Food processing – TOMATO

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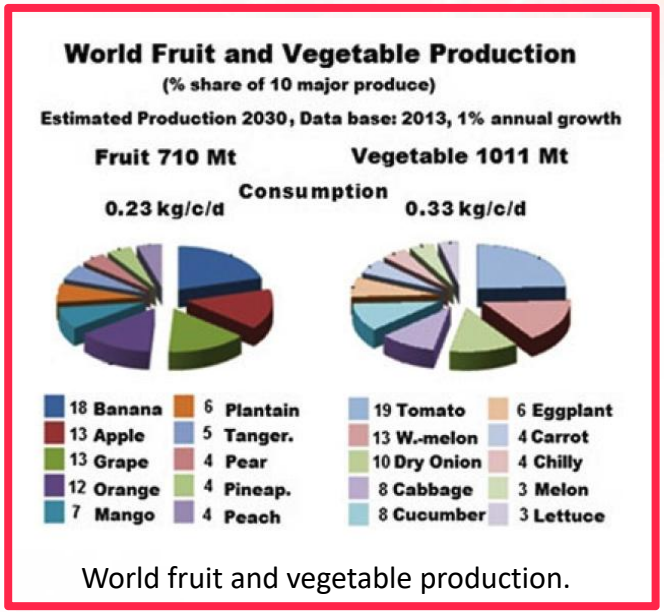
1.1 General Introduction

agricultural industry

fruit and vegetable processing

1.1 General Introduction

Fruit and vegetables represent an important part of world agriculture production.



World fruit and vegetable production.

	Process			
	Canning	Freezing	Drying	Juice/precut vegetable ready-made salads
Share %	40	36	10	14

Share of preservation processes of vegetable and fruit

1.1 General Introduction

What fruit and vegetables can be processed?

- the demand for a particular fruit or vegetable in the processed form;
- the quality of the raw material, i.e. whether it can withstand processing;
- regular supplies of the raw material.

1.1 General Introduction

What is fruit and vegetable processing?

Using fresh fruits and vegetables as raw materials, according to different physical and chemical properties, using different methods and machinery to make various products.




1.2 Before Processing

Production planning

- Number of workers required and their different jobs
- Equipment needed to achieve the planned production level
- Weights of raw materials and ingredients to be bought
- Number of packages required
- It can also identify any ‘bottle-necks’ in the process.

1.2.1 Daily production rate

- How much product is sold each month?
- How many hours are worked per day?
- How many days are worked per month?

$$\text{Production rate (kg or litres/day)} = \frac{\text{amount of product sold/month (kg or litres)}}{\text{N° days production/month}}$$

1.2.2 Raw materials and ingredients

Worked example 1: calculating weights of ingredients from a recipe.

A recipe for mango chutney (from Table 4.7) is shown in the left column of the table below and the amounts of ingredients needed to make 50 kg are shown in the right column, with the calculation in the centre.

Recipe		Calculation	Amount needed to make 50kg
Mango	500g	(500/803.5) x 50	31.1 kg
Sugar	300g	(300/803.5) x 50	18.7 kg
Ginger	0.5g	(0.5/803.5) x 50	31.1 g
Mustard	0.5g	(0.5/803.5) x 50	31.1 g
Chillie	1.0g	(1.0/803.5) x 50	62.2 g
Garlic	0.5g	(0.5/803.5) x 50	31.1 g
Salt 1.0g		(1.0/803.5) x 50	62.2 g
Total	**803.5g**		**50.0 kg**

1.2.2 Raw materials and ingredients

$$\text{Yield (\%)} = \frac{\text{weight of raw material actually used in the process}}{\text{weight of raw material that is bought}}$$

$$\text{True raw material cost} = \frac{\text{Supplier cost}}{\text{\% yield}}$$

Worked example 2: calculating the true cost of raw materials

Pineapples cost USh 200 each and on average a single fruit weighs 1250g (i.e. Ush 160/kg). 30 kg are bought for USh 4800 and after peeling and coring there is 15.5 kg available for processing.

$$\text{Yield} = \frac{15.5}{30} \times 100 = 51.7\% \text{ (i.e. 48.3\% is waste)}$$

$$\text{The true cost of the usable part of a single fruit} = \frac{200}{51.7} \times 100 = \text{USh } 387$$

1.2.2 Raw materials and ingredients

Worked example 3: calculating the weight and value of fruit after drying.

Taking 15.5 kg of fresh fruit, initially the fruit contains 75% water and 25% solids.
Therefore 15.5 kg of fruit contain 11.6 kg of water and 3.9 kg solids
After drying the weight of solids has not changed (only water is removed) and the moisture content is reduced to 8%.

Therefore the solids content is (100 - 8) = 92%

If 3.9 kg solids is 92%, then the total weight of product = $\frac{100}{92}$ x 3.9 = 4.2 kg

Therefore (15.5 - 4.2) = 11.3 kg water is removed

There were also losses of 200g due to rejected dried fruit. Therefore 4 kg of product is available for sale.
Ignoring other production costs (labour, depreciation etc.) the value of the product is therefore:

$$\frac{\text{Cost of raw materials}}{\text{Weight of product}} = \frac{\text{USh 4800}}{4} = \text{USh 1200/kg}$$

i.e. processing has increased the value of the fruit from Ush 160/kg to Ush 1200/kg

1.2.3 Packaging

- technical requirements of the product
- the design
- the relative cost

Red alert! Covid-19 pandemic leads to ketchup packet shortage, Internet jokes 'sauce another condiment'

By Srivats Lakshman

Updated On : 00:40 PST, Apr 7, 2021

1.2.4 Equipment

- specify exactly what is required (many manufacturers have a range of similar products).
- give the throughput required per hour and the type of food to be processed
- where possible, give other information (model number of machine, single or three-phase power, number and types of spares required).

1.2.5 Staff

- health and safety

- Do not leave metal stirrers in boiling liquids.
- Do not leave handles of boiling pans over the heat source.
- Carry knives with the point down. Do not try to catch falling knives.
- Cut fruits and vegetables on a board and not using the other hand.
- Do not use a damp cloth to carry hot pans.
- Wear shoes that protect your feet from falling or hot objects.
- Cover burning cooking oil with a damp cloth. Never use water to put out flames.
- Shield gas burners from direct sunlight because the flames can become invisible.
- Do not carry large containers of hot food on your own; get assistance.
- Do not put cleaning fluids into old food containers.

- record keeping

Type of record	Information to be recorded
Production records	Recipes Raw materials and ingredients received and suppliers Wastage % at different stages of the process Stock levels for each ingredient Production volumes and measurements Maintenance programs and schedules
Quality assurance records	Target amounts of ingredients and any changes made to recipe Measurements made at process control points Batch numbers and product code numbers Cleaning procedures and schedules
Sales records	Names of customers and amounts sold to each Weekly and monthly sales volumes
Financial records	Income from sales Costs of all process inputs Staff records Cash flow Profit/loss Tax records Bank statements

1.3 Primary processing of fruits and vegetables

Primary processing:

- Sorting
- Trimming
- Grading
- Washing
- Drying…

sorting

washing

1.3.1 Cleaning/ Washing

- Addition of detergents or 1.5% hydrochloride solution;
- Use of warm water in the pre-washing phase;
- Higher water pressure in spray/shower washers.

1.3.2. Sorting/Grading

- Removal of damaged fruit and any foreign bodies;
- Qualitative sorting based on organoleptic criteria and maturity stage.

1.3.3. Trimming and peeling

- Mechanically
- By using water steam;
- Chemically;

1.3.4. Cutting

1.4 Secondary processing of fruits and vegetables

The Secondary processing converts primary processed food into other food products.

