batch to batch, you will know how long to dry the leather for.

Determine the final moisture content of your dried fruit product as follows:

1. Dry the product following the instructions given in the recipe (e.g. dry at 55°C in an artificial dryer for 5 hours).
2. Weigh this dried product to determine the "product weight". The weight of the tray has to be determined initially so that it can be deducted from the combined weight.
3. Continue to dry the product at 105°C in a dryer or oven for 24 hours until it reaches a constant weight (this removes all the moisture from the product).
4. Reweigh the product to determine the "dry weight".
5. Use the formula in the box on the right to calculate the moisture content of the product which has been dried at 55°C for 5 hours. If the calculated moisture content is still higher than the recommended moisture content, you have to increase the drying time so that your product weight decreases.

How to determine the moisture content of fruit products?

$$\text{Moisture content (\%)} = \frac{\text{(product weight – dry weight) x 100}}{\text{product weight}}$$

Example for a 1 kg batch of puree for leather production:

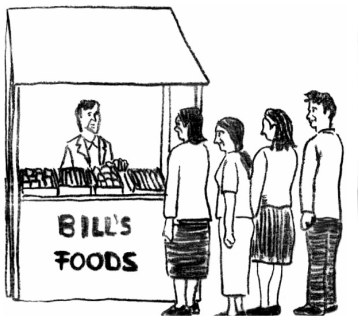
Weight of product after drying at 55°C for 5 hours: 438 g.
Weight of product after drying at 105°C for 24 hours: 350 g.

$$\frac{(438\text{ g} - 350\text{ g}) \times 100}{438\text{ g}} = 20\%$$

Introduction

1. Aims and scope of the manual

This manual is designed to assist rural communities to increase their incomes and to contribute to improving livelihoods through the establishment of fruit processing enterprises. It is devised to enable village level people to identify potential products and to develop markets for them thus providing extra income and benefits. By applying the improved post-harvest and processing techniques that are proposed in this manual, post-harvest losses can be reduced and high quality products from eight selected underutilised fruits can be produced. Appropriate alternatives to the proposed technology are also provided. The information presented can be adapted and used for other fruit tree species as well as the eight focused on in this manual.



The manual brings together the most important aspects of the technological and business skills needed to establish and operate a small fruit processing enterprise. Emphasis is placed on thorough planning before setting up the business, on careful control of production to minimise costs, and on maintaining desired product quality. It reduces the risks of spending time and resources on unsuccessful enterprise development by focusing on cost-effective methods necessary to develop viable enterprises.

2. Audience of the manual

The ultimate beneficiaries of the manual are community level people who use fruits to generating off-farm income. They include producers, small-scale fruit processing entrepreneurs and/or traders who plan to develop or expand their business.

The manual is also intended for use by government extension officers, staff of non-governmental organisations (NGOs) or private company professionals including business owners and cooperative members, who provide back-up to individuals and groups wanting to set up small rural fruit processing enterprises.

3. How to use the manual

3a. Contents of the manual

This manual includes three Modules preceded by a Glossary, Weights and measures and a general note entitled 'Why set up a fruit processing business?'. All topics are supported by illustrations. Such illustrations may be used by extension workers and trainers to develop posters or other supportive training tools and the text can be translated into local languages for greater effectiveness in reaching small-scale fruit processors. A brief outline of the contents of the manual is provided below.

Glossary

The glossary explains the technical terms and abbreviations used.

Weights and measures

The measuring units for mass, size, volumes and concentrations used in the manual are given as precisely as possible to enable those processors, having sufficient means to purchase the necessary measuring equipment, to produce high quality products. However, the recommended measuring equipment, (such as measuring tape, thermometer, refractometer and weighing scale) might not always be available locally.

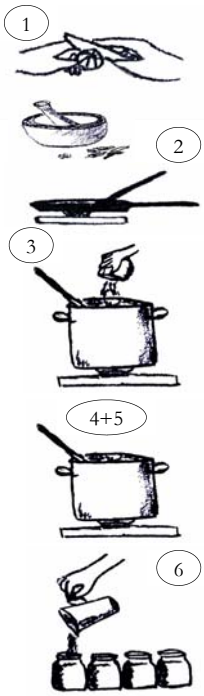
The Note on Weights and measures explains how to follow the instructions given in the manual as exactly as possible, even when there is no measuring equipment available. It also converts the weights and measures given into locally understandable and replicable units, using simple measuring units such as cup, teaspoon and tablespoon. If necessary, trainers can convert these units into other locally-used measuring units. Nonetheless exact measures of raw materials and ingredients are critical for the quality of the product and the success of the business.

Why set up a fruit processing business?

This describes the opportunities which can be generated by setting up a fruit processing business.

Module I: Post-harvest handling

This Module comprises 9 Technical Notes. Note 2 gives general information on post-harvest handling of fruits and explains the preparation of fruit pulp as an intermediate method of storage. Technical Notes 3 to 10 give more specific information on post-harvest handling, including all necessary steps such as grading, sorting, washing, packaging, storing and transportation.



Module II: Processing methods for fruit products

Module II contains 7 Technical Notes, each presenting the processing methods for a different fruit product, such as pickled fruits, non-alcoholic beverages, jams and jellies, dried fruits, fruit leathers, candies and preserves and powder. Each Technical Note first gives some general information on the product and its shelf-life, then provides notes on equipment requirements, packaging needs and quality controls that are important for high quality products. The following pages of each Technical Note then detail the processing methods for one specific product. The processing steps are presented as flowchart, supported by small illustrations and explanatory text. Ingredient requirements are always calculated for 1 kg of raw material, hence ingredients needed have then to be adjusted to the actual batch size.

Module III: Starting a small-scale fruit processing enterprise

This Module consists of 8 Technical Notes, each describing systematically the different steps necessary to identify potential products and to set up and successfully operate a fruit processing business. The Technical Notes are illustrated and partly supported by examples.

3b. Why the manual is split into Modules and Technical Notes

Different users of this manual may want to affect different stages from setting up to operating a business. They might also be interested in the post-harvest technologies and processing methods of different fruit species. For easier use, the post-harvest handling of each fruit species (Module I), processing methods for different fruit products (Module II) and different aspects of starting and operating a small-scale fruit processing enterprise (Module III) are presented as a series of Technical Notes so that diverse users can take only the Notes that they need for individual requirements.

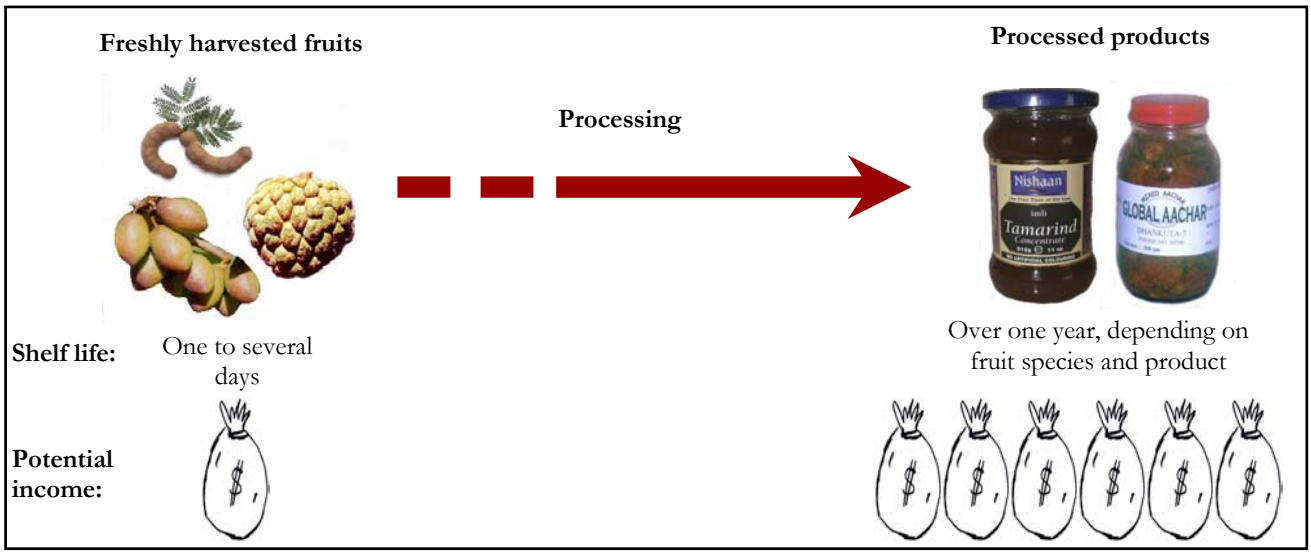
Why set up a fruit processing business?

Traditionally, the main aim of food processing was preservation - to maintain the supply during the year and in particular to preserve for periods when supplies were low. However, the generation of income for the producer and seller is becoming more and more important.

A large proportion of fruits produced in developing countries is at risk of loss through spoilage. To overcome this, producers sell their marketable surplus within a short time after harvest at give-away prices. However, income could be increased significantly if produce were able to be stored correctly or processed, since fruit prices double or even triple only a few months after the harvest.

The opportunities of setting up a fruit processing business are therefore as follows:

- Reduce post-harvest losses
- Increase the shelf-life of the fruit
- Preserve fruit for when it is out of season
- Transform the raw material into edible products
- Increase food security
- Add variety to the diet
- Improve nutrition and health
- Add value to the fruit and generate increased income
- Create employment opportunities in producing areas



Women producing juice and jam

Most processing technologies are available, accessible and affordable at scales that are suitable for small operations. Equipment can often be manufactured locally. Compared to other technologies, small-scale fruit processing is particularly suitable for women.

REASONS for PROCESSING

1a

Post-harvest handling of fruits

Post-harvest handling includes all the steps such as grading, sorting, washing and packaging. It also covers storage and transportation and the intermediate processing of fruits into a form for increased storage.

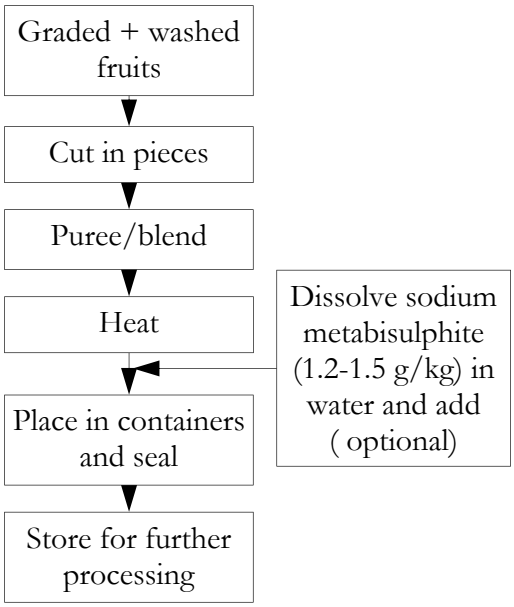
1. General information on post-harvest handling

High quality products can only be made from top quality raw materials. Correct post-harvest handling and storage of fruits is therefore essential to ensure the raw material is of top quality and to reduce losses through wastage.

All fruits have different requirements in terms of storage temperature and humidity. However, there are several basic steps that are common to all fruits:

Post-harvest losses of raw material can be as high as 70% if the fruits are not treated and stored correctly. This is obviously costly to the processor and should be avoided.

- Immature fruits should be removed and set aside to ripen. Some fruit species will ripen after harvest while others will tend to rot.
- Diseased and damaged fruits should be removed as these will infect the good fruit.
- Fruits should be graded according to colour, size and maturity.
- Fruits should be handled gently to avoid bruising.
- They should be washed in clean water and drained to remove all water. Chlorinated water (up to 100 ppm) can be used if preferred (see Technical Note 20 for more information on preparation of chlorinated water).
- The storage life of most fruits is increased if the ambient temperature is reduced. Low energy cool chambers can be constructed for the storage of raw material.
- Some fruits will spoil if the storage temperature is too low. The skin and flesh go brown due to injury through chilling.
- Care should be taken to avoid bruising during transport.



2. Preparation of fruit pulp as an intermediate form of storage

Most fruits can be turned into a pulp that can be stored for up to 6 months and used for further processing at a later date. This is useful as it helps to spread out the processing over a longer period. Fruit pulp is preserved by heating and treating with SO_2 in form of sodium metabisulphite (800-1000 ppm). Therefore sodium metabisulphite (1.2-1.5 g per kg of pulp) is dissolved in some water and added to the pulp. It is then packaged in sealed containers until it is required for further processing. After storage, the pulp should be heated and pasteurised, which will liberate some of the SO_2 and reduce it to an acceptable level (about 200 ppm).

POST-HARVEST HANDLING

2a

Handling amla fruits after harvest

1. Post-harvest operations

1. Remove immature, damaged and diseased fruits.
2. Grade the remaining fruits according to their size, weight, colour and maturity into three grades (see table).
3. Wash fruits using chlorinated water (100 ppm) and drain them. See Technical Note 20 for further information on how to prepare chlorinated water.

Grade	Standard	Use
large	> 40 mm	preserves
medium	30-40 mm	other products
small	< 30 mm	medicinal uses

Fresh fruits
↓
Remove immature and damaged fruits
↓
Sort
↓
Wash + drain
↓
Pack + store

Due to poor handling and packaging, losses may be as high as 20%. Care should be taken when packing amla fruits.

Packaging of amla fruits in gunny bags and baskets

2. Packaging of fresh fruits

- For short distance transport: pack fruits in gunny bags or baskets (40-45 kg capacity) made of pigeon pea stems lined with newspaper as cushioning material.
- For long distance transport: pack fruits in corrugated fibreboard boxes which give better protection.

3. Storing of fresh fruits

- Mature fruits can be kept at room temperature for about 6-9 days, depending on the variety.
- Stored in low energy cool chambers, the shelf-life can be extended up to 12-18 days.
- Mature fruits can be stored up to 2 months at 5-7°C.
- Kept in 15% brine solution (150 g salt/l) at room temperature, the shelf-life can be extended for up to 75 days.

4. Pre-processing into pulp

Graded + washed amla fruits

De-stone → Cut into pieces

Blanch for 6-8 minutes → Separate segments from stones

Add water (1:1)

Blend → Heat to 78°C → Place in containers and seal → Store

Dissolve sodium metabisulphite (1.5 g/kg) in water and add (optional)

1a) De-stone fruits and cut into pieces, or

1b) Blanch fruits for 6-8 minutes in boiling water and separate fruit segments from stone.

2. Add equal amount of water to fruit pieces.
3. Blend fruit pieces or segments using a pulper.
4. Heat pulp to 78°C.
5. Treat pulp with 1000 ppm of SO_2 (optional). Dissolve sodium metabisulphite (1.5 g/kg) in some water and add.
6. Place pulp in airtight containers and seal.
7. Store for further processing.

Handling bael fruits after harvest

1. Post-harvest operations

1. Remove immature and injured fruits.
2. Grade the remaining fruits according to their size. There is no standard practice for the grading of bael fruits.
3. Wash fruits using chlorinated water (100 ppm) and drain them. See Technical Note 20 for further information on how to prepare chlorinated water.

Fresh fruits
↓
Remove immature and injured fruits
↓
Grade
↓
Wash + drain
↓
Pack + store

Care is needed when handling bael fruits to avoid causing cracks in the rind as this can lead to fungal infections.

2. Packaging and storing of fresh fruits

Fruits are packed in gunny bags, baskets or wooden crates for transportation, storage and marketing. Use cushioning material, such as straw or paper, when packing bael fruits.

- Fruits harvested at full maturity (light green colour) can be kept for about 15 days at 30°C.
- Fruits harvested ripe can be stored for only one week at 30°C.
- Ripe fruits can be stored for about 3 months at 9°C and relative humidity of 85-90%. After that, mould is likely to develop at the stem-end and at any cracks in the rind.

Graded + washed bael fruits
↓
Break fruits
↓
Scoop out pulp along with seeds and fibres
↓
Mix (Add water (1:1); Add 5 g citric acid per kg pulp)
↓
Heat to 80°C
↓
Pass through pulper
↓
Place in containers and seal (Dissolve sodium metabisulphite (1.5 g/kg) in water and add (optional))
↓
Store

3. Pre-processing into pulp

1. Break fruits using a strong knife or special bael breaking equipment.
2. Scoop out the pulp along with the seeds and fibres and discard the peel.
3. Add water equal to weight of pulp (1:1).
4. Add 5 g citric acid per kg pulp.
5. Mix the pulp.
6. Heat mixture to 80°C for one minute.
7. Pass mixture through a pulping machine or stainless steel sieve of 20 mesh. Discard seeds and fibres.
8. Treat pulp with 1000 ppm of SO_2 (optional). Dissolve sodium metabisulphite (1.5 g/kg) in some water and add.
9. Place pulp in airtight containers and seal.
10. Store pulp for up to 6 months for further processing.

POST-HARVEST BAEL

4a

Handling ber fruits after harvest

1. Grading

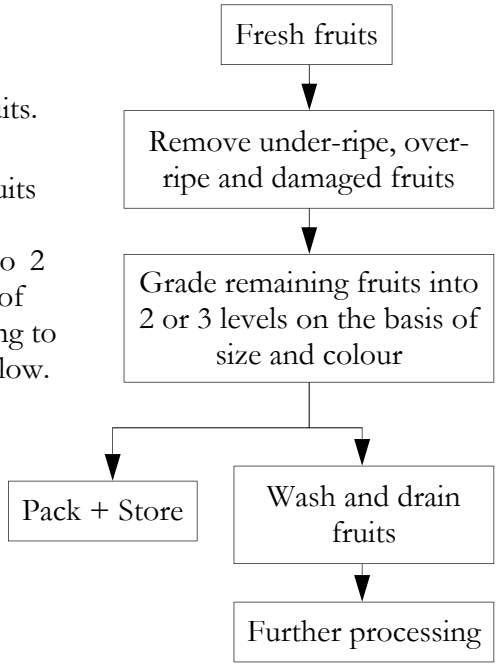
1. Remove under-ripe, over-ripe, damaged and misshapen fruits.

Grading of ber manually

2. Grade the remaining fruits manually or by passing them through sieves into 2 or 3 levels on the basis of size and colour according to the grading standard below.

3. Wash graded fruits using chlorinated water (100 ppm) and drain them for further processing or pack them for storing. See also Technical Note 20.

Improved ber grader, developed at CAZRI, Jodhpur, India



Grade	Standard
A	Shining yellow, large (>35mm) to medium size (25-35mm) fruits of uniform shape with no blemishes.
B	Uneven yellow or yellow red, large (>35mm) to medium size (25-35mm) fruits, of uniform shape with some blemishes.
C	Red, large (>35mm) to small (<25mm) fruits. Uneven yellow, small (<25mm) fruits.

2. Packaging

Pack ber fruits either for proper storage or for safe transport to local or distant markets:

- In small packages of 1-2 kg in perforated 150 gauge polythene or nylon-net bags or cardboard cartons.
- In large packages of 10-20 kg in gunny bags, net bags, cloth packages or wooden or plywood boxes with holes or slits.

For transportation, corrugated cartons of about 10 kg are the most suitable packaging material. For short distances, cheaper materials can be used if cushioning and ventilation is provided.

Ber fruits should be packed in non-organic materials to avoid spoilage caused by microbes during storage and transport.

Transportation of fruits in cloth bags

3. Storage

- Freshly harvested fruits can be stored in containers such as gunny-, net- or polythene bags, cloth packs and boxes for 4-15 days at room temperature (25-35ºC) without loss of organoleptic quality.
- Fruits can be stored in a cool chamber for 6-10 days. However, the high humidity which develops in the cool chamber is conducive to spoilage.
- Fruits can retain acceptable organoleptic quality for 3 weeks kept in polythene bags and baskets at 13ºC in an incubator.
- Kept in polythene bags in a cold storage at 10ºC, fruits of some cultivars can be stored for 28-42 days.
- Fruits can be stored frozen at -18ºC for 6 weeks.

The shelf-life depends mainly on the ber cultivar, storage temperature, packaging method and stage of harvest. During storage, the fruits loose weight and shrivel, change colour and become red, loose acidity and ascorbic acid, but gain in sweetness.

Packaging of ber fruits in cloth bags

Post-harvest treatments:

To extend the shelf-life and to reduce decay losses in storage ber fruits can be treated as follows (optional):

- They can be dipped in cold water for 2 hours or exposed to cold air for 4 hours immediately after harvest to remove field heat.
- They can be dipped in calcium chloride or ascorbic acid solution.
- They can be treated with growth regulators (e.g. cycocel), waxed or fumigated.
- They can be sprayed with fungicides, e.g. thiobendazole (at 500 ppm) or 0.2% $ZnSO_4$. Fungicides should only be used provided certain health and safety regulations are followed (see box below).

Health and safety when using Thiobendazole and Zinc Sulphate ($ZnSO_4$):

Handling and storage:

Store the material in a well-ventilated, secure area out of reach of children and domestic animals. Do not store food, beverages or tobacco products in the storage area. Prevent eating, drinking and tobacco use in areas where there is a potential for exposure to the material. Wear protective clothing and avoid contact with the skin and eyes. Where eye contact is likely, use chemical splash goggles. Wash thoroughly with soap and water after handling.

Environmental impact:

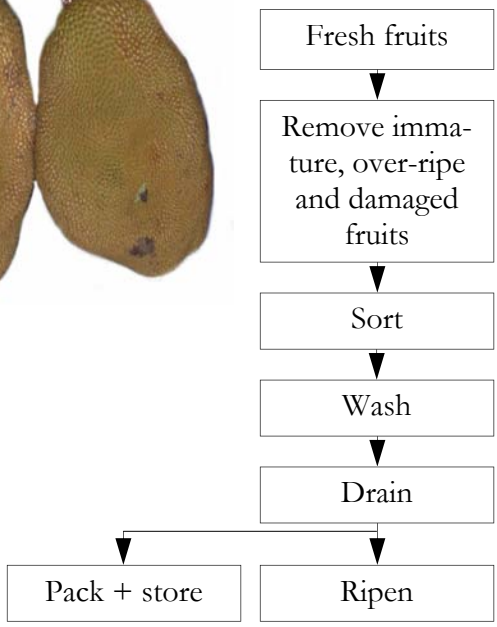
Thiobendazole: very toxic to aquatic organisms.

$ZnSO_4$: no ecological problems are expected when the product is handled and used with due care.

Handling jackfruits after harvest

1. Post-harvest operations

1. Remove immature, over-ripe, damaged and misshapen fruits.
2. Grade the remaining fruits according to size as follows:
   - Large: weighing 16 kg and above
   - Medium: weighing 8 kg to 16 kg
3. Wash fruits using chlorinated water (100 ppm) to remove dirt, latex stains and any field contamination. See Technical Note 20 for further information on how to prepare chlorinated water.
4. Drain fruits properly to remove excess moisture from the surface of the fruit for further processing or storing.



2. Packaging and storage of fresh fruits

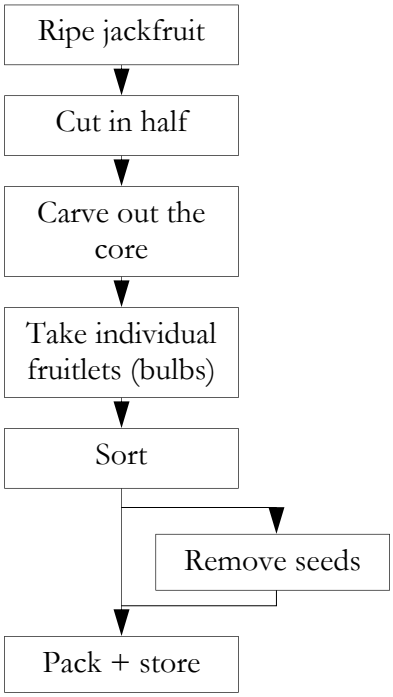
Graded and washed fruits are packed into plastic containers or bamboo baskets for storage.

- Freshly harvested ripe fruits can be stored for 4 to 5 days at 25-35ºC.
- Fruits can be kept for 2 to 6 weeks at 11-13ºC and relative humidity of 85-95%, depending on cultivar and maturity stage.
- Jackfruits stored at temperatures below 12ºC before transfer to higher temperatures show injury due to chilling. This includes dark-brown discoloration of the skin, pulp browning, a deterioration in flavour and increased susceptibility to decay.

3. Ripening

Prior to the pre- or minimal processing, jackfruits should be ripened fully to achieve optimum aroma, sweetness, taste and eating quality.

- Keep mature jackfruits at 24-27ºC. They will ripen in 3 to 4 days. However, uneven ripening is a major problem in the natural ripening process, especially for large-sized fruits.
- To achieve more uniform ripening, expose fruits to 50 ppm ethylene for 24 hours at 25ºC. The fruits ripen 3 to 4 days after the treatment with ethylene gas when kept at room temperature.

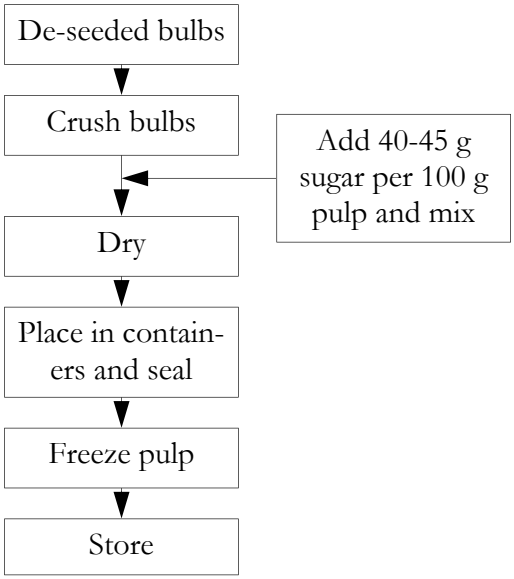


4. Pre-processing into fruitlets

1. Cut fruits in half lengthwise. Latex may exude from the cut surfaces when extracting the flesh. Coat hands, knives and work surfaces with vegetable oil to make clean-up easier.
2. Carve out the sticky central core.
3. Scoop out the individual fruitlets (bulbs).
4. Sort bulbs according to the required size, maturity and colour. Only full bulbs, (not half or partly cut) are recommended for retailing.
5. Cut the end of the bulbs to remove the seeds according to consumers' preference.
6. Pack fruitlets for storage for direct consumption.

5. Packaging and storage of jackfruit fruitlets

- Jackfruit bulbs are packed in polythene bags which are heat-sealed or in polypropylene containers with lids. They can be kept at 2ºC for 3 weeks.
- Maintain the chilled temperature of 2ºC throughout the distribution process to avoid deterioration.



6. Pre-processing into pulp

1. Crush de-seeded jackfruit bulbs using a blender.
2. Add 40-45 g of powdered sugar to every 100 g of smashed pulp and mix thoroughly.
3. Dry mixture in a hot air drier at 80-85ºC until moisture content reaches 20-22%.
4. Place pulp in plastic containers and seal.
5. Freeze pulp and store for further processing.

7. Packaging and storage of pulp

- Pre-processed pulp is packed in polythene bags or in plastic containers. It can be kept for more than one year when stored at -20 - -22ºC.

Handling lapsi fruits after harvest

1. Post-harvest operations

1. Remove immature and injured fruits.
2. Grade the remaining fruits according to their size. There is no standard practice for the grading of lapsi fruits.
3. Wash fruits using chlorinated water (100 ppm) and drain them. See Technical Note 20 for further information on how to prepare chlorinated water.

Fresh fruits
↓
Remove immature and injured fruits
↓
Grade
↓
Wash + drain
↓
Pack + store

Care is needed when handling lapsi fruits to avoid bruising or damage in the peel.

