Home-based Fruit and Vegetable Processing in Afghanistan

A Manual for Field Workers and Trainers

Book Two:
Practical Guidance and Recipes for Fruit and Vegetable Processing

HOME-BASED FRUIT AND VEGETABLE PROCESSING:
A Manual for Field Workers and Trainers

BOOK 2:
Practical Guidance and Recipes

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USING THIS MANUAL

The Manual on *Home-based Fruit and Vegetable Processing* is composed of two books. This book is designed to complement Book One, "Principles of post-harvest handling, storage and processing of fruits and vegetables", by providing recipes and guidance that will enable you to put into practice the principles described in Book One. It is advised that you start by reading Book One before applying the recipes provided here. You can also regularly refer back to Book One to better understand the purpose of each processing step described in Book Two.

Book Two is organised in seven chapters. Six chapters provide guidance and recipes on different food processing techniques, namely:

- Drying
- Jam-making
- Sauces and chutneys
- Pickles
- Vinegar
- Potato crisps

Each chapter begins by describing the processing outline for a given technique, and then providing detailed guidance on each step of the process. A colour code and icons will enable you to follow clearly how the process unfolds. Detailed recipes for specific fruits or vegetables are then given, enabling you to put in practice the processing outline.

The last chapter, on "Measurements and Preparation of Solutions" gives guidance on essential tasks, such as how to calculate proportions of ingredients, chlorinate water, prepare solutions, and measure the strength of vinegar.

The definitions of words written in *italic* can be found in the Glossary of Book One.

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DRYING






Drying

Drying is one of the most popular methods of preserving fruit and vegetables. You can dry most fruit and vegetables and, if you dry them properly and store them well, they will keep for a long time.

Common fruits and vegetables suitable for drying:

apricots
grapes
plums
tomatoes
onions
okra
egg plant
garlic
green vegetables such as spinach, mint, dill ("shibet").

At the home level, there are two main options for drying:

- drying in the sun,
- solar drying with either a direct or indirect solar dryer.

Each type of dryer has its advantages and disadvantages. The information provided in Book 1 allows you to decide which is the best type of dryer for your own situation.

Annex 2 of Book 1 also provides different models of dryers and guidance on how to build them

Should I dry fruit and vegetables?

Yes, if you live in a hot dry climate

- Drying is one of the cheapest methods of food preservation
- It requires very little equipment
- You can dry most fruit and vegetables and save them for the off season
- Dried foods have a long shelf life and can be used in a variety of ways

No, if you live in a cold and/or humid climate

- You will need to use a fuel-assisted dryer which is expensive
- The foods may not dry properly and will spoil during storage.

DRYING - Equipment needed

Knife
Sulphur tent or cabinet (optional)
Large pan for blanching (optional)
Dryer (optional)
Packaging material
Heat sealer (optional)

Processing outline for dried fruit and vegetables

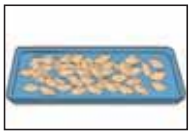
Selection and preparation of the fruit (washing and cutting)

Blanching (optional)

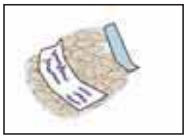
Sulphuring or sulphiting (optional)

Drying

Dried product



Conditioning and Packaging



Preparation of the fruit or vegetable

Washing

Wash the fruit and vegetables to remove dirt and bacteria that are present on the skin.

Wash unpeeled fruits and vegetables, using chlorinated water (see the section on the preparation of chlorinated water for washing, page X). Take care not to break the skin of the fruits as this will contaminate the flesh. Wear gloves and aprons to protect your hands and clothes. Ten litres of treated water (100ppm *chlorine*) will be sufficient for about 20kg fruit. Change the wash water after this amount has been washed as it becomes contaminated by the fruit.

Chopping and slicing

Cut the fruit and vegetables into slices of similar thickness and size so that they dry at the same rate. The table below gives recommended thickness for different fruit and vegetables.

The following points are useful to consider:

- thick pieces dry at a slower rate than thinner ones;
- thicker pieces may not dry fully in the centre and will not store well;
- very thin pieces tend to stick to the drying trays;
- packets of mixed thick and thin pieces do not look attractive.

It is best to use stainless steel knives to peel and chop the fruit and vegetables. If you do not have a stainless steel knife, make sure you use one with a clean, sharp blade.

Table 1: Preparation and slice thickness for fruits and vegetables

Recommended preparation and slice thickness for various fruit and vegetables	
Okra	Wash the pods. If the pods are bigger than 7cm long, cut them into slices (10mm thick). Pods less than 7cm long can be sliced in half from top to bottom.
Spinach	Wash thoroughly to remove soil. Cut out the hard tough stem from the centre of older leaves. The stem in younger leaves is not as tough and can be used. Pat dry to remove excess water.
Leek	Wash and dry thoroughly. Remove the outer dark green layers which may be old and tough. Cut into rings (10mm).

Onion	Remove the outer skin. Remove the top and root end. Cut into slices 3-5mm thick.
Apricot	Select firm, mature, but not over-ripe fruit. Wash well. Do not peel. You can cut the apricots in half or leave them whole (this makes the final product softer and easier to clean). If you leave them whole, squeeze out the pit after two to three days of drying –when apricots are still soft- by pressing gently on the apricot.
Apple	Select mature, firm apples. Wash well. Remove the peel and take out the central core. Cut in rings or slices 3-5mm thick or cut in quarters or eighths.
Grape	Wash, sort, remove stems. Leave the small seedless grapes whole. Large grapes should be cut in half. If drying whole, crack the skins by dipping in boiling water for 30 seconds. If halved, dip in a solution of diluted lemon juice (250ml lemon juice per litre of water) for up to 10 minutes. Drain.
Tomato	Dip in boiling water to loosen the skins. Chill in cold water and peel. Cut into sections less than 20mm wide or cut in half, depending on the size of the tomato.
Plums	Wash well. Leave whole if small; cut large fruit into halves or slices and remove the stone. If left whole, crack skins in boiling water for 1 to 2 minutes. If cut in half, dip in a solution of lemon juice for 10 minutes. Remove and drain.
Cherries	Select fully ripe fruit. Wash well. Remove stems and stones. Dip whole cherries in boiling water for 30 seconds to crack the skins. If cut in half, dip in a solution of dilute lemon juice (250ml lemon juice per litre of water) for up to 10 minutes. Remove and drain well.

Blanching

Vegetables are blanched to inactivate the *enzymes* and reduce the number and activity of *microbes*. *Blanching* is used for hard vegetables such as carrots, beans and peas as it helps to preserve a good colour and softens the vegetable so that it dries more quickly later on. It is not used for soft vegetables or fruits such as tomatoes, onions and peppers.

Place the cut pieces of vegetable into boiling water or hold them in steam for up to 5 minutes.

The length of time needed to blanch a vegetable varies with the type of vegetable, the size of the pieces and the number of pieces blanched at any one time. The following table gives a rough guide. If vegetables are blanched for too long, they lose their colour and taste.

Blanching

Table 2: Blanching time for selected vegetables

	***Blanching* time (minutes)**	
Vegetable	**Steam *blanching***	**Water *blanching***
Eggplant (slices)	3.5	2
Leafy green vegetables	2-2.5	1.5-2
Green beans	2-2.5	1.5-2
Carrots (sliced)	3-3.5	2
Cabbage	2.5-3	1.5
Okra (whole pods)	4.5-6	3-4
Cauliflower florets	4.5	3

You need a large volume of water so that all the pieces are heated thoroughly in as short a time as possible. Use 4.5 litres of water for each 500g of prepared vegetable.

Hot water *blanching*

1. Cut the vegetables into even sized pieces. Large thick pieces take longer to blanch than small thin pieces.
2. Boil a large pot of water.

3. Add the vegetables to the *boiling* water. Do not add too many at one time or the temperature of the water will drop and the process will take longer. If you have a sieve, mesh basket or clean muslin cloth, place the vegetable pieces in this and dip it in the *boiling* water. Move the muslin cloth around to ensure that the vegetables receive heat evenly.

Why should I blanch vegetables before drying?

Blanching is usually only used for hard or green vegetables. It softens the hard vegetables which makes it easier for the water to be lost from them during the drying process.
It also helps to maintain a good colour, especially in green vegetables.
Blanching kills microbes that can cause spoilage. It also inactivates enzymes that cause the vegetable to ripen and mature.

4. Wait until the water starts to boil again (if it does not boil after 1 minute, there are too many vegetables for the amount of water). Boil for the required time then quickly remove the vegetables from the pan of water.
5. Immediately put the vegetables into a large pan of cold (iced, if possible) water. This stops the heating process and helps to keep a good colour.

Steam *blanching*

1. Cut the vegetables into even sized pieces. Large thick pieces take longer to blanch than small thin pieces.
2. Boil a large pot of water.
3. Place the vegetable pieces in a sieve or colander. Hold the colander in the steam above the pot of *boiling* water. Place a lid on the pot and leave the vegetables in the steam for the required time (steam *blanching* takes about 1½ times longer than water *blanching*). You can use a *mantoo* pot for this step.
4. After the set time, quickly immerse the colander of vegetables into a large pan of cold (iced, if possible) water. This stops the heating process and helps to keep a good colour.

Sulphuring and sulphiting

Sulphur dioxide is used to preserve the colour and increase the *shelf life* of dried foods, especially fruits. It cannot be used to treat red fruits such as cherries as it bleaches the flesh. It is commonly used to preserve apricots.

There are two methods of treating fruit with sulphur: *sulphiting* and *sulphuring*.

Why do I need to use sulphur dioxide (SO2)?
Sulphur dioxide is not essential, but it helps to keep a good colour in fruits, especially apricots, and helps to prevent the growth of mould and fungus

1. Sulphiting,

Pieces of fruit or vegetables are dipped in a solution that is made by dissolving sodium or potassium metabisulphite in water. If the fruit is also being blanched, the chemical can be added to the blanching water.

Blanching

The strength of the sulphite solution and the dipping time depend on the type of fruit and the size of the pieces.
The strength of sulphur dioxide is expressed as "parts per million" (ppm). 1.5 grams of sodium metabisulphite in one litre of water gives 1000 ppm of sulphur dioxide.

Warnings about sulphiting :

- *Do not get sulphite solution on the skin as it can cause a rash.*
- After dipping a batch of fruit or vegetable, refill the container to the original level with fresh preservative solution of correct strength. After five lots of produce have been dipped, the solution should be thrown away
- Sulphiting wets the fruit or vegetable: this makes the drying period longer

See page X on how to prepare sulphite solutions of various strengths.

Fruit halves should be dipped in the solution for up to 15 minutes. Fruit slices should be dipped for up to 5 minutes.

2. Sulphuring

A piece of sulphur is burned in a closed chamber so that it gives off sulphur dioxide gas.

The sulphur chamber is either a cabinet or tent with a stack of perforated trays inside. *(see Annex 3 of Book 1, to see how to make a simple sulphur box or tent)*.
Food is placed on the trays, and the sulphur is placed on a metal plate, under the lowest tray in the chamber. Allow the sulphur to burn for 2-3 hours, or until all the fumes are absorbed by the fruits.

The amount of sulphur used and the time of exposure depend on the type of fruit, its *moisture content*, the size of the pieces and the permitted final levels in the product.

For most fruits 1.5-3g sulphur per kg food is sufficient.

Warning about sulphuring :

Take care when using sulphur or sulphite as the gas is not pleasant and can cause breathing problems. You need to do sulphuring in a well ventilated place, preferably outdoors. Place the burning sulphur in an enclosed chamber and DO NOT breathe in the gas.

Warning: If too much sulphite is used it gives the fruit a bad taste. The maximum permitted levels of sulphur in dried fruits are 0.005 to 0.2%. Some people do not like fruit that is treated with sulphur.

Table 3: Pre-treatments required for selected fruit and vegetables

Fruit or vegetable	Pre-treatment required
Apple	Wash in clean water, peel, cut into 1/8 pieces. *Blanching* is optional. Either sulphur using 1.5-3g/kg fresh fruit or dip in sulphite (3g/litre) for 5 minutes
Cabbage	Wash in clean water, shred coarsely. Blanch 3 minutes. Sulphite dip (3g/litre) for 5 minutes
Carrots	Wash in clean water, peel, cut into strips. Blanch for 4 minutes. Sulphite dip (3g/litre) for 5 minutes
Spinach	Cut the stems near the base of the bunch, wash the leaves
	thoroughly in clean water. Blanch 2 minutes. Sulphite dip (3g/litre) for 5 minutes
Okra	Wash in clean water. Keep whole or slice lengthwise. Blanch 3 minutes using 1% $NaHCO_3$ (Sodium bicarbonate). Sulphite dip (3g/litre) for 5 minutes
Tomato	in clean water, cut in half lengthwise, remove seeds. Blanch 1-2 minutes. Do not sulphite.

Drying

Place the fruits and vegetables on drying trays, such as wooden frames with a fitted base of netting. Mesh made of woven grass or thin branches can also be used. Metal netting must NOT be used because it discolours the product.

Make sure that the fruit and vegetable pieces are in a single layer and that the pieces are not touching. With 80 cm x 50 cm trays, the approximate load for a tray is 3 kg;

- **Sun drying:** place the trays on a framework at table height from the ground to allow the air to circulate freely around the drying material and to keep the food away from dirt. You can also make a bed of rocks, lay out a thin sheet (e.g. of cotton) on the rocks, and place the produce on the sheet.

Blanching

If there is no dust, expose the drying trays to the wind to speed up drying. Dry or nearly dry products can be blown away by the wind. You can prevent this by covering the loaded tray with an empty one; this also protects against insects and birds.
At night the trays should be stacked in a ventilated room or covered with canvas.
Plastic sheets should NEVER be used for covering individual trays during sun drying: they will cause condensation to form and the product will not dry. If you need to cover the trays use a clean cotton sheet.

Products for sun drying should be prepared early in the day; this will ensure that the material enjoys the full effect of the sun during the early stages of drying.

- **Solar drying:** Place the cut, prepared pieces of fruit and vegetable onto trays or drying racks that go inside the dryer.
If you are using a cabinet dryer, you need to control the drying temperature so that the fruit and vegetables do not over-heat and dry too quickly. Most fruit and vegetables are dried at about 60-70°C

- **Shade drying:** Shade drying is carried out for products which can lose their colour and/or turn brown in direct sunlight, such as tomatoes, herbs, green and red sweet peppers, chilies, green beans and okra.
The material to be dried requires full air circulation. Therefore, shade drying is carried out under a roof or thatch which has *open* sides.
If using a dryer, it is better to place a screen inside the drying cabinet than to place the whole dryer in the shade. The screen can be made from a clean sheet that is suspended above the food. A portable shelter is useful. It can be used to cover the dryer to protect them from both the sun and the rain.

Under dry conditions when there is a good circulation of air, shade drying takes a little more time than is normally required for drying in full sunlight.

During the first part of the drying period, the material should be stirred and turned over at least once an hour. This will help the material dry faster and

more evenly, prevent it sticking together and improve the quality of the finished product.

Dry the prepared fruit and vegetables until they reach the required final *moisture content* (10-15% for fruit and less than 10% for vegetables).

What is case hardening?
Sometimes fruits can dry too quickly in the early stages of drying (this usually only happens when artificial dryers are used) and a hard skin forms on the outside of the fruit pieces. This prevents any more water from being lost from the inside of the fruit piece. This is known as case hardening. It can be prevented by using a lower drying temperature at the start of drying and by cutting the fruit into smaller pieces so that the water from the inside of the fruit does not have as far to travel to reach the outside of the fruit piece.

How do I know when the fruit and vegetables are dry?

Dry vegetables should be hard and brittle. Take out a small handful of the dried vegetables and cool for a few minutes before testing for dryness.

Dry fruits are more leathery and flexible than dried vegetables. To test them for dryness, take out a few pieces of dried fruit and let them cool to room temperature. Squeeze a handful of the fruit. If no moisture is left on the hand and pieces spring apart when you release your hand, they are dry.

To ensure safe storage of the fruit and vegetables, the final moisture content should be less than 10-15% for fruits and less than 10% for vegetables.

It is important to let the fruit or vegetable cool before you test them as they are more soft and bendy when they are warm.

How long should a food be dried for?

The drying time depends on several factors:

- the temperature inside the dryer
- the flow of air through the dryer
- the amount of *humidity* in the air
- the amount of water inside the food
- the size of the pieces of food.

When a new type of dryer is used, or if a different type of food is being dried, you have to do a few tests to find the rate of drying. The information can then be used to find the time that the food should spend in the dryer before the *moisture content* is low enough to prevent spoilage by *micro-organisms*.
The rate of drying has an important effect on the quality of the dried foods.

How to find the rate of drying

You need a clock and a set of scales.

1. Make a graph that shows the time on the bottom and the weight of the food on the side axis. (see figure 1)
2. Weigh the food and place it in the dryer. Record the weight on the graph.
3. Leave for 5-10 minutes, take it out and re-weigh it. Record the weight.
4. Replace in the dryer and leave for another 5-10 minutes.
5. Continue this process, recording each weight, until the weight of food does not change.
6. In the graph, you will see two separate phases of drying - the 'constant rate' (A-B on the graph) and the 'falling' rate periods (B-C on the graph).

In the constant rate the surface of the food remains wet which means it can be spoiled by moulds and bacteria. In the falling rate the surface is dry and the risk of spoilage is much smaller. When drying foods, the period from A to B should be as short as possible to cut down on potential spoilage. The falling rate depends on the temperature and efficiency of the dryer. It should be quick to prevent spoilage, but not too fast so to avoid the problem of case hardening.
You should aim to get to the final weight (D on the graph) as quickly as possible to ensure the best quality product.