Secondary processing ensures that foods:

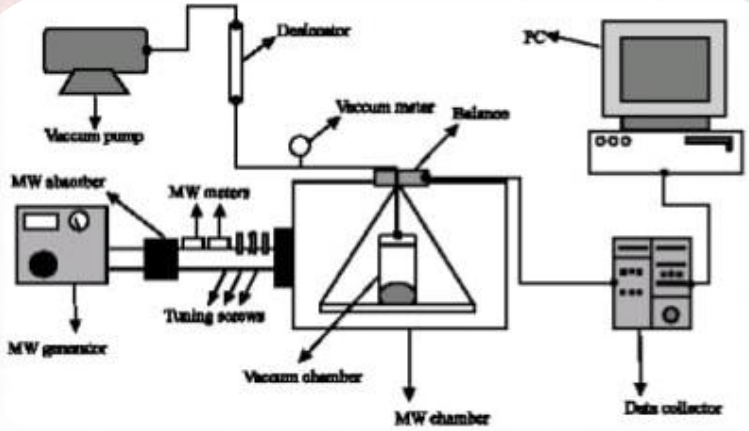
- Can be used for a number of purposes
- Do not spoil quickly
- Are available all year (e.g. seasonal foods)

1.4.1 Drying

- solar drier
- poly tunnel solar drier
- mechanical drier

1.4.2 Osmotic dehydration

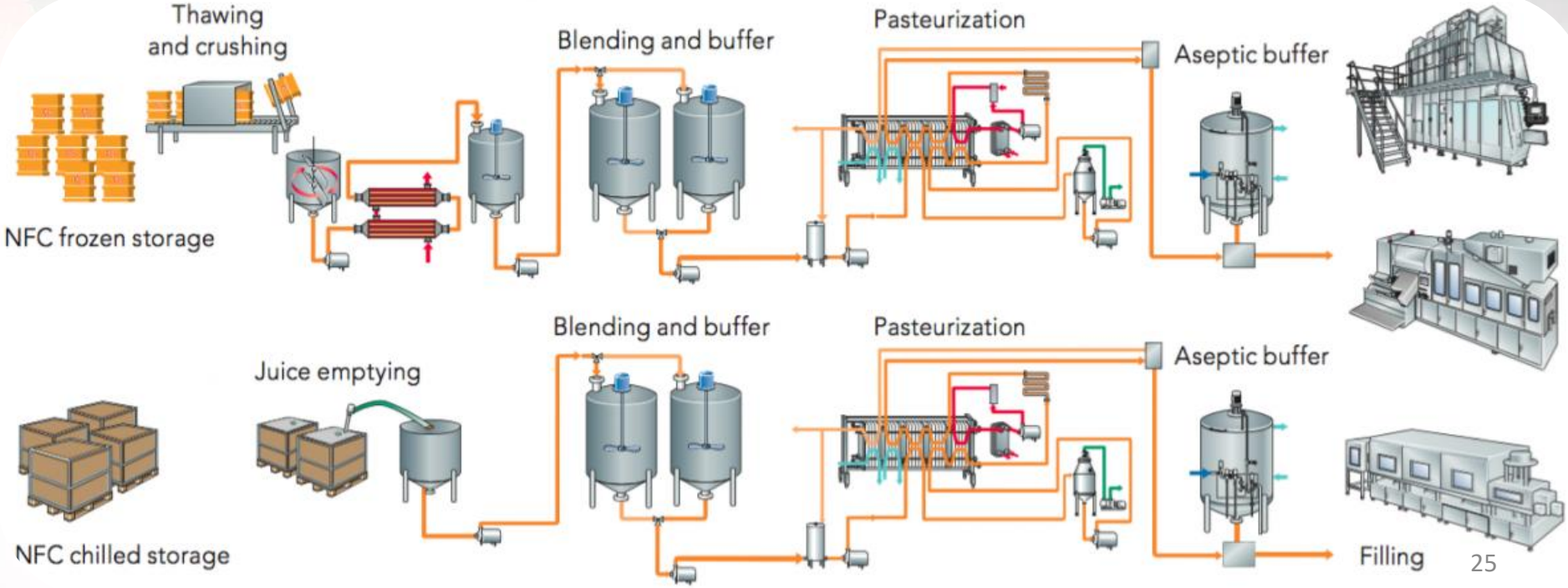
- partial removal of water
- dipping in sugar syrup prior to washing
- pineapple slices, mango slices, banana slices, sapota, apricot, apple and grapes etc.



1.4.3 Processing of lesser utilized fruits

- Bael fruit: hard shell
- Hill lemon: high acidity
- Unripe mango drink: high fiber and anti-oxidant rich.
- …

1.4.4 Value addition



II. Fruit & Vegetable Products

2.1 General Introduction

2.2 Fried products

2.3 Dried fruits and vegetables

2.4 Juices

2.5 Sauce

2.6 Wine

2.7 Chutney

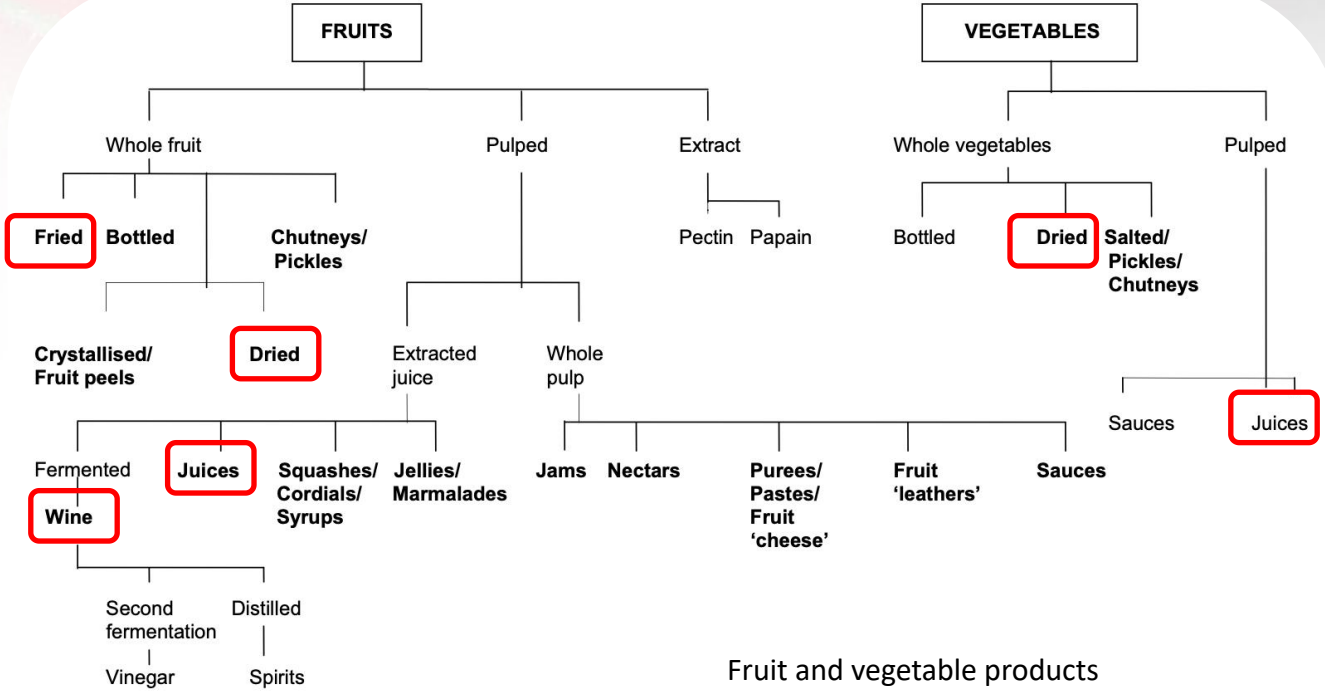
2.8 Jam and jelly

2.9 Pickles and salted vegetables

2.10 Quick-frozen products

2.11 Others

2.1 Fruit & Vegetable Products



Fruit and vegetable products

2.2 Fried products

Stage In Process	Notes
Inspect ↓	Select fruit that is slightly under-ripe and has a firm texture. Remove mouldy, rotten, and badly damaged fruit. **Poor quality raw materials produce poor quality, and perhaps unsafe, finished products.**
Pre-wash ↓	Pre-wash to remove surface contaminants, e.g., pesticide residue, insects, soil or dirt, etc.
Peel ↓	Peel by hand.
Slice ↓	Using a knife. A thinner, more uniform product can be made using small manual or electric slicing machines. Check that the thickness of slices is 1-2 mm.
Wash ↓	Wash with potable water in a bowl or wash tank to separate the slices. Citric acid or sodium meta-bisulphite can be added to the wash water at 10 g/litre to keep the colour and prevent darkening of the fruit.
Drain ↓	To prevent excess water being added to the hot oil
Fry ↓	At 180-200°C for 5-10 minutes using a pan over a fire or in a deep fat fryer, until the required golden colour has formed. Regularly check oil quality (see text). Care is needed when adding fruit to hot oil to prevent splashing.
Drain/cool ↓	On racks or mesh. Collect drained oil and reuse it. Cool product to room temperature to prevent condensation forming inside the package.
Pack/label ↓	In plastic bags using a heat sealer. Check the fill weight. Check that the seal is correctly formed because the product shelf life is reduced if air or moisture enters through a poorly formed seal. Polypropylene gives a longer shelf life than polythene. If a paper label is used, this should either be on the outside of the pack or a double layer of film is used to avoid oil seepage into the paper.
Store	Store away from heat and sunlight to avoid the development of a rancid taste in the product.