2. Packaging and storing of fresh fruits

Fruits are packed in bamboo baskets or jute bags for transportation, storage and marketing.

3. Pre-processing into pulp

1. Boil graded and washed fruits in water (lapsi:water = 2:1) until the peel splits.
2. Drain the water using a stainless steel sieve.
3. Mash the fruits including the peel, using a pulping machine (see photo).

Lapsi pulper

4. Sieve to remove the seeds.
5. Add salt and mix with pulp.
6. Place pulp in polythene drums and seal.
7. Store pulp for further processing for several months.

Fresh washed lapsi
↓
Boil in water (lapsi:water=2:1)
↓
Drain water
↓
Mash peeled fruits
↓
Remove seeds
↓
Add salt and mix
↓
Place in containers and seal
↓
Store

POST-HARVEST LAPSI

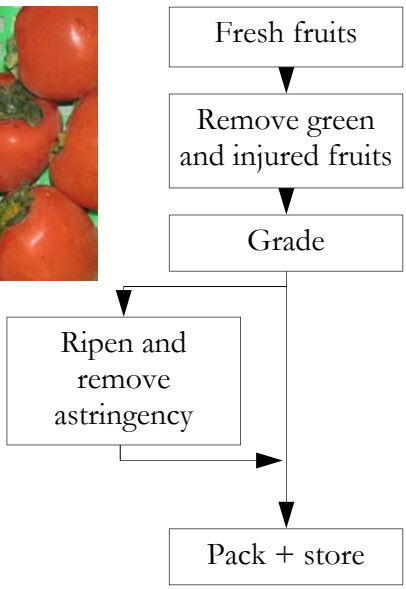
7a

Handling persimmon fruits after harvest

Persimmons are classified into two major types based on fruit astringency. The non-astringent types may be eaten while the fruit is still mature and firm. Astringent fruits must be soft or artificially treated to remove astringency and to make them suitable for eating. Mature persimmons can be pre-processed into pulp in order to extend the shelf-life.

1. Post-harvest operations

1. Remove green and injured fruits.
2. Grade the remaining fruits according to their size, shape, firmness, degree of blemish and colour. A typical export market size for fresh fruit is 200-250 g. Fruits are rated for ripeness by a colour chart: the increasing development of yellow and/or orange to orange-red is a general indication of marketable fruits.



Persimmons can be harvested before they have softened on the tree, however they must have fully coloured. There are various possibilities to ripen and soften the fruits after the harvest.

2. Ripening and removal of astringency

Non-astringent cultivars and astringent varieties which will be stored for a longer period can be kept at about 20°C for 24-48 hours or at lower temperatures for 48-72 hours. The fruits are ready to be sold, but they are still quite firm and can be transported easily.

Fruit softening and removal of astringency can be induced in various ways such as:

- Freeze fruits for 24 hours.
- Place fruits in a loosely closed plastic bag with an apple or banana. Apples and bananas produce the gas ethylene, which promotes fruit softening and ripening.
- Cover fruits with uncooked dry rice for 3-5 days.
- Enclose fruits for three days in an airtight container and expose them to the vapours of 35-40% ethyl alcohol (13-18 ml per kg fruit). Remove fruits and keep them at room temperature for several days until they are edible. Alternatively, spray fruits with 35-40% ethyl alcohol and place them in a sealed container for 10 days at 20.5°C.
- Enclose fruits for 2-3 days in an airtight container with dry ice (22 g frozen carbon dioxide per kg fruit). The dry ice should not contact the fruits. The carbon dioxide from the dry ice will remove the astringency without softening the fruit.
- Immerse fruits in 500-1000 ppm Ethrel for 5-30 minutes resulting in a complete loss of astringency in 3-5 days.

3. Packaging and storing of fresh fruits

Persimmons must be handled very carefully during post-harvest handling, transport and storage to avoid bruising. Only fruits without imperfections store well over a long period.

Fruits are packed into single layer standard trays or white polystyrene containers (450 x 290 x 290 mm), containing plastic inserts.

- Non-astringent persimmons can be stored up to 30 days at room temperature.
- Fruits can be stored for 2-3 months under optimum conditions of 0-2ºC and 90-95% relative humidity.

In general, non-astringent and early ripening cultivars are less suitable for storage than the astringent and late ripening ones.

- Fruits which are individually wrapped in thin polythene can be stored for 4-5 months at 0ºC.
- Post-harvest life can be extended up to 5 months under optimum conditions in ethylene-free controlled atmosphere (3-5% O_2 and 5-8% CO_2) conditions.
- Some cultivars are chilling-sensitive at temperatures between 2 and 15ºC and will exhibit flesh browning and softening. Exposure to ethylene aggravates chilling injuries at these temperatures.

Soft + ripe fruits
↓
Cut in half
↓
Scoop out pulp
↓
Puree pulp
↓
Place in containers and seal
↓
Freeze
↓
Store

4. Pre-processing into pulp

1. Cut persimmons in half.
2. Scoop out the pulp with a stainless steel spoon and discard the peel.
3. Pass pulp through a pulping machine or puree with a blender.
4. Place pulp in airtight containers and seal.
5. Freeze pulp.
6. Store for further processing.

Handling sugar apple fruits after harvest

Sugar apple fruits ripen 2-5 days after harvesting, thus becoming soft and easily injured. Careful, appropriate handling and transportation of the fruits is necessary to avoid bruising.

1. Post-harvest treatments

Sugar apple fruits can be treated as follows prior to storage or transport:

Rinse them in chlorinated water (100 ppm) at 10-12°C for 20 minutes, followed by 10 minutes in less chlorinated water (20 ppm). To remove chlorine residues, immerse them in water containing 2 ppm of chlorine. See Technical Note 20 for further information on how to prepare chlorinated water.

Pre-cooling treatment prior to shipment as recommended for other annona types does NOT improve the post-harvest life of sugar apple fruits.

Sugar apple fruits protected with soft cushioning and packed in cardboard boxes

2. Packaging

Fruits are packed either for proper storage or for safe transport to local or distant markets.

- Only pack fruits in a single layer, with 6-8 kg in cardboard boxes or plastic trays as they are very delicate.
- If 2 or 3 fruit layers have to be used, protect fruits with soft cushioning.

3. Storage of fresh fruits

- Physiologically mature sugar apples stored at 13ºC for 12 days ripen within:
  - 2-4 days when transferred to room temperature (27ºC);
  - 6 days when transferred to 20ºC.
- Ripe fruits can be kept for only 1 day at room temperature. When packed in straw, they can be kept for 2 days.
- Ripe fruits can be stored for 5 days at 5ºC. Kept at 4.5ºC, they can be stored for 5-6 weeks in good condition for consumption. However, the skin shows injuries due to chilling and becomes brown.
- Immature fruits stored below 15ºC develop injury due to chilling, resulting in an unpleasant appearance.

Sugar apple fruits are very perishable and have a short post-harvest life, therefore they require efficient storage techniques.

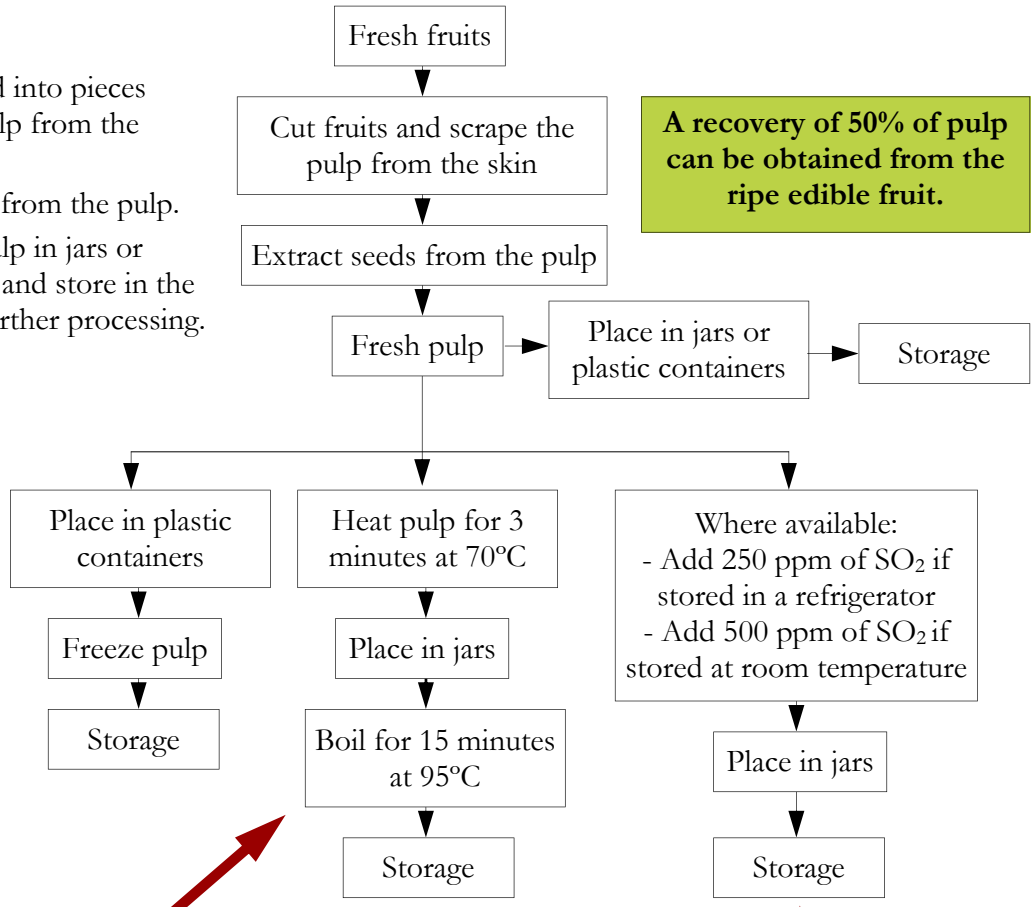
Optimal conditions to extend the storage life of sugar apple fruits are temperatures of 15-20ºC and 85-90% relative humidity.

POST-HARVEST SUGAR APPLE 9a

4. Pre-processing into pulp

Fresh pulp:

1. Cut fruits by hand into pieces and scrape the pulp from the skin.
2. Extract the seeds from the pulp.
3. Place the fresh pulp in jars or plastic containers and store in the refrigerator for further processing.



A recovery of 50% of pulp can be obtained from the ripe edible fruit.

Frozen pulp:

1. Place fresh pulp in plastic containers and seal.
2. Freeze fresh pulp and store for further processing.

Pasteurised pulp:

1. Heat pulp for 3 minutes at 70°C.
2. Pour pulp into clean jars/bottles and seal.
3. Pasteurise sealed jars/bottles at 95°C for 15 minutes.
4. Store for further processing.

Treated pulp:

Sugar apple pulp can be preserved with potassium metabisulphite, where available.

1. Treat fresh pulp with 250 ppm of SO_2 (0.4 g potassium metabisulphite per kg pulp) when stored in refrigerator afterwards.

   Use 500 ppm of SO_2 (0.8 g potassium metabisulphite per kg pulp) when stored at ambient temperature.
2. Pour treated pulp in jars/bottles and seal.
3. Store for further processing.

5. Storage of pulp

- Pasteurised pulp can be stored for 150 days in sealed jars at 27°C.
- Pulp can be stored for 180 days at room temperature when treated with 500 ppm SO_2.

Handling tamarind fruits after harvest

1. Manual pre-processing

1. Dry fresh pods in the sun for 5-7 days. Small-scale dehydrators can be used, if available.

2. Crack the shells by hand and separate the pulp. Mature pods can be processed without prior drying.

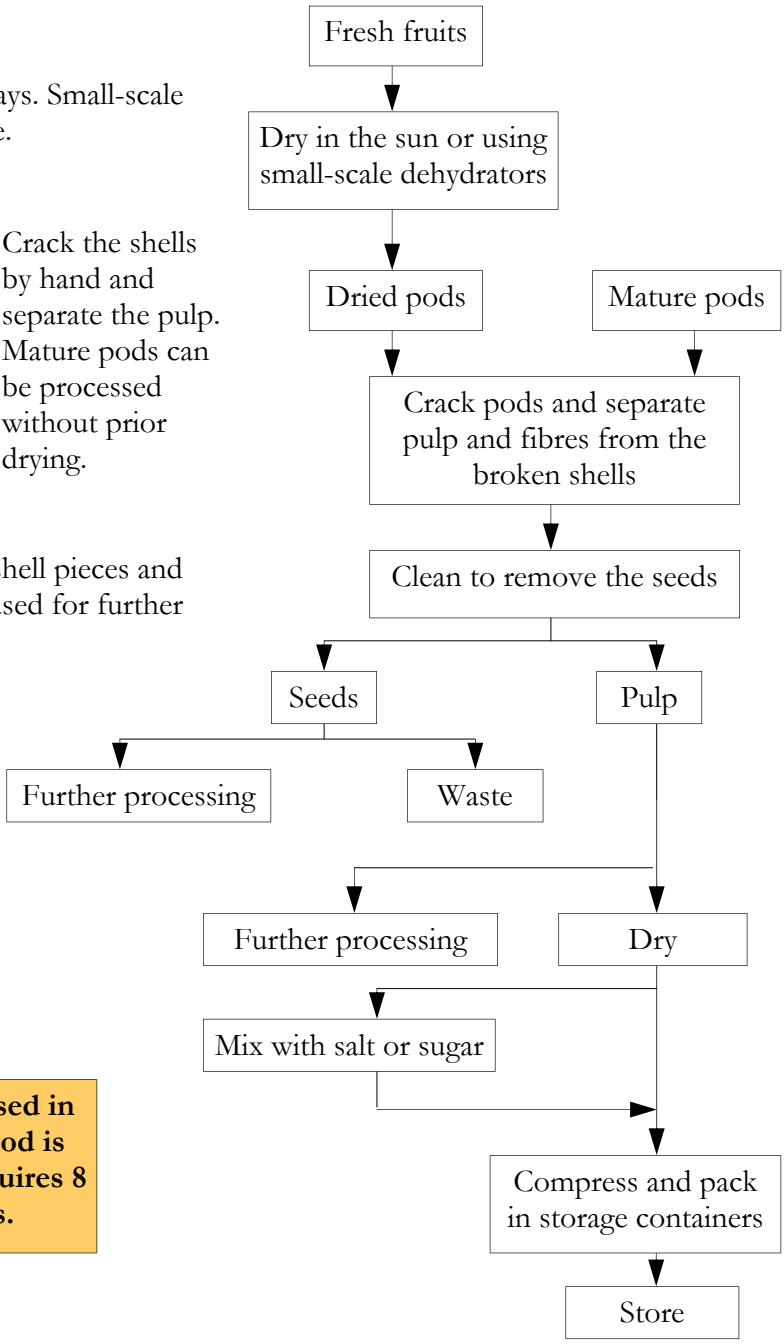
3. Peel and remove the fibre strands, shell pieces and seeds from the pulp. Seeds can be used for further processing.

4. Pulp can be immediately processed into further products.

5. For storage, dry the pulp for 3-4 days.

6. Mix it with salt or sugar according to preference (optional).

7. Compress and pack the pulp in storage containers.



Shelling by hand is commonly practised in many countries. However, this method is labour intensive and inefficient. It requires 8 man-hours to shell 45 kg of fruits.

2. Mechanical pre-processing

Fruits can be de-hulled mechanically using a de-huller that has been developed at the Post Harvest Technology Scheme of the ICAR, UAS, Bangalore, India. The machine has a hulling capacity of 500 kg/hour, with a hulling efficiency of 80% for large fruits and 58% for small fruits.

3. Storage of pods

- Freshly harvested fruits can be stored for 2-5 days in a cool, dark area, or a refrigerator.
- Dried tightly packaged pods can be stored at about 20ºC for several weeks.
- Pods can be steamed for 5 minutes and then dried in a hot air oven at 80ºC for 2 hours. Kept in plastic bags at room temperature, they can be stored for 4 months without any deterioration in quality.

4. Storage of pulp

The pulp is usually stored with the seeds. However, if the seeds are still contained in the pulp, improper storage may cause heavy losses through insect attack.

- Pulp can be compressed and packed in palm leaf mats, baskets, corn husks, jute bags or plastic bags for storage and marketing. When packed in high density polythene, it can be stored below 10ºC in a dry place for 4-6 months.
- Dried pulp mixed with salt or sugar and packed in clay pots, stone jars or plastic bags can be stored for about one year. Clay pots and stone jars have to be kept in a cool dry place.
- Frozen pulp can be stored for about 1 year.
- The pulp can be steamed for 20 minutes and then dried at 60ºC for 2.5 hours. Kept in clear plastic bags at room temperature, it can be stored for 3 months.

Processing of pickled fruits

Product information

Pickles:

- They are usually made from a mixture of vegetables and fruits. They are eaten as a savoury, spicy accompaniment to curries or other main meals.
- They can be prepared using one of two main methods:
  - Lactic acid fermentation of fruits, either with or without the addition of salt: they are not heated, therefore strict attention must be paid to cleanliness and hygiene.
  - Preservation of fruits in acetic acid (vinegar): they have salt and sugar added, are not fermented and therefore have a different texture and flavour.

Shelf-life: They are preserved by a combination of increased acidity (reduced pH), added salt, reduced moisture and added spices. They can be kept for several months when stored in a cool dry place, away from direct sunlight.

Chutneys:

- They are thick, jam like mixtures made from a variety of fruits and vegetables, spices, sugar and some vinegar.
- Any edible sour fruit can be used as a base for chutney to complement the sweet taste from the sugar.
- Most chutneys are boiled which produces a caramelised syrup and alters the taste, colour and thickness of the product.

Shelf-life: The high sugar content has a preservative effect and vinegar is not always necessary, depending on the natural acidity and maturity of the fruits that are used. Boiling also helps preserve the product through pasteurisation. Chutneys can be kept for several months when stored in a cool dry place, away from direct sunlight.

It is essential that the preservation index (which is a combination of the acidity and total soluble solids content) is at least 3.6%.

Preservation index:

$$\frac{\text{Total acidity} \times 100}{(100 - \text{total solids})} = \text{not less than } 3.6\%$$

Equipment required

- Sharp stainless steel knife
- Scale
- Plastic bowls, containers
- Cooker or stove
- Measuring jug
- Stainless steel sieve
- Mortar and pestle
- Boiling pan (stainless steel or aluminium)
- Spoons for measuring
- Wooden spoon for stirring
- Jars and lids (or plastic bags)
- Capping machine (optional)
- Labels and label gummer

Quality control points:

- **Use only spices of good quality and free of mould or adulteration and oil of good quality without rancidity.**
- **Weigh all ingredients to the correct formulation.**
- **Monitor the boiling stage to ensure a consistent product from each batch.**
- **If using re-usable bottles pay special attention to their quality. They have to be checked for cracks and washed thoroughly before using.**
- **Pre-sterilise all jars and bottles (also new ones) and use only new lids for sealing.**
- **Check the correct fill-weight before sealing the jars/bottles.**
- **Ensure that no air bubbles become trapped in the pickle and that a layer of vinegar, citrus juice or oil covers the product.**

Processing of amla pickle

Fresh washed amla

Use only ripe fresh fruits without bruising or damage.

↓

Cut fruit vertically without splitting

↓

Grind and mix spices → Fry spices in mustard oil → Add spice mix and salt

↓

Add sugar

↓

Cook for 30 min

↓

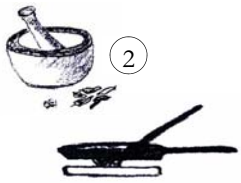
Poor into jars and seal

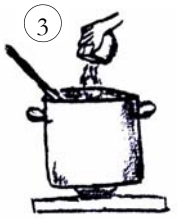
↓

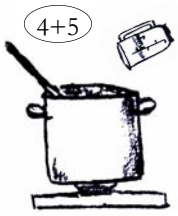
Cool at room temperature

↓

Label







1. Cut graded and washed fruits vertically to facilitate the entry of spices, but do not split them.
2. Grind and mix the following spices (for 1 kg amla) and fry them lightly in mustard oil:

   150 g salt
   15 g red chillies
   10 g turmeric powder
   10 g cumin seeds
   10 g black pepper
   300 ml mustard oil
3. Add spice mix and salt to the fruits.
4. Add sugar (150 g per kg amla) to the mix.
5. Cook the mix for 30 minutes while stirring.
6. Pour pickle into pre-sterilised jars and seal (see Technical Note 22).
7. Cool jars at room temperature.
8. Label.

Ingredients for 1 kg amla fruits:

- 150 g salt
- 15 g red chillies
- 10 g turmeric powder
- 10 g cumin seeds
- 10 g black pepper
- 300 ml mustard oil
- 150 g sugar

Remarks: The amounts of spices can be varied according to local taste and preference.

Processing of ber pickle

Graded and washed ber

Use only mature, but not ripened fruits without bruising or damage.

Place slices in a container and cover with brine solution

Prepare 3-5% brine solution

Brine for 7-8 days

Wash 3 times

Prick

Roast and grind spices

Add the spice mix and mix

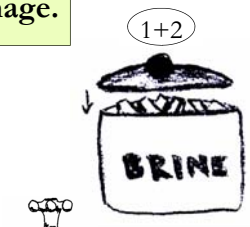
Add vinegar or citrus juice

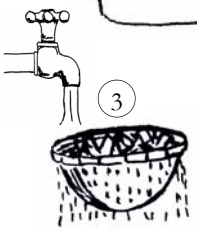
Pack mixture in containers and store

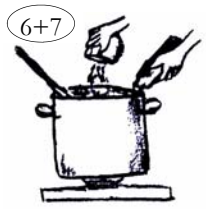
Pour into jars and top with vegetable oil

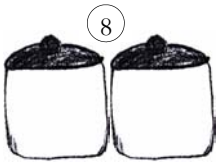
Seal jars

Label









1. Prepare a 3-5% common salt solution by mixing salt with water (30-50 g salt/l).
2. Soak fruits in brine solution for 7-8 days.
3. Wash fruits 3 times with clean water.
4. Prick fruits using a fork or a pricking board.
5. Lightly roast the dried seeds. Grind the following spices together (for 1 kg ber):
   20-40 g coriander seeds
   20-40 g cumin seeds
   4-5 cloves of garlic
   20-40 g mustard seeds
   10 cm long rhizome of ginger
   3-4 cloves
   15-30 g dried chillies
   20-40 g fenugreek seeds
6. Add the spice mix to the fruits and mix thoroughly.
7. Check the pH of the mixture. Ensure it is below 3.6. Add vinegar or citrus juice to reduce the pH and mix.
8. Pack mixture in containers and store for 2-3 weeks in a cool, dark place.
9. Pour pickle into pre-sterilised glass jars (see Technical Note 22).
10. Top the pickle with a layer of vegetable oil.
11. Seal the jars.
12. Label.

Ingredients for 1 kg ber fruits:

- Salt to prepare 3-5% brine solution
- 20-40 g coriander seeds
- 20-40 g cumin seeds
- 4-5 cloves of garlic
- 20-40 g mustard seeds
- 10 cm long rhizome of ginger
- 3-4 cloves
- 15-30 g dried chillies
- 20-40 g fenugreek seeds
- Vinegar or citrus juice to adjust acidity
- Vegetable oil to top the pickle

Special equipment required:

- Pricking board or fork

Remarks: The amounts of spices can be varied according to local taste and preference.

PICKLED FRUITS

Processing of jackfruit pickle

PICKLED FRUITS

Fresh jackfruit

Use only young green fresh fruits without bruising or damage.

↓

Peel skin

↓

Cut into slices

↓

Place slices in a container and cover with brine solution ← Prepare 5% brine solution

↓

Brine for 24 hours

↓

Drain and wash to remove excess salt

↓

Add spice mix and vinegar ← Grind and mix spices

↓

Cook for 30 min

↓

Poor into jars and seal

↓

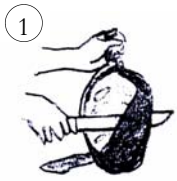
Cool at room temperature

↓

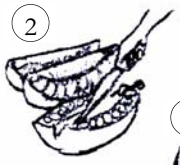
Label

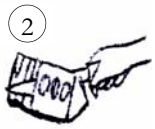
Ingredients for 1 kg peeled jackfruit:

- Salt to prepare 5% brine solution
- 2.5 g turmeric powder
- 25 g coriander seeds
- 10-20 g chilli powder
- 10 g salt
- 150 g sugar
- 10 ml vinegar

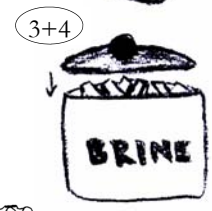


1. Peel the skin.

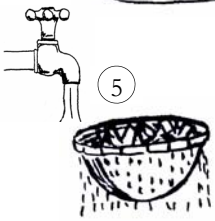




2. Cut peeled fruits into 12 to 18 mm thick slices.



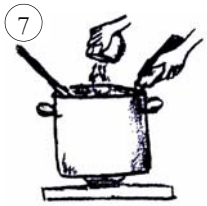
3. Prepare a 5% common salt solution by mixing salt with water (50 g salt/l).
4. Place slices in a container and cover with brine solution. Weigh them down to keep them submerged in the brine.



5. Drain the slices after 24 hours using a stainless steel sieve and wash them to remove the excess salt.

6. Grind and mix the following spices (for 1 kg peeled jackfruit):

   2.5 g turmeric powder
   25 g coriander seeds
   10-20 g chilli powder
   10 g salt
   150 g sugar



7. Add spice mix and vinegar (10 ml/kg) to the jackfruit slices and cook the mix in a stainless steel boiling pan for 30 minutes while stirring.

8. Pour pickle into pre-sterilised jars and seal (see Technical Note 22).
9. Cool jars at room temperature.
10. Label.

Remarks: The amounts of spices can be varied according to local taste and preference.

Processing of lapsi pickle

Fresh washed lapsi

Use only fresh fruits without bruising or damage.

↓

Boil in water (lapsi:water = 2:1)

↓

Drain water

↓

Peel fruits (manually)

↓

Remove seeds

↓

Boil until mixture thickens ← Add sugar (1:1)

↓

Add spice mix and salt and mix ← Grind spices and mix with oil

↓

Cook for 30 min

↓

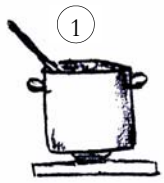
Poor into jars and seal

↓

Cool at room temperature

↓

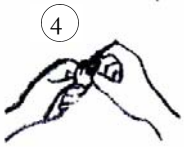
Label



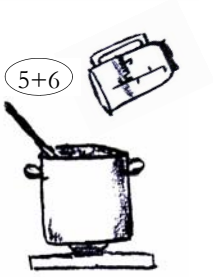
1. Boil graded and washed fruits in water (lapsi:water = 2:1) until the skin of the fruit splits.

2. Drain the water using a stainless steel sieve.

3. Remove the peel manually.

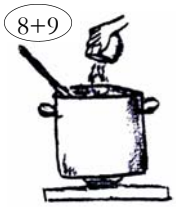


4. Remove the seeds.



5. Add sugar (1 kg of sugar for each 1 kg of fruits).
6. Boil the mixture until it thickens.
7. Grind the following spices to make a paste with the oil:

   40 g coriander seeds
   50 g cumin seeds
   3-4 cloves
   3-4 pods of cardamom
   10-12 chillies
   30 g pepper
   250 ml mustard oil



8. Add spice mix and 30 g salt/kg to the hot lapsi mixture and mix thoroughly.
9. Cook the mix for 30 minutes while stirring.