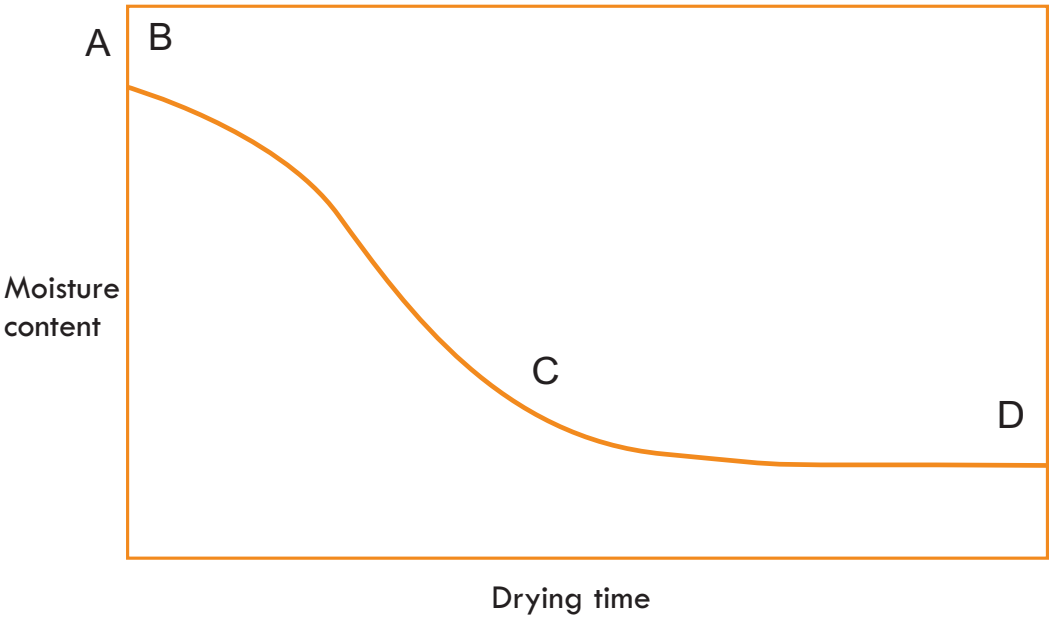


Figure 1. Example of a drying curve

Table 4: Drying times in a cabinet dryer for fruits and vegetables

Drying times in a cabinet dryer for fruit and vegetables	
Okra	8-10 hours until tough and brittle. Ratio of wet to dry weights = 12:1*. *Moisture content* = 5%
Spinach	6-10 hours until crisp. Ratio of wet to dry weight = 12:1.* *Moisture content* = 5%
Leek	6-10 hours until very brittle (5% moisture)
Onion	6-10 hours until very brittle (5% moisture)
Apricot	Arrange in single layer on trays. If cut in half, place the pit side up with cavity popped up to expose more flesh to the air. Dry until soft, pliable, and leathery; no moist area in centre when cut (24-36 hours) If left whole, leave to dry for one to 2 days and then press the pit out. Leave to dry until soft and leathery.
Apple	Arrange in single layer on trays, pit side up. Dry until soft, pliable, and leathery and there is no moist area in centre when cut (6-24 hours)
Grape	Dry until pliable and leathery with no moist centre (12-24 hours)
Tomato	6-24 hours until they are leathery and pliable
Plums	Arrange in single layer on trays pit side up, cavity popped out. Dry until pliable and leathery (6-10 hours for slices; 24-36 hours for halves)
Cherries	Arrange in single layer on trays. Dry until tough, leathery, and slightly sticky (24-36 hours)

* *This ratio means that dry okra is twelve times lighter than fresh okra.*

Note: the drying times for tent dryers and sun drying are not provided because they depend on the climatic conditions.

Conditioning and packaging

When drying is complete, some pieces of fruit will contain more moisture than others due to their size and placement in the dryer during drying. *Conditioning* is a process that is used to distribute any remaining moisture throughout all the pieces. This reduces the chance of spoilage, especially from mould.
Dried vegetables contain less moisture than fruits so do not usually need to be conditioned.

To condition the dried fruits, place them in large plastic or glass containers, about two-thirds full. Cover the container and store in a warm, dry, well-ventilated place for four to 10 days. Stir or shake the containers daily to separate the pieces. If beads of moisture form inside the container, return the dried pieces to the dryer to continue the drying process, then repeat the *conditioning* step.

Pack the dried fruits or vegetables into sealed moisture-proof poly*ethylene* bags.

Dried tomato

Preparation of the tomatoes

Select firm, ripe tomatoes. Reject any tomatoes that are over-ripe, rotten or damaged. The under-ripe fruit can be left to ripen and used at a later date.

You can choose to leave the skin on, or remove it from the tomatoes.
If you remove the skin, the fruit will dry more evenly. To do so, plunge the tomatoes in *boiling* water to loosen the skins. Remove from the hot water, cool in cold water and peel the skin.

If you leave the skin on, the drying process will take longer as it is difficult for the tomatoes to lose water through the skin. The final product will have a wrinkled leathery skin with curled up edges (see figure 2). If the unpeeled pieces of tomato are too big, it might be difficult to remove all the moisture from the centre of the pieces and they will not keep for very long after drying.

Cut the tomatoes. You can choose whether to leave them in half or quarters, or to cut them into slices (20mm thick). The amount of chopping depends on the size of the tomatoes. Remember that the smaller pieces dry more quickly so you will get a better dried product. But do not make the pieces too small (no less than 20mm thick) or they will shrivel and become crisp during drying.

Drying

Place the cut pieces of tomato on the drying tray. If you are using tomato halves, place them with the cut side upwards. If you are not peeling the tomatoes, make sure the side with the peel is in contact with the tray. Place the pieces close together so you get as many as possible in the dryer. But do not let the pieces touch or overlap.

Place the trays of fruit into the dryer, or outside in a well-ventilated area protected from dust. Place the trays or dryer in the shade, as direct sunlight will cause the red colour to fade.

Dry until the pieces are soft and leathery.

Conditioning and packing

C*onditioning* is especially important to carry out if you leave the peel on the tomato and there is the risk of some moisture remaining in the dried pieces.
Let the dried fruit pieces cool and then place in a large plastic or glass container. Fill the container to about two thirds full. Stand in a warm, dry, well ventilated place for up to 10 days. After this time, inspect the pieces of tomato. If there are beads of moisture on the pieces, return them to the dryer or sun. Check them daily and retrieve them when they are dry.

Once you are sure that the pieces are all dry, pack them in moisture proof packaging.

Figure 2 Dried tomatoes with a wrinkled skin.
www.trainafoods.com

Dried apricots

Preparation of the apricots

Select firm, ripe apricots. Reject any fruit that are soft and over-ripe, rotten or damaged. Wash the fruit in clean water.

Cut the fruit. Leave the apricots whole, or cut them apricots in half and take out the stone. Do not peel the fruit.

Sulphuring (optional)

Apricots are treated with sulphur dioxide to help them keep a bright orange colour. It is not essential to treat with sulphur, but if you have some, it will also help to preserve the fruit.

Place the apricot pieces (if cut, peel side downwards) onto mesh trays that fit into the sulphur cabinet or tent. Place the pieces close together so that you can get as many as possible onto the tray. Do not let the pieces touch or overlap.

Place the sulphur (2g per kg of fruit) in a small dish inside the sulphur tent or cabinet. Burn the sulphur for 2-3 hours to allow the gas to penetrate into the apricots.

Make sure that the sulphur gas cannot escape from the *sulphuring* chamber as it can cause breathing difficulties.

Drying

Place the trays of apricot into the dryer. Solar drying is better than sun drying as it gives the fruit some protection from dust and insects during drying. If you do not have a dryer, place them out in the sun, in a well ventilated area protected from dust.
Dry the apricot pieces until they are soft and leathery.
If you have left the apricots whole, squeeze out the pit by pressing gently, after 1 or 2 days of drying (when the apricots are still soft but firm)

Conditioning and packing

Remove the dried apricots from the dryer or sun. Allow them to cool to room temperature.

Place the dried apricot pieces in a large plastic or glass container. Fill the container to about two thirds full. Stand in a warm, dry, well ventilated place for up to 10 days. After this time, inspect the pieces of apricot. If there are beads of moisture on the pieces, return them to the dryer or sun. Check them daily and retrieve them when they are dry.

Check that the pieces are all dry and pack in moisture proof packaging.

Dried onions

Preparation of the onions

Select firm onions. Discard any that are rotten.
Remove the outer skin and slice the onion into rings 3-5mm thick.

Drying

Place the onion rings onto the drying tray. Separate the smaller rings from the larger ones. Place the pieces close together so you get as many as possible in the dryer. But do not let the pieces touch or overlap.

Place the trays of onion into the dryer or in the sun and dry until the pieces are dry and brittle – the dried pieces should crumble in the hands when they are crushed.

Packing

Remove the dried onions from the dryer or sun. Allow them to cool to room temperature. Check that the pieces are all dry and pack in moisture proof packaging.
C*onditioning* is not necessary for onions as they are dried until they are brittle and crisp.
Do not pack them while they are still warm or condensation will form on the inside of the packet, and spoil the onions.
Also, do not leave dried onions in the open air: they easily attract water and become moist and soft again, and will need re-drying.

Dried apples

Preparation of the apples

Select ripe apples. Wash the fruit in clean water.

Peel the fruit and remove the core. To make apple rings, slice the apple in half and remove the core of the apples. Then slice each half into rings (3-5mm thick). Make sure all the slices are of the same thickness so they dry at the same rate. Alternatively, cut the apple into quarters and remove the core from each segment. Cut the quarters in half again for drying.
Apple rings are the preferred method of drying as they are the same thickness throughout. Apple segments are thicker on the outer edge than at the centre and will not dry as well as the flat rings.

Place the slices of apple into a bowl of water that contains 250ml lemon juice per litre of water to prevent the apple pieces browning. Drain well and place the slices on a tray for drying. The pieces should be close together but not touching.

Drying

Place trays of fruit into the dryer. Solar drying is better than sun drying as it gives the fruit some protection from dust and insects during drying. If you do not have a dryer, place them out in the sun, in a well ventilated area protected from dust.
Dry the apple pieces until they are soft and leathery. Depending on the size of the pieces and the climate, drying will take about 2 to 3 days in the sun.

Conditioning and packing

Remove the dried apples from the dryer or sun. Allow them to cool to room temperature.

Place the dried apple pieces in a large plastic or glass container. Fill the container to about two thirds full. Stand in a warm, dry, well ventilated place for up to 10 days. After this time, inspect the pieces of fruit. If there are beads of moisture on the pieces, return them to the dryer or sun. Check them daily and retrieve them when they are dry.

Check that the pieces are all dry and pack in moisture proof packaging.

JAM-MAKING









Jam making

Jam making is quite a technical process. It requires a large amount of sugar (equal quantities of fruit and sugar), citric *acid* (or lemon juice) and *pectin*. It also requires considerable amounts of fuel to boil the mixture to the required consistency and final *moisture content*. These ingredients and the fuel can be quite expensive. In addition, glass jars are required for packaging, which may be difficult and expensive to acquire. (Jam is sometimes packaged in plastic containers, but this reduces its keeping quality considerably, and makes it prone to rapid spoilage).

Common fruit and vegetables suitable for jam-making

Apricots
Cherries
Plums
Mulberries
Apples – apples can be used alone or mixed with other fruit, such as mulberries
Carrot
Pumpkin

JAM MAKING - equipment required
Sharp stainless steel knife
Weighing scales (large and small if available)
Plastic bowls
Cooker or stove
Boiling pan (stainless steel or aluminum)
Spoons for measuring
Wooden spoon for stirring
Sugar thermometer (if available)
Refractometer (if available)
Jars and lids
Labels

Should I make jam?

Yes

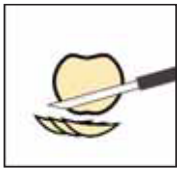
- Jam can be made with relatively simple equipment that is available in the home
- The products are quite safe and have a fairly long shelf life due to the combination of high sugar and low moisture content
- Jam can be prepared from a range of different fruits depending on local taste and availability

No

- Jam requires a lot of sugar, which may be expensive
- Jam requires a lot of fuel for heating ,which is expensive
- Glass jars for packaging are difficult to find
- There is a limited market for the product.

Processing outline for Jam and Jelly

Selection and preparation of the fruit (sorting, washing, cutting)



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Preparation of the jars & lids

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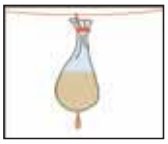
Juice extraction (for jelly)



Added ingredients

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Heating and addition of sugar

↓

Jam/jelly

↓

Filling and packaging

↓

Storage

Fruit jam or jelly – process details and quality assurance

Preparation of the fruit

Wash the fruit in clean water, peel it and remove stones and damaged parts. Chop large fruits into smaller pieces. The fruit should be as fresh as possible and slightly under-ripe. Over-ripe and/or bruised fruit will not make good jam as it has low levels of *Pectin* and/or *acid*; in this case, the jam will not set.

Preparation of the jars and lids

Wash the glass jars and lids and put them into a large saucepan. Fill the saucepan with water so that the jars and lids are covered and heat until the water boils. Let the water boil for about 5 minutes. Remove the jars and turn upside down so that the water can all drain out. Do not dry them with a dirty cloth.

If you are using plastic jars they cannot be sterilised by heating like this. If the jars are new and unopened, do not open them until they are needed. If the jars are recycled, wash them thoroughly in chlorinated water (100ppm). Stand upside down and leave to drain well. Do not dry them with a dirty cloth.

Extraction of fruit juice (for making jelly)

Jelly making

To make a *jelly*, you need to soften the fruit to turn it into a *pulp*, then extract the juice from the pulp.

- Place the washed fruit in a pan and heat over a low heat. This is to soften the fruit and allow the juice to be released. Add a little water to prevent the fruit burning or sticking to the bottom of the pan. Do not add too much water because you need to remove it all later during the *boiling* stage.
- Transfer the softened fruit to a *jelly* bag: a bag made from muslin cloth that is tied and suspended above a bowl into which the fruit juice drips. Allow the juice to drip out from the cloth; this may take overnight. Make sure that the juice cannot be contaminated by insects and dust while it is dripping. Do not squeeze the bag as this makes the juice cloudy. You can use the fruit left in the bag as a substrate for vinegar production.
- Measure the volume of juice extracted. Weigh out the sugar (you should have equal amounts of juice and sugar) and add it to the juice.

Heat treatment (for jam and jelly)

For jam making

To make jam, the fruit also needs to be softened (turned into pulp):

- Place the washed fruit in a pan and heat over a low heat. This is to soften the fruit and allow the juice to be released. Some fruits will need a little water to be added at this stage to prevent the fruit burning or sticking to the bottom of the pan. Do not add too much water because you need to remove it all later during the *boiling* stage.
- When the fruit has all softened and there is juice in the pan, add the sugar and continue to heat gently until all the sugar has dissolved.

From now on, the process is the same for jam and jelly.

Add the *pectin* if you are using it. Follow the instructions on the packet. In general, it is better to mix the *pectin* powder with a small amount of sugar taken out of the total sugar in the recipe, rather than just adding the *pectin* directly to the pulp. This helps the *pectin* to disperse more evenly throughout the fruit pulp. If you are using a liquid *pectin*, this can be added directly to the juice or pulp. If you cannot buy *pectin*, you can use apples as these are a good source of *pectin*. You can make a mixed fruit jam by substituting some of your fruit for apples.

Return the pan with the pulp (for jam) or juice (for *jelly*) plus dissolved sugar and *pectin* to the heat. Use a large pan as this will allow the water to evaporate more quickly and reduce the time needed for *boiling*. Turn up the heat and start to boil the mixture. Stir with a wooden spoon to prevent the mixture sticking to the bottom of the pan.

The aim of *boiling* is to reduce the water content of the mixture and concentrate the fruit and sugar. The final *Total Soluble Solids* (TSS) content of a jam (also known as the "Degrees *Brix*" or "end-point of the jam") should be 65 to 68%. (The TSS is a measure of the amount of material that is soluble in water. It is expressed as a percentage -a product with 100% *soluble solids*, has no water, one with 0% *soluble solids* is all water).

If the final TSS of jam is lower than 65-68% the *shelf life* will be reduced. The jam will have a runny consistency and *bacteria* and *moulds* will be able to grow in the product. If the TSS is higher than 68%, the jam will be very stiff and the sugar might start to form crystals in the jam.

The end-point of *boiling* is measured in different ways. The most accurate method is to use a *refractometer* to measure the total sugar *concentration*. This method is not really suitable for home-use as a *refractometer* is expensive. It is only when making jam for sale that you might consider using a *refractometer* to ensure consistency between different batches of the jam.

When making jam for home consumption, you can use other methods: the *drop test*, the *skin wrinkle test*, or the use of a jam thermometer to test the temperature. All these methods are described in the section below, on page X.

Remove the jam from the heat while you test for the *end point* otherwise it will continue heating and may become overcooked.

Filling and packaging

Cool the jam to about 85°C and pour into the hot sterilised jars. The jars should be hot when they are filled or they may crack. If the jam is hotter than 85°C, condensation will form under the lid. This can drop down onto the surface of the jam and dilute it, which may allow mould to grow. If the jam is colder than this, it will be difficult to pour.
Fill the jars to about 9/10ths of their volume. Place the clean lids onto the jars, fasten them loosely and invert the jars to sterilise the lid with the hot jam.

If you are using plastic jars, leave the jam to cool until about 80°C before you pour into the jars. If the jam is hotter than this it may cause the plastic bottle to melt and become misshapen. Do not cool too much though or the jam will be difficult to pour.

It is preferable to use glass jars with new screw-on lids but if these are not available, you can use plastic jars and cover with foil lids. These are less expensive, but have a shorter *shelf life* than glass packaging.