2.3 Dried fruits and vegetables

Dried organic pineapple

Stage In Process		Notes
Essential	**Optional**	
Fruit ▼		Harvest as carefully as possible to reduce bruising and other damage.
Inspect ▼		Remove mouldy, rotten, and badly damaged fruit. Also remove all visible foreign material (physical contaminants): leaves, stems, stalks, sticks and stones. Poor quality raw materials produce poor quality, and perhaps unsafe, finished products.
Wash ▼		Use wash tanks or special washers with clean, potable water to remove surface contaminants, e.g., pesticide residues, insects, soil or dirt, etc.
Sort/grade ▼		By hand select fruits with the same colour, size or maturity (fully mature but not over-ripe). Uniform size and maturity are important to get uniform drying times for all pieces. Over-ripe fruits are easily damaged and difficult to dry. Under-ripe fruits have poorer flavour, colour and appearance.
Peel		Peel prevents moisture leaving the food and allows faster blanching, sulphur dioxide treatment and drying. Peel by hand using knives or peelers, or using small peeling machines. Check that all traces of peel are removed.
	← Cut/slice/core	Depending on the type of fruit/vegetable, cut by hand using sharp stainless steel knives, corers etc. or using choppers, cutters, slicing or dicing machines. Check for uniform sized pieces.
	← Blanch	For vegetables, using a boiling pan, heater, wire basket or steamer. Check water temperature, time of heating and concentration of any salts added (see text). Care is needed to prevent re-contamination of blanched foods before drying.
	← Acid dip	Can be used to prevent browning of light coloured fruits and vegetables. It involves dipping fruit in 2% citric acid, lemon or lime juice for 5-10 minutes. Equipment required includes weighing scales or scoops and food-grade plastic tank.
	← Treatment with sulphur dioxide ▼	Optional for some fruits and vegetables, using either a sulphuring cabinet or a food-grade plastic tank for a sulphite dip (see text). Other equipment includes weighing scales or scoops. Check weight of sulphur or concentration of sulphite and time of exposure. **Safety: do not breathe fumes. Sulphur dioxide causes coughing and eye irritation.**
Dry ▼		The time needed for drying depends on the temperature, humidity and speed of the air, the type of dryer and the size of the food pieces. Check for mould growth, insect contamination and the temperature and time of drying.
Pack[1] ▼		Using an electric heat sealer to produce moisture-proof, airtight plastic bags. Check fill-weight and seal.
Label		Check that label is correct for type of product.
Store		Store in a cool dry place away from sunlight. Protect fragile foods from crushing.

2.3 Dried fruits and vegetables

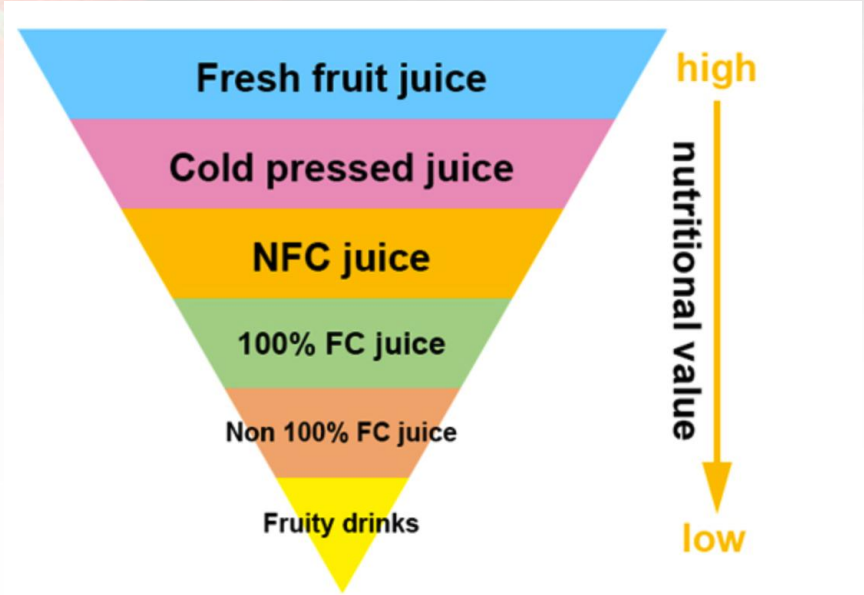
2.4 Juices

Passion Fruit Juice

Stage In Process		Notes
Fruit ↓		Mature but not over-ripe fruit without mould growth, picked carefully to reduce puncturing, splitting or bruising etc. Transport in stackable boxes to avoid crushing.
Inspect ↓		Remove mouldy, rotten, and badly damaged fruit. Also remove all visible foreign material (physical contaminants): leaves, stems, stalks, sticks and stones. Poor quality raw materials produce poor quality, and perhaps unsafe, finished products.
Wash ↓		Wash in clean, potable water in a wash tank to remove surface contaminants, e.g. pesticide residues, insects, soil or dirt, etc.
Sort/grade ↓		Sort by hand on a sorting table to get similar colour or maturity. **Shape and size are not important.**
Pulp ← ↓	Peel/ core/ chop	Depending on the fruit, peeling and cutting are optional before pulping. Peels are removed by hand using sharp stainless steel knives or small peeling machines. Manual or motorised corers are available for pineapples. Fruits are pulped and skins and seeds are separated (see text).
EITHER ← ↓	Heat	To 80-90°C in a stainless steel boiling pan for 10-15 minutes. Check to ensure that colour does not darken excessively.
Fill/seal ↓		Pack into pre-sterilised bottles (boiled in water or in an oven for 10 - 15 mins) or in plastic pots or sachets if they can be adequately sealed against insects. Seal and check fill- weight and properly sealed lids/sachets. Re-used bottles should be carefully washed using detergent and thoroughly rinsed. An optional bottle rinser can be used to save time.
OR ←	Heat	Fill juice into bottles and pasteurise in hot water at 88-90°C for 10-20 minutes depending on the size of the bottle.
Cool ↓		To room temperature, either by lying bottles on their side on a table or using a bottle cooler (optional).
Label ↓		By hand or with label applicator. Check that the correct label is used and that label quality is satisfactory. Check that each one is correctly aligned.
Store		Store in cool dry place away from sunlight.

2.4 Juices

- fresh fruit/vegetable juice
- FC juice (from concentrate juice)
- NFC juice (not from concentrate)
- cold press juice
- fruity drinks