10. Pour pickle into pre-sterilised jars and seal (see Technical Note 22).
11. Cool jars at room temperature.
12. Label.

Ingredients for 1 kg peeled and de-stoned lapsi fruits:

- 1 kg sugar
- 40 g coriander seeds
- 50 g cumin seeds
- 3-4 cloves
- 3-4 pods of cardamom
- 10-12 chillies
- 30 g pepper
- 250 ml mustard oil
- 30 g salt

Remarks: The amounts of spices can be varied according to local taste and preference.

PICKLED FRUITS

11e

Processing of tamarind pickle

Mature tamarind pods

Use only ripe fresh fruits without bruising or damage.

↓

Crack pods and separate pulp and fibres from shells

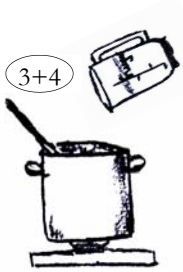
1. Crack the pods by hand and separate the pulp from the broken shells.
2. Peel and remove the fibres, shell pieces and seeds from the pulp.

↓

Remove seeds

↓

Mix with sugar (1:1)



3. Add sugar to pulp (1 kg of sugar for each 1 kg of tamarind).
4. Boil the mixture while stirring continuously.

↓

Boil

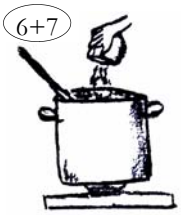
Grind and mix spices

5. Grind the following spices and mix them to a paste (for 1 kg of tamarind):

   40 g coriander seeds
   50 g cumin seeds
   30 g black cumin seeds
   3-4 cloves
   3-4 pods of cardamom
   3-4 cinnamon quills
   10-12 chillies
   30 g salt
   250 ml mustard oil
   15 g caraway seeds
   30 g black pepper

↓

Add the spice mix and mix



6. Add the spice mix to the boiling tamarind and mix thoroughly.
7. Cook for another 20 minutes.

↓

Cook for 20 minutes

↓

Pour into jars and seal

8. Pour the hot pickle into pre-sterilised jars and seal (see Technical Note 22).
9. Cool jars at room temperature.

↓

Cool at room temperature

↓

Label

10. Label.

Ingredients for 1 kg tamarind pulp:

- 1 kg sugar
- 40 g coriander seeds
- 50 g cumin seeds
- 30 g black cumin seeds
- 3-4 cloves
- 3-4 pods of cardamom
- 3-4 cinnamon quills
- 10-12 chillies
- 30 g salt
- 250 ml mustard oil
- 15 g caraway seeds
- 30 g black pepper

Remarks: The amounts of spices can be varied according to local taste and preference.

Processing of non-alcoholic beverages

BEVERAGES

Product information

Fruit juices:

- They are made from pure fruit pulp which is then filtered. They contain no additives. Juices can be made from almost any fully ripened fruit.

Fruit nectars:

- They are not filtered after pulping and contain at least 30% fruit solids. They contain no additives.

Squashes and cordials:

- They contain at least 25% fruit pulp which is mixed with sugar syrup and citric acid to give a final sugar level of about 12-14%. All fruits contain natural sugar, usually around 8-10%, and the addition of sugar to give the recommended levels, must take into account the natural sugar content that is already in the fruit. They are diluted with water before consumption.

Beverages:

- They are made from fruit pulp which is mixed with water, sugar and citric acid.

Shelf-life: Non-alcoholic beverages rely on a combination of acidity, pasteurisation and packaging in sealed containers for their preservation. They can be kept for several months when stored in a cool dry place, away from direct sunlight. In some places, sodium – or potassium metabisulphite is added as preservative to extend the shelf-life. However, chemical preservatives should not be used to cover up for poor hygiene. The permitted levels for use are 0.005 to 0.2 % concentration in fruit juices and beverages. If too much sulphite is used, it taints the fruit and gives it a bad taste. Preservatives can be purchased from food processing ingredient suppliers, brewing shops or pharmacists.

Equipment required

- Sharp stainless steel knife
- Hand-powered pulper
- Scale
- Bowls, containers
- Cooker or stove
- Boiling pan (stainless steel or aluminium)
- Spoons for measuring, wooden spoon for stirring
- Jug and funnel or stainless steel bucket with outlet tap
- Muslin cloth or stainless steel filter
- Glass bottles and caps
- Bottle sealer
- Bottle steriliser or boiling water bath
- Thermometer
- Clock
- Bottle cooler
- Labels and label gummer

Quality control points:

- **Choose only ripe fruits which are free from insect damage and signs of deterioration.**
- **Weigh all ingredients to the correct formulation.**
- **Filter sugar syrup through muslin cloth prior to mixing in/with the pulp.**
- **Filter the juice to remove pulp particles in order to obtain a clear bright juice.**
- **If using re-usable bottles pay special attention to their quality. They have to be checked for cracks and washed thoroughly before using.**
- **Pre-sterilise all jars and bottles (also new ones) and use only new caps for sealing.**
- **Check the correct fill-weight before sealing the bottles.**
- **Use a thermometer and a clock during the pasteurisation. Temperature and time of heating are critical in order to achieve the correct shelf-life and retain a good colour and flavour. As a guideline, place bottles in a boiling water bath as shown in the table.**
- **Take care not to break the glass containers by cooling them too rapidly in cold water.**

Bottle size (litres)	Pasteurisation time (min)
0.33	10
0.5	15
0.75	20

12a

Processing of bael squash

Bael breaking equipment

Ripe washed bael

Use only ripe fresh fruits without bruising or damage.

↓

Break fruits

↓

Scoop pulp including seeds and fibres

Add water (1:1) →

↓

Mix and pass through pulper

↓

Filter

Dissolve 25 g citric acid per kg pulp in water and add →

Prepare syrup by mixing 1.4 l water and 1.6 kg sugar per kg of pulp

↓

Filter and add →

Dissolve potassium metabisulphite (2.5 g/kg) in water and add →

↓

Mix

↓

Pour into bottles and seal

↓

Heat pasteurise in bottles

↓

Cool in cold water

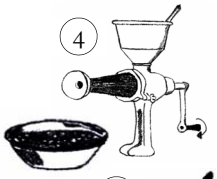
↓

Label

1. Break fruits using a strong knife or special bael breaking equipment (see photo).

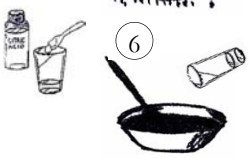
2. Scoop out the pulp using a spoon along with the seeds and fibres. Discard the peel.

3. Add water equal to weight of pulp (1:1).



4. Mix and pass the mixture through the pulping machine.

5. Filter the mixture using a stainless steel sieve and discard seeds and fibres.



6. Dissolve 25 g citric acid per kg pulp in water and add to the extract. Alternatively, lemon juice can be used. Check that the pH is between 3.5 and 3.8.

7. Prepare syrup by mixing 1.4 l water and 1.6 kg sugar per kg of pulp.

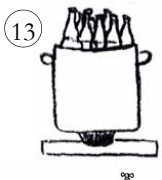
8. Filter syrup through a muslin cloth and add to the pulp.

9. Dissolve 2.5 g potassium metabisulphite per kg pulp in water and add (optional).

10. Mix thoroughly.

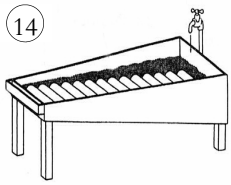
11. Fill pre-sterilised bottles with squash by using either jug and funnel or stainless steel bucket with an outlet tap.

12. Cap bottles.



13. Pasteurise sealed bottles at 80-95°C for 10-20 minutes.

14. Cool bottles to room temperature by immersing in cool water.



15. Label.

See Technical Note 22 for more information.

Ingredients for 1 kg bael pulp:

- 25 g citric acid
- 2.5 g potassium metabisulphite
- 1.6 kg sugar

Special equipment required:

- Bael breaking equipment or sharp strong knife

Processing of ber beverage

Washed fruits

Use only juicy fully ripe fruits free from insect damage and signs of deterioration.

↓

De-stone fruits

1. De-stone fruits.

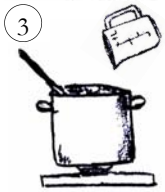
↓

Cut fruits into small pieces

2. Cut them into small pieces.

↓

Boil fruit pieces with water (1:1)



3. Boil fruit pieces with an equal amount of water for 20-30 minutes.

↓

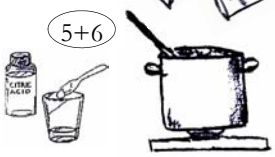
Filter

4. Pass through a stainless steel sieve to produce a clear juice.

↓

Add 500 g sugar, 10 g citric acid and 2.5 l water per 1 l extract and mix

5. Add 500 g sugar, 10 g citric acid and 2.5 l water per 1 l of extract and mix.



6. Boil for 5-10 minutes.

↓

Boil

↓

Filter

7. Filter the liquid again.

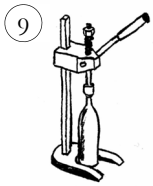
↓

Pour into bottles and seal

8. Fill pre-sterilised bottles with hot beverage by using either jug and funnel or stainless steel bucket with an outlet tap.

↓

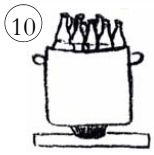
Heat pasteurise in bottles



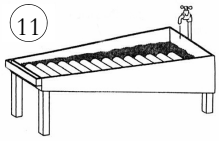
9. Crown cork bottles.

↓

Cool in cold water



10. Pasteurise sealed bottles at 80-95°C for 10-20 minutes.
11. Cool bottles to room temperature by immersing in cool water.



12. Label.

↓

Label

See Technical Note 22 for more information.

Ingredients for 1 kg ber extract:

- 500 g sugar
- 10 g citric acid

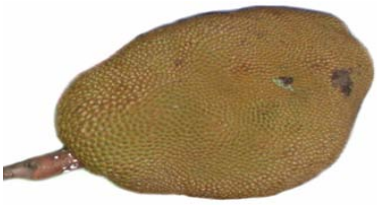
Special equipment required:

- De-stoner (optional)

BEVERAGES

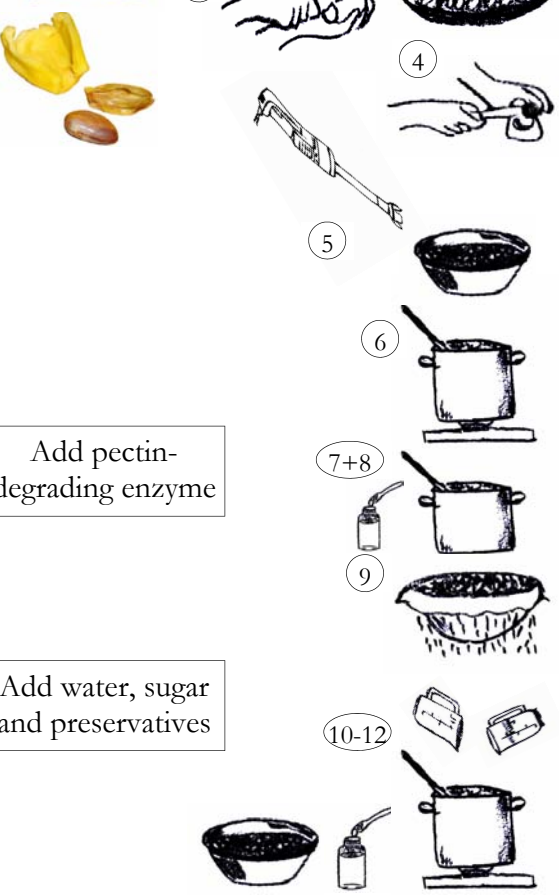
12c

Processing of jackfruit beverage



Ripe jackfruit
↓
Cut in half
↓
Carve out core
↓
Scoop out the bulbs
↓
Remove the seeds
↓
Homogenise
↓
Boil for 5 min
↓
Cool
↓
Keep overnight ← Add pectin-degrading enzyme
↓
Filter
↓
Mix ← Add water, sugar and preservatives
↓
Pour into bottles and seal
↓
Heat pasteurise in bottles
↓
Cool in cold water
↓
Label

Use only freshly harvested ripe fruits without bruising or damage.



1. Cut fruit in half lengthwise.
2. Carve out the core of the fruit.
3. Scoop out the bulbs.
4. Cut the end of the bulbs to remove the seeds.
5. Homogenise the pulp using a pulper or blender.
6. Boil pulp for 5 minutes in a stainless steel boiling pan.
7. Cool pulp.
8. Add pectin-degrading enzyme according to instructions on the packet. Keep mixture at room temperature overnight.
9. Filter the extract using a muslin cloth or stainless steel filter.
10. Prepare a 50% sugar syrup solution at 90°C by dissolving 500 g sugar in a small amount of water and make the volume up to 1 litre.
11. Combine the fruit juice (30%) and sugar syrup (70%). To obtain 1 l of beverage mix 300 ml juice and 700 ml sugar syrup.
12. Add preservative such as sodium metabisulphite (concentration up to 0.05%) (optional).
13. Pour into pre-sterilised bottles by using either jug and funnel or stainless steel bucket with an outlet tap.
14. Cap bottles.
15. Pasteurise sealed bottles at 80-95°C for 10-20 minutes.
16. Cool bottles to room temperature by immersing in cool water.
17. Label.

See Technical Note 22 for more information.

Ingredients for 1 kg de-seeded jackfruit bulbs:

- Pectin-degrading enzyme (see instructions on the packet)
- Sugar
- 0.5 g sodium metabisulphite (optional)

Processing of sugar apple nectar

Fresh sugar apple

Use only ripe fresh fruits free from insect damage and signs of deterioration.

↓

Cut into pieces

↓

Scrape pulp from the skin

↓

Remove seeds

↓

Add 2.5 l water, 370 g sugar and 1 g citric acid per 1 kg of pulp and mix

↓

Boil for 3 minutes at 70°C

↓

Pour into bottles and seal

↓

Heat pasteurise in bottles

↓

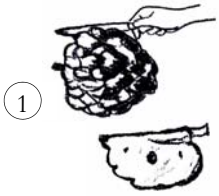
Cool in cold water

↓

Label

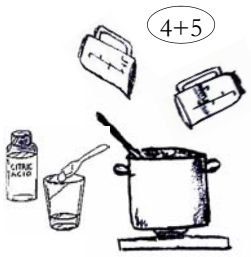
Ingredients for 1 kg sugar apple pulp:

- 370 g sugar
- 1 g citric acid



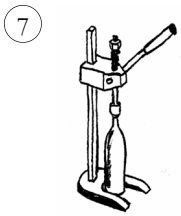
1. Cut fruits into pieces.

2. Scrape the pulp from the skin.
3. Extract the seeds.

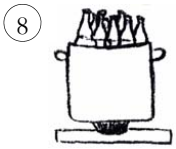


4. Add 2.5 l water, 370 g sugar and 1 g citric acid per kg of pulp and mix thoroughly.
5. Boil mixture for 3 minutes at 70°C.

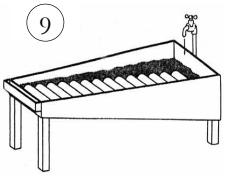
6. Fill pre-sterilised bottles with hot nectar by using either jug and funnel or stainless steel bucket with an outlet tap.



7. Crown cork bottles.



8. Pasteurise sealed bottles at 95°C for 10-20 minutes.



9. Cool bottles to room temperature by immersing in cool water.
10. Label.

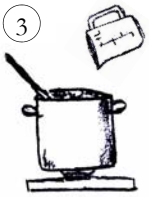
See Technical Note 22 for more information.

Processing of tamarind juice

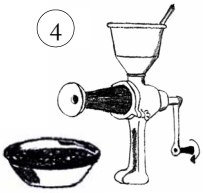
- Mature tamarind pods
- Crack pods and separate pulp and fibres from shells
- Remove seeds
- Boil pulp in water
- Extract juice by pulping
- Filter
- Pour into bottles and seal
- Heat pasteurise in bottles
- Cool in cold water
- Label

Use only ripe fruits free from insect damage and signs of deterioration.

1. Crack the pods by hand and separate the pulp from the broken shells.

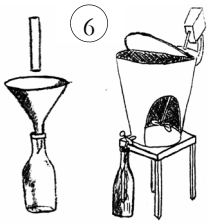


2. Peel and remove the fibres, shell pieces and seeds from the pulp.
3. Boil the pulp in water.

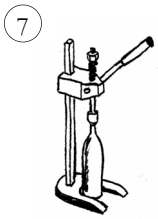


4. Extract the juice by using a hand-powered pulper.

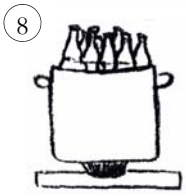
5. Filter the extract using a muslin cloth or stainless steel filter to remove pieces of pulp and to produce a clear juice.



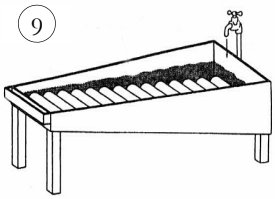
6. Pour into pre-sterilised bottles by using either jug and funnel or stainless steel bucket with an outlet tap.



7. Cap bottles.



8. Pasteurise sealed bottles at 80-95°C for 10-20 minutes.



9. Cool bottles to room temperature by immersing in cool water.
10. Label.

See Technical Note 22 for more information.

When produced on a large scale, juice is first pasteurised and then filled into sterilised containers and sealed.

Processing of jam and jelly

JAM and JELLY

Product information

Jam:

- Jam is a solid gel made from the pulp of a single fruit or combination of fruits with a fruit content of at least 40% and a total sugar content of not less than 68% to prevent mould growth after opening the jar. In mixed fruit jams the first-named fruit should be at least 50% of the total fruit added.

Jelly:

- Jelly is a crystal-clear jam, made from filtered juice instead of fruit pulp.

Shelf-life: The principles of preservation are heating to destroy enzymes and micro-organisms, combined with high acidity and sugar content to prevent re-contamination. Jams and jellies can be kept for several months when stored in a cool dry place, away from direct sunlight.

Equipment required

- Sharp stainless steel knife
- Scale
- Plastic bowls, containers
- Cooker or stove
- Boiling pan (stainless steel or aluminium)
- Spoons for measuring, wooden spoon for stirring
- Sugar thermometer
- Refractometer (if available)
- Measuring jug
- Funnel or jar filler
- Jars and lids
- Capping machine (optional)
- Labels and label gummer

Quality control points:

- **Use only refined granular sugar to produce a high quality preserve. If it contains impurities it is advisable to dissolve the sugar in water to produce a strong syrup that is filtered through a fine mesh prior to use.**
- **Weigh the ingredients accurately.**
- **Monitor the boiling stage and avoid localised overheating which leads to burning and colour changes.**
- **Check the final sugar content. If the sugar level of 68% is not reached, mould will grow on the product or the jam will not form a gel. If the sugar concentration is too high, the jam will crystallise.**
- **If you use re-usable jars pay special attention to their quality. They have to be checked for cracks and washed thoroughly before using.**
- **Pre-sterilise all jars (also new ones) before filling them.**
- **Check the temperature before filling. If it is hotter than 85ºC condensation will form under the lid and drop down onto the surface of the jam. This will dilute the sugar on the surface and allow mould growth. If it is colder than this the jam will begin to set and be difficult to pour and a partial vacuum will not form in the jar.**
- **Check the correct fill-weight and the cleanliness of the container before sealing the jars. In particular it is important to avoid getting preserve around the rim of the jars as this may prevent a vacuum forming and will attract insects.**
- **Use only new metal lids for sealing. It is possible to use paper, polythene or cloth tied with an elastic band or cotton to cover jars. The appearance is less professional and there is a risk of contamination by insects.**
- **Keep jars upright for cooling. A partial vacuum should form between the surface of the jam and the lid which can be seen by a slight depression in the lid. If the vacuum does not form, it means that the jar is leaking or the temperature of filling was too low.**

Principles of jam and jelly making

Three main ingredients are needed for making a good jam/jelly:

Pectin: forms the gel structure which makes the jam/jelly firm. A pectin content of 0.75 to 1.0% is needed to get an adequate gel. Some fruits contain enough pectin for this, while others need to have pectin added. There are three sources of pectin:

1. If commercially available, add pectin powder or solution to the pulp.
2. Produce your own pectin solution by boiling the sliced skins of citrus fruits such as lime, lemon or orange and passion fruit in water for 20-30 minutes. Filter the solution before adding to the fruit pulp.
3. Add fruits with high pectin content (e.g. apple or banana) to fruits with low pectin content.

Notes on calculations:

Mix 500 g sugar and 500 g fruit with a sugar content of 10% (= 50 g). This mixture of 1 kg contains 550 g sugar (= 55%). 160 g of water needs to be boiled off to give a sugar content of 65%.

Sugar: is important to help the pectin form a firm gel structure. It is present in all fruits at a level of 10-12%. In order to obtain the required sugar content of 65 to 68%, additional sugar must be added. Normally an equal amount of sugar is added to the fruit (1:1) and the excess water is boiled off to obtain the high sugar content. The sugar content should not exceed 72% to prevent crystallisation.

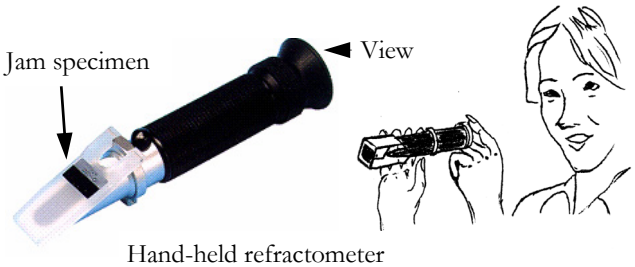
Acid: helps the pectin to set into a firm gel, reacts with some of the sugar so that it will not crystallise when the jam/jelly sets and gives a better flavour. The optimum pH for a jam to set is pH 3.0-3.3. Some fruits need to have additional acid added. There are several sources of acid:

1. If available, add citric acid (usually available from chemists), tartaric acid (cream of tartar) or malic acid in powdered form.
2. Add fruits which are high in acid to fruits low in acid. Generally lemon or lime juice are best for this.
3. Add some unripe fruits to provide a higher acid content.

Determination of the end-point when boiling a jam/jelly

There are three main ways in which the end-point of boiling a jam/jelly can be determined:

1. Use of a refractometer: a hand-held refractometer has a scale which gives a reading in percent of sugar present. The total sugar should be 65-68%.



Hand-held refractometer

2. Use of a sugar-thermometer: a solution of 68% sugar content boils at 105ºC at sea level. For higher altitudes, the end point for finishing the boiling of jam/jelly should be 4.5-5ºC higher than the boiling point of water at that altitude.

3. Make a drop test: take a small portion of the jam/jelly on a spoon, cool it slightly and drop it into a glass of water. If the drop falls in a single piece until it reaches the bottom, the end point has been reached.

Altitude above sea level	Boiling point of water ºC	End boiling point for jam/jelly ºC
0	100	105
1000	99	104
2000	97.9	102.9
3000	96.9	101.9
4000	95.8	100.8
5000	94.8	99.8
6000	93.7	98.7

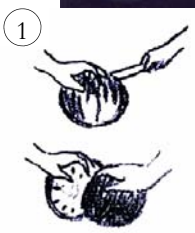
Processing of bael jam

Ripe washed bael

Use only ripe fresh fruits without bruising or damage.

Bael breaking equipment

↓ Break fruits



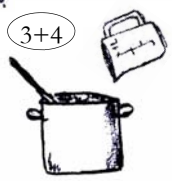
1. Break fruits using a strong knife or special bael breaking equipment (see photo).

↓ Scoop pulp including seeds and fibres

2. Scoop out the pulp using a spoon along with the seeds and fibres. Discard the peel.

Add water (1:1) →

↓ Mix by kneading and stirring



3. Add water equal to weight of pulp (1:1).
4. Mix pulp with water by stirring.

↓ Filter

5. Filter the mixture using a stainless steel sieve and discard seeds and fibres.

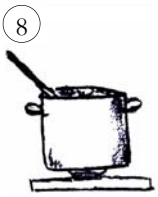
↓ Mix pulp

Mix 1 kg sugar and 10 g pectin per kg of pulp and add →

6. Mix pulp again to obtain a thickened pulp.
7. Mix together 1 kg of sugar and 10 g of pectin per kg of pulp. Add to the pulp.

↓ Heat mixture while stirring

Dissolve 5 g citric acid per kg pulp in water and add →

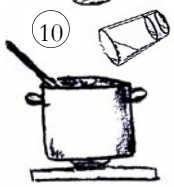


8. Heat mixture in a stainless steel vessel while stirring continuously until weight of the pulp taken before cooking is reduced to half.

↓ Continue cooking mixture

9. Dissolve 5 g citric acid per kg pulp in some water and add to the mixture.

↓ Poor into jars and seal



10. Continue cooking the mixture until the total sugar content is 68.5% (see page 13b).

↓ Cool at room temperature

11. Pour jam into pre-sterilised jars and seal (see Technical Note 22). The ideal pouring temperature is 82-85°C.
12. Cool jars at room temperature.
13. Label.

↓ Label

Ingredients for 1 kg bael pulp:

- 1 kg sugar
- 10 g pectin
- 5 g citric acid

Special equipment required:

- Bael breaking equipment or sharp strong knife

Processing of ber jam

Graded + washed ber

Use only fully ripe fruits of juicy varieties without bruising or damage.

De-stone fruits and cut into small pieces

Boil fruit pieces with water (2:1)

Filter to obtain pulp

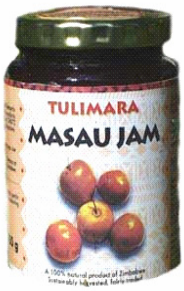
Add 1 l water and 725 g sugar per 1 kg pulp and mix

Dissolve 8 g citric acid per kg pulp in water and add

Heat mixture while stirring

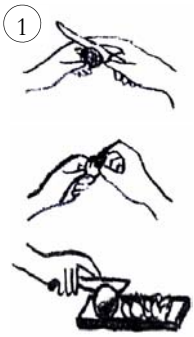
Dissolve potassium metabisulphite (0.1 g/kg) in water and add

Poor into jars and seal

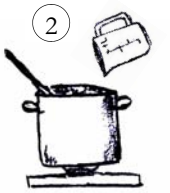


Cool at room temperature

Label

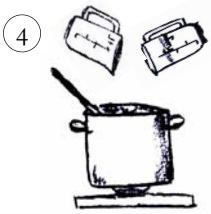


1. De-stone fruits and cut them into small pieces.



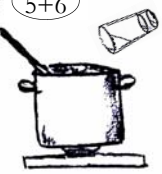
2. Boil fruit pieces with water (half to equal weight of the fruit) for a few minutes.

3. Pass through a stainless steel sieve to obtain the pulp.

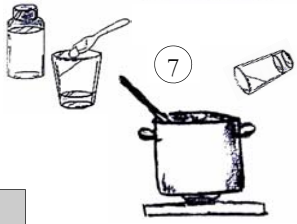


4. Add 1 l water and 725 g sugar per 1 kg of pulp and mix.

5. Dissolve 8 g citric acid per kg pulp in some water and add to the pulp.



6. Heat mixture in a stainless steel vessel while stirring continuously until the total sugar content is 65% (see page 13b).



7. Dissolve potassium metabisulphite (0.1 g/kg) in water and add to the product (optional).

8. Pour jam into pre-sterilised jars and seal (see Technical Note 22). The ideal pouring temperature is 82-85°C.
9. Cool jars at room temperature.
10. Label.