Storage

Jams and jellies that are made according to the correct recipe will have a long *shelf life*. Jam stored in glass jars will have a longer storage life (up to 12 months) than those packed in plastic bottles (up to 4 months). For the optimum storage time, jams should be stored in a cool dry place, away from direct sunlight.

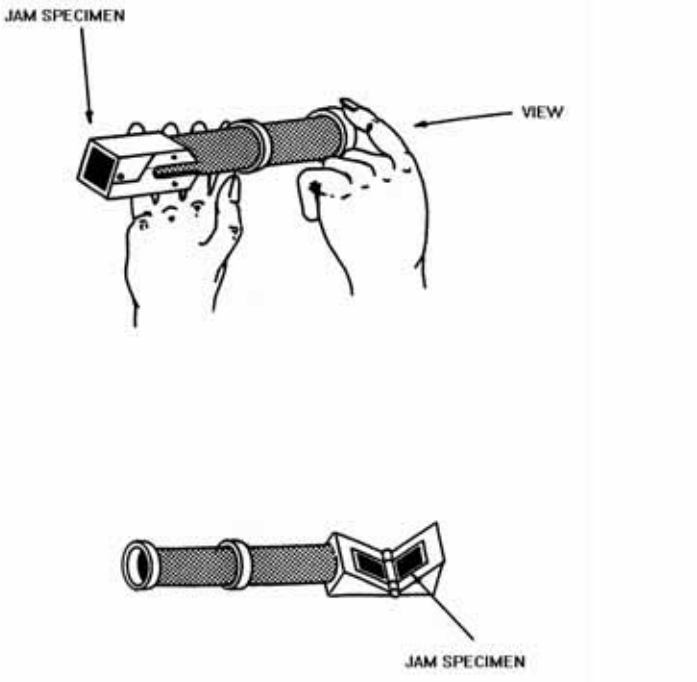
Determination of the end point of a jam

To make sure that the jam is well preserved and will have a long *shelf life*, it is essential that the final sugar content (which is measured as the total *soluble solids*) **be 65 to 68%.**

When the jam is starting to thicken and will coat the back of the spoon you are stirring it with, it is time to start testing it to see if it has reached the *end point*. There are four main ways to test when a jam has been boiled for long enough.

a) Use a refractometer

This is the most accurate method.



Measuring the sugar content with a refractometer

1. Take a small portion of jam from the pan. Let it cool to 20°C. (Remember to take the pan off the heat)
2. Place one or two drops of the jam onto the prism and carefully close the prism. Make sure the sample spreads evenly over the surface of the prism.
3. Hold the refractometer near a source of light and look through the end piece.
4. The line between the dark and light fields will be seen through the viewer. Read the corresponding number on the scale, which is the percentage of sugar in the sample.
5. Open the prism and remove the sample with a piece of tissue paper or wet cotton wool.

A small *refractometer* costs about US$ 100 to $150. A *refractometer* will not be used in the home. It is a tool that is only necessary once you start making jam on a larger scale and making it for sale.

b) Use a sugar thermometer

This method is slightly less accurate, but is very useful at the small-scale. A solution of 68% sugar boils at 105°C at sea level. When the *boiling* jam reaches this temperature, it is at its *end point*.

After *boiling* for a few minutes, stir the jam and remove the pan from the heat. Dip the thermometer into hot water and then into the jam. If the thermometer reads 104-105°C, the jam is ready. If it is lower than this, return to the heat and continue to boil. Test the temperature frequently as the jam soon reaches its *end point*.

Note: At higher altitudes the *boiling* point decreases and should be adjusted. The *end point* is about 4.5-5°C above the *boiling* point of water at any altitude (see table 5 for the estimates of the *boiling* point of water at different altitudes). A *sugar thermometer* costs about US$10.

Table 5. Boiling point of water and end point of jam at different altitudes

Altitude above sea level		Boiling point of water (°C)	End boiling point of jam (°C)
Feet	Meters		
0	0	100	105
1000	305	99	104
2000	610	97.9	102.9
3000	915	96.9	101.9
4000	1220	95.8	100.8
5000	1525	94.8	99.8
6000	1830	93.7	98.7

c)\Use the drop test

This is the cheapest option, but is the least accurate of the methods. It is good enough for use at the home level, for jam that will be used within a fairly short time. It is not recommended for jams that are meant for sale as there is no guarantee of consistency from one batch of jam to another.

After two minutes of rapid *boiling*, remove the pan from the heat. Dip a clean wooden spoon into the jam and hold it over the pan for 1 to 2 seconds. If the jam runs back freely, repeat the test every two minutes until the jam looks like a heavy syrup. When a small lump of jam forms on the back of the spoon and breaks away from the rest, the setting point has been reached.

Alternatively, you can drop the jam into a glass of cold water: Take a small drop of the boiled jam on a spoon. Cool it slightly and drop into a glass of cold water. If the drop falls in a single piece until it reaches the bottom of the glass the *end point* has been reached. If it disperses in the water it requires *boiling* for longer.

d) Use the skin wrinkle test

This method is also cheap and about as accurate as the *drop test*. You need a cold plate or saucer. After two minutes of rapid *boiling*, remove the pan from heat. Dip a clean wooden spoon into the jam and drip a small amount of jam onto the cold plate surface. Let it cool and then push the lump of jam with your finger. If the surface of the lump of jam wrinkles when you push it, it is cooked.

http://www.davidlebovitz.com/archives/2005/06/norecipe_yikes.html

Remember to remove the pan of *boiling* jam from the heat source while you are doing these tests as the jam will continue to cook and may become over-cooked.

Figure 3: the skin wrinkle test

! TIP

You can always cook for a little longer, but you cannot go back if you heat for too long. It is better to take the jam off the heat too early and then re-heat if it is too soft.
Test the jam at frequent intervals so you do not miss the end point.

Calculation of jam yield from different combinations of fruit and sugar.

You can use the following basic recipes to make jams. As you can see, you can vary the proportion of fruit and sugar that you use in each recipe.
The maximum amount of fruit that can be used to make a good quality jam is 50% fruit, with 50% sugar (recipe 1).
The minimum amount of fruit that can be used to make a good quality jam is 40% (plus 60% sugar) (recipe 3).

You can use these formulae to work out the approximate yield of jam from the given recipe. From the examples you can see that by increasing the percentage of sugar in the recipe (recipe 3) you get a higher total yield of jam for the same amount of fruit.

Table 6: Proportions of ingredients for high quality jam

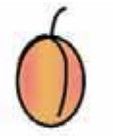
Recipe 1. fruit:sugar =50:50 Desired *Brix* in final product =68%	**Yield = 11.115x100/68 = 16.4 kg**
Ingredients	**Soluble Solids (SS)**
10kg fruit at 10% TSS	1.000 kg
10kg sugar	10.000kg
60g *pectin* (grade 200)	0.060 kg
55g citric acid	0.055 kg
Total Soluble Solids	**11.115 kg**

Table 7: Proportions of ingredients for medium quality jam

Recipe 2. fruit:sugar =45:55 Desired *Brix* in final product =68%	**Yield = 13.325x100/68 = 19.6 kg**
Ingredients	**Soluble Solids (SS)**
10kg fruit at 10% TSS	1.000 kg
2.5 litre water	
12.2 kg sugar	12.200kg
65g pectin (grade 200)	0.065 kg
60g citric acid	0.060 kg
Total Soluble Solids	**13.325 kg**

Table 8: Proportions of ingredients for lower quality jam

Recipe 3. fruit:sugar =40:60 Desired *Brix* in final product =68%	Yield = 16.165x100/68 = 23.8 kg
Ingredients	**Soluble Solids (SS)**
10kg fruit at 10% TSS	1.000 kg
3.3 litre water	
15kg sugar	12.200kg
85g *pectin* (grade 200)	0.085 kg
80g citric *acid*	0.080 kg
Total Soluble Solids	**16.165 kg**



Apricot jam

Ingredients (to make 2.4kg jam):
1.5kg fresh apricots
1.5kg sugar
300ml water

Preparation of the fruit

Sort the fruit and discard any unripe, over-ripe or damaged fruit.
Wash in clean water and leave to drain
Cut the fruit in half and remove the stone. Cut the pieces in half again if preferred.
Weigh the prepared fruit and place in a large cooking pan with the water.

Preparation of the jars and lids

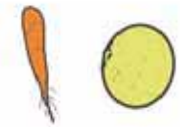
For glass jars: Wash the glass jars and lids and put them into a large saucepan.
Fill the saucepan with water so that the jars and lids are covered and heat until the water boils. Let the water boil for about 5 minutes.
Remove the jars and turn upside down so that the water can all drain out.
DO NOT dry them with a dirty cloth.
If you are using recycled **plastic jars,** clean them with a solution of chlorinated water (100ppm). Turn upside down so all the water can drain out.

Heat treatment and addition of sugar

Cook over a medium heat until the fruit has softened and the volume has reduced by one third. Stir with a wooden spoon to prevent burning at the bottom of the pan.
Add the sugar and stir until it has all dissolved
Turn up the heat and boil rapidly until the product reaches its *end point* (use a *refractometer* if available. If not use a jam thermometer, the *drop test* or the wrinkle test).
Cool the jam to about 85°C and pour into the hot sterilised jars. The jars should be hot when they are filled or they may crack.

Filling and packaging

Fill the jars to about 9/10ths of their volume. Place the clean lids onto the jars, fasten them loosely and invert the jars to sterilise the lid with the hot jam. If you are using plastic jars, let the jam cool to about 80°C before pouring into the jars.



Carrot and lemon jam

Ingredients (to make 5.7-6.4kg jam):

2-4kg carrots
4-8 medium size lemons (including 35ml lemon juice)
3.5kg sugar
Water (about 1200ml per kg grated carrot)

Preparation of the fruit

Choose carrots that are all of a similar size and maturity.
Peel the skin and cut off the green stalk residue.
Wash the carrots with plenty of water. Use a brush to remove all the soil. Drain well.
Cut lengthwise into 3-6mm strips and then cut the strips in half or into quarters; or grate using a cheese grater.
Weigh the grated carrot and place in a pan.
Wash the lemons and cut into thin slices. Remove the pips.
Cut the lemon rind into thin strips without removing the white part. Add the strips of rind, the pulp and the lemon juice to the carrots. Add enough water to cover the carrots.

Preparation of the jars and lids

For glass jars: Wash the jars and lids and put them into a large saucepan.
Fill the saucepan with water so that the jars and lids are covered and heat until the water boils. Let the water boil for about 5 minutes.
Remove the jars and turn upside down so that the water can all drain out.
DO NOT dry them with a dirty cloth.
If you are using recycled **plastic jars,** clean them with a solution of chlorinated water (100ppm). Turn upside down so all the water can drain out.

Heat treatment and addition of sugar

Cook the carrots with the lemon and water over a low heat for 60-90 minutes to soften the carrots. Stir with a wooden spoon to prevent burning at the bottom of the pan.
When the carrot pieces disintegrate and become transparent and the lemon rind strips are soft, add one third (1.2kg) of the total sugar and dissolve rapidly. Continue cooking on a medium fire for 10 minutes.

Add the remaining sugar (2.3kg) and dissolve rapidly. Boil on a high fire until the mixture sets (use a *refractometer* if available, a jam thermometer or the *drop test*). Stir with a wooden spoon to prevent burning.

Filling and packaging

Cool the jam to about 85°C and pour into the hot sterilised jars. The jars should be hot when they are filled or they may crack.

Fill the jars to about 9/10ths of their volume. Place the clean lids onto the jars, fasten them loosely and invert the jars to sterilise the lid with the hot jam. If you are using plastic jars, let the jam cool to about 80°C before pouring into the jars.

Cherry jam

Ingredients (to make 2.3kg jam):

1.8kg stoned cherries
Juice of 3 lemons (about 135ml or 9tbsp)
1.4kg sugar

Preparation of the fruit

Wash the cherries and drain well.
Remove the stones from the centre.
Either leave the cherries whole (minus the stone) or cut into half or quarters
Crack a few of the cherry stones and remove the kernels (optional step).
Weigh the cherries and place in a pan together with the lemon juice and kernels.

Preparation of the jars and lids

For glass jars: Wash the jars and lids and put them into a large saucepan.
Fill the saucepan with water so that the jars and lids are covered and heat until the water boils. Let the water boil for about 5 minutes.
Remove the jars and turn upside down so that the water can all drain out.
DO NOT dry them with a dirty cloth.
If you are using recycled **plastic jars,** clean them with a solution of chlorinated water (100ppm). Turn upside down so all the water can drain out.

Heat treatment and addition of sugar

Cook over a low heat for about 45 minutes until the cherries are soft. Stir with a wooden spoon to prevent burning at the bottom of the pan.
Remove from the heat. Add the sugar and stir until it is dissolved.
Bring to the boil. Boil rapidly for about 30 minutes until the jam is set (use a *refractometer* if available, a jam thermometer or the *drop test*). Stir with a wooden spoon to prevent burning.

Filling and packaging

Cool the jam to about 85°C and pour into the hot sterilised jars. The jars should be hot when they are filled or they may crack.
Fill the jars to about 9/10ths of their volume. Place the clean lids onto the jars, fasten them loosely and invert the jars to sterilise the lid with the hot jam.
If you are using plastic jars, let the jam cool to about 80°C before pouring into the jars.

Mulberry jam

Ingredients (to make 0.9kg jam):
1kg mulberries
Juice of 1 lemon (about 3tbs or 45ml)
500g sugar

Preparation of the fruit

Sort the fruit. Remove under-ripe, over-ripe and rotten berries.
Wash the mulberries and drain well.
Weigh the mulberries and place in a pan together with the lemon juice.

Preparation of the jars and lids

For glass jars: Wash the jars and lids and put them into a large saucepan. Fill the saucepan with water so that the jars and lids are covered and heat until the water boils. Let the water boil for about 5 minutes.
Remove the jars and turn upside down so that the water can all drain out.
DO NOT dry them with a dirty cloth.
If you are using recycled plastic jars, clean them with a solution of chlorinated water (100ppm). Turn upside down so all the water can drain out.

Heat treatment and addition of sugar

Cook the mulberries and lemon juice over a low heat for about 15-20 minutes until the mulberries are soft and the juice begins to run out. Stir with a wooden spoon to prevent burning at the bottom of the pan.
Remove from the heat. Add the sugar and stir until it is dissolved.
Return to the heat and boil rapidly for about 30 minutes until the jam is set (use a *refractometer* if available, a jam thermometer or the *drop test*). Stir with a wooden spoon to prevent burning.

Filling and packaging

Cool the jam to about 85°C and pour into the hot sterilised jars. The jars should be hot when they are filled or they may crack.
Fill the jars to about 9/10ths of their volume. Place the clean lids onto the jars, fasten them loosely and invert the jars to sterilise the lid with the hot jam.
If you are using plastic jars, let the jam cool to about 80°C before pouring into the jars.

Apple jam

Ingredients (to make 1kg jam):
7 cups apples (peeled and cored)
6 cups sugar
¼ cup lemon juice
1tsp cinnamon powder (optional) or cardamom powder according to personal taste
1-2 cups water

Preparation of the fruit

Sort the fruit. Remove under-ripe, over-ripe and rotten apples.
Wash the apples, peel them and remove the core.
Slice the apples finely and place in a large saucepan with enough water to prevent the fruit from burning on the base of the pan (do not add too much water as you will need to cook for longer to remove the excess).

Preparation of the jars and lids

For glass jars: Wash the jars and lids and put them into a large saucepan.
Fill the saucepan with water so that the jars and lids are covered and heat until the water boils. Let the water boil for about 5 minutes.
Remove the jars and turn upside down so that the water can all drain out.
DO NOT dry them with a dirty cloth.
If you are using recycled **plastic jars**, clean them with a solution of chlorinated water (100ppm). Turn upside down so all the water can drain out.

Heat treatment and addition of sugar

Cook the apples over a low heat for about 15-20 minutes until the apples are soft. Add the lemon juice, sugar and cinnamon or cardamom if you are using it. Keep over a low heat until the sugar had dissolved. Turn up the heat to high so that the mixture boils. Stir continuously to prevent the jam burning.
Boil rapidly for about 30 minutes until the jam is set (use a *refractometer* if available, a jam thermometer, or the *drop test* or wrinkle test). Stir with a wooden spoon to prevent burning. If any foam rises to the surface of the jam during *boiling*, scoop it off with the spoon to remove it.

Filling and packaging

Cool the jam to about 85°C and pour into the hot sterilised jars. The jars should be hot when they are filled or they may crack.
Fill the jars to about 9/10ths of their volume. Place the clean lids onto the jars, fasten them loosely and invert the jars to sterilise the lid with the hot jam.
If you are using plastic jars, let the jam cool to about 80°C before pouring into the jars.

Apple jelly

Ingredients: (to make 0.8-1.0kg jelly)

1.8kg apples
1200ml water
Stick of cinnamon, a few cloves or cardamon (optional)
500g sugar per 500ml juice obtained

Selection and preparation of the fruit

Sort the fruit. Remove any rotten or bruised apples. Wash well.
Cut the apples into quarters but do not remove the skin or core (most of the *pectin* is contained in the apple skin). Make sure you cut out any bad pieces of apple.

Preparation of the jars and lids

For glass jars: Wash the jars and lids and put them into a large saucepan. Fill the saucepan with water so that the jars and lids are covered and heat until the water boils. Let the water boil for about 5 minutes.
Remove the jars and turn upside down so that the water can all drain out.
DO NOT dry them with a dirty cloth.
If you are using recycled **plastic jars,** clean them with a solution of chlorinated water (100ppm). Turn upside down so all the water can drain out.

Heat treatment

Put the fruit in a large pan with the water. Tie the cinnamon or cloves in a piece of muslin and add that to the pan.
Cook over a low heat until the fruit is soft and pulpy. Remove the bag of spices.