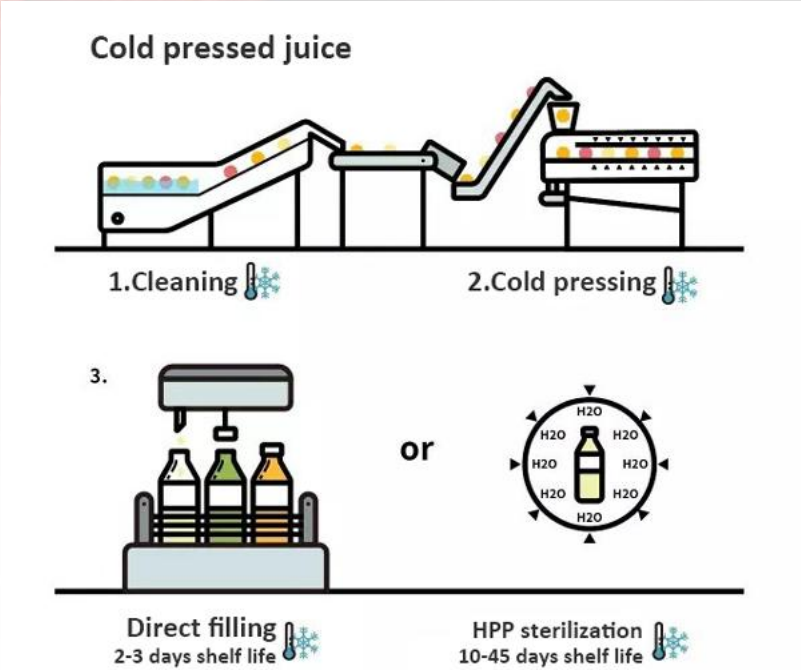


2.4 Juices

★ fresh juice

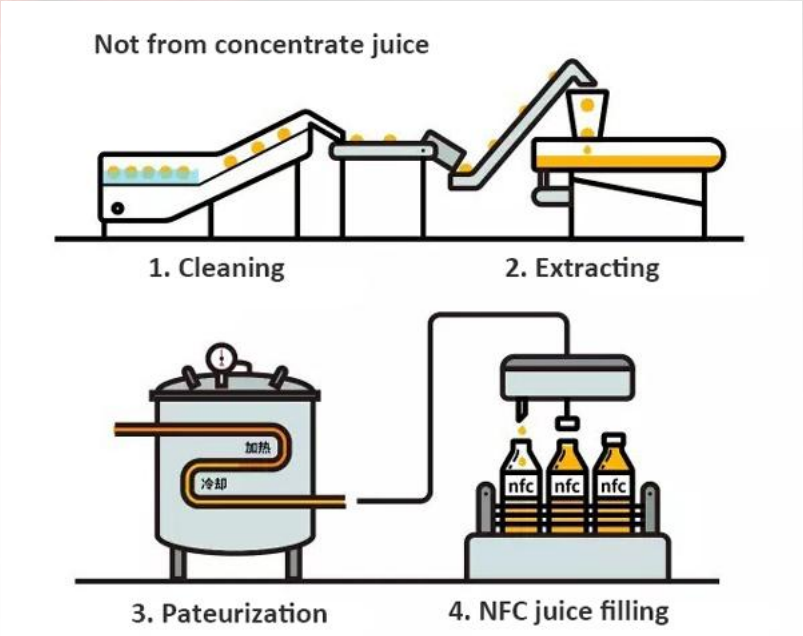
2.4 Juices

★ cold press juice



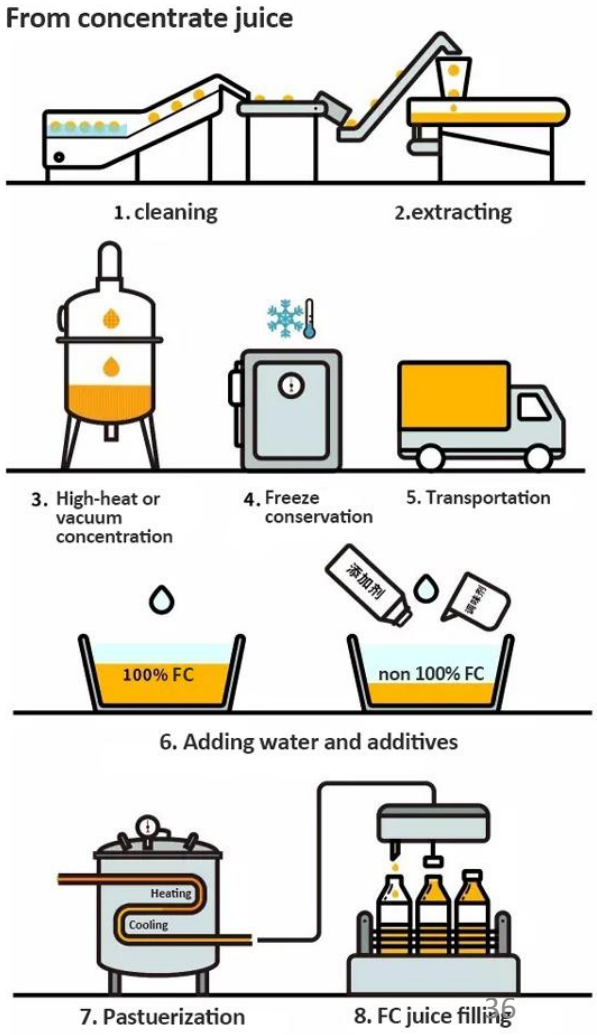
2.4 Juices

★ NFC juice (not from concentrate)



2.4 Juices

★ FC juice (from concentrate juice)

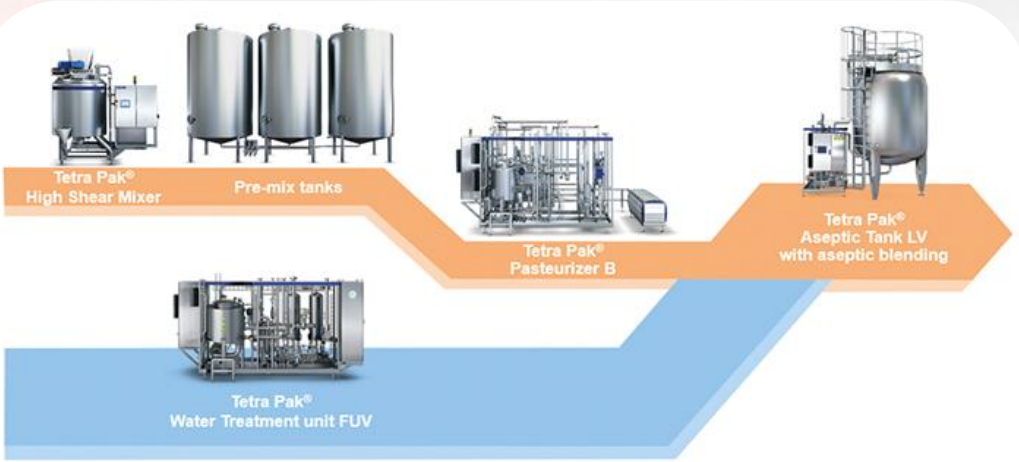


2.4 Juices

- **What's the difference between NFC juice and fresh juice?**
- **Comparison between NFC juice and FC juice**

2.4 Juices

★ fruity/vegetable drinks



2.5 Sauce

Sauces

Stage In Process		Notes
Vegetable or fruit ▼		Mature but not over-ripe fruit or vegetables picked carefully to reduce puncturing, bruising etc. Transport in stackable boxes to avoid crushing.
Inspect ▼		Remove mouldy, rotten, and badly damaged raw materials. Also remove all visible foreign material (physical contaminants): leaves, stems, stalks, sticks and stones. Poor quality raw materials produce poor quality, and perhaps unsafe, finished products.
Wash ▼		Wash with clean, potable water in a wash tank to remove surface contaminants, e.g., pesticide residues, insects, soil or dirt, etc.
Sort/grade ▼		Sort by hand on a sorting table to get similar colour or maturity. Shape and size are not important.
Pulp ▼	← Peel/ chop	Depending on the fruit/vegetable, peeling and cutting are optional before pulping. Peels are removed by hand using sharp stainless steel knives or small peeling machines. Tomatoes can be placed into a wire basket and heated in boiling water for 10 minutes to loosen the skin. They are then removed and peeled by hand. Fruit/vegetables can be pulped in a liquidiser or a pulper-finisher can be used for soft fruits and separate pulp from skins and seeds.
Mix ▼		Different mixtures of salt, sugar, vinegar and spices are used depending upon the product and local tastes. A typical recipe for tomato sauce is (per kg of tomatoes) 10g salt, 200ml vinegar (containing 10% acetic acid) and 80g sugar, 1g each of cinnamon, ground cloves, allspice and cayenne pepper, in a tied muslin bag submerged in the pulp. Check weights of ingredients. Use a food grade plastic mixing tank and scales, (pH meter optional)
Heat ▼		To 80-90°C in a stainless steel boiling pan until thick, usually within 20 minutes. Vinegar is added towards the end of boiling to reduce losses of acetic acid by evaporation (refractometer optional). Check to ensure that colour does not darken excessively. Remove spice bag.
Fill & Seal ▼		Pack into pre-sterilised bottles (boiled in water or in an oven at 100°C for 10-15 mins) or in plastic pots or sachets if they can be adequately sealed against insects. Seal and check fill- weight and seals. Re-used bottles should be carefully washed using detergent and thoroughly rinsed. An optional bottle rinser can be used to save time.
Cool ▼		To room temperature, either by lying bottles on their side on a table or using a bottle cooler (optional).
Label ▼		By hand or with label applicator. Check that the correct label is used and that label quality is satisfactory. Check that each one is correctly aligned.
Store		Store in cool dry place away from sunlight

2.6 Wine

Pineapple Wine

Stage In Process		Notes
Fruit ↓		Mature but not over-ripe fruit without mould growth, picked carefully to reduce puncturing, splitting or bruising etc. Transport in stackable boxes to avoid damage.
Inspect ↓		Remove mouldy, rotten, and badly damaged fruit. Also remove all visible foreign material (physical contaminants): leaves, stems, stalks, sticks and stones. Poor quality raw materials produce poor quality, and perhaps unsafe, finished products.
Wash ↓		Use clean, potable water in a wash tank to remove surface contaminants, e.g., pesticide residues, insects, soil or dirt, etc.
Sort/grade ↓		Sort by hand on a sorting table for similar maturity. Shape and size are not important. Remove unwanted parts.
Pulp ↓	← Peel / core/ chop	Peeling and cutting are optional before pulping. Peels removed using sharp knives or small peeling machines. Manual or motorised corers are available for pineapples. Fruits pulped in a liquidiser or pulper-finisher. Check that all traces of peel are removed
Filter ↓		Coarse filter the pulp to produce a juice. A manual press increases juice yields.
Mix ↓		Add yeast (2-3% of weight of juice) and optional sugar (up to 20% depending on the sweetness of the fruit and the final product). Add yeast nutrient (optional) at approximately 1g per litre.
Ferment ↓		At 20-28°C for 5-21 days in a clean fermentation vessel[1] fitted with an air lock to prevent air from entering. Transfer to fermentation drums fitted with airlocks after the initial fermentation. Fermentation is complete when gas bubbles are no longer produced and the yeast has settled out.
Clear & standardise ↓		Decant into a clean container. In some wines sediment settles over a few weeks, whereas others require clearing agents (e.g. gelatine, bentonite, perlite, tannin, isinglass). Adjust the alcohol content to 10-13%[2], as declared on the label, by blending with previous batches or adding clean water and check using an alcohol hydrometer.
Fill & Seal ↓		When crystal clear, cold fill into pre-sterilised bottles and fit sterilised corks (boiled for 10 minutes or soaked in sodium metabisulphite solution), plastic stoppers, or caps, depending on the type of bottle. Check fill-volume. Re-used bottles should be carefully washed using detergent and thoroughly rinsed.
Label ↓		Check that the correct label is used and that label quality is satisfactory. Check that each one is correctly aligned.
Store		Store on racks, bottles inclined with the cork down to keep the corks wet, or in cartons in a cool dry atmosphere away from sunlight.