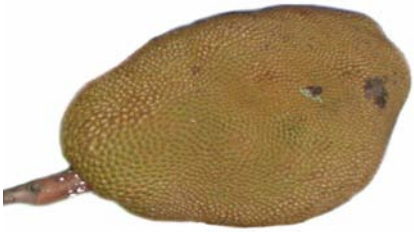
Ingredients for 1 kg ber pulp:

- 725 g sugar
- 8 g citric acid
- 0.1 g potassium metabisulphite (optional)

Special equipment required:

- De-stoner (optional)

Processing of mixed jackfruit jam



Ripe jackfruit

↓

Cut in half

↓

Carve out core

↓

Scoop out the bulbs

↓

Remove the seeds

↓

Smash or grind bulbs to pulp

↓

Mix with other fruits (1:1)

↓

Add pectin, sugar and water and mix

↓

Cook mixture while stirring

↓

Poor into jars and seal

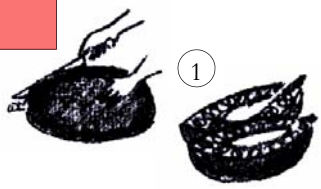
↓

Cool at room temperature

↓

Label

Use only ripe but firm fruits without bruising or damage.

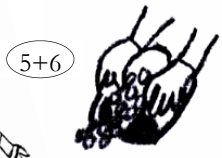


1. Cut fruit in half lengthwise.

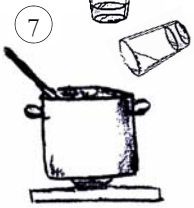
2. Carve out the sticky core.

3. Scoop out the bulbs.

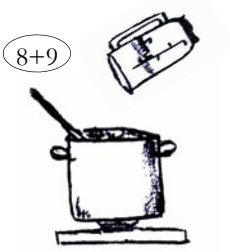
4. Cut the end of the bulbs to remove the seeds.



5. Smash bulbs or grind them to pulp using a blender.
6. Mix with other fruit pulp (jackfruit : other fruits = 1:1).



7. Dissolve 10 g pectin per kg mixed fruit pulp in some water and add to the mixture.



8. Add 1 kg sugar per kg mixed fruit pulp and mix.
9. Heat mixture in a stainless steel vessel while stirring continuously until the total sugar content is 68 to 70% (see page 13b).

10. Pour jam into pre-sterilised jars and seal (see Technical Note 22). The ideal pouring temperature is 82-85°C.
11. Cool jars at room temperature.
12. Label.

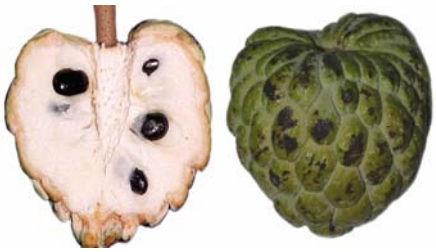
Ingredients for 1 kg jackfruit pulp:

- 1 kg other fruit pulp (e.g. pineapple)
- 2 kg sugar
- 20 g pectin

Special equipment required:

- Blender (optional)

Processing of sugar apple jam



Fresh sugar apple

Use only ripe fruits without bruising or damage.

↓ Cut into pieces

↓ Scrape pulp from skin

↓ Remove seeds

↓ Add sugar (1:2)

↓ Heat mixture while stirring

↓ Dissolve citric acid in water and add

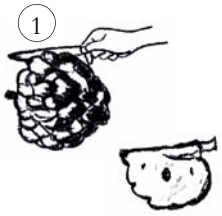
↓ Continue cooking mixture

↓ Dissolve potassium metabisulphite (0.1 g/kg) in water and add

↓ Poor into jars and seal

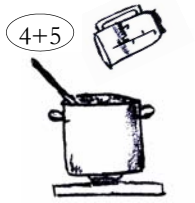
↓ Cool at room temperature

↓ Label

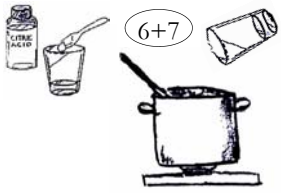


1. Cut fruits into pieces.
2. Scrape the pulp from the skin.

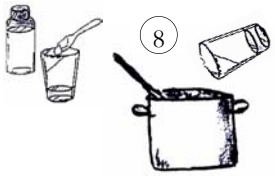
3. Extract the seeds.



4. Add sugar to pulp (1 kg of sugar for each 1 kg of pulp).
5. Heat the mixture in a stainless steel vessel while stirring continuously.



6. Dissolve citric acid (5-7 g/kg) in water separately and mix it with the pulp. Alternatively, lemon juice can be used (50 ml/kg). Check that the pH is between 3.0 and 3.3.
7. Continue heating stirring all the time, until the total sugar content is 68% (see page 13b).



8. Dissolve potassium metabisulphite (0.1 g/kg) in water and mix with the pulp (optional).

9. Pour jam into pre-sterilised glass jars and seal (see Technical Note 22). The ideal pouring temperature is 82-85°C.
10. Cool jars at room temperature.
11. Label.

Ingredients for 1 kg sugarapple pulp:

- 1 kg sugar
- 5-7 g citric acid, or
- 50 ml lemon juice
- 0.1 g potassium metabisulphite (optional)

Processing of tamarind jam

Mature tamarind pods

Use only ripe fruits without bruising or damage.

Crack pods and separate pulp

Remove seeds

Add sugar (1:2)

Cook mixture while stirring

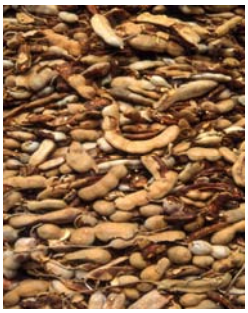
Poor into jars and seal

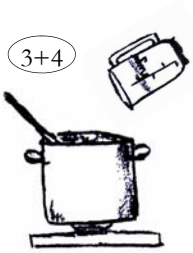
Cool at room temperature

Label

Ingredients for 1 kg tamarind pulp:

- 2 kg sugar





1. Crack pods by hand and separate the pulp from the broken shells.
2. Peel and remove the fibres, shell pieces and seeds from the pulp.
3. Add sugar to pulp (2 kg of sugar per kg of pulp).
4. Cook the mixture while stirring continuously until the total sugar content is 68% and it becomes thick (see page 13b).
5. Pour jam into pre-sterilised glass jars and seal (see Technical Note 22). The ideal pouring temperature is 82-85°C.
6. Cool jars at room temperature.
7. Label.

Processing of dried fruits

Product information

- They are made by dehydrating fruits or fruit pieces by sun-drying, or using a solar or cabinet drier.
- They can be made from most fruits. They have a soft rubbery texture and a sweet taste with the characteristic flavour and colour of the fruit which has been used.
- They are used in confectionery, in baked goods or other food preparations.

Shelf-life: The preservation relies on the very low moisture content of 15%. When properly dried and packaged, they have a shelf-life of several months.

Sulphuring: The use of sulphur dioxide during drying improves the colour and increases the shelf-life of some dried fruits.

There are two methods of applying sulphur dioxide:

- Sulphuring by burning sulphur in a sulphur cabinet
- Sulphiting by soaking fruits in a solution of sodium metabisulphite (or potasium metabisulphite)

Importers in the European Union and United States may specify that sulphur dioxide is not used in products.

The strength of the sulphite solution or the amount of sulphur used and the time of exposure, depend on the commodity, its moisture content and the levels permitted in the final product which are set by legal standards in each country. Typically a 3 g/l sulphite solution or 2 g of sulphur for each kg of prepared fruits are used with a sulphuring time of 60-90 minutes. The permitted levels for use are 0.005 to 0.2 % concentration in dried fruits. If too much sulphite is used, it taints the fruit and gives it a bad taste. Potassium - and sodium metabisulphite can be purchased from food processing ingredient suppliers, brewing shops or pharmacists.

Equipment required

- Sharp stainless steel knife
- Scale
- Bowls, containers
- Cooker or stove
- Boiling pan (stainless steel or aluminium)
- Stainless steel sieve
- Mesh trays
- Cabinet or solar dryer (optional)
- 400 gauge polythene bags
- Heat sealer
- Self-adhesive labels

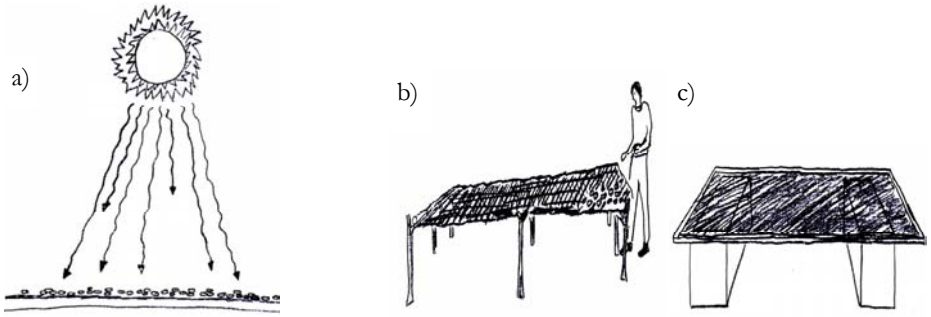
Quality control points:

- **Use only ripe but firm and good quality fruits without bruising or damage.**
- **Fruit pieces should have a uniform size.**
- **Blanch fruits in order to induce the development of a uniform colour, to soften the fruit for uniform dehydration and to control the activity of enzymes and micro-organisms. The optimum time required depends on fruit species and cultivars.**
- **Sulphur fruits before drying to improve product quality. Sulphuring helps in the retention of ascorbic acid content and colour in the dried fruit. Do not sulphur red fruits because it bleaches the red colour.**
- **If available, dry the fruits in a solar or cabinet drier to improve the quality. By sun drying only, a fairly good product is obtained.**
- **Check the correct fill-weight before sealing the bags.**
- **If available, use 400 gauge polypropylene bags as they provide greater protection against moisture.**

Drying of fruits

Drying of fruits can be carried out as follows:

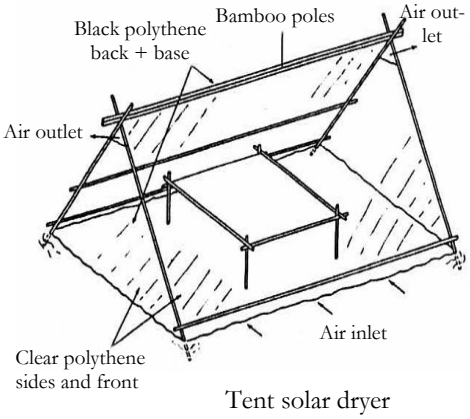
1. Under bright sun by spreading fruits on mats or polythene sheets on the ground, or by constructing a raised platform and covering the frame with mats.



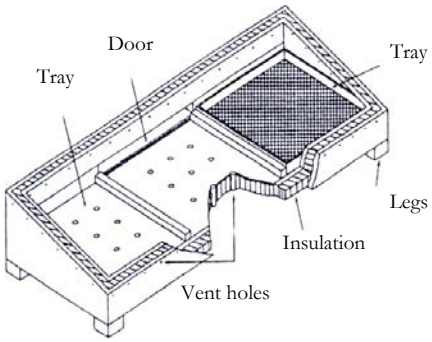
Drying under bright sun on:
a) sheets on the ground
b)+c) on raised platforms

Drying fruits in the sun is simple and has the advantage of little or no fuel and equipment costs. However, it is not the most reliable method, especially in humid climates and during the rainy season.

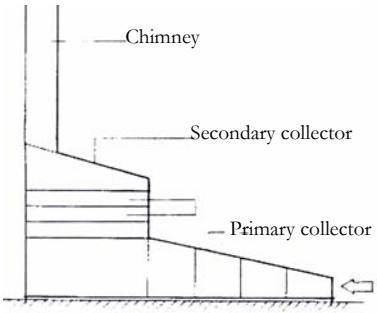
2. In solar dryer. Three basic types are available:
   a) Tent solar dryer (direct system): the product is exposed to the sunlight.
   b) Cabinet solar dryer (direct or indirect).
   c) Chimney solar dryer (indirect): uses a separate solar collector which supplies heated air to the chamber containing trays with the product.



Tent solar dryer

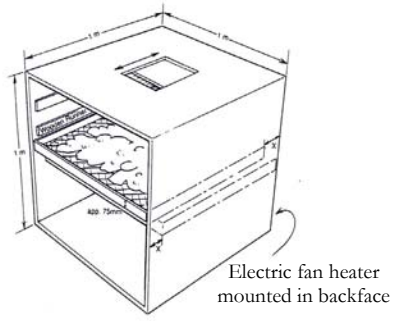


Cabinet solar dryer (direct)

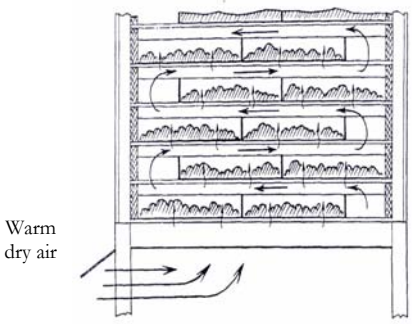


Chimney solar dryer (indirect)

3. In mechanical tray dryer: uses fuel to increase the air temperature.
4. In electric tray dryer: heated air is supplied by a fan heater.



Electric tray dryer



Mechanical tray (or cabinet) dryer

Solar drying or the use of an artificial dryer are both possible options that produce a better quality product.

Processing of dried amla

Fresh washed amla

Use only ripe fresh fruits without bruising or damage.

↓

Drain

1. Drain washed fruits in a stainless steel sieve.

↓

Cut into slices

2. Cut fruits into thick slices.

Add salt →

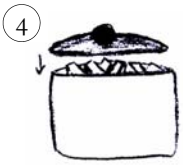
↓

Mix

3. Layer fruit slices with salt to draw moisture out of the fruits and to speed up the drying process.

↓

Cover and keep for 3-4 hours



4. Cover and keep in salt for 3-4 hours.

↓

Drain

5. Drain in a stainless steel sieve for 1 hour until all liquid has drained out.

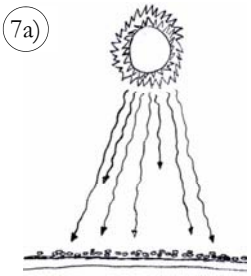
↓

Place on mesh trays

6. Place fruit slices in a single layer on the mesh dryer trays. Put them close together but not touching.

↓

Dry



7. Dry fruits:
   a) under bright sun for 6-8 days.
   b) in solar dryer for 4-5 days.
   c) in cabinet dryer at 60-65°C for 10-35 hours.

See page 14b for more information on drying.

Dried amla

8. Pack dried fruits in moisture-proof containers, e.g. 400 gauge polythene or polypropylene pouches and heat-seal them.

↓

Pack and seal

↓

Label

9. Label.

See also Technical Note 22.

Ingredients:

- Salt to cover fruits

Processing of dried ber

Graded + washed ripe fruits

↓

Blanch fruits

↓

Sulphur fruits

↓

Place on mesh trays

↓

Dry

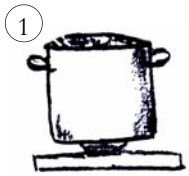
↓

Pack and seal

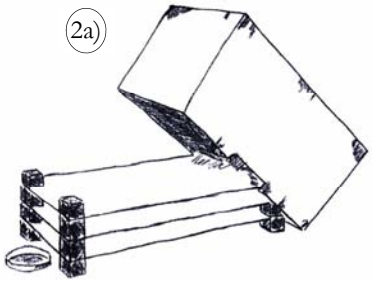
↓

Label

Use only ripe but firm fruits without bruising or damage. Golden yellow to reddish brown fruits give the best quality.

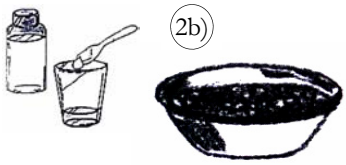


1. Blanch fruits by dipping them in boiling water for 2-6 minutes.

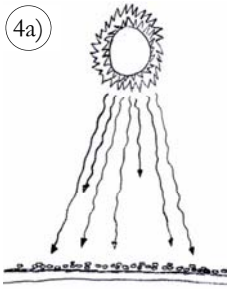


Low-cost sulphuring box

2. Sulphur or sulphite fruits (if available) by:
   a) Exposing them to SO_2 fumes in a box for 3 hours by burning sulphur powder at the rate of 3.5-10 g/kg fruit. Take a large cardboard box and slash it in several places to allow adequate ventilation. Make trays using bricks and wooden spools as spacers. Place the sulphur in a container well away from the side of the box and seal the bottom edges of the box with soil.
   b) Soaking them in a solution of sodiumsulphite or sodium metabisulphite (3 g/l).



3. Place fruits in a single layer on mesh trays. Put them close together but not touching.



4. Dry fruits:
   a) under bright sun for 7-10 days.
   b) in solar dryer for 4-5 days.
   c) in cabinet dryer at 60-65°C for 20-35 hours.

See page 14b for more information on drying.

5. Pack dried fruits in moisture-proof containers, e.g. 400 gauge polythene or polypropylene pouches or biscuit tins and heat-seal them.
6. Label.

See also Technical Note 22.

Ingredients:

- Sulphur powder, sodium sulphite or sodium metabisulphite (optional)

Special equipment required:

- Sulphuring box (optional)

Processing of dried jackfruit

Ripe jackfruit

↓

Cut in half

↓

Carve out core

↓

Scoop out bulbs

↓

Remove the seeds

↓

Cut into slices

↓

Blanch for 2 min

↓

Cool under cold water

↓

Place on mesh trays

↓

Dry

↓

Pack and seal

↓

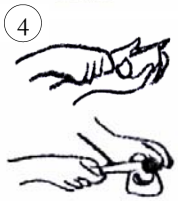
Label

Use only freshly harvested ripe fruits without bruising or damage.

1. Cut fruit in half lengthwise.

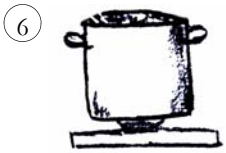
2. Carve out the core of the fruit.

3. Scoop out the bulbs.



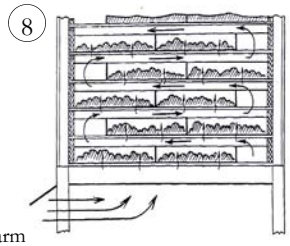
4. Cut the end of the bulbs to remove the seeds.

5. Cut deseeded bulb into two or four pieces.



6. Blanch fruit segments by plunging into boiling water for 2 minutes and cool them rapidly under clean cold water.

7. Place blanched segments in a single layer on mesh dryer trays. Put them close together but not touching to achieve the maximum capacity and an even rate of drying.



Warm dry air

8. Load trays into the drying cabinet and dry at 55°C for 6-7 hours until the moisture content is reduced to 5% (see page 14b for more information on drying).

Dried jackfruit

9. Remove trays and pack dried fruits immediately in moisture-proof containers, e.g. 400 gauge polythene or polypropylene pouches and heat-seal them.
10. Label.

See also Technical Note 22.

Processing of fruit leather

Product information

- They are dried sheets of fruit pulp, which have a soft, rubbery texture and a sweet taste.
- They can be made from most fruits, although mango, apricot, banana and tamarind leathers are amongst the most popular. They can be also made from a mixture of fruits. Sugar, chopped nuts or spices can be added to vary the flavour.
- They are eaten as snack foods instead of boiled sweets. They are also used as ingredients in the manufacture of cookies, cakes and ice cream.

Shelf-life: The preservation depends on their low moisture content (15-25%), the natural acidity of the fruit and the high sugar content. When properly dried and packaged, fruit leathers have a shelf-life of up to 9 months. In some places, sodium – or potassium metabisulphite is added to preserve the colour and to extend the shelf-life. The permitted levels for use are 0.005 to 0.2 % concentration in fruit leathers. If too much sulphite is used, it taints the fruit and gives it a bad taste. Preservatives are purchased from food processing ingredient suppliers, brewing shops or pharmacists.

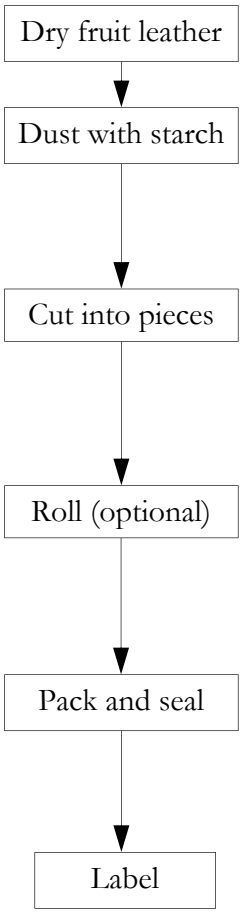
Equipment required

- Sharp stainless steel knife
- Blender or pulper
- Scale
- Bowls, containers
- Cooker or stove
- Boiling pan (stainless steel or aluminium)
- Measuring jug
- Spoons for measuring, wooden spoon for stirring
- Grease proof paper or plastic sheet
- Trays (stainless steel, plastic or wooden)
- Solar or mechanical dryer (optional)
- Polythene bags
- Heat sealer
- Self-adhesive labels

Quality control points:

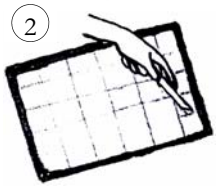
- **Use only ripe fruits without bruising or damage. Over-ripe ones can easily become damaged and bruised. Under-ripe fruits will not have the full flavour.**
- **Use a double boiling pan to avoid burning which can occur if direct heating is used.**
- **Weigh all ingredients to the correct formulation.**
- **Do not dry the leather in direct sunlight as there will be loss of colour and vitamins A and C.**
- **Dust the leather lightly with starch before packing to reduce their stickiness.**
- **Seal the leather packed in the form of a roll interleaved with greaseproof paper to avoid it sticking together.**
- **Check the correct fill-weight before sealing the bags.**
- **If available, use 400 gauge polypropylene bags as they provide greater protection against moisture.**

Packaging of fruit leather



Carry out the following steps after the drying operation:

1. Dust lightly with starch to reduce stickiness.



2. Cut pieces or strips of the desired weight and size.

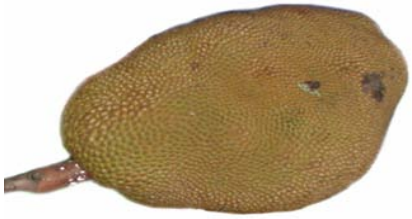
3. Roll them like a scroll (optional). To avoid them sticking together, lay them on a piece of grease proof paper and roll them with the paper.
4. Pack the final product in polythene or polypropylene bags and heat-seal them. To increase the shelf-life, place the bags into outer boxes to protect them from light.
5. Place labels on bags.

Lapsi leather – final product cut in pieces and packed in heat-sealed polythene bags

Dusted jackfruit leather roll

Tamarind leather rolls packed in heat-sealed polythene bags

Processing of jackfruit leather



Ripe jackfruit

Use only ripe but firm fruits without bruising or damage.

Cut in half

Carve out core

Scoop out the bulbs

Remove the seeds

Add sugar

Blend

Dissolve potassium metabisulphite (0.1 g/kg) in water and add

Concentrate mixture

Spread concentrate on trays

Dry

See page 15b for further steps

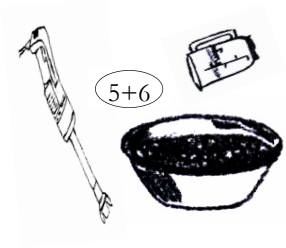
Jackfruit leather

1. Cut fruit in half lengthwise.

2. Carve out the sticky core.

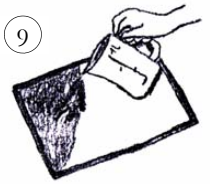
3. Scoop out the bulbs.

4. Cut the end of the bulbs to remove the seeds.

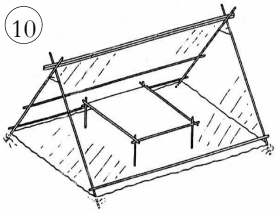


5. Add sugar (10-15% the weight of the bulbs = 100-150 g/kg) according to variety used and taste.
6. Blend the bulbs.

7. Dissolve preservative (e.g. potassium or sodium metabisulphite (0.1 g/kg) in water and add to the product.
8. Concentrate mixture in a steam-jacketed pan.



9. Spread concentrate on stainless steel trays lined with grease proof paper in 3 mm thickness.



10. Dry leather using a solar (2 days) or mechanical dryer (18 to 20 hours). Turn it over after 1 day in a solar dryer or 5 hours in an artificial dryer until the moisture content is 9-12% (see Technical Note 14 for more information on drying).

See page 15b for further steps regarding packaging of leather.

Ingredients for 1 kg de-seeded jackfruit bulbs:

- 100-150 g sugar
- 0.1 g sodium metabisulphite

Special equipment required:

Double boiling or steam-jacketed pan

Processing of lapsi leather

Fresh washed lapsi

Use only fresh fruits without bruising or damage.

Boil with water (lapsi:water=2:1)

Drain water

Peel fruits (manually)

Mash peeled fruits

Mash fruits with peel

Remove seeds

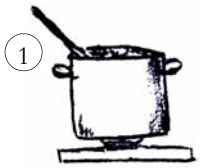
Spread pulp on trays

Dry

See page 15b for further steps

White lapsi leather

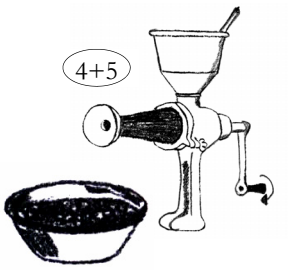
Black lapsi leather



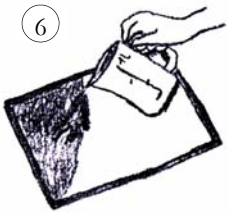
1. Boil graded and washed fruits in water (lapsi:water = 2:1) until the skin of the fruit splits.

2. Drain the water using a stainless steel sieve.

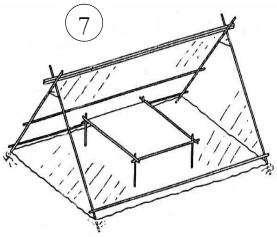
3. Remove the peel manually (only for white lapsi leather).



4. Mash fruits (peeled for white leather, including the peel for black leather) using a pulping machine (see photo).
5. Remove the seeds.



6. Spread pulp on stainless steel (alternatively plastic or wooden) trays lined with grease proof paper or plastic sheet in a thin layer of 5-10 mm.



7. Dry the pulp in the sun for 2 to 3 days or by using a solar dryer (see Technichal Note 14 for more information on drying).

See page 15b for further steps regarding packaging of leather.

Processing of tamarind leather

Mature tamarind pods

Use only ripe fruits without bruising or damage.

↓

Crack pods and separate pulp and fibres from shells

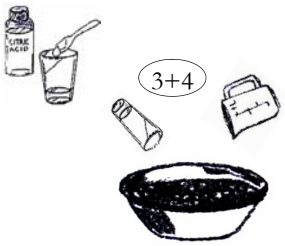
1. Crack the pods by hand and separate the pulp from the broken shells.
2. Peel and remove the fibres, shell pieces and seeds from the pulp.

↓

Remove seeds

↓

Prepare either:
- citric acid or lemon juice dip
- sulphite dip



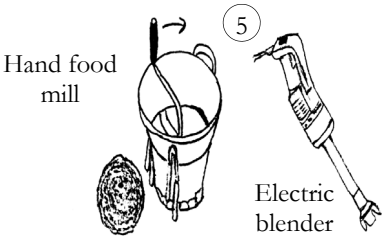
3. Prepare either citric acid, lemon juice or sulphite dip. For the latter dissolve 6 g metabisulphite in 10 l of water.
4. Dip pulp for 5-10 minutes (optional).