Juice extraction

Place the pulp in a *jelly* bag (a piece of clean muslin cloth that is suspended over a bowl). Leave to strain overnight. Make sure that the dripping juice is in a clean place where it cannot be contaminated by flies and dust. Do not squeeze the bag to extract the juice as this makes the juice cloudy.
Measure the juice into a large pan.

Heat treatment and addition of sugar

Heat the juice gently in a pan. Add the sugar (500g per 500ml juice) and stir until the sugar has dissolved.

Turn up the heat and boil the mixture rapidly until the jam is set (use a *refractometer* if available, a jam thermometer, the *drop test* or the wrinkle test). Stir with a wooden spoon to prevent burning. Remove any foam from the surface of the jam with a wooden spoon.

Filling and packaging

Cool the jam to about 85°C and pour into the hot sterilised jars. The jars should be hot when they are filled or they may crack.

Fill the jars to about 9/10ths of their volume. Place the clean lids onto the jars, fasten them loosely and invert the jars to sterilise the lid with the hot jam. If you are using plastic jars, let the jam cool to about 80°C before pouring into the jars.

SAUCES AND CHUTNEYS









Sauce, ketchup, paste and chutney

A range of fruits and vegetables can be used to make sauce, ketchup and chutney. The base ingredients are often tomatoes, mixed with other vegetables and fruit. Tomatoes are good for making sauce as they are acidic, so preserve well. You can add any vegetables and spices that you like and which are commonly available in your area. Adding chilli powder or chopped whole chillies to the sauce or chutney makes a spicy hot product. The basic principles of the preservation method are the addition of sugar or salt and *acid* (*acetic acid* or vinegar) combined with *concentration* of the mixture by heating to reduce the water content.

Chutneys

Chutneys are thick, jam-like mixtures that are made from a variety of fruit and vegetables, with added salt, spices, vinegar and sometimes sugar. Any edible sour fruit or vegetable can be used to make chutney.

Sauces, ketchup and pastes

Sauces and purees are made from a mixture of vegetables, spices, salt and sugar which are heated to remove the water and to concentrate the mixture. Sauces are thinner than chutneys and tend to be more acidic. If sauces and purees are heated further to remove more water, they can be made into paste.

Common fruits and vegetables suitable for chutneys and sauces:

Tomatoes
Onions
Carrots
Chilli
Coriander
Mint
Lemon
Orange

SAUCE AND CHUTNEY -equipment required

Sharp stainless steel knife
Weighing scales
Plastic bowls
Cooker or stove
Boiling pan (stainless steel or aluminum)
Measuring jug or bottle
Spoons for measuring,
Wooden spoon for stirring
Glass jars and lids

Should I make sauce and chutney?

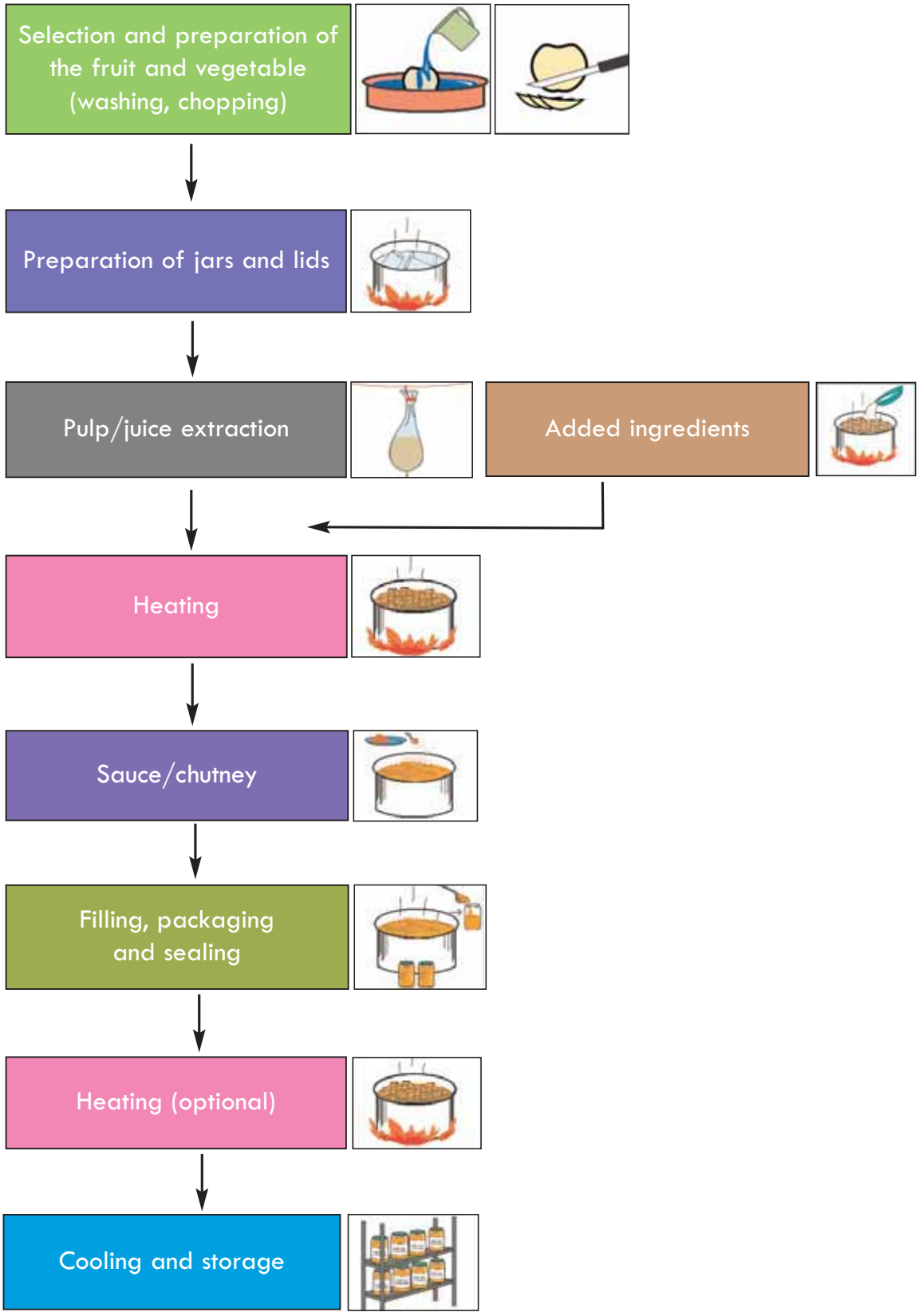
Yes

- Chutneys and sauces can be made with relatively simple equipment that is available in the home.
- The products are quite safe and have a fairly long shelf life due to the combination of high acidity, high salt and low moisture content
- tomato based products are a staple ingredient used in every day cooking

No

- The availability of vinegar (acetic acid) may be a problem in some areas
- The high levels of sugar required for some chutney recipes may be prohibitively expensive.

Processing outline for sauce and chutney



Sauce and chutney – process details and quality assurance

Selection and preparation of the fruit or vegetable

Only use ripe fruit and vegetables to make sauce. Leave under-ripe products to ripen and use at a later date. Chutneys are often made from fruits that are slightly under-ripe. Do not use over-ripe or rotten fruits.
Wash the fruit and vegetables in clean water.
Some fruits, particularly tomatoes, are blanched in hot water for up to 5 minutes to soften the skin and to destroy *enzymes* and *microbes*. After *blanching*, they should be cooled by plunging into cold water.
Peel fruits and chop into various sized pieces according to the recipe.

Preparation of the jars and lids

For glass jars: Wash the jars and lids and put them into a large saucepan. Fill the saucepan with water so that the jars and lids are covered and heat until the water boils. Boil for about 5 minutes.
Remove the jars and turn upside down so that the water can all drain out.
DO NOT dry them with a dirty cloth.
If you are using recycled **plastic jars,** clean them with a solution of chlorinated water (100ppm). Turn upside down so all the water can drain out.

Pulp/juice extraction

Extract the fruit pulp with a manual pulper or a pulper-finisher that separates out the seeds and skins from the pulp. Pass the seeds and skin through the pulper a second time to obtain the maximum amount of juice and pulp from the fruit.
If you do not have a pulper or mouli, heat the fruit gently with a little water to extract the juice. Pass the fruit through a sieve or extract the juice using a muslin bag.
The acidity of the pulp should be 4.0 or lower. The following recipes are all tried and tested so the *pH* does not need to be measured. If you are making your own chutney from a new recipe, you should check the acidity of the pulp with a *pH meter* or *pH* paper. If it is above 4.0, add lemon juice to reduce it.

Added ingredients

Spices.
You can add a range of spices to chutneys and sauces to suit your taste. Any spices you use should be clean and in good condition. If you are making products for sale, you need to make sure that you use the same recipe formulation and add **exactly** the same amount of spice to each batch that you make.
Always use the same measuring spoon or container

Chemical preservatives.

Sodium benzoate is sometimes added to sauces and purees to help preserve the products after the bottle has been opened. Some consumers do not like *additives* such as this, so prefer to buy products that do not contain them. Make sure that you do not add too much benzoate as it gives the product a bad taste. All countries have maximum permitted levels for preservatives. The recommended level for benzoate is 0.2%.

Heat treatment

Heat the mixture of pulp and added ingredients in a large open pan over a low heat. An open pan is best as it allows moisture to evaporate more quickly. Stir continuously with a wooden spoon during heating to prevent burning.
The bright red colour of tomato sauces can be preserved by very slow heating.

Filling and packaging

Hot-fill the sauce or chutney into hot, clean jars or bottles. If the glass jars are cold, there is the risk of breaking when the hot liquid is added.
It is preferable to use glass jars with new screw-on lids but if these are not available, you can use plastic jars covered with foil lids. These are less expensive, but have a shorter *shelf life* than glass packaging.
Alternatively, the chutney can be cooled and filled into poly*ethylene* bags or pouches.

Heating

If using glass bottles, sauces should be pasteurised in the jar after filling. Immerse the jars or bottles in a large pan or water bath and heat.
N.B. Pasteurization can only be done in glass bottles, not in plastic bottles. For this reason, it is preferable to use glass bottles.
Both the time and temperature of *pasteurisation* are critical to achieve the correct *shelf life* and to retain the colour and flavour of the juice.

Cooling and storage

Cool the bottles to room temperature by immersing them in clean cold water. If the bottles are cooled too quickly they will crack and break.
The high acidity of sauces and chutney gives them a long *shelf life* of up to 12 months, if packed in pasteurised glass bottles. The products should be stored in a cool dry place away from direct sunlight to prevent any changes in the colour of the products.

Basic sauce and chutney recipes

The following basic recipes are guidelines for the production of sauces and chutneys. The ingredients can be varied according to local taste and availability of fruits, vegetables and spices.

Italian style tomato sauce

Ingredients (to make 11kg sauce)

5kg fresh tomatoes
5 medium onions (1 medium onion per kg tomato)
25 medium garlic cloves (5 medium garlic cloves per kg tomato)
Salt and pepper to taste
1kg of carrots (1kg carrots per 5kg tomato)
50-100ml vegetable oil
Herbs to taste (dried oregano, fresh basil, chilli powder) (optional)

Selection and preparation of the fruit

Select ripe tomatoes. Remove any that are under-ripe, over-ripe or rotten. Wash in clean water and drain. Cut each tomato in half and discard any that are rotting inside.
Chop the onion in small cubes. Cut the garlic cloves into quarters.
Peel the carrots and chop into small cubes.

Preparation of the the jars and lids

For glass jars: Wash the jars and lids and put them into a large saucepan. Fill the saucepan with water so that the jars and lids are covered and heat until the water boils. Boil for about 5 minutes.
Remove the jars and turn upside down so that the water can all drain out.
DO NOT dry them with a dirty cloth.
If you are using recycled **plastic jars,** clean them with a solution of chlorinated water (100ppm). Turn upside down so all the water can drain out.

Heat treatment and addition of ingredients

Add oil to a pan and fry the garlic and onion over a low flame until the onion turns pink. Take care not to burn the onion and garlic.
Place the cut tomatoes and carrots in a large pan and heat over a low flame. Add the cooked onion and garlic, salt, pepper and chilli powder if using these. Increase the heat and boil for 40 minutes, stirring constantly until it reaches a total solid *concentration* of 10-12° *Brix* (10-12% TSS), measured with a *refractometer*. If you do not have a *refractometer*, boil for 40 minutes until the vegetables can be squashed against the side of the pan with a spoon.

Add fresh basil or dried oregano according to taste. Boil for a further 5 minutes and remove the pot from the heat.

Pulp/juice extraction

Pass the sauce through a pulper, mouli or sieve to remove the seeds and skin.

Heat treatment

Cook the sauce for 10-15 minutes until it starts to bubble and thickens.

Filling and packaging

Fill the hot sauce into clean sterile glass jars or bottles. Fill them to the top and immediately close with clean lids. If you do not have glass jars, let the sauce cool slightly then fill into polyethylene bags that are heat sealed, or clean plastic jars.

Heating (for glass jars)

Place the glass containers into a water bath that is at the same temperature as the bottles. The water must cover the jars. Sterilise in *boiling* water for 45 minutes from the time that the water starts to boil.

Cooling and storage

Allow the bottles to cool a little, then place them in a bowl containing clean cooler water. Change the cooling water as it warms up and the temperature of the bottles decreases. Do this until the bottles are cooled to room temperature. Do not use cold water straight away as this will cause the bottles to crack.

Store the bottles of sauce in a cool dry place away from direct sunlight to prevent the colour from fading. When prepared properly and stored in dry cool conditions, the tomato sauce should have a *shelf life* of about 12 months, if packed in pasteurised glass bottles.

Tomato paste

Ingredients:

Fresh ripe tomatoes (10kg)
Lemon juice (50ml per litre of tomato juice - to adjust the acidity)
Salt (25g per kg tomato pulp)
Sodium benzoate (0.3g per 10kg pulp)

This is a thick bright red paste. It can be stored in jars or polythene bags and has a *shelf life* of several months. (Fellows, 1997)

Preparation of the fruit

Select ripe tomatoes. Discard any over-ripe or mouldy fruits. Save the under-ripe fruits for a later batch.
Wash in plenty of clean (chlorinated) water (8 litres per kg tomatoes). Drain. Cut each tomato in half and discard any that are rotting inside.
Blanch tomatoes in a water bath at 80°C for 5 minutes to soften the skins for peeling and to destroy *enzymes* and *micro-organisms*.

Preparation of the jars and lids

For glass jars: Wash the jars and lids and put them into a large saucepan. Fill the saucepan with water so that the jars and lids are covered and heat until the water boils. Boil for about 5 minutes.
Remove the jars and turn upside down so that the water can all drain out.
DO NOT dry them with a dirty cloth.
If you are using recycled **plastic jars**, clean them with a solution of chlorinated water (100ppm). Turn upside down so all the water can drain out.

Pulp/juice extraction

Pass the tomatoes through a pulper-finisher, mouli or sieve with a 1mm mesh. This removes the skins and seeds from the fruit. Ideally you should check the acidity (*pH*) of the pulp at this stage. If you have a *pH meter* or *pH* indicator papers, make sure that the pulp has a *pH* value of 4.0 or lower. If the *pH* is higher than this, add lemon juice or vinegar to increase the acidity. If you cannot measure the acidity of the tomato pulp, you should add lemon juice (50ml per litre of tomato juice) to make sure that the acidity is high enough.
Add 0.3g *sodium benzoate* per 10kg pulp to preserve the product.

Concentration

Concentrate the pulp by removing the water. There are two ways of doing this – by heating or by draining:

Heating - Heat slowly in an open pan, stirring constantly to prevent burning. If this is done carefully, the bright red colour can be retained. Continue heating until a paste with 30% total solids is obtained. For best results, this is measured using a *refractometer*. If you do not have a *refractometer*, you need to use another method:

- When it is cooked, the paste should easily coat the back of a spoon.
- You can also calculate how much water has been lost by weighing the pulp before and after heating. The pulp should be reduced to one third of its starting weight. *(Remember to substract the weight of the pan when estimating the pulp weight!)*

Draining - An improved method of concentrating is to place the pulp in a white cotton sack that is hung up for one hour to allow the water to drain out, until the pulp loses half its original weight.
Add 2.5% salt by weight of concentrate and mix thoroughly.
Re-hang the sack for one hour until the pulp is one third of its original weight (until it is 30% total solids).
Make sure that the sack is very clean (put it in *boiling* water for 5 minutes) and that the pulp is not exposed to insects and dust.

Filling and packaging

Fill the paste into bottles or plastic pouches. Seal the containers.

Heating (for glass jars)

Place the glass containers into a water bath that is at the same temperature as the bottles. The water must cover the jars. Pasteurise at 90°C for 45 minutes.

Cooling and storage

Remove the water bath from the heat. Gradually add cold water to slowly cool the water bath. Or, leave the jars to cool in the water bath until the following day.

Both glass and plastic packages of tomato paste should be stored away from direct sunlight to prevent the colour fading. The pasteurised paste stored in glass jars will have a longer *shelf life* (up to 12 months) than that in plastic pouches which cannot be pasteurised after packing (up to 3 months). *Shelf life* also depends on the correct level of acidity to prevent the growth of *bacteria*. Once opened, both glass and plastic bottles of tomato puree are susceptible to spoilage by *bacteria*.