2.7 Chutney

Mango Chutney

Stage In Process	Notes
Fruits/vegetables ▼	Fruits should be picked carefully to reduce bruising etc. and checked that they are fully maturity but not over-ripe. Vegetables should be fully mature.
Inspect ▼	Remove mouldy, rotten, and badly damaged fruits and vegetables. Also remove all visible foreign material (physical contaminants): leaves, stems, stalks, sticks and stones. Poor quality raw materials produce poor quality, and perhaps unsafe, finished products.
Wash ▼	Use clean, potable water in a wash tank to remove surface contaminants, e.g., pesticide residues, insects, dirt and soil, etc.
Sort/grade ▼	Sort by hand on a sorting table to get similar colour or maturity
Peel ▼	Most fruits and vegetables require peeling, but some chutneys include un-peeled fruits. Peel by hand using sharp stainless steel knives or small peeling machines that are made for some types of fruits. Check that all traces of peel are removed
Cut/slice/core ▼	Most fruits and vegetables are cut into thin strips or small cubes by hand using stainless steel knives, or using manual slicing or dicing machines. Pieces should be similar in size to produce uniform mixtures and allow faster penetration of sugar syrup into the pieces. Check for uniform sized pieces.
Mix ingredients ▼	Weigh ingredients and mix together in a stainless steel or food grade plastic mixing bowl.
Heat ▼	Boil the mixture in a stainless steel boiling pan with constant stirring, until it is thick and concentrated. Check the time and temperature of boiling. An optional check can be made of sugar content (68-70%) using a refractometer.
Fill & Seal ▼	Hot fill using a funnel or paste filler into pre-sterilised jars (boiled in water or in an oven at 100°C for 10-15 mins). Manually seal lids and check fill-weight and properly sealed lid. Re-used jars should be carefully washed using detergent and thoroughly rinsed. An optional bottle rinser can be used to save time If jars are not obtainable, plastic pots or bags can be used, provided that they can be adequately sealed against insects.
Cool ▼	To room temperature, either by lying jars on their side on a table or using a bottle cooler (optional).
Label ▼	By hand or with label applicator. Check that the correct label is used and that label quality is satisfactory. Check that each one is correctly aligned.
Store	Store in cool dry place away from sunlight

2.8 Jam and jelly

2.8 Jam and jelly

Mixed fruit jam

Stage In Process		Notes
Fruit ↓		Mature but not over-ripe fruit without mould growth, picked carefully to reduce puncturing, splitting or bruising etc. Transport in stackable boxes to avoid crushing.
Inspect ↓		Remove mouldy, rotten, and badly damaged fruit. Also remove all visible foreign material (physical contaminants): leaves, stems, stalks, sticks and stones. Poor quality raw materials produce poor quality, and perhaps unsafe, finished products.
Wash ↓		Use clean, potable water in a wash tank to remove surface contaminants, e.g., pesticide residues, insects, soil or dirt.
Sort/grade ↓		Sort by hand on a sorting table to get similar colour or maturity. Shape and size are not important. Remove unwanted parts
Peel ↓	← Pulp/ core/ chop	Depending on the fruit, peels are removed by hand using sharp stainless steel knives or small peeling machines. Manual or motorised corers are available for pineapples. Other fruits are chopped into large pieces for boiling. Small fruits (e.g. strawberries or other berries) may be used whole. Pulper-finishers are suitable for soft fruits and separate pulp from skins and seeds. Check that all traces of peel are removed
←	Filter	For clear jellies and marmalades
Mix ↓		Add approximately equal weight of sugar to weight of fruit and if required, citric acid to obtain pH 3.0-3.3, (pH meter optional) and any extra pectin required. For marmalade, add thinly sliced citrus peels that have been boiled in 60% sugar syrup for 15 minutes and stored for at least 24 hours before use. Check thickness of peels. A preservative, such as 1.8% sodium benzoate is optional.
Heat ↓		To 104-105°C in a stainless steel boiling pan for 15-20 mins., or until the solids content reaches 68-70%, measure by refractometer. Check temperature and time of boiling. Check to ensure that colour does not darken excessively.
Fill & Seal ↓		Hot-fill into pre-sterilised jars (boiled in water or in an oven at 100°C for 10-15 mins) or in plastic pots or sachets if they can be sealed against insects. Seal and check fill- weight and seals. Re-used bottles should be carefully washed using detergent and thoroughly rinsed. An optional bottle rinser can be used to save time.
Cool ↓		To room temperature, upright on a table or using a bottle cooler (optional).
Label ↓		By hand or with label applicator. Check that the correct label is used and that label quality is satisfactory. Check that each one is correctly aligned.
Store		Store in cool dry place away from sunlight

2.8 Jam and jelly

- There must be the correct proportions of juice, sugar, acid and pectin in order to form a good gel.
- Water must be boiled off quickly to concentrate the mixture before it darkens.

Fault	Possible cause	Prevention
1 Gel does not set or is not firm	Incorrect pectin type Too little pectin Solids content too low Incorrect pH value Pectin not fully dissolved Boiling for too long Pectin solution too old Pre-setting Holding at high temperature for too long (pan too big)	Select correct type of pectin Check formulation Add more sugar Check pH, adjust with citric acid Mix with sugar before dissolving Produce smaller batches Use new stock Increase filling temperature Lower filling temperature, make smaller batches or use slow-setting pectin.
2 Gel too firm	Too much pectin Solids content too high pH too low	Check formulation Heat less, add less sugar or add more water Adjust pH
3 Pre-setting	Filling temperature too low Filling time too long Solids content too high pH too low	Increase filling temperature or choose slow-setting pectin Produce smaller batches or use slow-setting pectin See above See above
4 Fruit floats	Filling temperature too high Pectin sets too slowly, gel not strong enough Solids content too low, giving slow setting pH too high, giving slow setting	Lower filling temperature Choose rapid-set pectin See above Adjust pH
5 Syneresis (cracked gel with oozing liquid)	Pre-setting due to low filling temperature pH too low Solids content in fruit and in gel are different	See above Adjust pH Pre-mix fruit and sugar syrup and hold overnight or cook longer

2.9 Pickles and salted vegetables

1) *fermented pickle*
2) *'salt stock' pickle*
3) packed in vinegar
4) *Sweet pickles*
5) *Salted vegetables*

Stage In Process		Notes
Essential	Alternative	
Vegetable or fruit		Cucumber, cabbage, courgette, olive, or other types of vegetable, picked carefully to reduce splitting or bruising. Check for full maturity but not over-ripe.
Inspect ▼		Remove mouldy, rotten, and badly damaged fruits and vegetables. Also remove all visible foreign material (physical contaminants): leaves, stems, stalks, sticks, stones and rocks. Poor quality raw materials produce poor quality, and perhaps unsafe, finished products.
Wash ▼		Use clean water in a wash tank to remove surface contaminants, e.g., pesticide residue, stones, leaves, insects, soil or dirt, etc.
Sort/grade		Sort by hand on a sorting table to get similar colour, size, shape or maturity. Remove discoloured leaves, stems or other unwanted parts
◄	Peel	Most fruits and vegetables do not require peeling, but some pickles have peeled fruits. Peel by hand using sharp stainless steel knives or small peeling machines. Check that all traces of peel are removed
◄ ▼	Cut/slice/ core	Cucumber, okra or courgette are often pickled whole. Olives are pitted (the stone is removed), limes are sliced into halves or quarters and cabbage is cut into thin strips using stainless steel knives. Cutting allows faster penetration of pickling liquor. Check for uniform sized pieces to allow uniform penetration of salt.
Mix		In food grade plastic tank, different mixtures of salt, sugar, vinegar and spices depending upon local tastes and the product requirements. Check weights of ingredients with scales (pH meter, brine hydrometer optional)
◄	Ferment	Natural fermentation for 3-7 days or up to 18 months depending on the product. Check for contamination by insects, especially ants, which can introduce yeasts or moulds. Check time and temperature of fermentation.
◄ ▼	Heat	Pasteurise for 10-15 mins at 90-100°C in a stainless steel boiling pan.
Fill & Seal ▼		Pack into pre-sterilised jars (boiled in water or in an oven at 100°C for 10 - 15 mins). Fill with hot brine/ vinegar to cover the vegetables. Seal and check fill-weight and seals. Re-used jars should be carefully washed using detergent and thoroughly rinsed. An optional bottle rinser can be used to save time. If jars are not obtainable, plastic pots or bags can be used, provided that they can be adequately sealed against insects.
Cool ▼		To room temperature, either by lying jars on their side on a table or using a bottle cooler (optional).
Label ▼		By hand or with label applicator. Check that the correct label is used and that label quality is satisfactory. Check that each one is correctly aligned.
Store		Store in cool dry place away from sunlight