↓

Dip for 5-10 min

↓

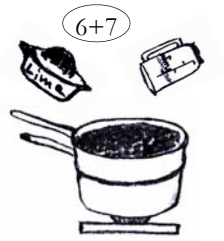
Puree pulp



5. Puree pulp by hand, using a food mill, a food liquidiser or a high-speed blender.

↓

Heat



6. Heat puree to 90ºC using a double boiling pan.
7. Add sugar (10-15% the weight of the pulp = 100-150 g/kg) according to taste to improve the flavour.

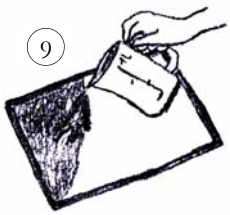
Add sugar and citric acid or lemon juice

Add nuts, spices and other flavourings (optional)

8. Add nuts, spices and other flavourings to improve the flavour (optional).

↓

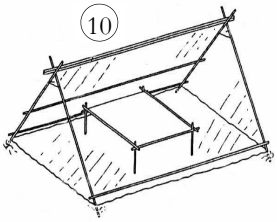
Spread pulp on trays



9. Pour the fruit puree in a thin layer (3-6 mm thick) onto plastic or wooden trays lined with grease proof paper or plastic sheet.

↓

Dry



10. Dry the leather using a solar or mechanical dryer (see Technical Note 14 for more information on drying).
11. Turn the leather over to dry it from the other side after 1 day in a solar dryer or 5 hours in an artificial dryer.

See page 15b for further steps

See page 15b for further steps regarding packaging of leather.

Ingredients for 1 kg tamarind pulp:

- Citric acid, lemon juice or sodium metabisulphite for dip (optional)
- 100-150 g sugar
- Nuts and spices (optional)

Processing of candies and preserves

Product information

Candied fruits:

- They are also known as crystallised fruit.
- They are made by submerging fruit pieces in sugar syrup solutions of gradually increasing strength, then drying. During the soaking, sugar is absorbed by the fruit and moisture is lost from the fruit.

Shelf-life: The preservation relies on the high sugar and the low moisture content. They can be kept for several months when stored in a cool dry place, away from direct sunlight.

Preserves:

- They are prepared by soaking mature fruits in sugar solution and keeping them in syrup.

Shelf-life: They can be kept for several months due to the high sugar content, when stored in a cool dry place, away from direct sunlight.

Equipment required

- Sharp stainless steel knife
- Scale
- Bowls, containers
- Cooker or stove
- Boiling pan (stainless steel or aluminium)
- Stainless steel sieve
- Spoons for measuring, wooden spoon for stirring
- Refractometer or hydrometer
- Measuring jug
- Wire trays
- Solar dryer (optional)
- Jars, tins, cartons or polythene bags
- Capping machine or heat sealer
- Labels and label gummer or self-adhesive labels

Quality control points:

- **Use only fully mature fruits at the hard stage without bruising or damage.**
- **Use only refined, granular white sugar.**
- **Weigh all ingredients to the correct formulation.**
- **To be efficient, it is essential to recycle the syrup solution and use it for several batches always adjusting the °Brix value to the required level by adding more sugar. However, re-use the syrup solutions only 3 to 4 times, as the heating required to dissolve the extra sugar begins to impart a burnt taste to the syrup.**
- **If available, check the correct sugar content by using a refractometer.**
- **Check the correct fill-weight before sealing the bags.**
- **If available, use 400 gauge polypropylene bags as they provide greater protection against moisture.**

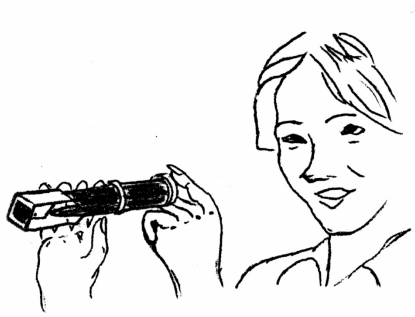
Preparation of sugar syrup solutions

1. Prepare the first sugar syrup solution of 40°Brix by dissolving 400 g sugar in a small amount of water and make the volume up to 1 litre.
2. Increase the concentration of the sugar solution by adding sugar and using a refractometer. The refractometer has a scale which gives a reading in percent of sugar present.
3. Alternatively the sugar syrup concentration can be measured by using a hydrometer, which measures specific gravity, density or baume (see table for relationship between °Brix and other measuring units). Use the hydrometer very carefully because it is made from glass, which may break and contaminate the food.

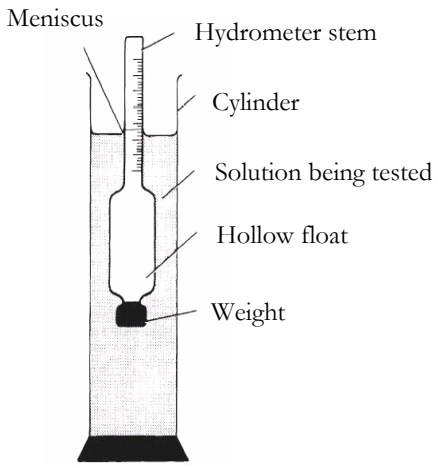
The strength of sugar solutions is measured in °Brix.

1% sugar solution = 1°Brix

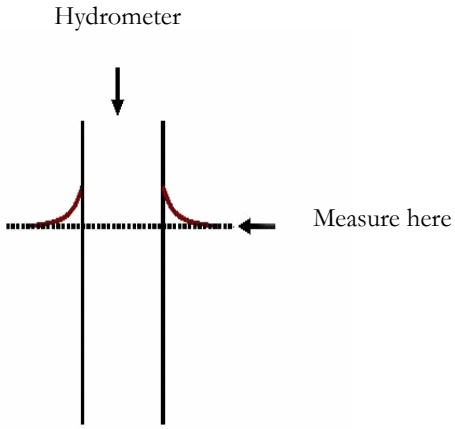
°Brix	Specific gravity 20°C	Density	Baume
30	1.13	1.12	10.57
40	1.17	1.16	21.97
50	1.23	1.23	26.28
60	1.29	1.29	32.49
72	1.36	1.36	38.55



Hand-held refractometer



Hydrometer



How to read a hydrometer

Processing of ber preserve and candy

Graded and washed fruits

Prick

Blanch

Rinse in cold water

De-stone

Impregnate with sugar

Keep fruits submerged in syrup for 10-25 days

Drain off the syrup

Dry fruits

Pack **candies**

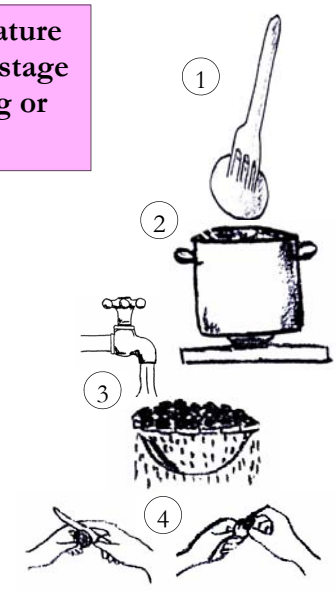
Label

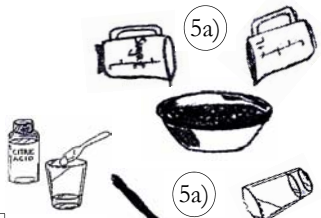
Pour **preserve** into jars or pouches and seal

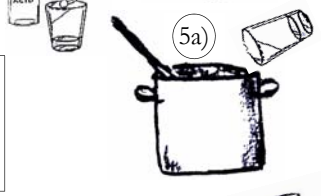
Label

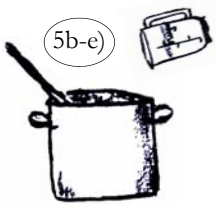
Roll over powdered sugar

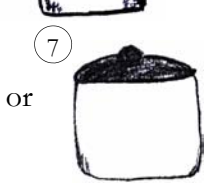
Use only fully mature fruits at the hard stage without bruising or damage.

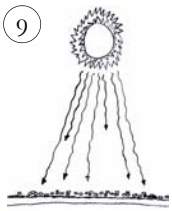


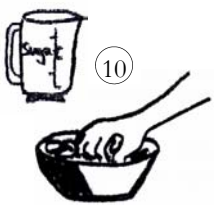












Ingredients:

- Sugar to prepare syrup
- Citric acid to prepare syrup (5g/l)
- Sugar powder (optional)

Special equipment required:

- Fork or pricking board
- De-stoner (optional)

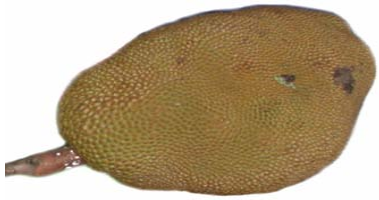
1. Prick fruits using a fork or a pricking board to improve the uptake of sugar.
2. Blanch fruits by dipping in boiling water for 2-10 minutes (according to the cultivars).
3. Rinse fruits in cold water.
4. De-stone fruits (optional).
5. Impregnate fruits with sugar:
   a) Submerge overnight in 30º Brix syrup and add 0.5% (5 g/l) citric acid.

   Slowly increase the strength of the sugar syrup:
   b) Add 250 g sugar/kg fruit to syrup and boil for a few minutes.
   c) On 4th day, repeat b).
   d) On 6th day, repeat b).
   e) Let the total solids of contents equalise for 2 days (65-70º). Measure with a refractometer.
6. Pour preserve into pre-sterilised jars, seal and label.
7. For processing into candied ber, keep the fruits submerged in the syrup for another 10-25 days.
8. Spread fruits on wire trays to drain the syrup.
9. Dry the drained fruits in the sun or in a warm room until they reach 10 to 15% moisture (see Technical Note 14 for more information on drying).
10. Roll fruits over powdered sugar to prepare a crystallised product (optional).
11. Pack candies in jars, tins, cardboard cartons or in polythene pouches.
12. Label.

CANDIES and PRESERVES

16c

Processing of jackfruit candy



Ripe jackfruit
↓
Cut in half
↓
Carve out core
↓
Scoop out bulbs
↓
Remove the seeds
↓
Soak in brine for 2 days
↓
Wash and drain to remove salt
↓
Boil bulbs for 5 minutes in syrup
↓
Keep for 24 hours
↓
Remove bulbs
↓
Immerse bulbs for 24 hours
↓
Remove bulbs
↓
Immerse bulbs for 24 hours
↓
Remove bulbs and rinse in water
↓
Drain
↓
Dry
↓
Pack and seal → Label

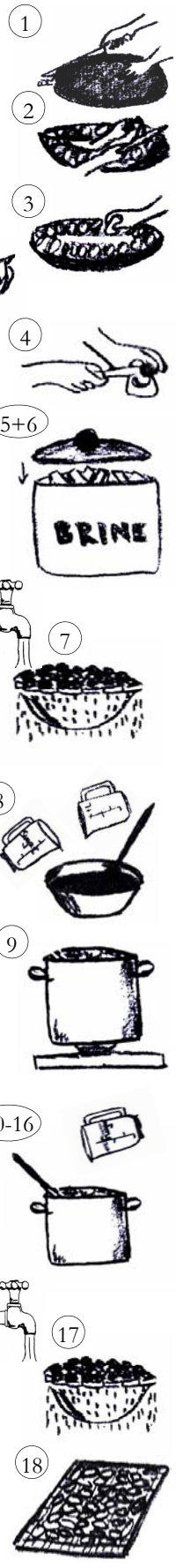
Use only freshly harvested ripe fruits without bruising or damage.

Prepare brine solution (15% salt and 1% calcium chloride)

Prepare 40°Brix sugar syrup

Add sugar to obtain 50°Brix

Add sugar to obtain 62°Brix



1. Cut fruit in half lengthwise.
2. Carve out the core of the fruit.
3. Scoop out the bulbs.
4. Cut the end of the bulbs to remove the seeds.
5. Prepare a brine solution containing 15% salt (150g/l) and 1% calcium chloride (10g/l).
6. Soak bulbs in brine solution for 2 days. Place a wooden plate with a weight on top of the fruit to keep them submerged in the brine.
7. Remove the bulbs from the brine, wash to remove the salt and drain using a stainless steel sieve. Check the flavour to ensure that all salt has been removed.
8. Prepare sugar syrup of 40°Brix.
9. Boil the deseeded bulbs for 5 minutes in the syrup.
10. Keep mixture at room temperature (28-31°C) for 24 hours.
11. Remove bulbs from the syrup.
12. Add more sugar to the syrup until it is 50°Brix (use a refractometer).
13. Immerse bulbs in the syrup and keep at room temperature for 24 hours.
14. Remove bulbs from the syrup.
15. Add more sugar to the syrup until it is 62°Brix.
16. Immerse bulbs in the syrup and keep at room temperature for 24 hours.
17. Remove bulbs and quickly rinse in water to remove surface syrup.
18. Drain off the syrup by spreading on wire trays.
19. Dry drained fruits for about 1 day in a solar or tray dryer.
20. Pack candies in jars, tins, cardboard cartons or in polythene pouches and seal them.
21. Label.

Ingredients:

- Salt to prepare brine solution (150 g/l)
- Calcium chloride to prepare brine solution (10 g/l)
- Sugar to prepare syrup

Processing of lapsi candy

Fresh washed lapsi

↓

Boil with water (lapsi:water=2:1)

↓

Drain water

↓

Peel fruits (manually)

↓

Mash peeled fruits

↓

Remove seeds

↓

Add sugar (1:1) → Mix

↓

Spread pulp on trays (1 cm thick)

↓

Dry for 4-5 days

↓

Cut into pieces

↓

Roll over sugar powder

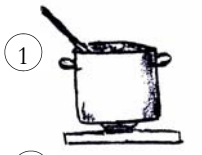
↓

Pack and seal

↓

Label

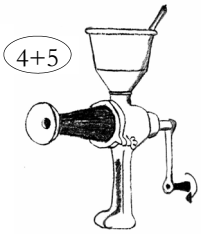
Use only fresh fruits without bruising or damage.



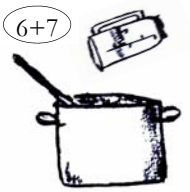
1. Boil graded and washed fruits in water (lapsi:water = 2:1) until the skin of the fruit splits.

2. Drain the water using a stainless steel sieve.

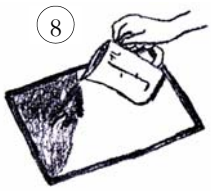
3. Remove the peel manually.



4. Mash fruits (using a pulping machine).
5. Remove the seeds.

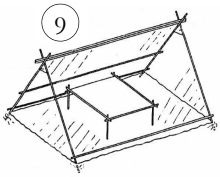


6. Add sugar (pulp:sugar = 1:1).
7. Mix thoroughly.

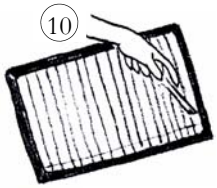


8. Spread pulp on stainless steel (alternatively plastic or wooden) trays lined with grease proof paper or plastic sheet in a layer of 1 cm. Alternatively, place portions of pulp of required size with a teaspoon on the trays (see photo).

Portions of lapsi pulp placed on trays

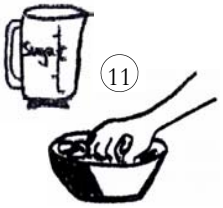


9. Dry the pulp in the sun or in a solar dryer for 4-5 days (see Technical Note 14 for more information on drying).



10. Cut pulp in the required size and shape.

Lapsi candies



11. Roll pieces in sugar powder to prevent stickiness (optional).
12. Pack candies in jars, tins, card board cartons or in polythene pouches and seal them.
13. Label.

Ingredients for 1 kg lapsi pulp:

- 1 kg sugar
- Sugar powder (optional)

Special equipment required:

- Pulper
- Grease proof paper or plastic sheets
- Trays (stainless steel, plastic or wooden)

Processing of powder

Product information

- They are made from dehydrated fruits by grinding into a powdered form.
- They are used in ayurvedic preparations or as an ingredient in pickles and sour foods.

Shelf-life: The preservation relies on the very low moisture content of less than 15% and increased acidity. When properly packaged, they have a shelf-life of up to one year.

Equipment required

- Scale
- Bowls, containers
- Cooker or stove
- Boiling pan (stainless steel or aluminium)
- Mesh trays
- Solar or cabinet dryer (optional)
- Pestle and mortar or grinder
- Stainless steel sieve
- 400 gauge polythene bags
- Heat sealer
- Self-adhesive labels

Quality control points:

- **Use only ripe but firm and good quality fruits without bruising or damage.**
- **Blanch fruits in order to induce the development of a uniform colour, to soften the fruit for uniform dehydration and to control the activity of enzymes and micro-organisms. The optimum time required depends on fruit species and cultivars.**
- **If available, dry the fruits in a solar or cabinet dryer to improve the quality. By sun drying only, a fairly good product is obtained.**
- **Check the correct fill-weight before sealing the bags.**
- **If available, use 400 gauge polypropylene bags as they provide greater protection against moisture.**

POWDER

Processing of amla powder

Fresh washed amla

Use only ripe fresh fruits without bruising or damage.

↓

Drain

↓

Cut into slices

↓

Add salt →

↓

Mix

↓

Cover and keep for 3-4 hours

↓

Drain

↓

Place on mesh trays

↓

Dry

↓

Grind into powder

↓

Sieve

↓

Pack and seal

↓

Label

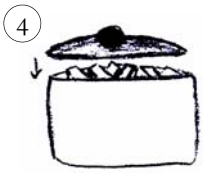
Ingredients:

- Salt to cover fruits

1. Drain washed fruits in a stainless steel sieve.

2. Cut fruits into thick slices.

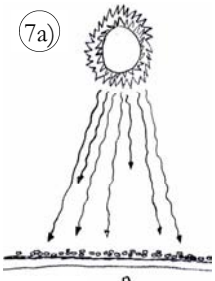
3. Layer fruit slices with salt to draw moisture out of the fruits and to speed up the drying process.



4. Cover and keep in salt for 3-4 hours.

5. Drain in a stainless steel sieve for 1 hour until all liquid has drained out.

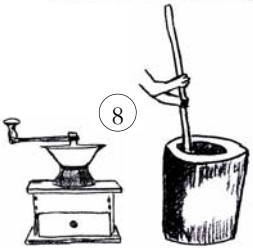
6. Place fruit slices in a single layer on the mesh dryer trays. Put them close together but not touching.



7. Dry fruits:
   a) under bright sun for 6-8 days,
   b) in solar drier for 4-5 days,
   c) in cabinet drier at 60-65°C for 10-35 hours,

   to a final moisture content of 5%.

   See Technical Note 14 for more information on drying.



8. Grind fruits into a powder using pestle and mortar or a grinder.

9. Sieve powder to remove lumps and unground material.

10. Pack powder in moisture- proof containers, e.g. 400 gauge polythene or polypropylene pouches and heat-seal them.
11. Label.

See also Technical Note 22.

17b

Processing of bael powder

Bael breaking equipment

Ripe fresh bael

Use only ripe fresh fruits without bruising or damage!

↓

Break fruits

↓

Scoop pulp and discard seeds and peel

↓

Pass through pulper

Add sodium carbonate →

↓

Mix

↓

Spread pulp on trays

↓

Dry

↓

Cut into pieces

↓

Dry

↓

Grind into powder

↓

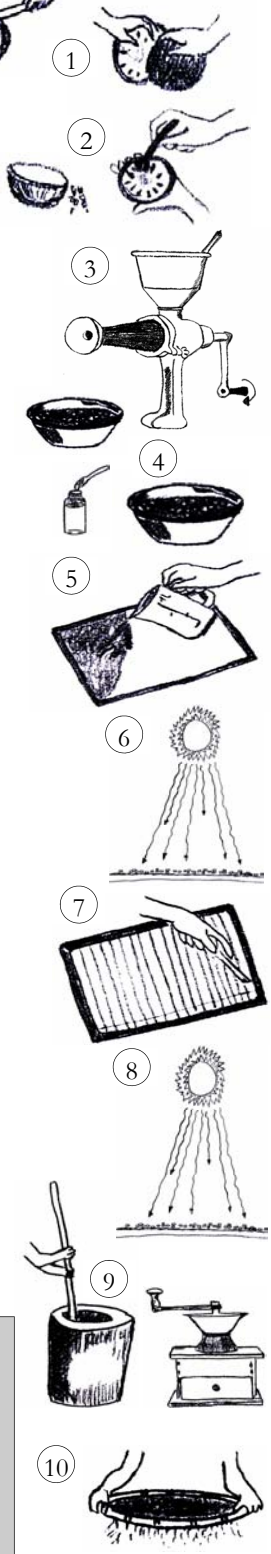
Sieve

↓

Pack and seal

↓

Label



1. Break fruits using a strong knife or special bael breaking equipment (see photo).
2. Scoop out the pulp using a spoon. Discard the seeds and peel.
3. Pass the pulp through the pulping machine.
4. Add 2000 ppm (2g/l) sodium carbonate (Na_2CO_3) and mix.
5. Spread pulp on stainless steel (alternatively plastic or wooden) trays lined with grease proof paper or plastic sheet in a thin layer.
6. Dry the pulp in the sun for 2-3 days or by using a solar dryer until the moisture content is approximately 10% (see Technical Note 14 for more information on drying).
7. Cut dried sheets into pieces.
8. Dry pieces until the moisture content is 4%.
9. Grind pieces into a powder using a grinder or by pounding them using pestle and mortar.
10. Sieve powder to remove lumps and unground material.
11. Pack powder in moisture-proof containers, e.g. 400 gauge polythene or polypropylene pouches and heat-seal them.
12. Label.

See also Technical Note 22.

Ingredients for 1 kg bael pulp:

- 2 g sodium carbonate (Na_2CO_3, usually available from pharmacists)

Special equipment required:

- Bael breaking equipment or sharp strong knife
- Pulping machine
- Grease proof paper or plastic sheet
- Trays (stainless steel, plastic or wooden)
- Jug

POWDER

17c

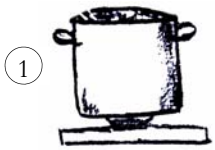
Processing of ber powder

Graded + washed ripe fruits

Use only ripe but firm fruits without bruising or damage.

↓

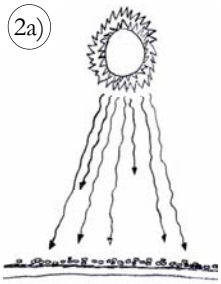
Blanch fruits



1. Blanch fruits by dipping them in boiling water for 2-6 minutes.

↓

Dry

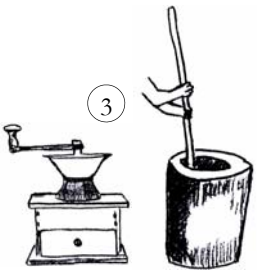


2. Dry fruits:
   a) under bright sun for 7-10 days.
   b) in solar dryer for 4-5 days.
   c) in cabinet dryer at 60-65°C for 20-35 hours.

   See Technical Note 14 for more information on drying.

↓

Grind into powder



3. Grind dried fruits into a powder using a grinder or by pounding them using pestle and mortar.

↓

Sieve

4. Sieve powder to remove lumps and unground material.

↓

Pack and seal

5. Pack powder in moisture-proof containers, e.g. 400 gauge polythene or polypropylene pouches and heat-seal them.

↓

Label

6. Label.

See also Technical Note 22.

Processing of jackfruit powder

Ripe jackfruit

Use only freshly harvested ripe fruits without bruising or damage.

Cut in half

Carve out core

Scoop out bulbs

Remove the seeds

Cut into slices

Blanch for 2 minutes

Cool under cold water

Place on mesh trays

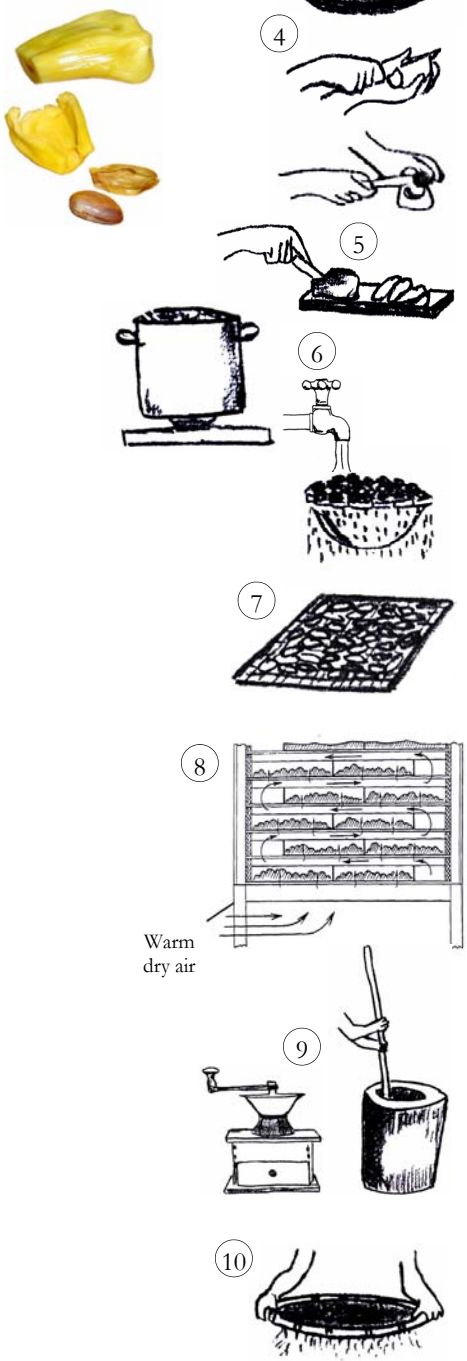
Dry

Grind into powder

Sieve

Pack and seal

Label



1. Cut fruit in half lengthwise.
2. Carve out the core of the fruit.
3. Scoop out the bulbs.
4. Cut the end of the bulbs to remove the seeds.
5. Cut deseeded bulb into 2-4 pieces.
6. Blanch fruit segments by plunging into boiling water for 2 minutes and cooling them rapidly under clean cold water.
7. Place blanched segments in a single layer on the mesh dryer trays. Put them close together but not touching to achieve the maximum capacity and an even rate of drying.
8. Load trays into the drying cabinet and dry at 55°C for 6-7 hours until the moisture content is reduced to 5% (see Technical Note 14 for more information on drying).
9. Grind pieces into a powder using a grinder or by pounding them using pestle and mortar.
10. Sieve powder to remove lumps and unground material.
11. Pack powder in moisture-proof containers, e.g. 400 gauge polythene or polypropylene pouches and heat-seal them.
12. Label.

See also Technical Note 22.

POWDER

17e

Conducting a feasibility study

An idea for a business is not a sufficient reason to begin production straight away. It is essential to be aware of the different aspects involved in actually running the business. To reduce the risk of failure, producers should first go through the following aspects and finally develop a business plan.