Tomato sauce or ketchup

Ingredients (to make 5-6kg sauce)

20kg ripe tomatoes
1.5kg sugar
450g onions
3 to 5g nutmeg (optional)
9g cinnamon
11.5g cumin
11.5g cardamom
11.5g ground black pepper
5g ground white pepper
800ml vinegar
330g salt

This is a thick, sweet red sauce made from fresh tomatoes. It has a *shelf life* of more than one year in glass bottles when the container is unopened. The recipe can be varied by adding different spices. For example, 2.5g chilli powder per 10kg tomato pulp can be added before processing. **(Fellows, 1997)**

Selection and preparation of the fruit

Sort the fruit and select ripe tomatoes. Discard any over-ripe or mouldy fruits. Save the under-ripe fruits for a later batch.
Wash in plenty of clean water (8 litres per kg tomatoes). Drain. Cut each tomato in half and discard any that are rotting inside.
Blanch tomatoes in hot water for 3-5 minutes until the skins are loosened. Remove from the heat and plunge into cold water to cool. Remove the skin and core of tomatoes.
Peel the onions and chop into small pieces.

Preparation of the jars and lids

For glass jars: Wash the jars and lids and put them into a large saucepan. Fill the saucepan with water so that the jars and lids are covered and heat until the water boils. Boil for about 5 minutes.
Remove the jars and turn upside down so that the water can all drain out.
DO NOT dry them with a dirty cloth.
If you are using recycled **plastic jars,** clean them with a solution of chlorinated water (100ppm). Turn upside down so all the water can drain out.

Pulp/juice extraction

Chop the tomato into pieces and pulp, either by hand or with a pulper-finishing machine.

Added ingredients

Add 500g sugar, the onions and the spices tied loosely in a muslin bag.

Heat

Heat to below *boiling* point in a pan, stirring continuously until the volume has reduced by half.
Remove the spice bag. Add 1kg sugar, the salt and vinegar. Continue heating for 5-10 minutes until the sauce is thick enough to coat the back of the spoon.

Filling and packaging

Hot-fill into clean, sterilised jars at 80°C. Close the tops with lids. Glass jars or bottles are the best packaging material. If you do not have glass, you can use plastic bottles or pouches.

Cooling and storage

Cool to room temperature. Dry the jars, add labels and store in a cool dry place away from light. The product should be stable for at least 12 months when packed in glass bottles and stored in good conditions.

Tomato puree or simple concentrate

Ingredients (to make 1kg puree or concentrate)
Fresh ripe tomatoes (10kg)
Salt (100g for puree; 200g for concentrate)

This recipe can be used to either make a tomato puree (10° *Brix*) or a simple concentrate (16° *Brix*). **(FAO, 1997)**

Selection and preparation of the fruit

Sort the fruit and select ripe tomatoes. Discard any over-ripe or mouldy tomatoes. Save the under-ripe tomatoes for a later batch.
Wash in plenty of clean water (8 litres per kg tomatoes). Drain. Cut each tomato in half and discard any that are rotting inside.

Preparation of the jars and lids

For glass jars: Wash the jars and lids and put them into a large saucepan. Fill the saucepan with water so that the jars and lids are covered and heat until the water boils. Boil for about 5 minutes.
Remove the jars and turn upside down so that the water can all drain out.
DO NOT dry them with a dirty cloth.
If you are using recycled **plastic jars,** clean them with a solution of chlorinated water (100ppm). Turn upside down so all the water can drain out.

Heating

Place the tomatoes in a large pot and cook over a medium heat, stirring with a wooden spoon occasionally. Add a little water to the pan to prevent them burning. Add salt to taste if desired.
Continue heating until the tomatoes are softened (if you have a *refractometer* you can measure the total solids (6.5-6.8° *Brix*)). Remove from the heat and allow to cool slightly.

Pulp/juice extraction

Extract the juice by passing the sauce through a pulper, mouli or sieve. Pass the skins and seeds through the pulper a second time to remove as much juice as possible.

Heat

To make the tomato puree:
Place the sauce back on the heat and boil to concentrate it. Weigh the pan before you start heating. You need to reduce the weight by 5%. For

example, if you start with 10kg pulp, you need to boil until the weight is 9.5kg. *(Remember to subtract the weight of the pan when estimating the weight of the pulp!)*
Weigh at 10 minute intervals until the correct amount of water has been removed. The amount of time taken to reach the final *concentration* depends on several factors – the volume of liquid you are heating (smaller volumes will reduce more quickly than large ones) and the type of pan you use – the water will evaporate more quickly from a wide, open pan. Stir occasionally with a wooden spoon to prevent burning.
Add 1% salt (100g for 10kg tomatoes), continue heating until it has dissolved, then remove from the heat.

To make the tomato concentrate:
You need to continue heating until 10% of the moisture has been removed and the sauce is more concentrated. e.g. for 10kg pulp, you need to heat until it weighs 9kg. *(Remember to subtract the weight of the pan when estimating the weight of the pulp!)*
Add 2% salt, dissolve and remove from the heat.

Filling and packaging

Hot-fill into clean, sterilised jars at 80°C. Close the tops with lids.
Glass jars or bottles are the best packaging material. If you do not have glass, you can use plastic bottles or pouches, but these will not have a shorter storage life than the puree packed in glass containers.

Heat

Place the glass containers into a water bath that is at the same temperature as the bottles. The water must cover the jars. Sterilise in boiling water for 45 minutes from the time that the water starts to boil.

Cooling and storage

Cool to room temperature.
Dry the jars, add labels and store in a cool dry place away from light. The product should be stable for at least 12 months when packed in a glass container. When packed in plastic, the product will only have a storage life of about 4 months.

Tomato concentrate (non-cook method)

This is an alternative method for making a concentrated tomato paste that does not involve heating the pulp. It is useful in areas where fuel costs are high. You prepare a puree and then squeeze out the excess water by hanging the pulp in a muslin cloth so the water can drip out. Salt is added to the pulp to act as a preservative and to help separate out the water from the pulp.

Ingredients (to make 1.5kg concentrate)

Tomatoes (15kg – which yields approximately 10kg pulp)
Sodium benzoate (optional) 0.3g/10kg pulp
Salt (250g per 10kg pulp)

Selection and preparation of tomatoes

Sort the tomatoes. Remove those that are under-ripe, over-ripe and rotten or diseased.
Remove the green stalks and wash the tomatoes in clean water.

The tomatoes are blanched to kill any *bacteria* and to split the skins so they are easy to remove. Place the clean tomatoes into the boiling water. Make sure they are all underneath the water; place a lid on the pan. When the water temperature returns to 80°C, keep it there for 5 minutes to blanch the tomatoes. Remove the tomatoes from the *blanching* pan and put them into a clean container. Cover them to prevent contamination from insects or dust.

Preparation of the jars and lids

For glass jars: Wash the jars and lids and put them into a large saucepan. Fill the saucepan with water so that the jars and lids are covered and heat until the water boils. Boil for about 5 minutes.
Remove the jars and turn upside down so that the water can all drain out.
DO NOT dry them with a dirty cloth.
If you are using recycled **plastic jars,** clean them with a solution of chlorinated water (100ppm). Turn upside down so all the water can drain out.

Pulp extraction

Blend the tomatoes to make a pulp. Pass the pulp through a strainer (sieve) to separate out the seeds and skin. The seeds and skin can be put aside and used to make vinegar. Weigh the pulp.

Add preservatives

If you are adding preservatives to the paste, you do it at this stage. Add *sodium benzoate* (0.3g per 10kg pulp). Mix the *sodium benzoate* with a small amount of the pulp and then mix it all together.

It is important that the pulp has a *pH* value of less than 4.5. Most tomatoes have a low *pH*, but sometimes they have a higher value. You should check the *pH* with a piece of *pH* paper.

If the *pH* is 4.5 or higher, you need to add citric *acid* (or lemon juice) to make it lower. Take a 1 litre sample of the pulp and add the juice of a quarter of a lemon to it (or 0.25g citric *acid*). Check the *pH* of this treated pulp again. If it is still high, add more lemon juice. Repeat this until you have a *pH* of 4.2 or lower. Then add the same amount of lemon juice or citric *acid* to every litre of your pulp.

Hanging the pulp

Transfer the pulp into clean cotton sacks. The sacks must be made of non-bleached cotton and should not be painted. They should be sterilized before you use them by boiling in water for 5 minutes.
Try using different fabrics as they will drip at different rates. You need a fabric that drips quickly so that the juice is extracted from the pulp in the shortest time possible. If the dripping takes a long time, the pulp may become contaminated or start to ferment.
Hang the cotton sacks over buckets to collect the juice that runs out. This juice can be used to ferment to make vinegar.

Let the pulp leak out until the sack is half the original weight (this should take about 1 hour for a 40litre sack, depending on the drip rate of the material you use).

Add salt

Add salt to the remaining pulp in the bag. Salt is added at a rate of 2.5%. This means that for 7.5kg pulp remaining in the sack, 187.5g salt is added. Dissolve the salt in some of the extracted juice and then add it to the remaining pulp in the sack.

Hang the sack again and let it continue to drip over the bucket. Let it drip until about 5kg concentrated pulp remains in the sack (this means that it is about one third of the original weight of tomatoes). This should take about 45 minutes to 1 hour depending on the fabric you use.

If you do not want to collect the unsalted juice after the first hanging (which can be used for making vinegar), you can add the salt to the pulp at the start of the hanging. This is better in terms of hygiene as the dripping process is completed in a shorter time. However, if you want to use the expressed juice for vinegar making, it is better to do this without salt.

Filling and packaging

Fill the concentrated pulp into glass bottles if you have them. If you do not have glass bottles, you can use plastic pouches (100g per pouch is a good amount to pack). Seal the pouches using a heat sealer. Make sure all the air is removed from the pouch when you seal it.

Heat treatment

If you are using glass jars, you need to place the jars into cooler water and slowly bring the temperature up to boiling point to prevent cracking the glass. Boil for 45 minutes.

If you are using pouches and the plastic is heat resistant (laminate of poly-*ethylene* –70 micron– and polyamide –30 to 40 micron), place the pouches into a pan of water that has been heated to boiling point. Wait until the water begins to boil again, then leave the pouches in for 45 minutes to ensure they are well pasteurized.

Cooling and storage

Cool the pouches by adding cold water to the hot water bath. Be careful with glass bottles – you need to let the bottles cool down more gradually so they do not shatter.

The pasteurised concentrate has a *shelf life* of at least 12 months as long as it is stored in a cool, dry place away from direct sunlight. Without *pasteurisation*, the concentrate will store for about 3-4 months.

Coriander chutney (chatni gashnize)

Ingredients (for 1.5 to 2 kg chutney)

1 kg fresh coriander
200g garlic
500g fresh hot pepper (green or red)
250 ml vinegar
Salt to taste
100g walnut (optional)

This is a tasty chutney that is prepared from fresh coriander, peppers and garlic. The chutney can be eaten as soon as it has been made or can be left to ferment for up to 2-3 months in the jars during which time it will become more acidic.

Selection and preparation of vegetables

Sort the coriander. Remove the unwanted parts. Wash in clean water and drain well.
Peel the garlic cloves.
Cut the pepper. Remove the stems and seeds. Wash the pepper in clean water.
Shell the walnuts.

Preparation of the equipment, jars a nd lids

Wash the blender with clean (boiled or chlorinated) water.
For glass jars: Wash the jars and lids and put them into a large saucepan. Fill the saucepan with water so that the jars and lids are covered and heat until the water boils. Boil for about 5 minutes.
Remove the jars and turn upside down so that the water can all drain out.
DO NOT dry them with a dirty cloth.
If you are using recycled **plastic jars,** clean them with a solution of chlorinated water (100ppm). Turn upside down so all the water can drain out.

Mix

Blend the prepared vegetables with the walnuts in the blender or pounder ("awang" or "oghor"). The vegetables should be blended until they are well mixed and form a very smooth paste
Add vinegar and salt and mix well.

Filling and packaging

Pour the chutney into clean jars. Do not fill the jars completely as the chutney will ferment during storage. You need to leave some place for the gas to escape during *fermentation*.
Place lids on the jars and seal.

Storage

After packaging in the jar, stand in the sunlight for 2-3 days to encourage the *fermentation* of the chutney. *Fermentation* adds flavour to the chutney and results in the formation of an *acid* that helps to preserve the chutney. After 2-3 days in the sun, remove to a cool place, where it can be stored for up to 3-4 months.

Vegetable chutney

Ingredients (makes 3kg chutney)

750g carrots	9 tea cups
600g cabbage	9 tea cups
100g capsicum	1 tea cup
450g onions	4 tea cups
120g chilli powder	3-9tbs
15g ginger powder	1 tbs
40g salt	3 level tbs
30g curry powder	6 level tsp
750ml sunflower oil	3 ¾ tea cups
300ml vinegar	1 ½ tea cups

If you do not have weighing scales, you can use a teacup to measure out the ingredients.
tbs = tablespoon (next size up from a teaspoon or equal to three teaspoons)
tsp = teaspoon (5ml)

Selection and preparation of the vegetable

Sort the vegetables and discard any unripe, over-ripe or damaged ones. Wash in clean cold water and drain.
Peel the onions and carrots. Chop the onions, cabbage and capsicum into small pieces about 5cm long. Do not use the core of the cabbage.
It is best to use a stainless steel knife to prevent marking the flesh of the fruit and vegetables, but if you do not have one, use a knife with a clean sharp blade.
Grate the carrots using the large holes on the grater.
Weigh out the ingredients accurately. Use weighing scales if you have them. If not, use the same measuring cup or container each time you make the product so that it is the same from one batch to the next.

Preparation of the jars and lids

For glass jars: Wash the jars and lids and put them into a large saucepan. Fill the saucepan with water so that the jars and lids are covered and heat until the water boils. Boil for about 5 minutes.
Remove the jars and turn upside down so that the water can all drain out.
DO NOT dry them with a dirty cloth.
If you are using recycled **plastic jars**, clean them with a solution of chlorinated water (100ppm). Turn upside down so all the water can drain out.

Mix ingredients

Mix the dry spices- chilli powder, ginger powder, salt and curry powder.

Heating

Heat the dry spices in some of the sunflower oil (about 50ml). Stir well to prevent the spices burning. Add the onions to the spicy oil and fry until they are soft (about 5 minutes).

Add the rest of the oil and the vinegar. Stir well.

Add the cabbage and cook for 5 minutes. Stir to prevent burning.

Add the carrots and capsicum and cook for 5 minutes until the carrot is soft. Keep stirring to make sure the chutney does not burn.

Filling and packaging

Hot-fill the chutney into clean sterile jars. Fill them to within 2cm of the top of the jar.

Make sure that there is a layer of liquid from the chutney covering the vegetables or they will spoil when the jar is opened. Clean the outside rim of the jar and put on the lid. Close the lid as tightly as possible.

Slowly turn the jar upside down so that any *bacteria* on the lid of the jar or in the space at the top are killed. Leave the jar upside down until it is cold. When the jars are cold test each lid to make sure it has a good seal.

Storage

Store the chutney in a cool dry place away from direct sunlight. It will store for up to 6 months.

Tomato chutney (Chatni Badenjani Romi)

Ingredients (to make about 1.5kg chutney)

1 kg fresh tomatoes
200g garlic
500g fresh hot pepper (green or red)
Salt to taste

This hot tomato chutney can be eaten fresh or packed in clean jars where it ferments and can be kept for 2 to 3 months

Selection and preparation of vegetables

Sort the tomatoes. Discard any that are unripe, infected or rotten. Wash in clean water and drain well.
Peel the garlic cloves.
Cut the pepper. Remove the stems and seeds. Wash the pepper in clean water.
Use chlorinated water to wash the vegetables

Preparation of equipment and jars

Wash the blender with clean boiled or chlorinated water.
For glass jars: Wash the jars and lids and put them into a large saucepan. Fill the saucepan with water so that the jars and lids are covered and heat until the water boils. Boil for about 5 minutes.
Remove the jars and turn upside down so that the water can all drain out.
DO NOT dry them with a dirty cloth.
If you are using recycled **plastic jars,** clean them with a solution of chlorinated water (100ppm). Turn upside down so all the water can drain out.

Mix

Blend the prepared vegetables in the blender or pounder ("awang" or "oghor") until they are well mixed. Add salt and mix well.

Filling and packaging

Pour the chutney into clean jars. Do not fill the jars completely as the chutney will ferment during storage. You need to leave some place for the gas to escape during *fermentation*.

Storage

The chutney should be stored in a cool and dry place and can be kept for 2 to 3 months.

Chili chutney (Chatni Morchi Sorkh/Sabz)

Ingredients (to make 1. 5 kg chutney)
1 kg fresh red/green chilli
300g garlic
250 ml vinegar
Salt to taste
100g walnut (optional)

This is a hot chutney made of red peppers and garlic. It can be consumed when it is fresh, or stored for up to 3 months in a sealed, clean jar.

Selection and preparation of vegetables

Sort the peppers and discard any that are damaged or diseased. Wash in clean water and drain well. Cut the peppers. Remove the stems and seeds
Peel the garlic cloves.
Use chlorinated water to wash the vegetables.

Preparation of equipment and jars

Wash the blender with clean boiled or chlorinated water.
Glass jars: Wash the jars and lids and put them into a large saucepan. Fill the saucepan with water so that the jars and lids are covered and heat until the water boils. Boil for about 5 minutes.
Remove the jars and turn upside down so that the water can all drain out.
DO NOT dry them with a dirty cloth.
If you are using recycled **plastic jars,** clean them with a solution of chlorinated water (100ppm). Turn upside down so all the water can drain out.

Mix

Blend the prepared pepper and garlic in the blender or pounder (*awang* or *oghor*) until they are well mixed. Add the walnuts to the blender if you are using them. Add the vinegar and salt and mix well.

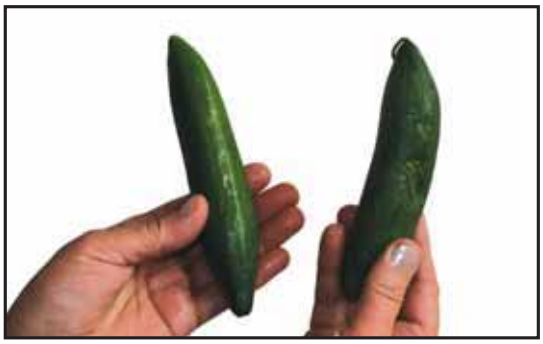
Filling and packaging

Pour the chutney into clean jars. Do not fill the jars completely as the chutney will ferment during storage. You need to leave some place for the gas to escape during *fermentation*.