2.11 Others

★★★Qusetion

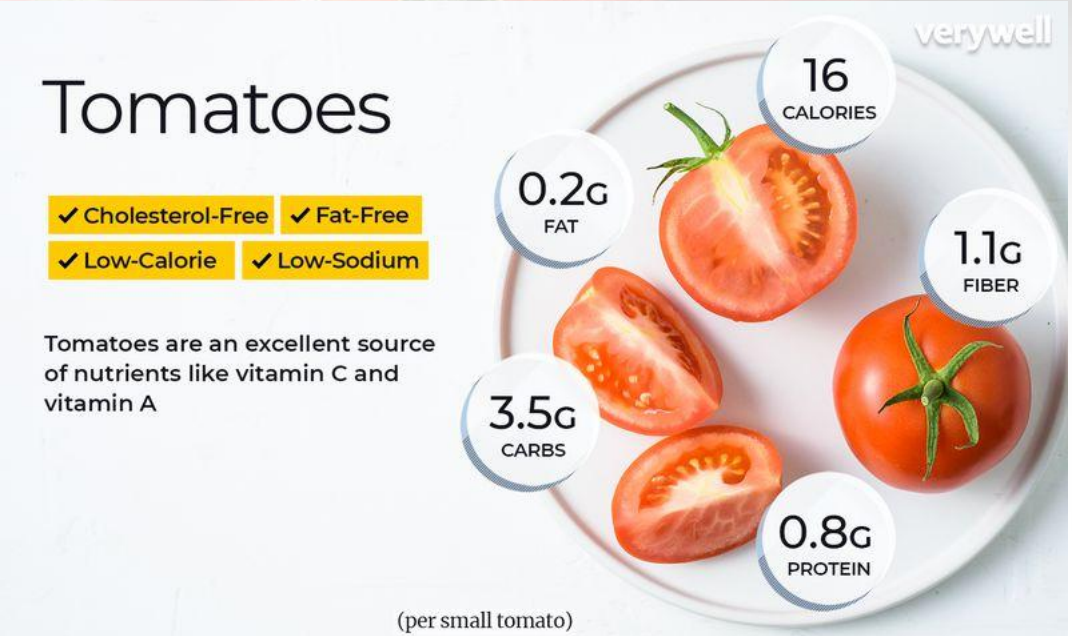
How to pick juice?

- Keep away from fruity drink
- Less sugar and additives
- Refer to the price
- Don’t rely on fruit juice to lose weight

III. Tomato Processing—— Ketchup

- Tomato
- The history of ketchup
- Ketchup processing
- Nutritional value

3.1 Tomato


Tomatoes
✓ Cholesterol-Free
✓ Fat-Free
✓ Low-Calorie
✓ Low-Sodium
Tomatoes are an excellent source of nutrients like vitamin C and vitamin A
verywell
16 CALORIES
0.2G FAT
1.1G FIBER
3.5G CARBS
0.8G PROTEIN
(per small tomato)

3.1 Tomato

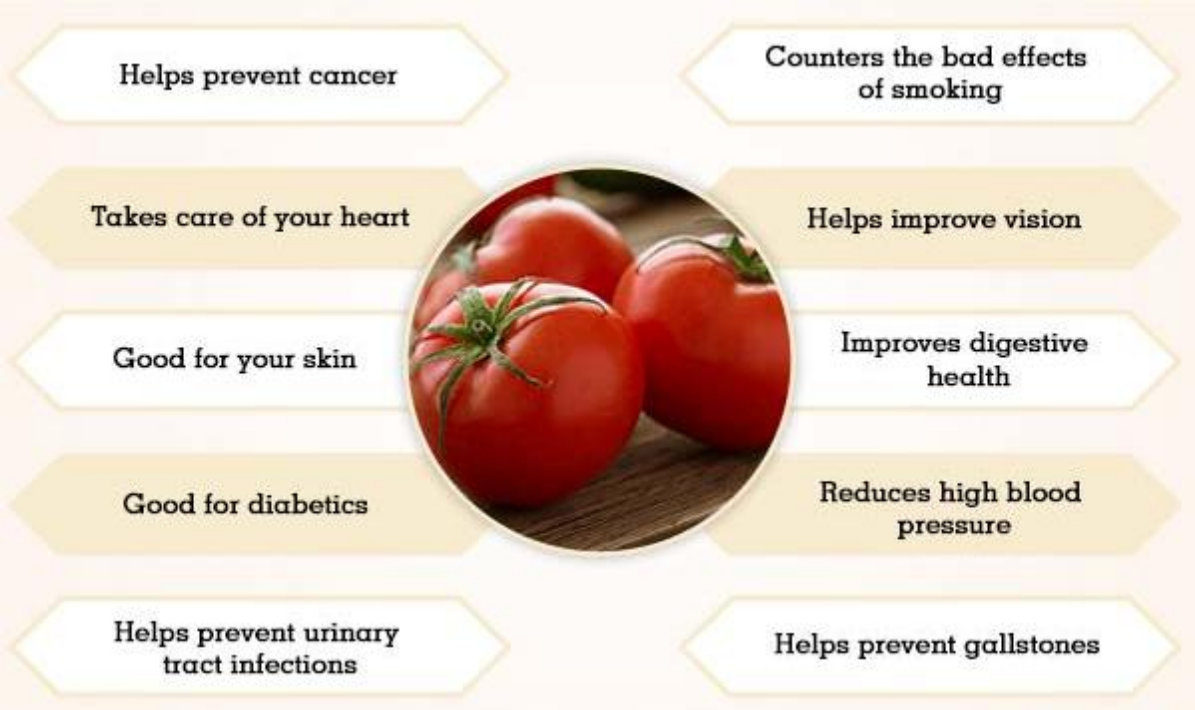
- varieties of tomatoes



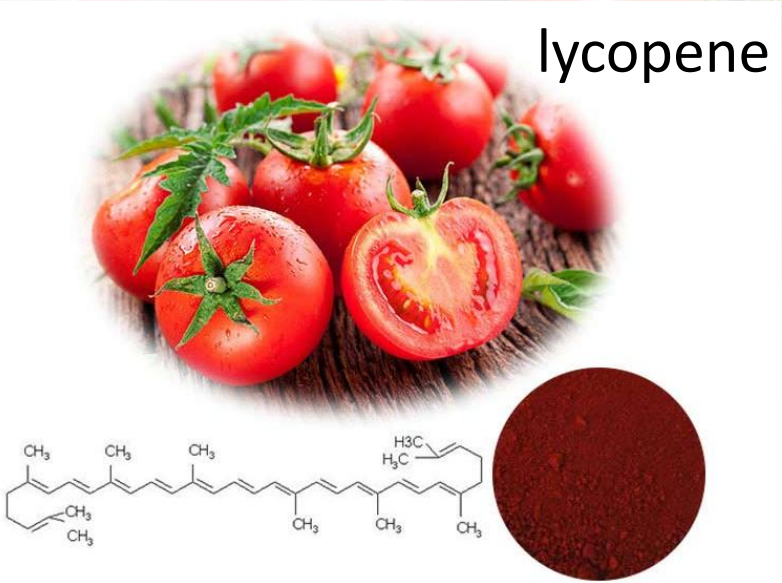

3.1 Tomato

Nutrient content per 100g tomato					
Protein	0.9g	Vitamin A	63µg	Potassium	179mg
Fat	0.2g	Vitamin B	60mg	Calcium	4mg
Carbohydrate	3.3g	Vitamin C	14mg	Phosphorus	24mg
Dietary fiber	1.9g	Vitamin E	0.42mg	Magnesium	12mg
Energy	11kcal	Folic acid	5.6µg	Manganese	0.06mg