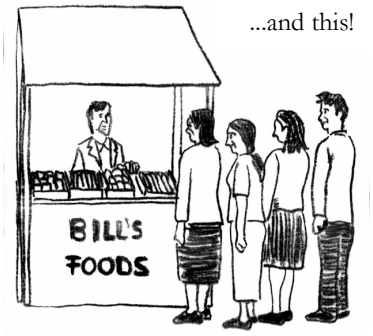
1. Assess yourself as an entrepreneur

The success of any business depends largely on the entrepreneur's personal characteristics, skills and financial situation. To be a successful entrepreneur you need to:

- Have a strong commitment to your business
- Have strong motivation to own your business
- Be able to take considered risks and to make important decisions
- Have the support of your family and friends
- Have the necessary technical skills to produce the product of your business
- Have enough business management skills, such as selling, record-keeping and costing, to run a business of your own
- Have sufficient knowledge of your line of business (post-harvest handling and storing of fruits)
- Have sufficient personal funds

A feasibility study can sometimes make the difference between this...

...and this!



2. Conduct a feasibility study

To reduce the risk of failure it is necessary to decide whether the idea is feasible. This involves carrying out a short market survey and a feasibility study. The following are the three stages of a feasibility study:

1st stage: Market feasibility

- Market research
- Selling strategy
- Expected market size/share
- Competitors

→

2nd stage: Technical feasibility

- Scale of production needed to meet market share
- Equipment, materials, services and labour needed for scale of production selected
- Quality control
- Distribution

←

3rd stage: Financial feasibility

- Startup costs
- Loan required
- Cashflow for one year (income and expenditure)
- Business development over three years
- Profitability/sustainability

→

Decision

FEASIBILITY STUDY

18a

2a. Market feasibility

I. Market research: The necessary steps of market research for fruit products are as follows:

- **Work out the size of the potential market:**
  - *What is the potential market area?*
  - *Who will be the potential customers?*
  - *What are the potential outlets?*
  - *Who will be the competitors?*
  - *How much of the product can be sold? (What quantities of the product are already sold and what quantities of similar products are being sold?)*
  - *What is the seasonality of demand?*

☞ What is market research?

Market research is the process of investigating a market to find out the sales prospects for a product and how to achieve success with it. It is the set of activities necessary to obtain the information required about the market. Market research activities include:

⇒ Consumer questionnaires;
⇒ Tasting tests, to see if people accept the product, or which taste they prefer;
⇒ Interviews with retailers and wholesalers.

Market research is important to avoid the failure of processing ventures.

- **Research consumer attitudes towards the new products:**
  - *What, where, and when do consumers buy?*
  - *What are consumers' preferences about tastes, smell, texture, etc.?*
  - *What is the consumers' reaction to packaging and labelling?*

- **Find out how the new products can be made attractive to consumers:**
  - *What are the size units and prices of competing products, according to location?*
  - *Where are quality weaknesses of the competition?*
  - *Which containers are used for competing products?*
  - *Which labelling is used by competitors and what are the legal obligations regarding label and contents?*

- **Identify the most appropriate option for distributing products:**
  - *Direct to consumers? To suitable retailers in an area? To supermarkets (if sufficient quantities can be delivered)? To wholesalers (suitable for larger processors)? To institutions and the catering trade?*
- **The factors to be considered in deciding on the marketing channel to use include:**
  - *Quantities processed and quantities required by distributors, transport and payment arrangements, margins and mark-ups.*

II. Market share: Estimate the proportion of the total market that the new business could expect to have (likely market share).

III. Scale of production: Once you have found information about potential consumers, their requirements and the likely share of the market that could be obtained for a new product, it is necessary to calculate the monthly and daily production required to meet that demand (see example).

The figure for the daily production rate is central to all following calculations of production capacity and investment requirements and it should therefore be as accurate as possible.

Notes on calculation – example for tamarind pickle production:

Estimated market size	14,240 kg/month
Estimated share of market	5 %
Production required per month to meet market share	712 kg
Production required per day @ 20 days work per month:	35.6 kg
Minimum process throughput @ 8 hours per day	4.5 kg/hr

2b. Technical feasibility

Once the scale of production needed to supply the likely share of the market is known, it is necessary to assess whether production at this scale is technically feasible. Therefore you have to:

- *Identify the raw material supply, their quality and buying costs;*
- *Identify production location and product quality;*
- *Identify price and price seasonality;*
- *Research sources and costs of services (fuel, water, electricity etc.) and other processing inputs;*
- *Identify sources and costs of packaging and label design;*
- *Identify distribution procedures to retailers or other sellers;*
- *Research availability of information and expertise to ensure that products are always made at the required quality;*
- *Research availability and costs of the equipment needed;*
- *Research availability of maintenance and repair costs of the equipment needed;*
- *Clarify labour requirements, costs and availability.*

Is electricity available and is the supply reliable?

To plan the different aspects of the production process, first put together a modified process chart showing the scale of operation and daily requirements for production (see table on page 18g showing an example for the processing of tamarind pickle). The chart is used to identify the:

I. Weights of raw materials and ingredients that should be scheduled each day.
II. Number and size of equipment required to achieve the planned throughput of product.
III. Number of packages that are required each day.
IV. Number of workers and their different jobs.

I. Weights of raw materials and ingredients

The different steps to identify the weights of raw materials and ingredients are as follows:

1. Experiment with different mixes of ingredients to produce a product that has the colour, flavour, appearance etc. that consumers like. Weigh each ingredient carefully and record all weights for each formulation tried.
2. Develop a successful formulation. Take care that it is always made in exactly the same way.
3. Experiment with different varieties of fruits and the particular process that is being used to calculate the actual amount of losses (see also table showing typical losses during the processing of fruits).
4. Calculate the amount of raw materials and ingredients that are needed to produce the required weight of product each day.

Typical losses during processing:	
Activities in a process	**Typical losses (%)**
Washing fruits	0-10
Sorting	5-50*
Peeling	5-60
Slicing/dicing	5-10
Batch preparation/weighing	2-5
Boiling**	5-10
Drying**	10-20
Packaging	5-10
Accidental spillage	5-10
Rejected packs	2-5

* Unsatisfactory raw materials depend on source and agreements with suppliers

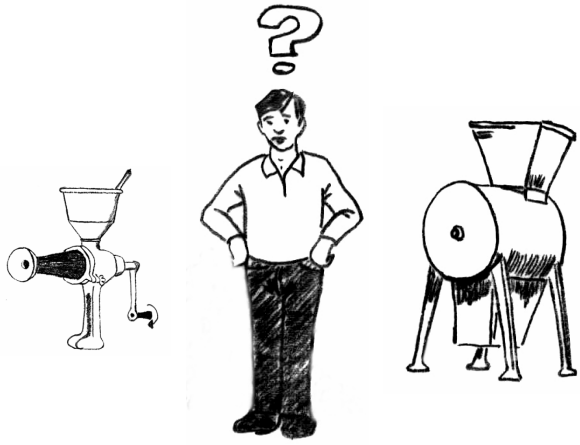
** does not include evaporation losses

How much raw material is needed to produce the required weight of product to meet the demand?

II. Equipment required:

Calculate the weight of food that should be processed at each stage (in kg per hour), using the process chart. Then decide on the type and size of equipment required.

Can I afford the costs for maintenance and repairs to the equipment?



Is the equipment too small or too large for the expected scale of production?

It is preferable to buy equipment from local suppliers because servicing and obtaining of spare parts should be faster and easier.

III. Packaging:

Decide on the type of packaging material and calculate the number of packages that is needed daily.

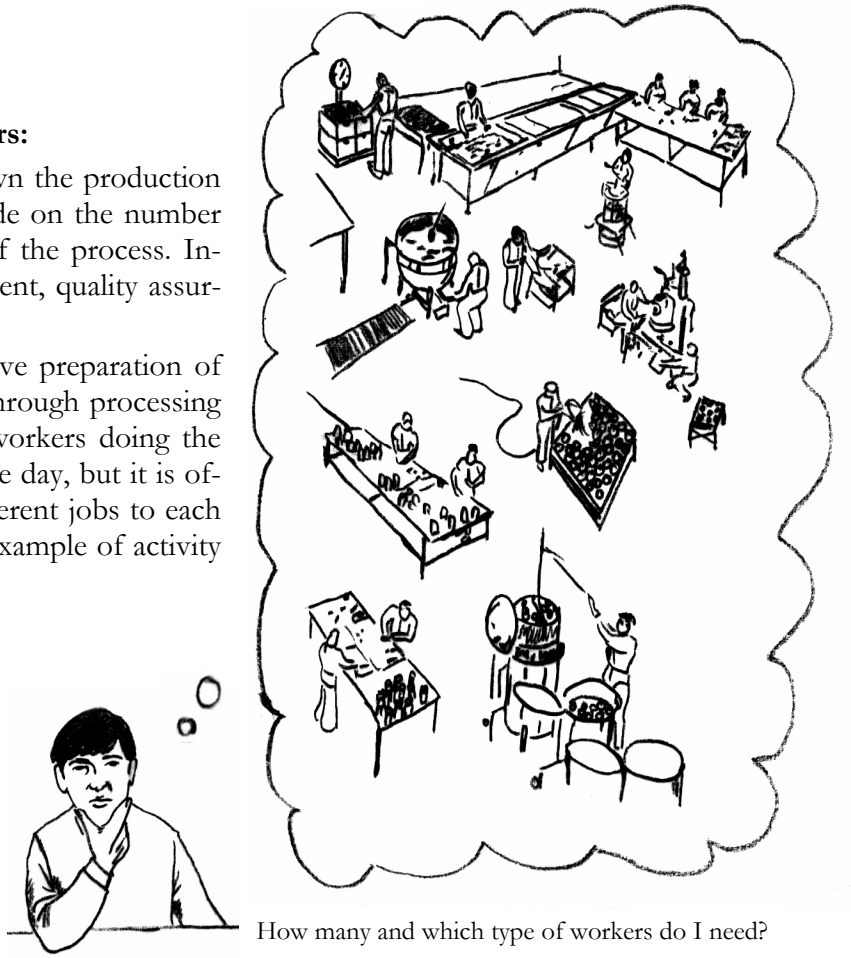
Which packaging material is the most convenient and cost effective?

Take into account the technical requirements of the product for protection against light, crushing, air, moisture etc., the marketing requirements and the relative costs and availability.

IV. Number and type of workers:

Use the process chart to break down the production into different stages and then decide on the number of people needed for each stage of the process. Include tasks such as store management, quality assurance and book-keeping.

Each day's work will initially involve preparation of the raw materials and then move through processing and packaging. You can have all workers doing the same type of activity throughout the day, but it is often more efficient to distribute different jobs to each worker as the day progresses (see example of activity chart on page 18g).



How many and which type of workers do I need?

2c. Financial feasibility

After completing the technical feasibility study, you should have sufficient information to determine the costs involved in production. Additionally, the market survey will have supplied information about the sale price that could be achieved for the new product. You can now calculate the expected income and expenditure and the gross profit that can be achieved.

Do you have enough money to start a business?

I. Start-up costs

Calculate the start-up capital and initial working capital to determine whether your savings (also called "equity") will be sufficient to start the business. If not, a loan may be needed from a bank or other lender.

II. Operating costs

Calculate your fixed and variable operating costs in advance based on the likely market share. If a loan is taken, the costs of repayment should be included in the fixed costs.

☞ What are operating costs?

The costs involved in producing a fruit product can be divided into:

- **<u>Fixed costs:</u> expenses that have to be paid even if no production takes place.**
- **<u>Variable costs:</u> expenses that depend on the amount of fruit products that are produced.**

☞ What are start-up costs?

The <u>start-up capital</u> is the amount of money that is needed to:

- **buy or convert the facilities and equipment,**
- **register and licence the business,**
- **get the necessary hygiene certificates.**

<u>Working capital</u> includes the costs of:

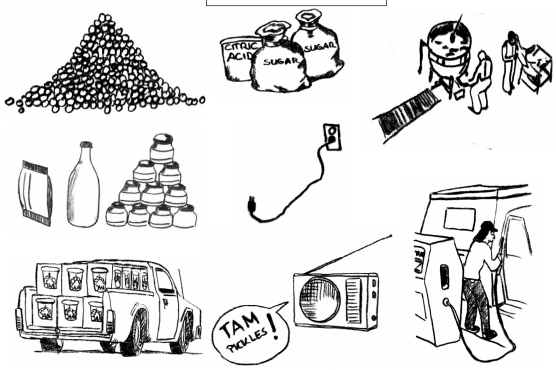
- **raw materials and ingredients,**
- **packaging,**
- **staff training,**
- **initial product promotion, and**
- **staff salaries for 6 weeks**

that have to be made before the business starts to generate income from sales of the product.

Operating costs for tamarind pickle production and income:	
FIXED COSTS	
Rent	
Labour (permanent staff + owner's salary)	
Insurance	
Loan repayment	
Interest charges	
Professional fees (e.g. accountant's fees)	
Depreciation of equipment (over 3 years)	
Maintenance/repair (building and equipment)	
Business registration fees, hygiene certificates and other licences	
Total fixed costs:	
VARIABLE COSTS	
Raw materials	
Other ingredients	
Fuel	
Power	
Packaging material	
Transport/distribution	
Labour	
Advertising and promotion	
Total variable costs:	
TOTAL OPERATING COSTS PER YEAR	
INCOME (at $ XXX per pot/bag)	
GROSS PROFIT (income-costs)	

Fixed costs

Variable costs



III. Income and profit

Calculate the expected sales and income using information from the market survey. The income depends on both the price of a product and the amount that is sold.

Setting the price of the product:

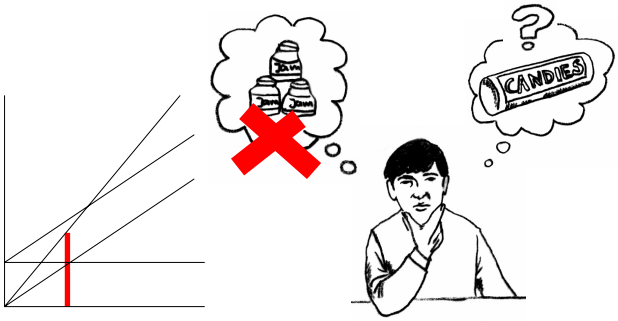
The correct price is important to be able to enter the market and to sell the product at a profit. There are two approaches:

1. Base price on production costs and set it to ensure that income exceeds the total costs.
2. Take into account competitors' prices and set price of the new product at or below the price of other similar products. Don't forget to include the profit expected by the wholesaler or retailer.

☞ What is the breakeven point?

This is the production level at which the total costs will equal the total income if everything produced is sold. Calculate the breakeven point as follows:

$$\frac{\text{Fixed costs}}{\text{Revenue – Variable costs}} = \text{Production level at breakeven point}$$



If the production level is below the breakeven point, forget the idea and choose another product

IV. Financial planning

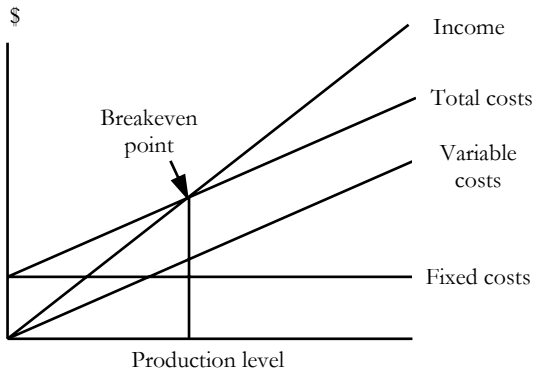
If the gross profit indicates that the proposed fruit processing is likely to be successful, you still need to carry out a **cashflow analysis**:

1. Compile a table (see example), showing sales incomes and expenses on a monthly basis for the first year. Work out when you have to spend money for equipment, raw materials, employees and when you can expect to be paid for your deliveries.
2. Calculate the monthly profit or loss by subtracting the expenses from the income. This will show when there are profitable months or when a loss is expected and further loans are needed.
3. Prepare a similar table for the next two years taking into account increases in price, changes in sales and the action of competitors.

☞ What is gross profit (or loss)?

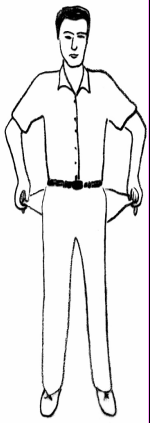
This is the difference between the expected income and the total operating costs over the first year, including any loan repayments. Calculate the income as follows:

Income = selling price per unit x number of units sold



The production level should be above the "breakeven point" for the business to be profitable. If this is not the case, you should examine the data to see if production costs can be reduced. If not, you should forget the idea and start again with a different product.

It is important to carry out a cashflow analysis to ensure that the cash you plan to put into the business, will be enough to meet your needs on a continuing basis.



- **Will you spend all your available cash before you are earning any revenue?**
- **Will you be able to pay your bills?**
- **Will you be able to buy raw material and ingredients?**

If not, you are likely to have problems, even if your earlier calculations have shown that the business will be profitable.

Cashflow plan:			
	Jan	**Feb**	**Mar**
Cash beginning of the month			
Cash in from sales			
Any other cash in			
TOTAL CASH IN			
Cash out for staff costs			
Cash out for operation costs			
Any other cash out			
TOTAL CASH OUT			
Cash end of the month			

Example: Tamarind pickle production

For the production of approximately 35.6 kg of tamarind pickle, approximately 45 kg of tamarind pods are needed.

Modified process chart showing scale of operation and daily requirements for processing of tamarind pickle:

Processing stage	% losses	Weight of fruits (kg)	Weight of other ingre-dients (kg)	Batch size (kg)	Process-ing time (minutes)	No. of workers	Minimum equipment size (kg/hr)
Tamarind pods		**45**					Scale
Crack and remove shells and fibres	11	40			240	2	Table or canvas cover for 2 workers, plastic bowls, con-tainers
Remove seeds	34	26.4					
Add sugar	5	26.4	26.4	50.2	240	1	Scale
Add spice mix	5	26.4	13.0	**60.0**			Mortar and pestle, spoons
Boil	34			39.6			Cooker or stove, 12-15 l boiling pan, wooden spoon
Fill and seal	10			**35.6**	180	2	Table, measuring jug, jars and lids (or plastic bags), Capping-or sealing machine
Cool and label				**35.6**	120	1	Labels and label gummer
Store				**35.6**			Cool, dark room, shelves
Weight of product				**35.6**			

Notes on calculations:

Capacity of boiling pan

If each batch takes approximately 30 minutes to boil, 1.5 batches can be prepared per hour. In order to meet the production target of 60 kg of raw materials, yielding 35.6 kg of product every day, 4 hours are needed to prepare 6 batches of 10 kg each. The boiling pan should therefore have a capacity of 12-15 litres.

Cracking and removing of shells, fibres and seeds

It requires 8 man-hours to shell and deseed 45 kg of fruits. 2 workers are needed to complete this task in 4 hours. Since tamarind pulp can easily be stored without deterioration, the cracking and removing of shells, fibres and seeds could be carried out in advance.

Filling and sealing of bags

Each worker can fill and seal 40 jars or bags of 150 g net weight per hour. 35.6 kg produces 237 bags or jars. 2 workers are needed to complete this activity in 3 hours.

Activity chart used to plan allocations for staff to produce tamarind pickle:

	Hours during working day									
Activity	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Cracking/removing seeds	X,Y	X,Y	X,Y	X,Y						
Mixing/boiling			Z	Z	L	Z	Z			
Filling/sealing					U	X,Y	X,Y	X,Y		
Labelling	Z	Z			N					
Cleaning					C			Z	X,Y	
Store management					H				Z	
Distribution									M	M
Management	M	M	M	M		M	M	M		

X, Y, Z = permanent workers; M = owner and manager of the enterprise

3. Prepare a business plan

Write down the results of the feasibility study. This helps to clarify and focus your ideas and to make the mistakes on paper rather than during the operation of the business. The information in the business plan will help you to make decisions on:

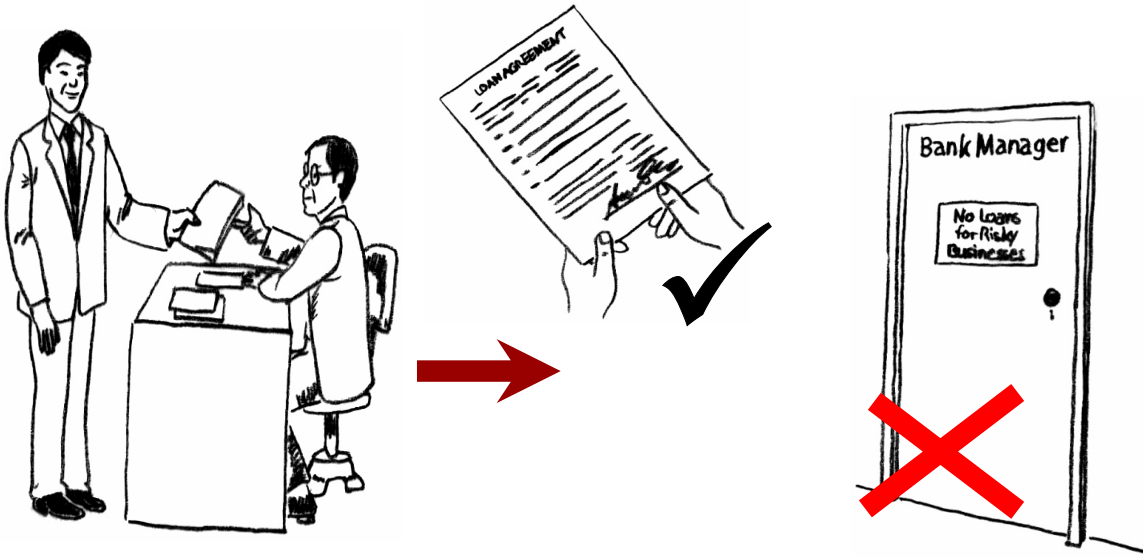
- Whether the business will work successfully;
- The demand for the product;
- The resources available to produce the product at the right quality and for the right price;
- Whether the business will be profitable;
- Whether a loan is needed, and if so, how much and when.

A well-prepared business plan will also help you to get a loan.

☞ **How to write a business plan?**

The results of the feasibility study need to be written down in a simple, concise way to show bankers or other lending agencies that the business is carefully planned. The different steps are as follows:

1. **<u>Introduction:</u> summarise what the product is, who the customers are and why the business is a good idea.**
2. **<u>Basic information:</u> name and address of the business, the owners, their qualifications and experience.**
3. **<u>Information on the product:</u> details of the raw materials, the production process, quality assurance, packaging etc. What is special about your product?**
4. **<u>Market:</u> potential customers and where they are located, size and value of the market, expected market share, likely expansion (or contraction) of the market, number and types of competitors, their strengths and weaknesses and their expected reactions to a new product.**
5. **<u>Selling plan:</u> distribution and sales methods, planned promotion, product cost.**
6. **<u>Premises/equipment needed:</u> location of the business, building to be used and services needed, steps taken to meet health and hygiene laws, equipment and its costs.**
7. **<u>Finance:</u> amount required for start-up and initial operation, profit and loss statement and cashflow forecast for three years, own resources that will be used, size of loan required and what it is for, security on the loan.**
8. **<u>Plans for the future:</u> objectives of the business and expectations for the next 3-5 years.**



A well-prepared business plan will help you to get a loan

GOOD LUCK !

Legal aspects

All business owners have responsibilities which they cannot evade. These responsibilities include getting licences and certificates, obeying laws and regulations and paying taxes.

1. Food related laws

There are several laws which need to be followed when starting a fruit processing enterprise:

- **Laws on food composition:** These laws are to ensure that all foods sold with that name have a standard composition.
- **Laws on food labelling:** These laws describe the information that must be included on a label (see Technical Note 22).
- **Laws on weights and measures:** This legislation ensures that the amount of food that is declared on the label as the net weight (the weight of product in a pack) is the same as the weight of food that is actually in the pack.
- **Laws on hygiene and sanitation:** These laws ensure that safe, high quality products are produced (see Technical Note 20).

Hygiene certificates and registration documents are usually needed before a food business can start production

2. Registration of the enterprise

Every business has a legal form which must comply with the laws and regulations of the country. The most common legal forms for businesses are:

- Personal business with unlimited liability
- Limited liability company with a single owner/director
- Limited liability company with several owners/directors

Before starting registration procedures, professional advice should be sought from small enterprise advisors, accountants or solicitors on what is the best type of enterprise to establish.

Procedures of registration:

Once the type of business has been decided, there are several registration procedures that need to be followed. These procedures vary in different countries, but are mainly as follows:

1. Notify the taxation authorities.
2. Apply to the Local Government Office for a business licence.
3. Request to the Ministry of Health that a Food Inspector examines the processing premises.
4. Apply for registration as a Food Premises and the issuing of a *Food Producer's Licence* or *Certificate* or equivalent, after the inspection is completed and a positive report is made.
5. Send a sample of your product to the Bureau of Standards for chemical analysis. If it conforms, a *Product Approval Certificate* or similar will be issued.
6. Apply to the Tax Authority or VAT Office if there are opportunities for remission of taxes on imported ingredients, packaging materials or equipment. This is also necessary to reclaim VAT.
7. Register the business at a bank and open an account.

Every business is affected by taxes

If you consider export, the following additional steps are also necessary:

8. Apply to the Ministry of Trade and Industry for a *Business Licence.*
9. Apply to the National or Central Bank for an *Export Licence.*
10. Apply to the Customs Department for clearance to export.

Sanitation and hygiene

It is essential that food processors take the utmost care to prevent their products causing illness of their customers.

The following three potential sources of contamination can make properly processed foods unsafe:

1. **Water supply:**

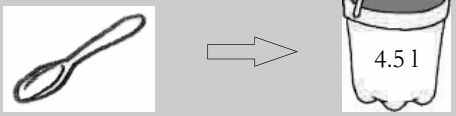
Use only potable water for the preparation of foods. If it is not available, treat the water before using it. There are two types of treatment:

- Removal of suspended solids: allow them to settle out in settling tanks and/or filter the water.
- Removal/destruction of micro-organisms:
  - Boil the water for at least 10 minutes to sterilise it. This is a less suitable alternative because it has a high fuel requirement and will increase processing costs.
  - Destroy them by adding sodium hypochlorite (see calculations in box below).

Preparation of chlorinated water using sodium hypochlorite (NaOCl) (6% available chlorine solution):

- **Prepare a 0.5 ppm chlorine solution for potable water supply:**
  For large quantities: Mix 40 ml (8 tsp) of sodium hypochlorite (NaOCl) per 1 m^3 (= 1000 litres) of water, or
  mix 8 ml (1½ tsp) of NaOCl per 200 litre drum of water.
  For small quantities: 1. Step: Mix 1 part by volume sodium hypochlorite to 5 parts of water to produce a dilute 1% solution.
  2. Step: Add 5 ml (1 tsp) of the dilute 1% solution to every 5 gallon (5 x 4.5 litres = 22.5 litres) of water.
  Let the chlorinated water stand for 20-30 minutes before using.
- **Prepare a chlorine level of 60-100 ppm for sanitation purposes (e.g. washing fruits during post-harvest operations and for cleaning equipment):**
  Use any of the following proportions: 1 ml of NaOCl for every litre of water
  10 ml (2 tsp) for every 10 litres of water, or
  20 ml (4 tsp) for every 5 gallon (22.5 litres) of water

NB: Household bleach can be used when there is no sodium hypochlorite available.
Use 5 ml (1 tsp) for every gallon (4.5 litres) of water.