Storage

The chutney should be store in the cool and dry place be kept for up to 3 months.

PICKLES



Pickles

Pickles include a range of savoury products that are made from a mixture of vegetables and fruit. They are eaten as a spicy accompaniment to a meal. The method of preservation is a combination of increased acidity (reduced *pH*), added salt, reduced moisture and added spices. The most common types of pickles in Afghanistan, known as 'atchar' or 'toorchi', are fermented through the addition of salt or *brine* (lactic *acid fermentation*) or with vinegar (*acetic acid*).

Fermented pickles (atchar)

Atchars are made by adding salt or vinegar to vegetables (or fruit) and leaving them to ferment for a few days. Wild mustard seeds (*awri*) are sometimes added to salt or *brine* pickles. During *fermentation*, *lactic acid* or *acetic acid* is produced which reduces the *pH* of the product and helps to preserve it by preventing the growth of spoilage *bacteria*. These pickles are usually not heated after *fermentation* and therefore strict attention must be paid to hygiene to make sure that the correct type of *bacteria* are present to carry out the *fermentation*. If the fermenting vegetables are contaminated with other *bacteria*, they may become toxic and cause food poisoning. Well made pickles can be stored for several months when they are kept in a cool dry place, away from direct sunlight.

Common vegetables and fruits suitable for pickles (atchar or toorchi):

Cucumber	Mint
Cabbage	Green and red chilli
Carrot	Pumpkin
Bonjon-e-atchar	Cauliflower
Garlic	Turnip
Onion	

PICKLES -equipment required
Sharp stainless steel knife
Weighing scales or,
  Measuring jug or bottle
  Measuring cup
Spoons for measuring
Plastic bowls
Sieve
Grater
Mortar and pestle or grinder
Boiling pan (stainless steel or aluminum)
Wooden spoon for stirring
Cooker or stove
Glass jars and lids

For fermented pickles: large bucket or pot for fermenting in

Should I make pickle?

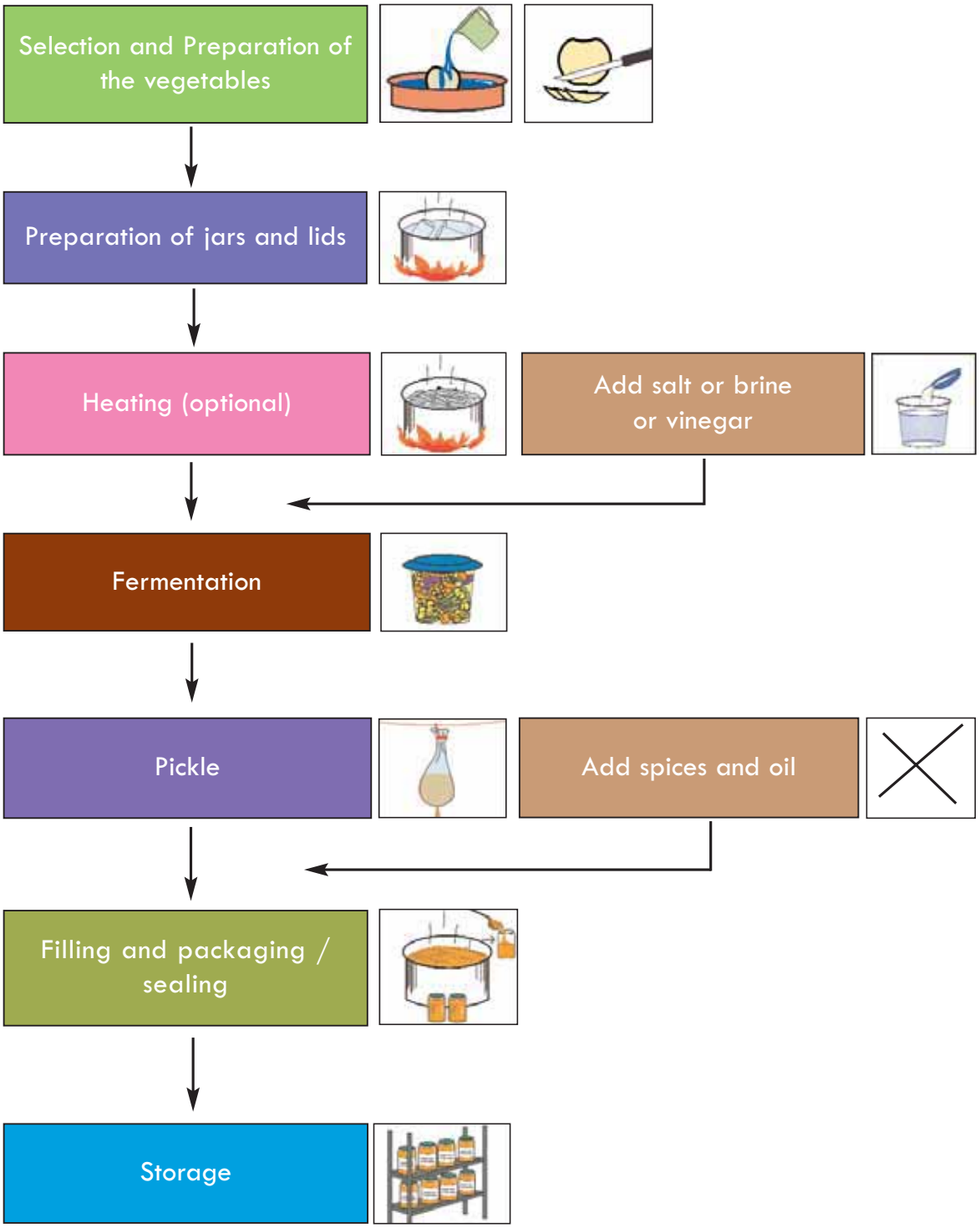
Yes

- Pickles can be made with relatively simple equipment that is available in the home.
- The products are quite safe and have a fairly long shelf life due to the combination of high acidity, high salt and low moisture content.
- Pickles can be prepared from a range of different fruit and vegetables depending on local taste and availability.

No

- The availability of vinegar (acetic acid) may be a problem in some areas.
- The conditions for fermentation (temperature, salt content and pH) should be closely monitored to get a good, safe product.

Processing outline for lactic acid fermented pickles (atchar)



Fermented pickles – process details and quality assurance

Selection and preparation of the vegetables

Select good quality vegetables. Discard any that are damaged or rotten.
Wash the vegetables in clean (boiled) water. Washing vegetables thoroughly is very important, especially if the pickle is prepared without heating the produce. Peel them if required and remove the stones.
Cut the vegetables into small, uniform sized pieces. Place the cut pieces into salted water (2-3% salt solution) to prevent the pieces turning brown.

Sterilise the jars and lids

Glass jars: Wash the jars and lids and put them into a large saucepan. Fill the saucepan with water so that the jars and lids are covered and heat until the water boils. Boil for about 5 minutes.
Remove the jars and turn upside down so that the water can all drain out.
DO NOT dry them with a dirty cloth.
If you are using recycled **plastic jars,** clean them with a solution of chlorinated water (100ppm). Turn upside down so all the water can drain out.

Heating

In some recipes, the vegetables are boiled to soften them prior to *fermentation*.

Fermentation: lactic acid fermentation

Place the pieces of vegetable in a clean container that is suitable for *fermentation*, for example a large clean earthenware pot (only used for *fermentation*) or plastic bucket that is made of food grade plastic and is only used for food. The container should have a lid or a cover that prevents contamination by insects and dust. A 2 litre container is needed for each kg of vegetables.

Lactic acid fermentation (salt or brine)

Add salt or *brine* to the vegetables.

- If you are adding salt, place the salt and vegetables into the container in alternating layers until the container is three quarters full. As a guide, **300g salt is needed for 10kg vegetables**. Make sure the top layer is of salt so that all the vegetable pieces are underneath the salt
- The *brine* starts to form as water is drawn out of the vegetables and dissolves the salt to make a *brine*. *Fermentation* begins as soon as the *brine* is formed.
- If you are using *brine*, prepare a 15-20% salt solution by dissolving salt in clean (boiled) water (150 to 200g salt per litre of *brine*; see page X for more details on making *brine*). *Do not use chlorinated water for the brine as this will prevent fermentation.*

- You need to make sure that all the vegetables are in the *brine* – use 2 litres per kg vegetables. Remember that most vegetables will float when you first put them in the *brine* so you must place a clean plate or similar heavy object on top to submerge the vegetable pieces.

To accelerate the *fermentation* process, you can pound wild mustard seeds (*awri*) and add the *awri* powder to the *brine*.

OR: Acetic acid fermentation (vinegar)

Cover the vegetables in vinegar.

Instead of vinegar, you can also use cover the vegetables in a 5% *acetic acid* solution available in the bazaar. (If the solution is 10% *acetic acid*, make sure to dilute it in water to make a 5% solution).

Remember that most vegetables will float when you first put them in the vinegar or *acetic acid* solution so you must place a clean plate or similar heavy object on top to submerge the vegetable pieces.

Once you have covered the vegetables with salt, or *brine*, or vinegar, place a lid on the *fermentation* pot and leave it to stand in a warm place (21°C) to ferment. It is important to use a lid to help maintain a constant temperature and to protect the fermenting liquor from contamination.

You can speed up the *fermentation* by adding a *starter culture* to the salt or *brine* mixture. The *starter culture* is the juice left over from a previous *fermentation* and which contains some of the *lactic acid bacteria*.

You can see the *fermentation* is taking place as small bubbles of carbon dioxide gas appear in the *brine*.

Fermentation takes between one and four weeks to complete. The time taken depends on the temperature, the salt concentration and the *pH* (acidity of the *brine* or vinegar). It is complete when the bubbles of carbon dioxide gas stop appearing.

Filling and packaging

Fill the fermented pickles into clean sterile jars or containers. The pickles are not processed any further, therefore it is essential to make sure it does not become contaminated at this stage. All equipment must be clean.

Pour a layer of good quality vegetable oil on top of the pickle to act as a seal. Make sure there are no air bubbles trapped in the pickle after filling the jars. Tap the bottom of the bottle lightly on the table to remove any trapped air.

Storage

The pickles should be stored in a cool place out of direct sunlight. The high level of acidity gives them a long *shelf life* of up to 6 months.

Pickled cucumbers

Ingredients

20kg small cucumbers
or 15kg large cucumbers
1kg salt

Cucumbers are fermented by *lactic acid bacteria* to make a dark green, slightly transparent product. Occasionally oil is added to the fermented product.

Selection and preparation of the vegetable

Select ripe cucumbers that are free from bruising or disease. Wash them in clean water and drain.
Cucumbers can either be pickled whole or sliced into smaller pieces. If you are slicing, cut into pieces that are 5-8mm thick. Cucumbers do not need to be peeled.

Preparation of the jars and lids

Glass jars: Wash the jars and lids and put them into a large saucepan. Fill the saucepan with water so that the jars and lids are covered and heat until the water boils. Boil for about 5 minutes.
Remove the jars and turn upside down so that the water can all drain out.
DO NOT dry them with a dirty cloth.
If you are using recycled **plastic jars,** clean them with a solution of chlorinated water (100ppm). Turn upside down so all the water can drain out.

Salting

Place the cucumbers and salt (1kg salt per 15-20kg cucumber) in alternate layers in a sealed container. A *brine* will form to cover the cucumbers. Ensure that they are submerged in the *brine*. If this *brine* is not sufficient to cover the cucumbers, prepare a 40% *brine* (see page X below) and add it to the pot to cover all the cucumbers.

Fermentation

As soon as the *brine* is formed, *fermentation* starts. Bubbles of carbon dioxide gas appear. Leave to ferment in a warm place for 1-4 weeks depending upon the temperature. *Fermentation* is complete when no more bubbles appear.

Filling and packaging

Fill into clean pots or glass jars and seal. The pickle is not further processed, therefore it is important to ensure that the jars are clean and good hygiene is practiced during filling. Oil can be added to the surface if desired.
Cap the jars after filling.

Storage

Store in a cool dry place for up to 6 months.

Mixed pickle

Ingredients (to make approximately 5 kg of pickle)
500g carrot
500g baby eggplant ('bonjon-e-atchar')
500g turnip
500g cauliflower
300g chilli
250g garlic
50g salt
250g 'awri' (wild mustard seeds)
3 litres water (enough to cover the vegetables) + water for boiling the vegetables

Preparation of vegetables

Select vegetables that are good quality and without bruising.
Wash well with clean, chlorinated water.
Peel the carrots. Remove the inedible parts. Chop into small pieces.
Peel the turnip. Remove the inedible parts. Chop into small pieces the same size as the carrots.
Chop the eggplant into pieces the same size as the carrots and turnips.
Take off the cauliflower florets. Chop into smaller pieces.
Peel the garlic and chop into small pieces.
Grind the wild mustard seeds (*awri*).

Preparation of the jars and lids

Glass jars: Wash the jars and lids and put them into a large saucepan. Fill the saucepan with water so that the jars and lids are covered and heat until the water boils. Boil for about 5 minutes.
Remove the jars and turn upside down so that the water can all drain out.
DO NOT dry them with a dirty cloth.
If you are using recycled **plastic jars,** clean them with a solution of chlorinated water (100ppm). Turn upside down so all the water can drain out.

Heating

Boil the carrot, turnip, eggplant, chilli and cauliflower with a little water for 10 to 15 minutes until they are soft. Place them in a sieve and allow the water to run out. Cover the vegetables with a clean cloth and leave to cool down.
Boil the 3 litres of water and leave to cool down.

Mix

Place the mixed vegetables in layers in a large pot (or plastic bucket). Include the chopped garlic and chilli in the layers.
Place the ground *awri* on top. Add the salt and the cool boiled water. (Do not use chlorinated water).

Fermentation

Place in a warm place (or in the sun) for 15 to 20 days to ferment. *Fermentation* starts when bubbles of carbon dioxide gas appear. The length of time taken to ferment depends on the temperature (optimum is between 20 and 25°C). *Fermentation* is complete when no more bubbles appear.

Filling and packaging

Fill the pickle into clean pots or glass jars and seal. The pickle is not further processed, therefore it is important to ensure that the jars are clean and good hygiene is practiced during filling. Oil can be added to the surface if desired. Cap the jars after filling.

Storage

Store the jars in a cool place. The pickle can be kept from two to four months.

Pumpkin pickle

Ingredients (to make approximately 5,5kg of pickle)
2kg pumpkin
250g chilli
250g garlic
200g *awri* (wild mustard seeds)
50g salt
3 litres water (enough to cover the vegetables) + water for boiling the vegetables
100g mint leaves

Selection and preparation of vegetables

Select vegetables that are good quality and without bruising. Wash well with clean chlorinated water.
Chop the pumpkin into smaller pieces.
Peel the garlic and chop into small pieces. Wash the mint leaves and chilli with boiled water.
Grind the *awri*.

Preparation of the jars and lids

Glass jars: Wash the jars and lids and put them into a large saucepan. Fill the saucepan with water so that the jars and lids are covered and heat until the water boils. Boil for about 5 minutes.
Remove the jars and turn upside down so that the water can all drain out.
DO NOT dry them with a dirty cloth.
If you are using recycled **plastic jars,** clean them with a solution of chlorinated water (100ppm). Turn upside down so all the water can drain out.

Heating

Boil the pumpkin in a little water for 10 to 15 minutes until it is soft soft. Place it in a sieve and allow the water to run out. Cover the vegetables with a clean cloth and leave to cool down.
Boil the 3 litres of water and leave to cool down.

Mix and add ingredients

Place the pumpkin in layers in a large pot (or plastic bucket). Include the chopped garlic, chilli and mint in the layers.
Place the ground awri on top. Add the salt and the cool boiled water. (Do not use chlorinated water)

Fermentation

Place in a warm place (or in the sun) for 15 to 20 days to ferment. *Fermentation* starts when bubbles of carbon dioxide gas appear. The length of time taken to ferment depends on the temperature (optimum is between 20 and 25°C). *Fermentation* is complete when no more bubbles appear.

Filling and packaging

Fill the pickle into clean pots or glass jars and seal. The pickle is not further processed, therefore it is important to ensure that the jars are clean and good hygiene is practiced during filling. Oil can be added to the surface if desired. Cap the jars after filling.

Storage

Store in a cool and dry place. The pickle can be stored up to 3 to 4 months.

VINEGAR







Preparation of vinegar

Vinegar is also known as *acetic acid*. It is a by-product of the *fermentation* of fruit and vegetables and because it is acidic, it can also be used to preserve fruit and vegetables. It is commonly added to fruit and vegetables to make pickles.

Common fruits and vegetables suitable for making vinegar:

Grape
Apple
Mulberries

Vinegar can also be made by utilising fruit waste, for example tomato peel and seeds, fruit peelings.

VINEGAR - equipment required

Sharp stainless steel knife
Weighing scales or,
  Measuring jug or bottle
  Measuring cup
Spoons for measuring
Plastic bowls
Blender or liquidizer (optional)
Sieve
Muslin filter cloth
Glass jars and lids
Large fermenting vessel
Air lock

Should I make vinegar?