3.1 Tomato

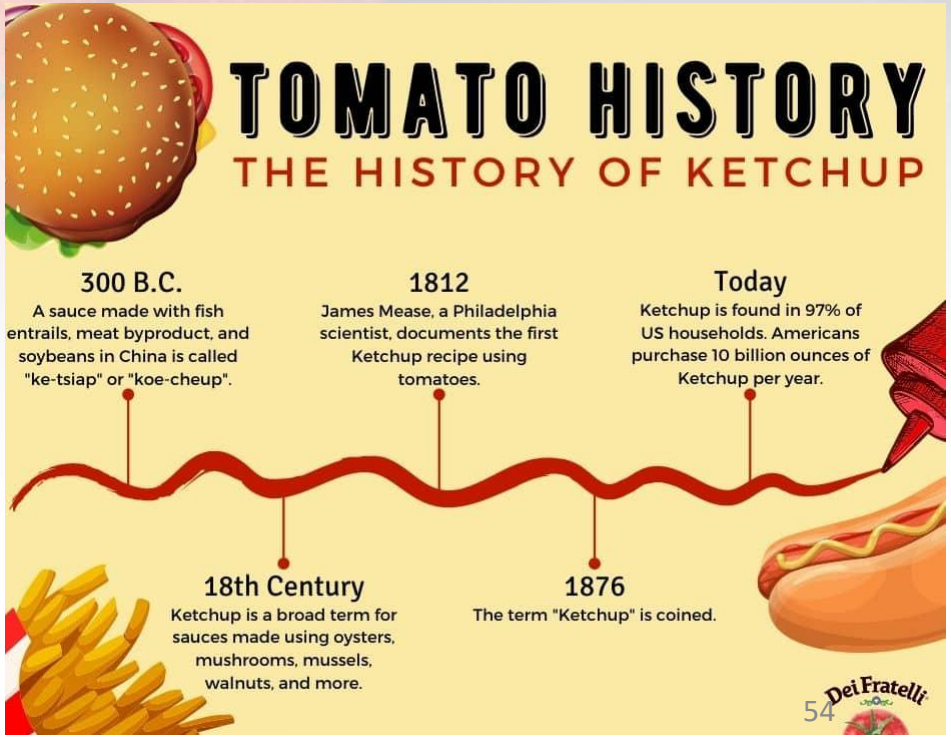

Helps prevent cancer
Counters the bad effects of smoking
Takes care of your heart
Helps improve vision
Good for your skin
Improves digestive health
Good for diabetics
Reduces high blood pressure
Helps prevent urinary tract infections
Helps prevent gallstones

3.1 Tomato



- Natural food colorant.
- Antioxidants.
- Reduce eye macular degeneration and pigmentation.
- Reduce and prevent cardiovascular diseases.
- Effectively eliminate free radicals in the body.

3.2 The history of ketchup



3.2 The history of ketchup

From China to England

- Chinese word *ke-tsiap*, meaning a pickled fish sauce.
- from Vietnam to the southeastern part of China.
- traveled to Malaysia and Indonesia
- English sailors discovered the delights of this Chinese seasoning
- British used ingredients such as anchovies or oysters, mushrooms, and walnuts to recreate those flavors

3.2 The history of ketchup

The Addition of Tomato

- first appeared in a recipe in 1801 in *The Sugar House Book*.
- squeezing the tomatoes dry and then salting and boiling them.
- the bottled ketchup will last for several years, due to the amount of salt.

3.2 The history of ketchup

The Ketchup We Know Today

- Heinz
- ripe tomatoes, which contain more of the natural preservative pectin, and adding sugar and vinegar.
- from the bottle to the large pump, small packets, and even a short-lived selection of different colored varieties.

3.2 The history of ketchup—— Heinz

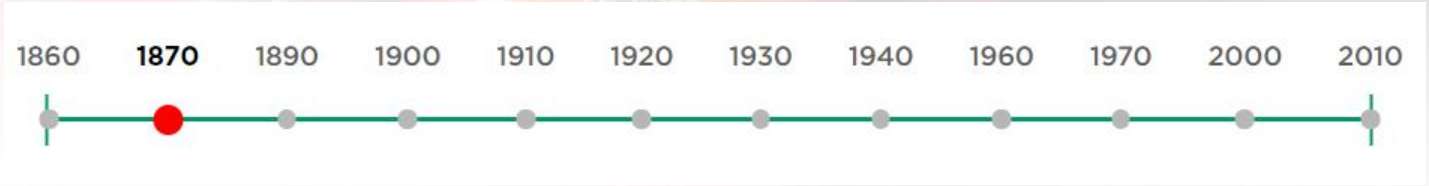
1860 1870 1890 1900 1910 1920 1930 1940 1960 1970 2000 2010

1869

HEINZ STARTS HERE

H.J. Heinz starts selling horseradish, pickles, vinegar, and a variety of other sauces near Pittsburgh. He bottles them in clear glass so that his customers can see their quality.

3.2 The history of ketchup—— Heinz



1876

WHAT'S IN A NAME?

HEINZ starts manufacturing the now legendary HEINZ Ketchup and introduces it to the world as "Catsup."

3.2 The history of ketchup—— Heinz

1860 1870 **1890** 1900 1910 1920 1930 1940 1960 1970 2000 2010

1896

MORE THAN JUST A NUMBER

H.J. Heinz coins his famous "57 Varieties" slogan. Not because that was the number of products he sold, which was over 60 at the time, but because he thought 57 sounded like a lucky number.

3.2 The history of ketchup—— Heinz

1860 1870 1890 **1900** 1910 1920 1930 1940 1960 1970 2000 2010

1908

HEINZ KETCHUP CATCHES ON

Through H.J. Heinz's outstanding leadership, HEINZ officially takes the top spot as the World's Largest Tomato Manufacturer.

3.2 The history of ketchup—— Heinz

1860 1870 1890 1900 **1910** 1920 1930 1940 1960 1970 2000 2010

1916

AGRICULTURAL RESEARCH BEGINS

Putting his money where his mouth is, H.J. Heinz creates a quality research facility in Bowling Green, OH. HEINZ becomes one of the first in the country to create a facility dedicated entirely to improving the quality of the produce in its products.

3.2 The history of ketchup—— Heinz

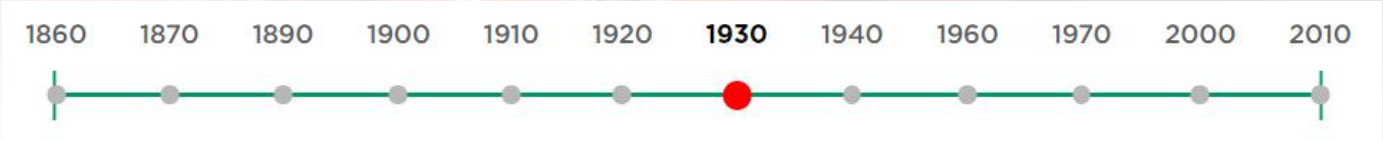
1860 1870 1890 1900 1910 **1920** 1930 1940 1960 1970 2000 2010

1923

57 MEANS GOOD THINGS TO EAT

In a full-page ad in The American Magazine, HEINZ lists 57 products, proclaiming "If you know only 4 or 5, you can be assured that the other 53 or 52 are just as good."

3.2 The history of ketchup—— Heinz



1934

GROWING A BETTER KETCHUP

HEINZ tomato breeding program begins, because H.J. Heinz recognized the impact that the variety of tomato had on the quality of the final ketchup.

3.2 The history of ketchup—— Heinz

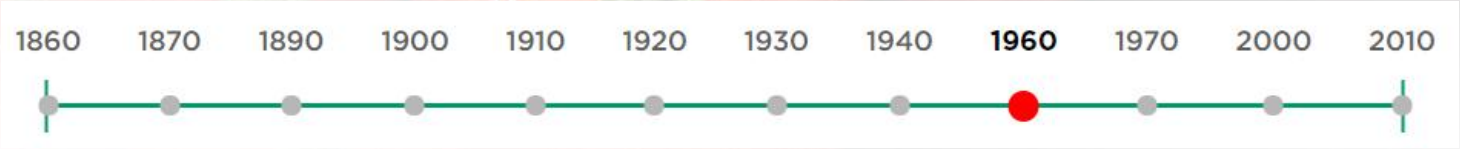
1860 1870 1890 1900 1910 1920 1930 **1940** 1960 1970 2000 2010

1948

A GLASS ICON IS BORN

HEINZ introduces the octagonal-shaped glass bottle, now a globally recognized symbol of HEINZ.

3.2 The history of ketchup—— Heinz



1967

BIG DEMAND, SMALL SOLUTION

American families resoundingly call for an easier way to take their ketchup with them on the go. HEINZ answers with portable ketchup packets.

3.2 The history of ketchup—— Heinz

1860 1870 1890 1900 1910 1920 1930 1940 **1960** 1970 2000 2010

1969

ADS LIKE NO OTHER

HEINZ takes to the national stage and rolls out the “No Other Ketchup” campaign.

3.2 The history of ketchup—— Heinz

1860 1870 1890 1900 1910 1920 1930 1940 1960 **1970** 2000 2010

1976

SHOUT OUT FROM MARGARITAVILLE

In one of his biggest hits, "Cheeseburger in Paradise," Jimmy Buffett sings, "I like mine with lettuce and tomato, HEINZ 57 and French fried potatoes." We do too, Jimmy.