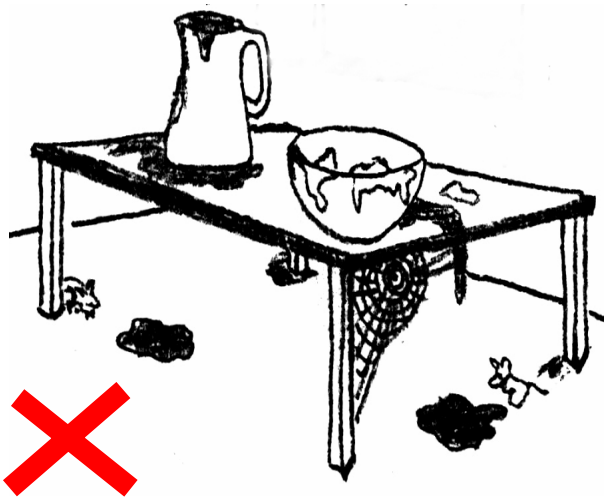


1 tsp (= 5 ml) household bleach — 1 gallon (=4.5 l) water

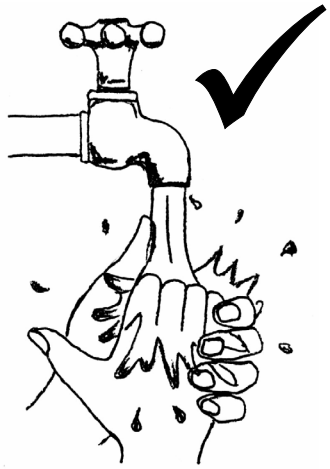
2. Unclean processing equipment:

The frequency and type of cleaning depends on the type of food being processed.

- Equipment for dry foods: brush down every day.
- Equipment for fruit products: clean carefully every few hours with detergents, to remove remnants of food, and then with disinfectant, to destroy bacteria. The most widely available sterilant is chlorine solution (bleach or hypochlorite) which is cheap and easy to use (see box on previous page).



The building and processing equipment should always be kept clean



Food processors should scrub their hands thoroughly before starting work and regularly throughout the day

3. Operators in the production unit:

Minimise risk by adopting simple rules in all food processing premises:

- Educate workers to be aware of the dangers of poor hygiene.
- Do not allow people to work if they have serious cold, boils, other skin infections or stomach problems.
- All food handlers should scrub their hands thoroughly (for more than 30 seconds) using non-perfumed soap and clean water before starting work and regularly throughout the day. Hands should always be washed after using a toilet.
- Wash all tools and work surfaces regularly with chlorinated water throughout the day.
- Do not allow smoking.
- Caps and aprons should be worn.
- All clothing should be clean.

Establishing processing facilities and securing supplies

All fruit processing operations require hygienically designed and easily cleaned premises to avoid contamination during processing. Several aspects should therefore be addressed when setting up a processing facility. There are a number of ways to secure the supply of raw materials. The best way is to make arrangements with suppliers to receive the correct amounts at the right time.

1. The site

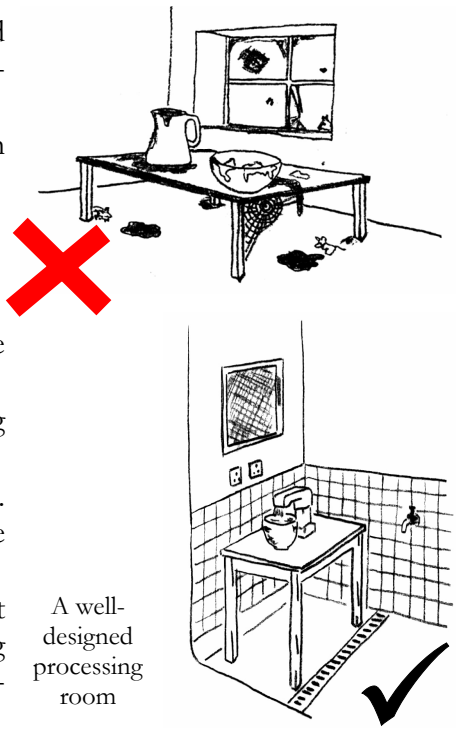
The location of a fruit processing building is very important and the following aspects need to be considered when choosing a site:

- Location in relation to raw material supplies and likely markets;
- Location in relation to nearby swamp land that would be a source of smells and insects;
- Ease of access for staff;
- Quality of road access (potholes may cause damage to products, especially when packed in glass containers);
- Any potential contamination of water supplies upstream of the processing site;
- Availability of land for waste disposal away from the building;
- Electricity supplies;
- Land should be cleared to reduce problems caused by insects and birds.

2. Design and construction of the building

In general, premises for fruit processing should be insect- and rat-proofed and should have enough space for all production processes to take place without congestion, including the storage of raw– and packaging materials and finished products. Take into account the following aspects when constructing a new facility or converting an existing building:

- Premises should have ceiling panels, to prevent dust and bird droppings falling into foods. Rafters or roof beams are unacceptable.
- Inner walls, especially the lower area, should be made from materials which can be easily cleaned.
- The floor should be made of easy to clean, non-slip material.
- The building should have a supply of clean water.
- Toilets should be outside the main processing room.
- The premises should have power and fuel supplies where these are needed.
- A management system to remove wastes from the building should be in place.
- Rooms should be large enough for people to work easily. This is especially important when hot foods or equipment are being handled to minimise the risk of accidents.
- The processing room should be designed in such a way that raw materials move through the room without paths crossing to avoid cross-contamination between raw materials and finished products and processed foods.

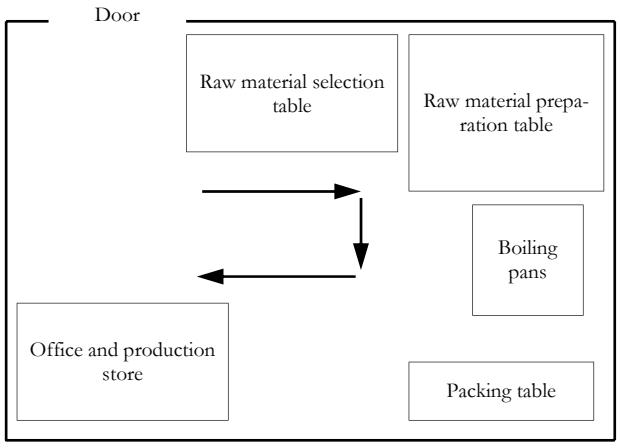


A well-designed processing room

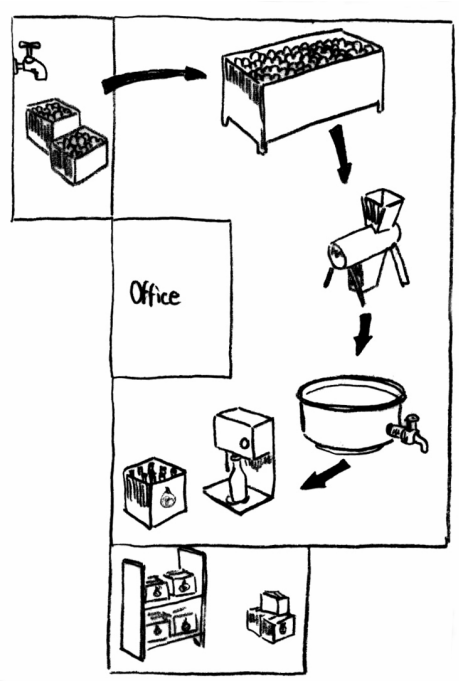
3. Equipment

Choose the correct size of the equipment for the intended scale of production and arrange it in the processing room to avoid cross-contamination (see feasibility study, and 2. Design and construction of the building). The Technical Notes 11-17 on processing methods outline the main equipment needed for each fruit product. However, all types of fruit processing require basic equipment to handle, weigh and prepare raw materials, such as buckets, tables, knives and scales.

Design a regular maintenance and cleaning schedule and ensure that they are followed.



Layout of a fruit processing room



4. Securing supplies

Buying raw materials each day from the nearest public market can create a number of problems for your processing business:

- You have little control over the price charged by traders each day and large seasonal price fluctuations make financial planning and control over cashflow more difficult.
- You are unable to schedule the raw materials in the quantities required which can lead to a failure to meet the target production.
- You have no control over the quality of the raw materials that are available.

To address these problems, arrange contracts with traders and farmers so that you have greater control over the amount, the quality and price of raw materials available for processing. Typical specifications which should be included in the contract are:

- The variety to be grown;
- The degree of maturity at harvest;
- Freedom from infection;
- Price to be paid.

Wherever possible, arrange credit facilities with the suppliers.

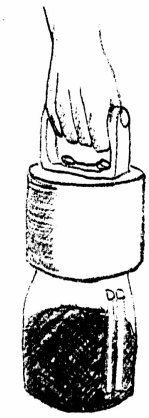
Arrange contracts with farmers, in order to have control over the amount and quality of raw materials

III. Sealing:

Plastic in crown to seal bottle

Seal containers immediately after filling. Most caps for bottles and jars have a ring of plastic material which forms a tight seal against the glass. During hot filling and heat processing this plastic softens and beds itself around the glass to make a hermetic seal. However, before this happens there is a risk that small amounts of air can be sucked into a container and cause contamination of the product. Therefore, lay the containers on their side for about 10 minutes to ensure that the seal is perfectly formed.

The type of closure and method of application usually depends on which of the different main types of container being used.



Push-on jar sealer

- **Jars**
  - **Push-on lids (Omnia caps):** fit using a simple manually operated sealer.
  - **Twist-on-twist-off (TOTO) lids**: fit by hand. Caps of this type can be opened and closed several times and are ideal for products that are not consumed all at once (e.g. jam, pickles, chutney, etc.)

TOTO lid

Neck shape for TOTO

Crown cork

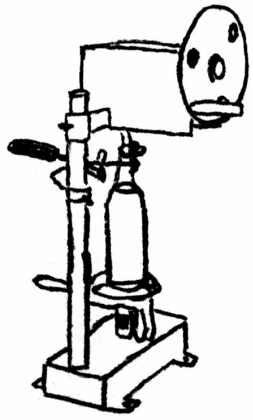
Neck shape for crown corks

- **Bottles**
  - **Crown caps:** apply by using pressure to the top of the bottle and seal hermetically onto a glass ring built into the bottle neck. They are commonly used for juices.

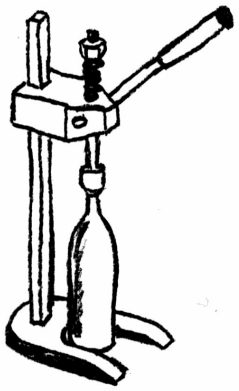
ROPP cap

Neck shape for ROPP

  - **Roll-on-pilfer-proof (ROPP) caps:** fit by placing a blank cap on the bottle and then pressing the metal into the screw thread of the glass. Form a ring of perforated metal at the base of the cap which shows evidence of tampering or pilfering.



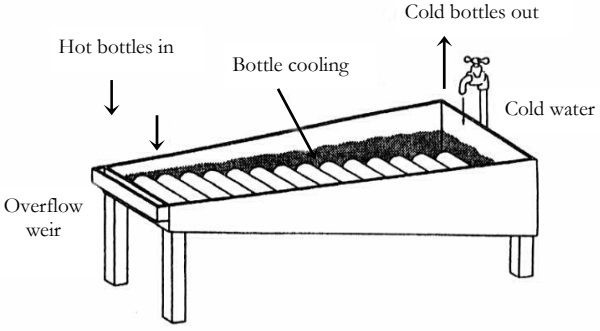
ROPP capping machine



Equipment to seal crown caps

IV. Pasteurising and Cooling (only for products such as juice, see Technical Note 12)

Locally constructed equipment can be used to cool containers after pasteurisation. Bottles should be cooled gently to avoid breaking the glass. Fill the trough at the deep end with cold water and let it overflow at the shallow end. Place hot bottles at the shallow end, where the water is hotter and let them roll down to the deep end where it is colder, so minimising the shock.



Equipment for cooling bottles

5. Packaging in rigid plastic containers

For packaging fruit products in plastic jars and bottles the same sequence is followed as described for packaging in glass containers.

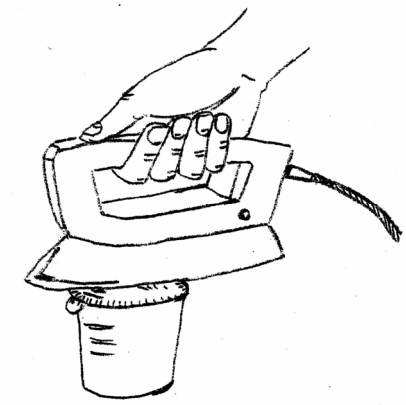
Filling:

Use the same filling equipment as described for glass containers.

Sealing:

There are two main types of closure:

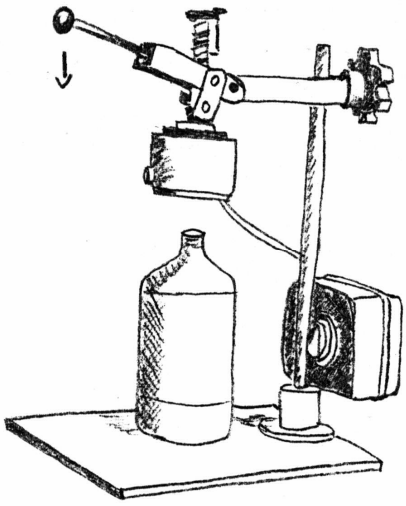
- **Plastic push-on lids:** apply by hand
- **Heat-sealed aluminium foil laminate:** apply with a household iron or by using an electric sealer.



Sealing foil lids with a domestic iron

Push-on lid

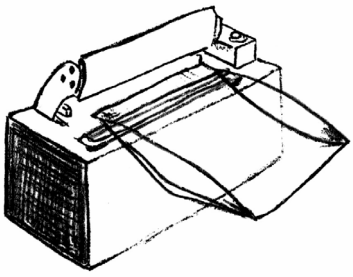
Heat-sealed aluminium foil laminate



Electric sealer for applying foil lids

6. Packaging in plastic films

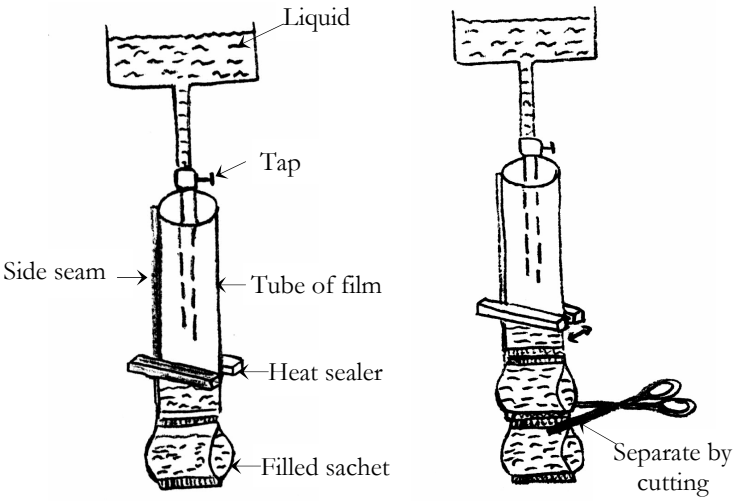
Bags can be made by either purchasing film in the form of a tube or cutting the film and sealing the long side to make a tube.



Bar-type heat sealer

Filling:

- **Liquids:** either by using a jug or through a long tube. Hot processed products have to be filled after cooling. It is important that liquids do not stick to the inside of the film as they may then become trapped in the seal and reduce its strength.
- **Solids:** usually by hand, using a scoop of known volume. The scoop should ideally fill about 90% of the required net weight into the pack. A second operator then places it on a scale and adds more product until the required net weight is reached.



Equipment for filling and sealing of polythene bags

Sealing:

Seal plastic bags by:

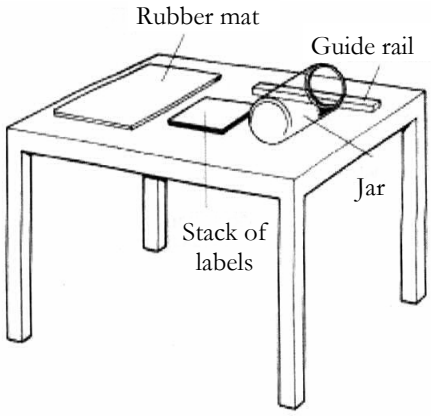
- folding the film over a used hacksaw blade and fusing it with a flame. However, the quality of the seal is variable and forms a relatively poor barrier to air and moisture.
- using a bar type heat sealer. The seal formed is broader and has better barrier properties and a better appearance. If electricity is not available, it is possible to heat the bar directly with a flame.

7. Labelling of containers

Two types of paper labels are available:

- **plain paper that is glued onto the glass:** label by using a simple frame to hold the labels. Wipe the glue over the top of label in stack, roll the jar along a guide rail over the label and then roll and press it into the rubber mat. If available, small labelling machines can be used to apply strips of glue to labels.

- **self-adhesive labels:** apply by hand, by small hand held machines or by powered labellers.

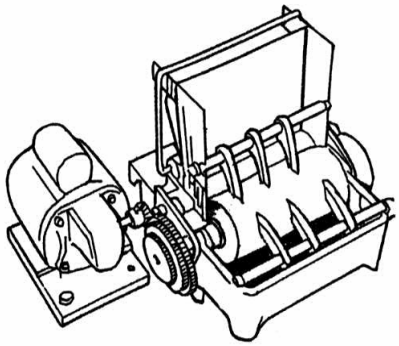


Equipment for labelling bottles

8. Label design and information needed

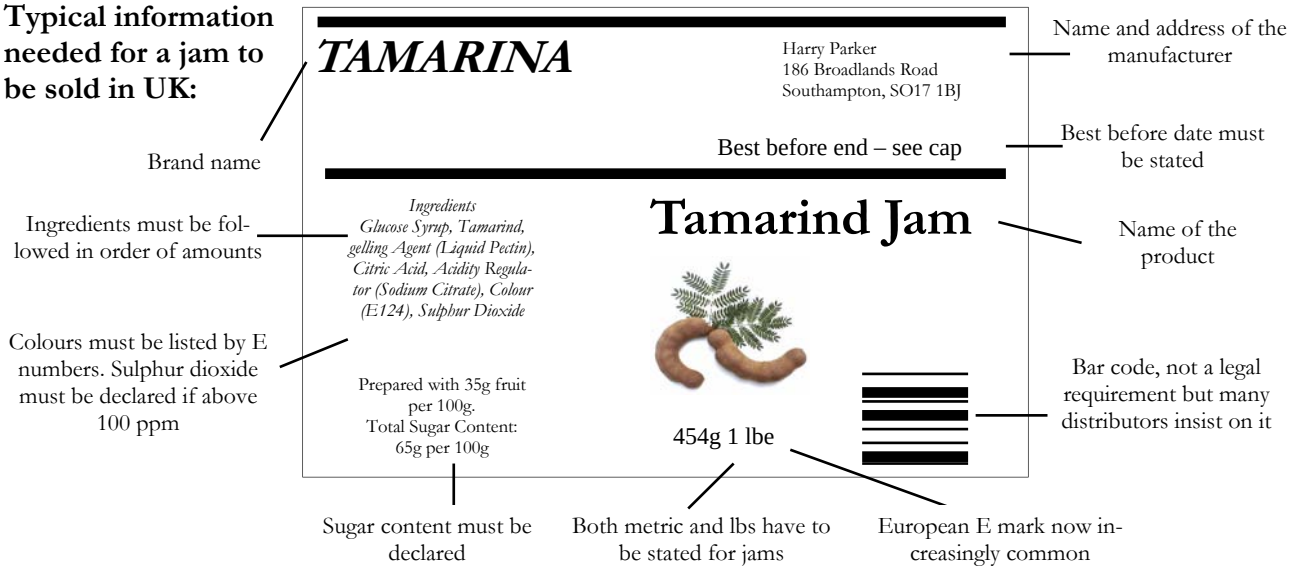
The most important roles of the label include:

- Persuading the buyer to purchase the product.
- Informing the customer about the product; contents, ingredients, weight, shelf-life etc. The label must also comply with any local labelling regulations, which vary depending on the country and the product.
- Informing the buyer about storing the food, e.g. frozen food or foods that need refrigeration after opening.
- Informing the customer how to use the food product. Recipes might be included.



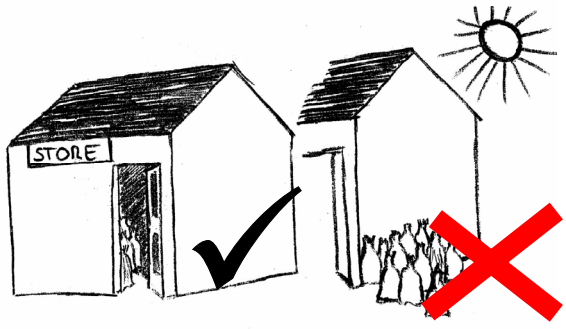
Small labelling machine

Typical information needed for a jam to be sold in UK:



9. Storage

All products depend on the package for their preservation and the containers and caps/lids should be carefully checked to ensure that they are sound and well-sealed. The shelf-life of the different fruit products can be kept if the recommended packaging is followed and the products are stored in a cool dry place, away from direct sunlight.



Packing and storing fruit products

Packaging serves two main purposes:

- **Technical aspects: packaging aims to extend the shelf-life of the product.**
- **Presentational aspects: packaging can increase sales by creating a brand image that the buyer instantly recognises.**

1. Why is packaging important?

Packaging has four important roles:

1. To act as a container, enabling the chosen quantity to be handled as a unit without loss, during distribution and storage;
2. To protect against squashing, breakage and spoilage during distribution and to maintain the product in a clean and good condition;
3. To communicate necessary information about the foodstuff, such as its origin, method of use, weight, ingredients and date of expiry.
4. Packaging often has a marketing role. Attractive packaging can help to sell the product.

Inadequate packaging in developing countries can have profound effects on the whole pattern and total amount of food consumed.

Good packaging protection is particularly important in countries with tropical and humid climates, where food spoilage is more rapid.

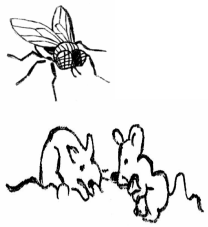
Juice filled in bottles without any information on the product for the customer

Tamarind sauce: packed in glass bottles and labelled

2. Important factors to consider when selecting a packaging material

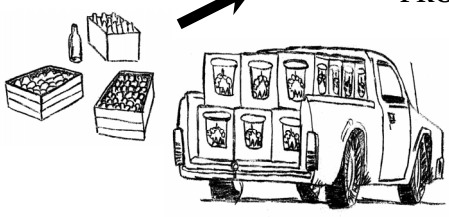
CLIMATE
Temperature
Moisture
Air
Light

CONTAMINATION
Bacteria
Moulds
Insects
Mites
Rodents



CHEMICAL COMPOSITION OF THE PRODUCT

PHYSICAL DAMAGE
Handling
Transport
Stacking
Sampling
Breaking



SIZE AND SHAPE OF THE PRODUCT

OTHER FACTORS
Price (value)
Availability of packaging material
Customer appeal
Legal requirements (labelling legislation)

3. Packaging materials for fruit products

Glass

Glass containers are used for the packing of:

- **Juice/nectar/squash/beverage/liquor**
- **Pickles/chutney**
- **Preserve**
- **Jam/jelly**
- **Concentrate/paste**

Advantages	Disadvantages
• are impermeable • are chemically inert and do not react with food • can be heat–sterilised • can protect against sunlight (coloured glass) • are reusable and recyclable • are resealable • are rigid, to allow stacking without damage	• are heavy which incurs higher transport costs • have a lower resistance than other materials to fractures, scratches and thermal shock • can be dangerous, when glass splinters get in foods

Rigid Plastic Container

Rigid plastic containers are used for the packing of:

- **Juice/nectar/squash/beverage/liquor**
- **Pickles/chutney**
- **Preserve**
- **Jam/jelly**
- **Concentrate/paste**
- **Milk shakes/sherbet/ice cream**

Advantages	Disadvantages
• are light and can be transported easily • can be moulded into various shapes • are tough, easy to seal and do not break easily • are produced at relatively low cost • are available both clear and coloured	• are rarely reused for their original application, which make them expensive • have low heat-resistance • are less rigid than glass • give less protection against sunlight and air

Plastic bags

Plastic films are mainly used for packing of:

- **Candies/leather/dried fruits/powder**
- **Milk shakes/sherbet/ice cream/frozen pulp**
- **Pickles**

A wide range of plastic materials with different qualities regarding resistance to physical shock, light, heat, moisture and air are available:

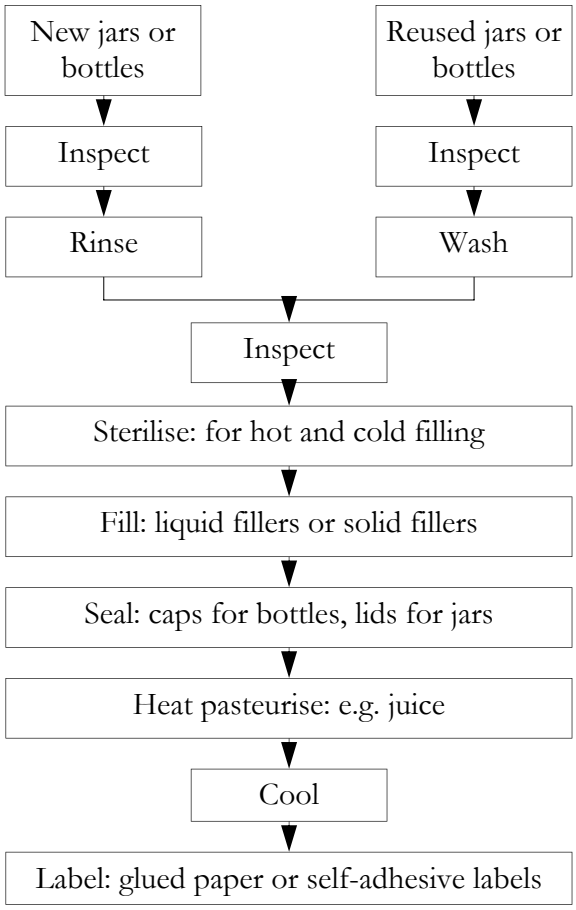
- **Low-density polyethylene (LDPE):** is cheap, heat-sealable and provides a reasonable barrier to moisture. It is, however, very permeable to gases and sensitive to oily products.
- **Cellulose:** is tough and puncture-resistant, but tears easily. It provides better protection against moisture or air than polythene. It is only heat-sealable when coated with a lacquer, and this material is then called cellophane.
- **Polypropylene:** is heat-sealable and provides greater protection against moisture and air.

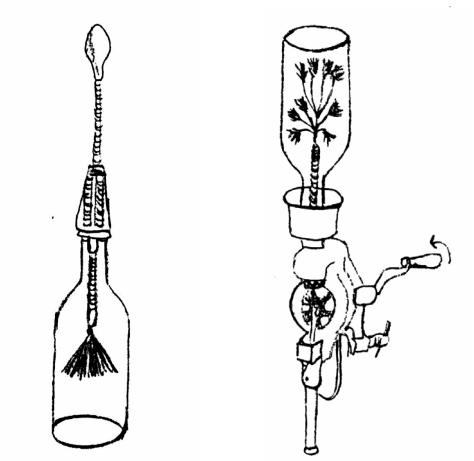
4. Packaging in glass containers

I. Inspection and preparation of containers:

1. Inspect all incoming glass containers for cracks, chips and small bubbles in the glass. Also inspect the smell of reused bottles to make sure that they have not been used for storing kerosene or poisonous chemicals. Remove all contaminated containers.
2. Rinse new jars and bottles in clean water, or chlorinated if necessary by adding 2-3 drops of household bleach per litre of water. Soak reused containers in a 1% solution of caustic soda with detergent to remove old labels. Clean the interior with a bottle brush and rinse thoroughly. Rinsing is time consuming and can be speeded up using a bottle rinser.