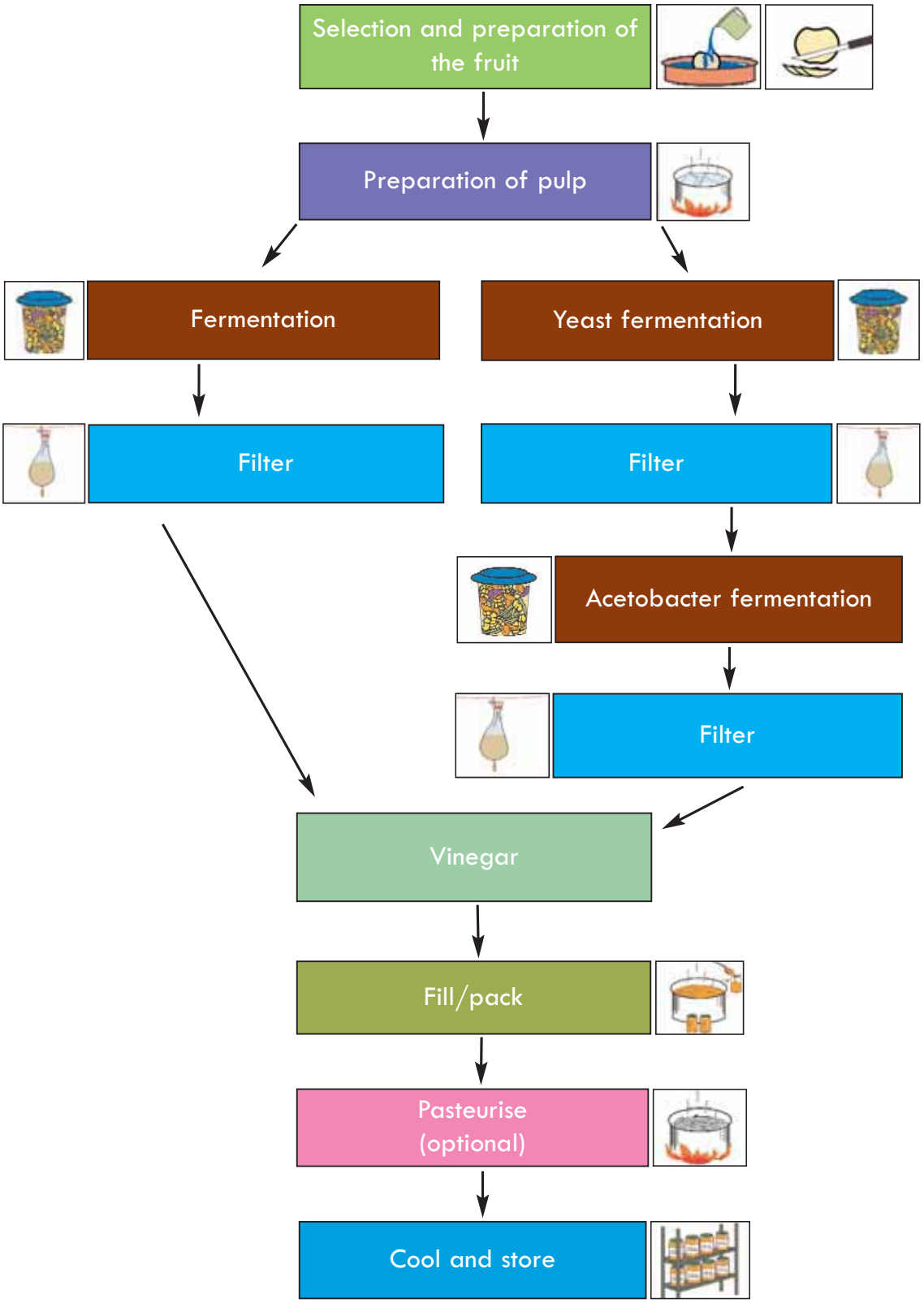
Yes

- Vinegar can be made with relatively simple equipment that is available in the home
- Making vinegar is a good way to utilise fruit waste, for example peels and extracted juice
- Vinegar is a useful ingredient for preserving other fruit and vegetables.

No

- Managing the two different fermentations requires some skill and knowledge of the process. You need to make sure the fermentation conditions are suitable to produce a good product
- To make a good product for sale, you do need some proper equipment to ensure consistency from batch to batch
- Make sure the fermenting vinegar is not contaminated by other bacteria which cause it to spoil
- If you want to use the vinegar in pickle making, you need to ensure it is strong enough to act as a preservative.

Process outline for fruit and vinegar



Fruit vinegar – quality assurance and processing notes

Selection and preparation of the fruit or fruit peels

Wash the fruit or vegetables in clean boiled (non-chlorinated) water. If you are using fruit peels they should be from clean ripe fruit. Do not use peels from rotten or damaged fruit as this will produce a bad product.

Do not use peels from fruit or vegetables that have been sprayed with fungicide or herbicide. Do not use fruit or vegetables that have been treated with preservative as this will prevent the growth of *bacteria* that are needed for *fermentation*.

Cut the fruit or fruit peel into thin strips and put into clay or plastic pots or buckets. Only use boiled water for vinegar making. ***Do not use chlorinated water for making vinegar or for washing the fruits*** as the *chlorine* will prevent the *fermentation* taking place.

Preparation of equipment

All the equipment you use should be clean. Steam–sterilise the bottles before use to get rid of any *bacteria* that can contaminate the *fermentation*. (Do not use chlorinated water).

Do not use aluminium or iron pots for the *fermentation* as the *acid* will react with the metal of the pots.

Fermentation

1. Traditional one-stage method

Mash or liquidise the fruit with boiled water to make a pulp. If you do not have a blender you can mash the fruit by hand and mix with boiled water to make a thick pulp. Dilute the pulp by adding 2 litres of boiled water per litre of pulp. Place the diluted fruit pulp in a large pot for *fermentation* and add sugar (use about 120g sugar per litre of diluted pulp).

Add a *starter culture* of acetobacter (waste fruit slurry saved from a previous *fermentation*) and cover the pot with a clean cotton cloth. Leave it in a warm place (20-22°C) for about 8 days.

While the fruit is fermenting, make sure the water level does not fall too low. If it is getting dry, add some more water.

After 8 days the liquid should have the correct level of acidity (about 4% or *pH*3 if using a *pH meter* or papers). If it is not strong enough, leave to ferment

for a little longer. You might need to add some more sugar. You need a *pH* paper to test the acidity. If you do not have one, you can do a simple *titration* test to find out how strong your vinegar is (See page X, below). If you need the vinegar to be stronger, leave it to ferment for a few more days. You might need to add some more sugar to the mixture.

You may need to adjust the acidity of the fermenting liquid. For apple vinegar, add 1 tsp sodium bicarbonate per 10 litres of fermenting liquid to reduce the acidity. For mulberry vinegar, add 1tsp citric *acid* (lemon juice) per 10 litres of fermenting liquid to increase the acidity.

2. Improved two stage method

This method involves two separate *fermentations*. Ethanol is made by adding yeast to the fruit mixture. The ethanol is then converted into vinegar by adding acetobacter.

- Place the fruit pieces or peels in a clean blender with cool boiled water to make a thick fruit pulp. If you do not have a blender you can mash the fruit by hand and mix with boiled water to make a thick pulp. Dilute the pulp with extra water (1 part pulp to 2 parts boiled water). Add sugar to the pulp (120g per litre of diluted pulp).
  Add the yeast to the pulp, place in a large plastic bucket and leave to ferment at 25°C for two days.
  You may need to adjust the acidity of the fermenting liquid. For apple vinegar, add 1 tsp sodium bicarbonate per 10 litres of fermenting liquid to reduce the acidity. For mulberry vinegar, add 1tsp citric *acid* (lemon juice) per 10 litres of fermenting liquid to increase the acidity.
  After fermenting, filter the mixture through a muslin cloth and collect the liquid.

- Add the *acetic acid bacteria* to the liquid (use a *starter culture* that has been saved from a precious batch of vinegar). Place in a warm place (20-22°C), cover with a clean cotton cloth and leave to ferment for 11 days.

Filter

Drain off the liquid. Filter it through a muslin cloth. Save some of the residual fruit slurry to use as a *starter culture* in the next batch of vinegar.

Filling and packaging

Fill the vinegar into clean, sterilised bottles. Place on the caps and fasten loosely.

Heating (optional) -Pasteurization

Place the bottles in a pan of water and heat to boiling for about 10 minutes to pasteurise the vinegar. This will give it a longer *shelf life*. This stage is optional. If you are using the vinegar straight away, for example to make pickle or chutney, you do not need to pasteurise it.

Cooling and storage

Cool the bottles to room temperature. Tighten the lids on the bottles as they cool down.

Vinegar will store for up to 12 months if kept in a cool, dry place away from direct sunlight.

Tomato vinegar

Ingredients (to make 15-20L vinegar)
10kg tomatoes or tomato skins
Or, 10L tomato juice extracted from the tomato puree
10 litres of boiled water
120g sugar per litre of diluted juice (approximately 2.4kg for the amount of tomato juice specified above)
Yeast (for improved *fermentation*)
Starter culture (left-over vinegar slurry from a previous *fermentation*)

Selection and preparation of the fruit

Sort the tomatoes and remove any damaged or rotten fruits. Wash the tomatoes in clean boiled (not chlorinated) water.
Cut the tomatoes into small pieces and press through a sieve to separate out the juice from the pulp, skin and seeds.
Boil the water and allow it to cool before you use it. Do not use chlorinated water for making vinegar as the *chlorine* will prevent the *fermentation* taking place.

Preparation of the equipment

All the equipment you use should be clean. Steam –sterilise the bottles before use to get rid of any *bacteria* that can contaminate the *fermentation*.

Traditional fermentation

Collect the tomato juice in a large pot for *fermentation*. Dilute the juice by adding 1 litre of boiled water per litre of juice. Add sugar (120g per litre of diluted juice).
Cover the pot with a clean cotton cloth to keep out the dust and insects. Leave to ferment until you can smell vinegar.
You can speed up the *fermentation* by adding a *starter culture* (some left over juice from a previous *fermentation*) to the tomato liquid. Keep the pot at 20-22°C to speed up the *fermentation*.
After about 8 days the level of acidity in the vinegar should be high enough (this depends on the temperature – if it is very cold, the *fermentation* will take a lot longer than this). You need a *pH* paper to test the acidity. If you do not have one, you can do a simple *titration* test to find out how strong your vinegar is (See page X, below). If you need the vinegar to be stronger, leave it to ferment for a few more days. You might need to add some more sugar to the mixture.

Filter

Filter the liquid through a muslin cloth. Save some of the liquid or fruit slurry to use as a *starter culture* in the next batch of vinegar.

Improved fermentation

The improved method involves two *fermentation* stages. The first one is an anaerobic (without oxygen) *fermentation* using yeast. The fermented juice is filtered and then a second *fermentation* takes place, using acetobacter (from a *starter culture* of old vinegar) that produces *acetic acid* (vinegar).

Fermentation 1

Place the tomato juice in a large pot with a small neck. Add water (1 litre per litre of juice) and sugar (120g per litre of diluted juice) to the juice

Activate the yeast – place the yeast in a cup with some sugar, warm water and a small quantity of the fruit juice. Keep the mixture warm (30C) and after about 15 – 20 minutes it should start to bubble. If the yeast does not start to produce bubbles in the glass, it is dead. You need to get another supply of yeast.

Add the yeast to the juice, place in a large plastic bucket and leave to ferment at 25°C for two days. You need to make sure that the first *fermentation* is in a closed container, to prevent any air getting into the mixture. The *bacteria* that convert sugar into ethanol have to do it without oxygen.

An airlock is usually fitted to the jar that is used for *fermentation* – this prevents air getting into the fermenting juice, but the gas that is given off during *fermentation* can escape through the airlock.

Filter

Filter the mixture through a muslin cloth and collect the liquid in a wide, open pot.

Fermentation 2

Add the *acetic acid bacteria* to the liquid (use a *starter culture* that has been saved from a previous batch of vinegar (use the slurry that is left over when you filter off the vinegar)). Place in a warm place (20-22°C), cover with a clean cotton cloth and leave to ferment for 11 days. It is essential that air gets to the liquid during the second stage as the acetobacter need oxygen to convert the ethanol into vinegar.

Filter

Filter the liquid through a muslin cloth. Save some of the liquid or the slurry left after filtering to use as a *starter culture* in the next batch of vinegar. You cannot use pasteurised vinegar as a *starter culture* as *pasteurisation* kills the *bacteria* that are needed for *fermentation*. Make sue you save a sample before it is pasteurised.

Filling and packaging

Fill the vinegar into clean, sterilised bottles. Place on the caps and fasten loosely.

Heating (optional)

Place the bottles in a pan of water and heat to boiling for about 10 minutes to pasteurise the vinegar. This will give it a longer *shelf life*. This stage is optional. If you are using the vinegar straight away, for example to make pickle or chutney, you do not need to pasteurise it.

Cooling and storage

Cool the bottles to room temperature. Tighten the lids on the bottles as they cool down.
Pasteurised vinegar will keep for up to 12 months if it is stored in a cool dry place away from direct sunlight.
Non-pasteurised vinegar should be used within one month.

Mulberry vinegar

Ingredients (to make 15 litres vinegar)

Single fermentation

10kg mulberries
10 litres of boiled water
2.4 kg sugar (120g sugar per litre of diluted juice)
2tsp lemon juice (1tsp lemon juice per 10 litres diluted juice)

Two-stage fermentation

10kg mulberries
20 litres boiled water
3.6 kg sugar (120g sugar per litre of diluted juice)
3tsp lemon juice (1tsp lemon juice per 10 litres diluted juice)

Selection and preparation of the fruit

Sort the mulberries and select those that are ripe. Discard any that are rotten or infected.
Place in a large plastic or clay pot that is suitable for *fermentation*. .
Boil the water and allow it to cool before you use it. Do not use chlorinated water for making vinegar as the *chlorine* will prevent the *fermentation* taking place.

Prepare equipment

All the equipment you use should be clean. Steam –sterilise the bottles before use to get rid of any *bacteria* that can contaminate the *fermentation*.

Traditional fermentation

Squash the mulberries to break the cells and extract the juice. You can liquidise the fruit if you have a liquidiser, otherwise do it by hand to make a pulp. Add clean boiled water to the mulberries (1 litre per litre of squashed mulberries) to make diluted pulp. Add sugar (120g per litre of diluted pulp). Add lemon juice (1tsp per 10litres of diluted pulp) to increase the acidity of the diluted pulp.
Cover the pot with a clean cotton cloth to keep out the dust and insects. Leave to ferment until you can smell vinegar.
You can speed up the *fermentation* by adding a *starter culture* (some left over juice from a previous *fermentation*) to the mulberry liquid.
Keep the pot at 20-22°C to speed up the *fermentation*.

After about 8 days the level of acidity in the vinegar should be high enough (about 4% *acid*, which is equivalent to a *pH* of 3). The time of *fermentation* this depends on the temperature – if it is very cold, the *fermentation* will take a lot longer than this). You need a *pH* paper to test the acidity. If you do not have one, you can do a simple *titration* test to find out how strong your vinegar is (See page X, below). If you need the vinegar to be stronger, leave it to ferment for a few more days. You might need to add some more sugar to the mixture.

Filter

Drain off the liquid. Filter it through a muslin cloth. Save some of the residual fruit slurry to use as a *starter culture* in the next batch of vinegar.

Improved two stage fermentation

This method involves two separate *fermentations*. Ethanol is made by adding yeast to the fruit mixture. The ethanol is then converted into vinegar by adding acetobacter.

Fermentation 1

Make the fruit pulp by mixing crushed mulberries with boiled water (1 litre per kg fruit). Dilute the pulp with extra water (1 part water to 1 part pulp). Add sugar to the diluted pulp (120g per litre diluted pulp) and lemon juice (1tsp per 10 litres diluted pulp).

Activate the yeast: place the yeast in a cup with some sugar, warm water and a small quantity of the fruit pulp. Keep the mixture warm (30°C) and after about 15 – 20 minutes it should start to bubble, If the yeast does not start to produce bubbles in the glass, it is dead. You need to get another supply of yeast.

Add the yeast to the pulp, place in a large plastic bucket and leave to ferment at 25°C for two days. You need to make sure that the first *fermentation* is in a closed container, to prevent any air getting into the mixture. The *bacteria* that convert sugar into ethanol have to do it without oxygen.

Filter

Filter the mixture through a muslin cloth and collect the liquid.

Fermentation 2

Add the *acetic acid bacteria* (acetobacter) to the liquid (use a *starter culture* that has been saved from a previous batch of vinegar). Place in a warm place (20-22°C), cover with a clean cotton cloth and leave to ferment for 11 days. It is essential that air gets to the liquid during the second stage as the acetobacter need oxygen to convert the ethanol into vinegar.

Filter

Drain off the liquid. Filter it through a muslin cloth. Save some of the residual fruit slurry to use as a *starter culture* in the next batch of vinegar. You cannot use pasteurised vinegar as a *starter culture* as *pasteurisation* kills the *bacteria* that are needed for *fermentation*. Make sure you save a sample before it is pasteurised.

Filling and packaging

Fill the vinegar into clean, sterilised bottles. Place on the caps and fasten loosely.

Heating (optional)

Place the bottles in a pan of water and heat to boiling for about 10 minutes to pasteurise the vinegar. This will give it a longer *shelf life*. This stage is optional. If you are using the vinegar straight away, for example to make pickle or chutney, you do not need to pasteurise it.

Cooling and storage

Cool the bottles to room temperature. Tighten the lids on the bottles as they cool down.

Pasteurised vinegar will keep for up to 12 months if it is stored in a cool dry place away from direct sunlight.

Non-pasteurised vinegar should be used within one month.