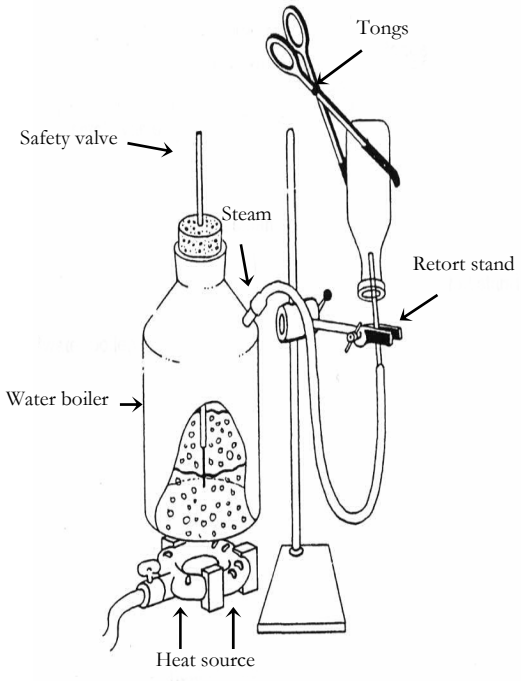
Process summary for packaging food in glass containers



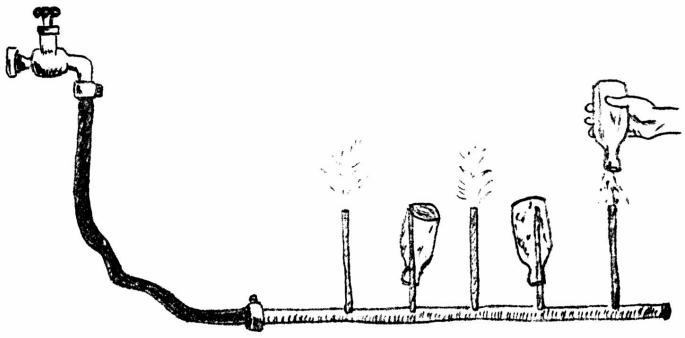


Bottle brush

Bottle rinser



Bottle steriliser



A multi-head bottle rinser

3. Pre-sterilise glass containers by placing them in a large pan of warm water and boiling them for 10 minutes.

   Alternatively steam them for 1-2 minutes using a bottle steriliser which can be constructed locally. This uses less energy and saves considerable amounts of time compared to using boiling water. Take care to make sure that the containers are not heated too quickly, as they will break. Carry out bottle sterilisation away from the food production area to avoid the risk of contamination by broken glass. Use tongs as shown in the figure in all cases when handling hot containers.

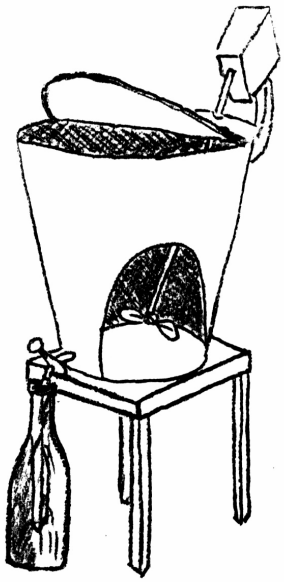
II. Filling:

Fill jars/bottles immediately after sterilisation by using the following filling equipment according to the viscosity of the product:

- **Jug:** calibrate it for the correct volume. Use a stainless steel or plastic funnel to assist filling narrow necked bottles. Use it for:
  - – Low viscosity (thin) liquids (e.g. juice, nectar, squash, beverage)
  - – Viscous liquids (e.g. jam, jelly, concentrate, pulp), without funnel
  - – Liquids that contain particles (e.g. pickles, chutney, preserve)

Jug for filling all types of liquids

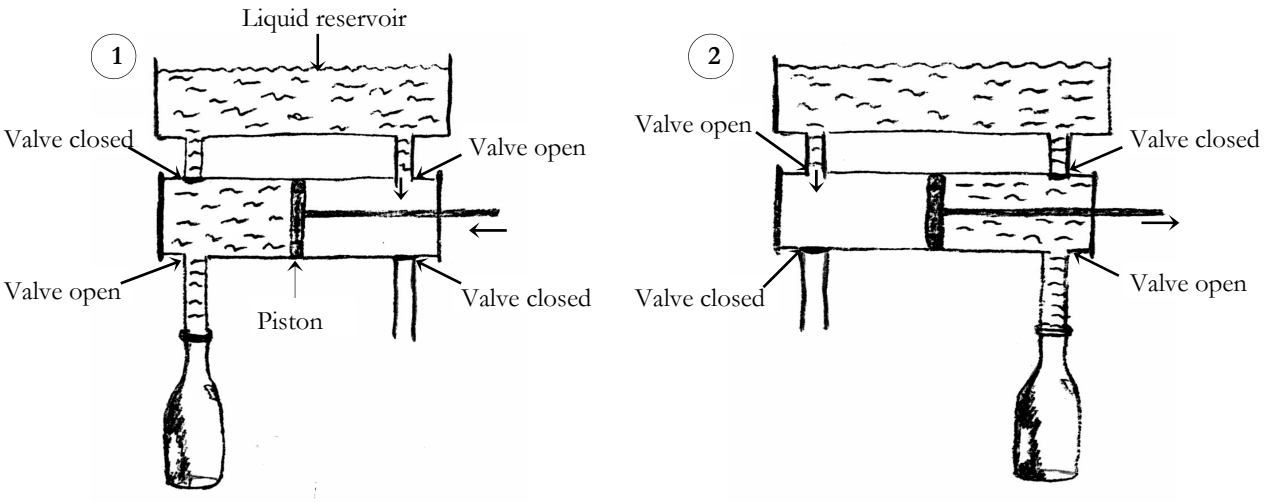
Funnel for filling thin liquids or liquids with particles



Bucket with taps for thin liquids

- **Bucket with taps:** can be made by fitting one or more taps to the base of a stainless steel bucket. Do not use iron or copper buckets in food handling. Use it for:
  - – Low viscosity (thin) liquids (e.g. juice, nectar, squash, beverage)

- **Piston filler:** the volume of liquid filled into each container is controlled by the piston. Use it for:
  - – Low viscosity (thin) liquids (e.g. juice, nectar, squash, beverage)
  - – Viscous liquids (e.g. jam, concentrate, paste, pulp)

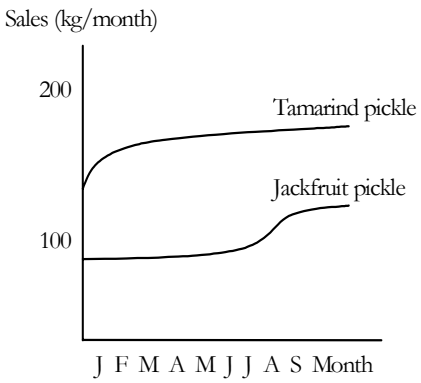


Piston filler for thin and viscous liquids

Managing production and quality assurance

Once the equipment and facilities are in place, it is necessary to organise staff for routine daily production. This involves five basic components: production planning, scheduling of inputs, maintenance, staff management and quality assurance.

1. Managing production



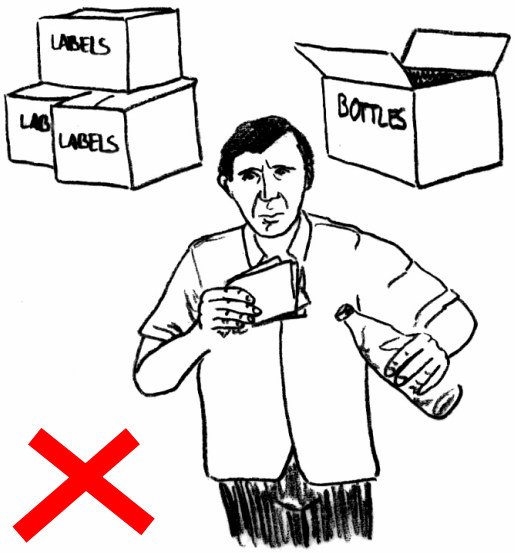
I. Production planning

1. Estimate the likely demand for the product by using up to date information from current sales figures kept by the business (see Technical Note 25). Add the daily sales figures and produce monthly totals. Produce a sales graph showing the trends in sales for each product.
2. Estimate the likely scale of production to be undertaken each day to meet the expected sales.

II. Scheduling inputs

1. Calculate all the inputs that will be needed to produce the required amount of product. This includes not only the raw materials, ingredients, packaging, labels etc. but also the number of staff required, cleaning materials, water requirements etc. The raw material and ingredients can be calculated with the knowledge of the formulation that is used to make each product.
2. Consult the records of the stocks that are held in store (see Technical Note 25), place orders with suppliers to maintain the required levels of inputs.

A common failure of small fruit processing enterprises is inadequate production planning, which may lead to production stopping halfway through the day because of missing inputs.



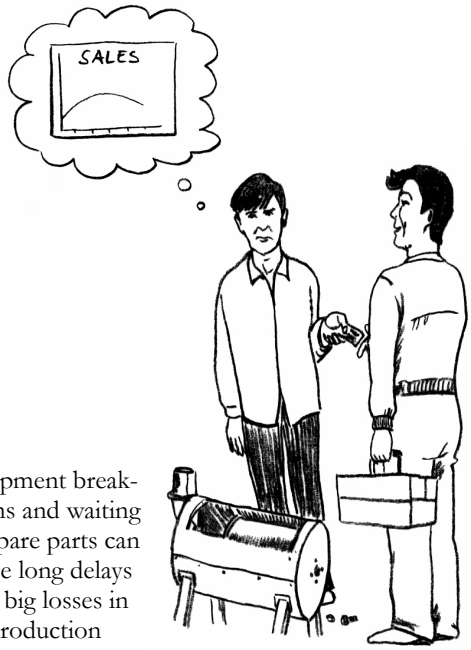
An example of poor production planning is to have too many labels and not enough bottles

The relatively short harvest season for the majority of fruits is the main difficulty for small-scale fruit processors. This has three consequences:

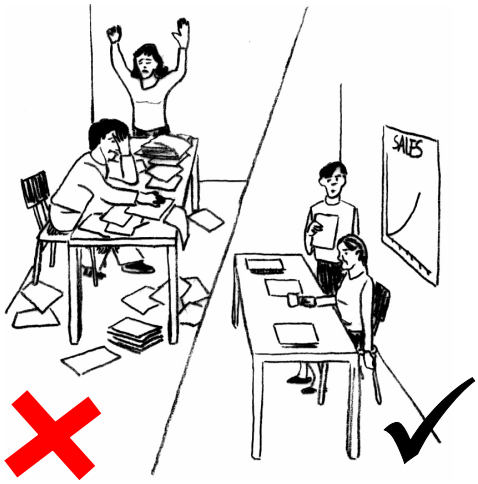
- **The majority of raw materials must be bought and paid for in a short period.**
- **Where intermediate products are made to be processed later, the cash in the business is tied up in part-processed materials for long periods.**
- **The complexity of production planning is increased, when a succession of fruits are processed throughout the year, because a large number of different ingredients and packaging materials need to be ordered in advance.**

III. Maintenance

1. Compare the costs of a stock of spare parts with the cost of delayed production. This is especially important when equipment has been imported and the supply of spare parts takes several weeks.
2. Identify the specific items of equipment that are likely to wear out and ensure that a spare component is always kept in stock.
3. Compare costs for repairs after a breakdown of the equipment with costs involved in stopping the production on a regular basis and replacing parts before they wear out.
4. Develop a programme of maintenance of equipment and facilities if your analysis has shown the benefits of maintaining the equipment on a regular basis.



Equipment breakdowns and waiting for spare parts can cause long delays and big losses in production



A well organised business is more profitable

IV. Staff management

The entrepreneur cannot do all the jobs in a business and has therefore to share some of the responsibilities. The following aspects should be considered when employing people:

1. Employ people who have the skills that are needed.
2. Ensure that all staff understand the nature of the business and are willing to contribute to its success. This is particularly important in relation to quality assurance.
3. Install a check-system to ensure that one employee does not have the full responsibility for a whole area of the business.
4. Decide on the internal structure, the levels of authority in the enterprise, responsibilities for different areas such as production, marketing, administration and the task each person must perform.
5. Ensure that all staff are properly trained to carry out their jobs efficiently and without danger to their own health and safety or that of other people working with them.
6. Provide reasonable working conditions for your employees for improved efficiency and staff morale.
7. Provide a safe and healthy working environment. The consequences of accidents and illness arising from poor working conditions are much greater than any difficulty in ensuring safety.

Trained staff help to guarantee the quality

2. Managing quality assurance

1. Establish detailed standards for hygiene and processing conditions.
2. Ensure that all the employees involved in the business are trained to meet those standards every day.
3. If necessary, consult food technologists for advice.

Specific steps of quality assurance for the processing of fruit products are explained in Technical Note 11 – 17.

☞ What is quality assurance?

It is a management system that is used to ensure a consistent product every time. The actual quality of a product is decided by the manufacturer to meet the needs of the customers at an affordable price.

Marketing fruit products

Fruit products can be marketed locally, regionally and internationally. However, much of the trade is local. National and international commerce is still limited.

☞ **What is a market and what are market segments?**

The term "market" includes more than just a physical location where suppliers offer their goods and consumers look, compare and buy. The market also represents the total supply and demand for a particular product. Middlemen (traders who buy from producers and sell to retailers or consumers), trade centres, co-operatives, etc. can also be part of the total market for a particular product.

Within each market there are a number of "market segments" which are different identifiable groups of customers.

1. Current market for fruit products

- **Products sold in the local and regional market are:** fresh fruits, pulp, juice, beverage, jam, chutney, pickles, sauce, paste, candy, leather and dried fruits.
- **Products sold in the international market are:** fresh fruits, semi-processed pulp, pickles, chutney, juice, paste and concentrate and powder.

2. Potential niche markets for fruit products

- Tourist areas, modern hotels
- People who have moved away from main fruit producing areas
- Health food and natural product shops
- Supply of bakeries with pulp, leathers and crystallised fruits

Potential niche markets for fruit products

☞ **What is marketing?**

Every producer or entrepreneur who wants to earn money will at some point become involved in marketing. Since supply and demand determine the price of a product, marketing is a way to take advantage of, or even influence, supply and demand.

Marketing is all of the activities that can contribute to selling a product for a better price.

3. The demand for fruit products

The following factors influence the public's demand for a product. Producers have to be aware of these factors in order to understand the price fluctuations of their products.

- **Wealth:** Poor people only have enough money to buy basic foodstuffs and other essentials. Rich people want to buy luxury items as well, and they are able and willing to pay more money for them.

- **Location:** Demand for a product can vary greatly from place to place. In cities, there is a high demand for basic food crops. In rural areas, many people grow these crops themselves. Therefore a producer of fruit products will probably be able to sell more at a market in the city than in the village. The demand for some products may extend beyond the producer's own country and they are exported. However, quality demands for export producers are very high.

- **Timing:** Some products are seasonal. For example, products consumed by children, such as candies and leathers, may depend on whether they are on holiday or at school. People in rural areas usually have more money available at harvest time and less when school fees have to be paid.

- **Taste:** People's tastes and preferences differ and it is difficult to predict how the public's tastes will develop.

- **Price:** Demand for a product depends on the price. A product that is expensive will be bought only by a few people.

☞**The price of products**

The price is determined by supply and demand. The total desire of consumers for a particular product is called the demand for that product. The total quantity of a product that producers offer for sale is called the supply of that product.

If the demand is high and the supply is low, consumers will be willing to pay extra money to buy the product, which is good for the producers, because the price will be high.

Demand > **Supply** (+)→ **Price**

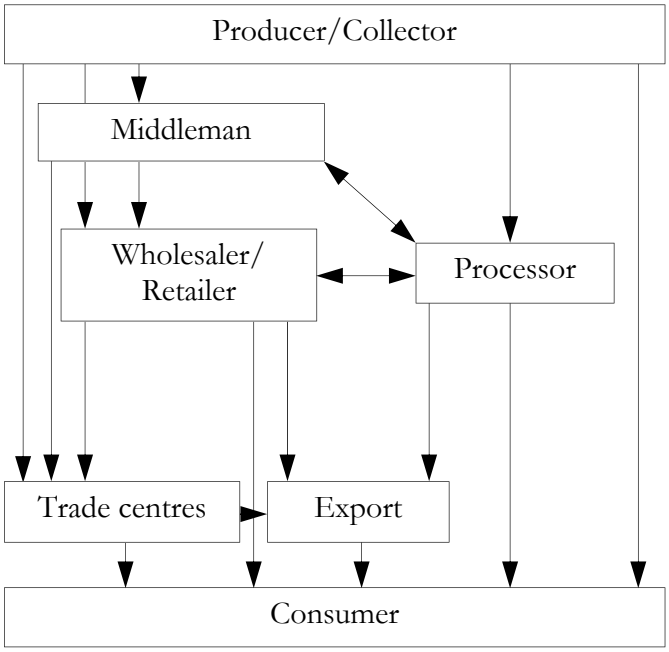
If the supply is high and the demand is low, producers will be willing to sell their products for a lower price. This is bad for producers, because the price will be low.

Demand < **Supply** (-)→ **Price**

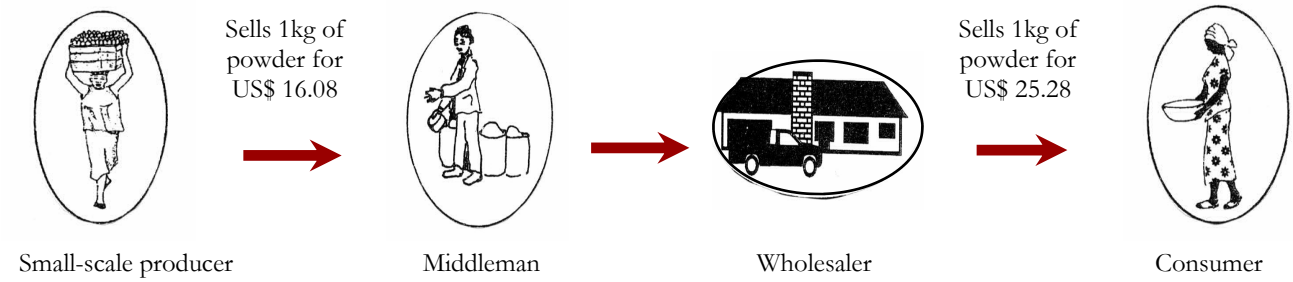
- **Promotion:** Demand for a product depends on the types of promotion and advertising carried out by the producer and by the competitors.

4. Available market channels for fruit products

The market channel is the chain of marketing activities that a product follows on its way from producer to consumer. Many things happen to a product in the market channel. It may be processed, transported, packaged, etc.



The cost of marketing increases with the length of the distribution channel. Each time the product is handled by a distributor or trader, it increases in value and price and a price mark-up of between 10% and 25% can be expected at each stage. However, neither the collectors nor the consumers benefit in the price spread due to unorganised marketing.

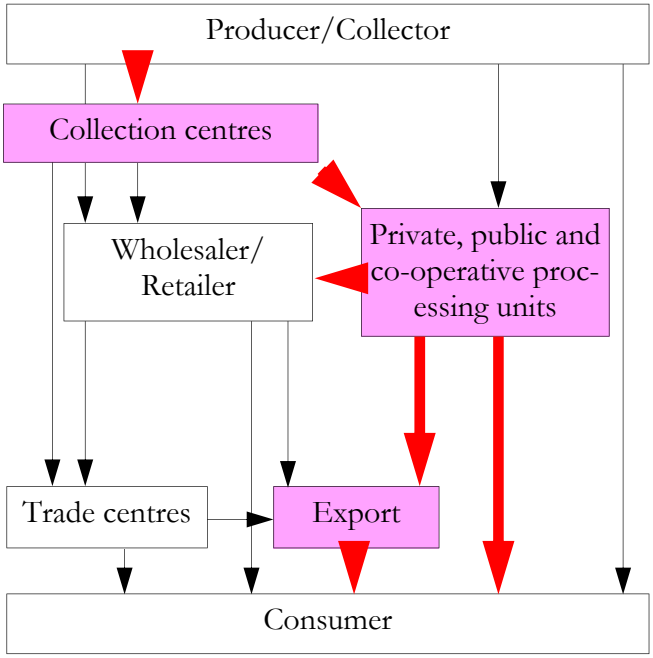


Margin of 36%!

5. How can the market channels for fruit products be improved?

- Establish small-scale collection centres in the villages to minimise the exploitation of the producers/collectors.
- Establish public, private and co-operative processing units.
- Reduce export of fresh fruits.
- Provide the opportunity to develop a network of processing units at a local level for manufacturing finished products.

Establishing co-operatives and transporting products together decreases costs. In addition the middleman can be eliminated and the producers can receive higher prices.



Profit for producers and processors can be increased by more direct marketing through the establishment of collection centres and co-operatives avoiding the middleman.

6. Promotion

All products need promotion either to introduce them into the market or to increase the demand. There are several types of promotion that are available to producers. Choose the one which you find to be most effective at the lowest cost.

- Newspapers;
- Radio and television;
- Signboard, posters and leaflets;
- Personal contacts;
- Special promotions;
- Free samples in retailers shops.

The best form of promotion is having a reputation for good products, friendly service, fair prices and good management. The cheapest form of promotion is recommendation by satisfied customers.

The type of promotion will be different for each market segment. Rural customers are unlikely to have access to television, but may listen to the radio or read newspapers. Posters or signboards in villages and special promotions in retailers shops are likely to reach a big number and variety of people including tourists.

☞ The marketing mix or the '4Ps'

- **Product:** taste and other attributes of the product that consumers prefer, quantities, packaging and sizes consumers buy, appearance (including labels), brand name.
- **Place:** where and how to sell the product, advantages of different types of distributor, how distributors can be supplied, distributors' requirements in terms of quantity, delivery and price, costs involved in the various distribution options.
- **Promotion:** the advertising required, other promotional tools that are used, such as free samples, costs involved with various types of promotion.
- **Price:** competitors' wholesale and retail prices, competitors' price response to a new product, price variations according to location and type of customer, methods of setting prices.

7. Developing a marketing strategy

Identify as precisely as possible:

- Who will be the main consumers of your product?
- Where are they located?
- How do they buy their food?
- What quality do they expect?
- What price are they willing to pay?

Developing a market strategy is not a single exercise that is only done when the business starts. The strategy should be continually monitored and reviewed. You should be constantly aware of the feedback from customers and retailers, the changes that competitors make and any consumer complaints that are received.

The result (see market feasibility, Technical Note 18) is known as the marketing mix. Use this information to refine your product to meet customers' needs and develop a strategy to market the products to the segment that you believe will provide the greatest sales. Put a system in place that will make customers believe they are buying something special that meets their needs and also supplies the right amount of product when the consumer wants to buy it.

The WEAN-co-operative in Nepal has chosen the brand-name 'Navaras' for their products.

8. Packaging and brand image

Choose a symbol that clearly identifies your products and establishes the differences from the competitors. This 'logo' should be used on all products to develop a 'brand image'. The label on the product is the first point of contact between a customer and the producer and is therefore a vital part of the marketing strategy. It does not only give information on the product, but the design and quality of the label also suggest an image of the product to the consumer and is of critical importance in promoting the product (see also Technical Note 22).

Record keeping

There are three sets of basic records that should be kept: financial records, sales records and records which relate to the production of the products.

1. Financial and sales records

The basic requirements for collecting all financial information that are needed to prepare monthly profit and loss statements, balance sheets and cashflow forecast are as follows:

1. **Cash Book:** record the cash that comes into a business and the cash that is used to buy daily items. If you have a bank account, you will also require a **Bank Book** to record cheques that have been received and paid.
2. **Accounts Receivable and Payable Book:** record how much money the business is owed by debtors at any given time and how much is owed to creditors.
3. **Sales Book:** record all the amounts of products sold and their value and when the payment has been received.
4. **Stock Book:** record which products and materials are transferred into and out of the store-rooms. Calculate the balance to indicate when reordering is needed.

It is important to keep records and accounts up to date to avoid confusion and loss of money.

Example of a Cash Book layout:				
Date	**Item**	**Cash in**	**Cash out**	**Balance**
01/05/03	Brought/forward	$ 20.00		$ 20.00
01/05/03	Sales pickle	$ 100.00		$ 120.00
02/05/03	Sugar 50 kg		$ 12.50	$ 107.50

Example of an Accounts Receivable and Payable Book:							
Date	**Item**	**Credit given**	**Balance**	**Date**	**Item**	**Credit taken**	**Balance**
01/05/03	Brought/forward		$ 100.00	01/05/03	Brought/forward		0
02/05/03	Invoice: 030125	$ 150.00	$ 250.00				
				03/05/03	Fruits 100 kg	$ 20.00	$ 20.00

Example of a page from a Sales Book:						
Product name: Tamarind pickle			**Batch number: 0403015**			
Date	**Customer**	**Amount sold**	**Value**	**Invoice date**	**Invoice No**	**Payment date**
01/05/03	Ms. XXX	100 jars @ 200 g	$ 100.00	01/05/03	030124	01/05/03
02/05/03	Mr. YYY	100 jars @ 450 g	$ 150.00	02/05/03	030125	31/05/03
05/05/03	Mrs. ZZZ	50 jars @ 200 g	$ 50.00	05/05/03	030126	05/05/03

Example of a Stock Book to keep account of ingredients:				
Ingredient name: sugar				
Date	**Amount to store**	**Amount from store**	**Process batch number**	**Balance**
01/05/03	Brought forward			5.000 kg
02/05/03	50.000 kg			55.000 kg
02/05/03		10.000 kg	0503001	45.000 kg

2. Production records

Record keeping is an important management tool to help to know the state of the enterprise at any time and to have reliable information on which the processor can base plans for development of the business.

The following production records are important to ensure that quality assurance procedures are in place and operating satisfactorily and to record the use of ingredients and amounts of stock for use in financial accounting.

1. Record each batch in an **Incoming Materials Test Book**. Use the same layout for recording incoming batches of ingredients and packaging materials.
2. Record in a **Process Logbook** the amount and type of raw materials and ingredients that are used and the important processing conditions such as drying and heating times and temperatures to ensure that the same ingredients are mixed together in every batch and that they are processed in the same way each time.
3. Give each batch of food a **Batch Number** which is recorded in stock control books, processing logbooks and production sales records. The batch number allows you to trace any subsequent faults in a batch of product back to the process or to the raw materials.

Example of an Incoming Materials Test Book:				
Product name: Tamarind pickle			**Batch number: 0403015**	
Raw material	**Supplier**	**Results of inspection for:**		
Tamarind fruits	Ms. AAAA	Ripeness: ok	Insect damage: ok	Signs of deterioration: ok
Sugar	Wholesaler XYZ	Impurities: ok		
Mustard oil	Wholesaler ABC	Rancidity: ok		

Example of a Process Logbook:			
Product name: Tamarind pickle			**Batch number: 0403015**
Ingredients	**Target**	**Check**	**Changes from target**
Pulp	26.4 kg	26.3 kg	0.1 kg
Sugar	26.4 kg	26.3 kg	0.1 kg
Spice mix	13.0 kg	13.0 kg	-
Batch weight	60.0 kg	59.9 kg	0.1 kg
Boiling time	30 min	30 min	-