POTATO CRISPS

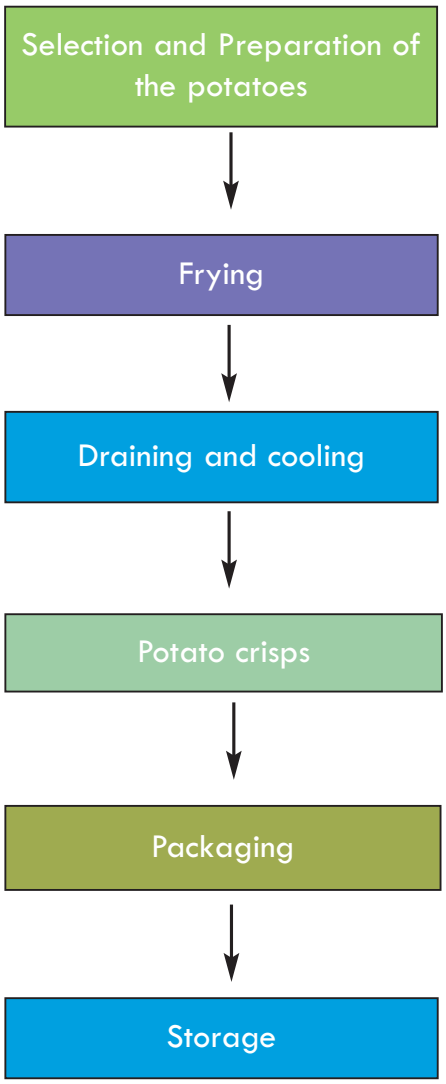





Potato crisps

Potato crisps are a popular snack food made by frying thin slices of potato in hot oil. Flavourings such as salt or chilli can be added to the crisps after they have been fried. They are best consumed soon after preparation. If you want to store them for any length of time, you need airtight bags for packaging.

Process outline for potato crisps



Potato crisps – quality assurance and processing notes

Ingredients

Potatoes
Oil
Salt (optional)

Selection and preparation of potatoes

Select good clean potatoes. If possible, select potatoes that have a high sugar content as they make a good golden colour crisp when they are fried. Wash the potatoes well. Peel and cut out any green parts or eyes that are present.

Slice the potatoes as thinly as possible. Make sure the slices are all the same thickness so they all cook at the same rate. Wash to remove the starch and dry before frying them.

Frying

Heat the oil to 180-200°C in a large pan. Use a thermometer if you have one. If you do not have one you can test the oil to see if it is ready by placing one of the potato slices into the oil. It will sink to the bottom. If the oil is hot enough, the slice will rise to the surface. If the oil is too cold, the potato slice will stay at the bottom until the temperature is hot enough; then it will rise to the surface of the pan. This is the correct temperature for frying. If the potato piece sizzles and burns when you put it in the oil, the oil is too hot and should be allowed to cool before frying.

When the oil is hot enough add a few crisps at a time. Do not add too many at any one time as this lowers the temperature of the oil and the crisps take longer to cook. Fry the crisps until they are golden brown.

Important! The oil you use affects the taste, texture and keeping quality of the crisps. Do not use old oil that has been used for frying more than a 3 or 4 times. Each time you heat the oil it becomes damaged and eventually becomes rancid. Old rancid oil develops a strong flavour which will spoil the flavour of your crisps. New oil makes better quality products. It is best to use vegetable oil for frying although animal fat, can also be used.

Draining

Remove the crisps from the hot oil. Drain on absorbent paper to remove any excess oil. Add flavourings such as salt or chilli if required.
It is important to drain the crisps to remove the excess oil. Poorly drained products leave a greasy film inside the packaging which looks unattractive and accelerates deterioration of the crisps.

Packaging

Fried crisps rapidly absorb water from the surrounding air and soon become soft. They should be packaged as soon as they are cool. Do not seal in the packets before they are cool or condensation will form on the inside of the packet. The packaging must be air tight and moisture proof.

Storage

Potato crisps should be stored in a cool dry place away from direct sunlight because they will soften if they are in a damp place. Crisps should be stored away from products with a strong taste or odour because they will pick up the taste from other products if they are stored together.
They should be consumed within one month of production.

MEASUREMENTS AND PREPARATION OF SOLUTIONS

Measuring ingredients

For accurate measurements of ingredients, weighing scales are recommended. However, if these are not available, you can use containers found in the kitchen to measure out different amounts. For accuracy and consistency of the product, the same measure should be used for each batch of product that you make.

Table 9: Approximate weight of different ingredients

	Approximate weight (g)		
Ingredients	**1 teaspoon full (1tsp)**	**1 tablespoon full (1tbs)**	**1 cup (250ml)**
Salt	7.0g	21.0g	350g
Sugar	6.0g	18.0g	300g
Pectin	3.5g	10.5g	
Citric *acid*	7.0g	21.0g	
Sodium metabisulpHite	6.5g	19.5g	

IMAGE 28 - pictures in the table of the different measures - cup, teaspoon, tablespoon, pepsi bottle and others that are commonly used

Table 10: Weight of volume of common containers

Container	Weight or volume
Cup (tea cup commonly used in Afghanistan)	250ml
Teaspoon	5mg or 5ml
Tablespoon	15mg or 15ml
Large pepsi bottle	1.5 litres or 3 litres
Coke/pepsi can	330ml
Oil plastic bottles	CHECK
Ghee / oil cans	CHECK

Preparation of syrup or brine solutions

Syrup or *brine* solution is made by dissolving sugar or salt in water. You should always weigh the amount of sugar or salt that is to be added to the water. You need to prepare the solution in a container, such as a measuring jug, that has volumes marked on it. For ease of calculation, it is best to use a measuring jug that can hold 1 litre of solution. If you are making a strong syrup or *brine*, you will need to heat the water to dissolve all the sugar or salt.

The following example explains how to make a 20% syrup. A 20% solution means that there is 20g sugar per 100g total syrup:
Weigh out 20g of sugar. The total weight of the syrup (which is only made from sugar and water) is going to be 100g. The sugar weighs 20g so the water must weigh (100g - 20g) = 80g (80g of water is equal to 80ml water).

You can use the same calculation to prepare a *brine* solution, but using salt instead of sugar.

The table 10 below provides amounts to prepare:
- 100ml (100g) of a 20% solution
- 1 litre (1000g) of 40% solution
- 3 litres (3000g) of 20% solution

Table 11: Calculations of ingredients for the preparation of syrups and brine solutions

Concentration required (% of sugar OR salt)	Total weight of final syrup or brine solution	Amount of sugar or salt required	Amount of water required (total weight – sugar or salt)
20%	100g	20g	80g (100-20)
40%	1000g (1L)	400g	600g (1000-400)
20%	3000g (3L)	3 x 200g = 600g	2400g (3000-600)

A common mistake in calculating syrup concentrations

Quite often, when people make a syrup or a *brine* solution, they assume that you add the given amount of sugar or salt to 1 litre of water. In fact the given amount of salt or sugar should be dissolved in a smaller amount of water and then the total volume made up to 1 litre.

For example, you need to make 3 litres of a 20% syrup.
Based on the calculations above, you need to take 3x200 g (600g) sugar and dissolve this in 3000-600 (2400g) water.

A common mistake is to take (3x200g) 600g sugar and dissolve this in 3litres (3000g) water. If you do this, you end up with a total syrup weight of 3,600g The proportion of sugar in this is 600g out of a total of 3,600g, which is equal to 17% (600/3600 x100) instead of the 20% that you require.

Water chlorination

Clean water is an essential part of food processing. Water is needed to clean the raw materials and the equipment and also for use as an ingredient in some processes.

Water can be made safe to use by boiling for 10-15 minutes. However, this is costly in terms of the amount of fuel needed and the time taken to sterilise large amounts of water.

An alternative method is to add *chlorine* to the water. *Chlorine* solutions of different strengths are needed for different purposes:

- For water that is used for cleaning, a *concentration* of 60-100ppm *chlorine* is required.
- For water that is to be used for drinking or as an added ingredient, 0.5ppm *chlorine* is needed. If too much *chlorine* is added to drinking water, it can affect the flavour of the products.

Water is chlorinated by adding ***sodium hypochlorite***, which has 50% available *chlorine*. If *sodium hypochlorite* is not available in the market, household bleach can be used. Household **bleach** contains between 3 and 6% available *chlorine*. But this will probably be more expensive
See the boxes below for detailed instructions.

Warning!
Chlorine kills most microbes, but is also a dangerous chemical. Care must be taken when making the solution. Wear gloves to avoid burning the skin. Do not get it in the eyes. Do not breathe in the fumes. Chlorine corrodes aluminium equipment, so use plastic buckets and spoons for mixing

Preparation of water for cleaning fruits, vegetables and equipment (cleaning solution)
A chlorine solution of 100ppm should be used.

Using bleach
Add 10ml (2 tsp) of bleach to 5 litres of water

Using sodium hypochlorite
Add 200mg sodium hypochlorite to 1 litre of water

ALLOW THE CHLORINATED WATER TO STAND FOR 30 MINUTES TO ALLOW CHLORINE TO REACT WITH THE WATER

Preparation of water to be used for drinking or in processing (as an ingredient)

A 0.5ppm chlorine solution should be used.

Using bleach:
Prepare the cleaning solution described in the other box, and dilute it 200 times: Take 1 tsp (5ml) of the cleaning solution (100ppm chlorine) and add it to 1 litre of water.

Using sodium hypochlorite
Add 5mg (1tsp) sodium hypochlorite to 5 litres of water.

Using the chlorine solution available in pharmacies (which contains 0.5% sodium hypochlorite)
Add 2ml chlorine solution to 10 L of water.

ALLOW THE CHLORINATED WATER TO STAND FOR 30 MINUTES TO ALLOW CHLORINE TO REACT WITH THE WATER

Preparing a sulphite solution

Sulphur dioxide is used during drying to help preserve the fruit and to prevent the colour fading. The gas can be produced by burning elemental sulphur, or by dissolving sodium metabisulphite ($Na_2S_2O_5$) in water to make a sulphite solution.

The *concentration* of sulphur dioxide is usually expressed as ppm (parts per million). 1ppm = 1 part in 1,000,000. It is equivalent to the measurement of mg/kg (or mg per litre).

When sodium metabisulphite is dissolved in water, only about two thirds (2/3) of the weight of sodium metabisulphite is turned into sulphur dioxide. Therefore, to achieve a known final *concentration* of SO_2, you have to dissolve 3/2 (1.5) times more weight of $Na_2S_2O_5$ than the final *concentration* you require.

For example, to achieve a *concentration* of 1000 ppm (mg/L), you have to dissolve 1000 x 1.5 (1500mg) of sodium metabisulphite in 1 litre of water.

To achieve a final *concentration* of 800ppm SO_2, you have to dissolve 800 x 1.5 (1200mg) sodium metabisulphite in 1 litre of water.
It is always easier to work out how much of a powder needs to be added to 1 litre water (remember mg per litre give ppm) and then multiply this to get the final quantity you require.

For example if you need 3 litres of a 800ppm SO_2 solution, you calculate that you need 1200mg to make 1 litre, therefore you will need 3 x 1200mg (3600mg) to make 3 litres.

The calculations for preparing a sulphur dioxide *concentration* are summarised in the table below.

Table 12: Amounts of sodium metabisulphite and water required to prepare different concentrations of SO_2.

Concentration of SO_2 required	Amount of total SO_2 solution required	Amount of sodium metabisulphite	Amount of water
1000 ppm (mg/L)	1L (1000g)	1500mg or 1.5g (1.5 x 1000mg)	1L (1000g)
800 ppm	1L (1000g)	1200mg or 1.2 g (1.5 x 800mg)	1L (1000g)
800ppm	3L (3000g)	3600mg or 3.6 g (=1.5 x 800mg x 3L)	3L (3000g)

The Pearson Square

The *Pearson square* is a method that processors can use to calculate the amounts of **two** components that should be mixed together to give a final known *concentration*.
For example, it can be used to calculate the amounts of fruit pulp and sugar to make a jam. The method can only be used for blending two components. When more than two components are involved, it becomes more complex.

Example of how to use the Pearson Square

You wish to produce a fruit jam with a final sugar content of 68%. You use apricot puree (that contains 15% sugar), mixed with sugar (that contains 100% sugar).

1. Draw a rectangle

2. Label the two horizontal lines with the names of the two products to be blended (fruit puree and sugar)

Apricot puree

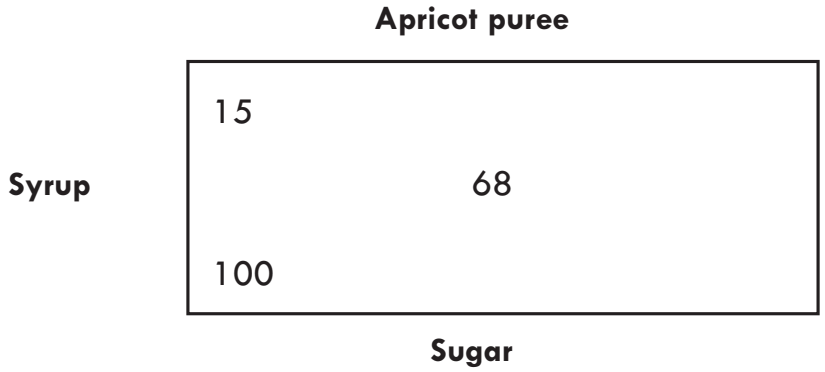
Sugar

3. Enter the sugar composition of each product in the rectangle as shown below:

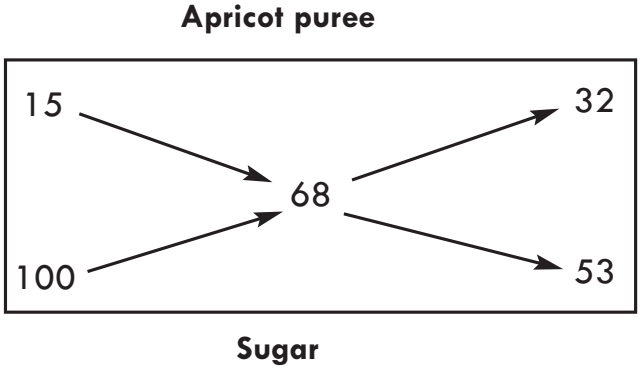
Apricot puree

Sugar

4. Enter the required final *concentration* in the centre of the rectangle.



5. Mix the two components by crossing diagonally through the centre of the rectangle.



6. Following the arrows, subtract the smaller number from the larger one to give two new numbers (32 and 53) in the opposite corners of the rectangle. These numbers (32% apricot puree and 53% sugar) are the amounts that need to be mixed to give a fruit jam with a final sugar *concentration* of 68%.

Measuring the strength of vinegar

You can test the strength (acidity) of your homemade vinegar by doing a simple *titration*. All you need is a few small glasses and jars, an eyedropper, a little baking soda (sodium bicarbonate), a small amount of commercial vinegar and some red cabbage or beetroot (you can also use dark coloured rose petals or a strong cup of tea as the indicator).

- In one small jar put a solution of baking soda in water. The amount does not matter, but it should be enough so that a little un-dissolved soda settles at the bottom of the jar after it has been mixed well.
- In the other jar, put some water that is left over from cooking beetroot or red cabbage. You want a strong purple colour: you can steam a head of cabbage or boil a beetroot in just a small amount of water.
- Next put a few millimeters of water in two glasses. The amount does not matter, but make certain you have the same amount in both glasses.
- Use the eyedropper to put enough drops of the purple liquid into the water in the glasses to give the water a definite colour. Again, be careful to put the same amount in each glass.
- Rinse the eyedropper in water, then in the store-bought vinegar. Then put seven drops of the store-bought vinegar into one of the glasses of coloured water which is your 'control' or standard.
- Rinse the eyedropper in water again, then in your homemade vinegar, and add seven drops of your homemade vinegar to the other glass – this one is your test glass.
- Rinse the eyedropper in water again, then in the baking soda solution. Put 20 drops of the baking soda solution in the 'control' glass (with store-bought vinegar). Stir it with a glass rod or plastic spoon. The water will turn blue. The exact shade depends on the pH of your water.
- Add baking soda solution, one drop at a time (remember to count the drops as you add them) to the test glass. Stir after adding each drop. Do this until the colour of the water in the test glass exactly matches the colour of the water in the control glass. If you add a drop too much, no problem. Just don't count that one.
- When the colours of the two glasses match, the *acid* content of your homemade vinegar is equal to the number of drops of baking soda solution you put in the test glass divided by four.

For example: if you used 28 drops of solution, the acidity is 28 divided by 4, or 7%. But you require a 5% vinegar to make pickles.
How do you make it 5%?
You need to water it down. To make it 5%, subtract 5 from whatever your homemade vinegar tested: in our example, 7-5=2. Multiply that by the amount of vinegar (in ml) you are going to dilute. For instance if you have 250ml, 250 x 2 = 500. Divide that by 5, and you get 100.
Add 100 ml of water to 250ml of 7% vinegar to make it 5% acidity.

Follow the method of the *Pearson square* (see page X above) to do this calculation.

Fruit and vegetable storage and processing are very important for the livelihoods and health of Afghan households. Improved storage and processing can help families improve their diet throughout the year, by increasing the availability of diverse foods in the winter. Fruit and vegetable processing can also increase the income of families by reducing post-harvest losses, adding value to food products, enabling households to sell produce when prices are higher and by making produce easier to transport to the markets.

This Book is the second part of the manual "Home-based Fruit and Vegetable Processing in Afghanistan: A Manual for Field Workers and Trainers". This manual focuses on small-scale fruit and vegetable processing and preservation, for home consumption and small enterprises. It is designed to help anyone wishing to promote and disseminate fruit and vegetable processing techniques at community level.

Book Two provides detailed processes and recipes for various food processing techniques, including: drying, jam-making, sauces and chutneys, pickles, vinegar, and potato crisps. All recipes use fruits and vegetables that are readily available in Afghanistan.

When using Book Two, you can refer to Book One, which provides the basic principles of food storage and processing. It describes optimal practices for each stage of fruit and vegetable handling, from harvesting, post harvest handling and storage, to processing and packaging. Book One also includes information on hygiene and quality control.

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