3.2 The history of ketchup—— Heinz

2000

KID FRIENDLY FRENZY

HEINZ introduces the EZ Squirt collection, featuring green and purple ketchups in a re-designed squeeze bottle. It's fun for the whole family.

3.2 The history of ketchup—— Heinz

1860 1870 1890 1900 1910 1920 1930 1940 1960 1970 2000 **2010**

2018

THE ULTIMATE MASHUP

We asked America if they'd like a combination of creamy HEINZ Real Mayonnaise and our world-famous HEINZ Ketchup and they said "YES!" By voting in what turned into the largest poll in Twitter history, the entire country helped us introduce HEINZ Mayochup to the world.

3.3 Ketchup processing technology

The main ingredients of ketchup

Ingredients	Percentage
Sterilize RO Water	38%
Concentrated Tomato Paste	30%
Liquid Glouse	13.5%
Sugar	12%
Fine Salt	3%
Vinegar	2%
Starch	1%
Flavours and Sweeteners	0.3%
Sodium Erythorbate	0.2%

3.3 Ketchup processing technology

- Tomatoes selection
- Cleaning and blanching
- Crushing and beating
- Blending
- Homogeneous
- Packing and pasteurization

3.3 Ketchup processing technology

3.3.1 Tomatoes selection

- Choose whole and mature tomatoes,
- Remove raw, rot, and diseased tomatoes.

3.3 Ketchup processing technology

3.3.2 Cleaning and blanching

Cleaning : Wash away the dirt and

pesticide residues on the surface of the tomato

3.3 Ketchup processing technology

3.3.2 Cleaning and blanching

Blanching:

- Hot blanching treatment inhibits the activity of pectinase and prevents the solid-liquid separation of ketchup.
- Reduce the loss during beating and increase the viscosity of the product

3.3 Ketchup processing technology

3.3.3 Crushing and beating

Crushing:

- Thermal crushing： After the tomatoes are crushed, they are heated to 80-85°C, and then circulated in the thermal crushing system.
- Cold crushing： The tomatoes are preheated immediately after crushing, and then sent to be beaten. The preheating temperature is below 65°C.

3.3 Ketchup processing technology

3.3.3 Crushing and beating

Beating:

- One of the important processes
- Tomato beating is to remove impurities such as peel and seeds to obtain a uniform and delicate homogenate

3.3 Ketchup processing technology

3.3.4 Blending

- core process
- hot blending.
- The temperature is controlled at about 60-65
- mixing time is controlled at about 15-30 minutes

Tomato ketchup blending tank

3.3 Ketchup processing technology

3.3.5 Homogeneous

- Through homogenization, the tomato sauce is more smooth, smaller particle size of the tomato suspension, higher viscosity.


0:00
CC

3.3 Ketchup processing technology

3.3.6 Packing and pasteurization

- Packing

3.3 Ketchup processing technology

3.3.6 Packing and pasteurization

- Pasteurization

Can or bottle container

Daypack pouches

3.3 Ketchup processing technology

GEA process design

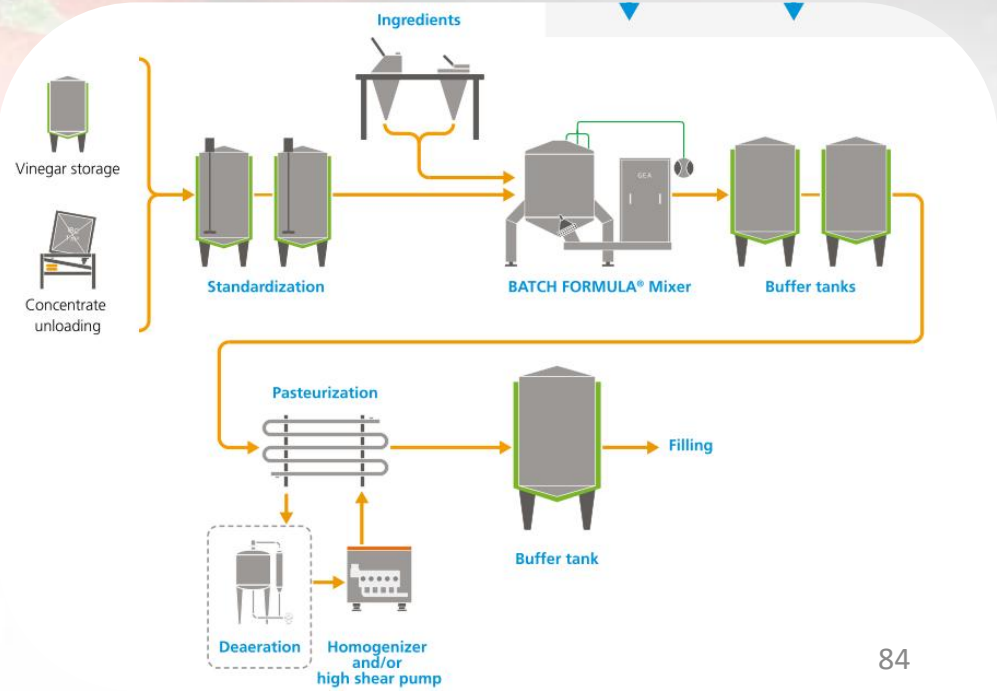
- complexities of designing efficient
- versatile plants for food processing
- configure and install equipment

3.3 Ketchup processing technology

Components
Valves & pumps
In-line measurement
Piping solution

Automation
Recipe management
Fully automated
MES Solutions

Cleaning-in-place
Automated CIP unit
Fully automated
CIP system



3.3 Ketchup processing technology

Ingredients handling

- All powder ingredients are scanned and weighed prior to delivery to the BATCH FORMULA® Mixer.
- Slurry can be standardized in a buffer tank before transfer to the mixing system.

3.3 Ketchup processing technology

Mixing

Mixing is a key manufacturing stage for viscous products such as ketchup, which can affect final product consistency and quality.

The BATCH FORMULA® Mixer

3.3 Ketchup processing technology

Pasteurization

- Indirect heating using heat exchangers
- Tubular heat exchangers have no wearing parts.

VARITUBE® heat exchangers

3.3 Ketchup processing technology

Homogenization

- The hot break method involves rapidly heating the chopped tomatoes to approximately 90° C, which inactivates the natural enzymes.
- High pressure homogenization is a mechanical method that changes the tomato's particle structure to deliver a better overall product quality.

high pressure homogenizer

3.3 Ketchup processing technology

Deaeration

- Remove any micro air bubbles trapped in the product.
- This ensures a higher quality product, but also avoids burn, and so ensures longer production runs and no CIP issue.

The BATCH FORMULA® Mixe

3.3 Ketchup processing technology

Cleaning-in-place

- Residual products are expelled from the pipes and returned into the product flow by pigging.
- Less product
- Remaining in the pipes and more efficient cleaning

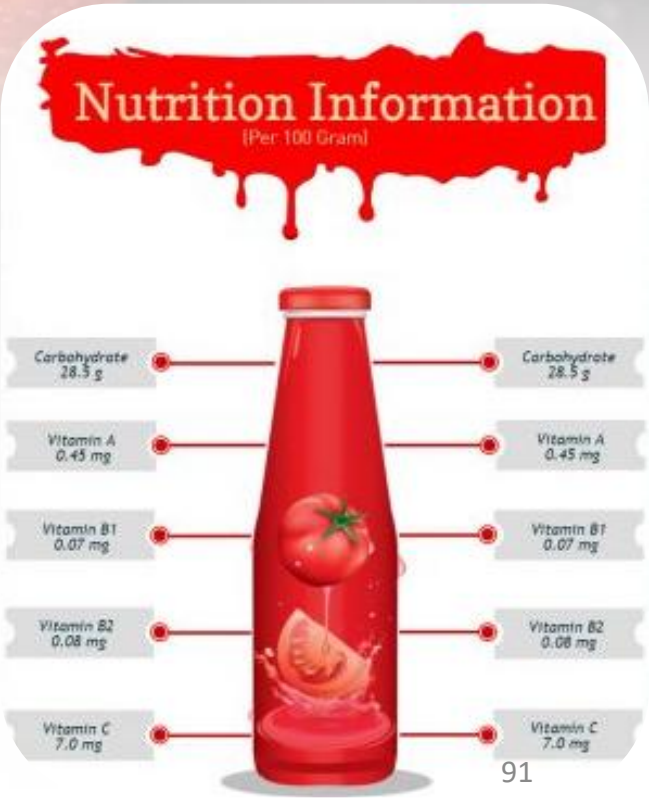
Cleaning-In-Place (CIP)

3.4 Nutritional value of ketchup

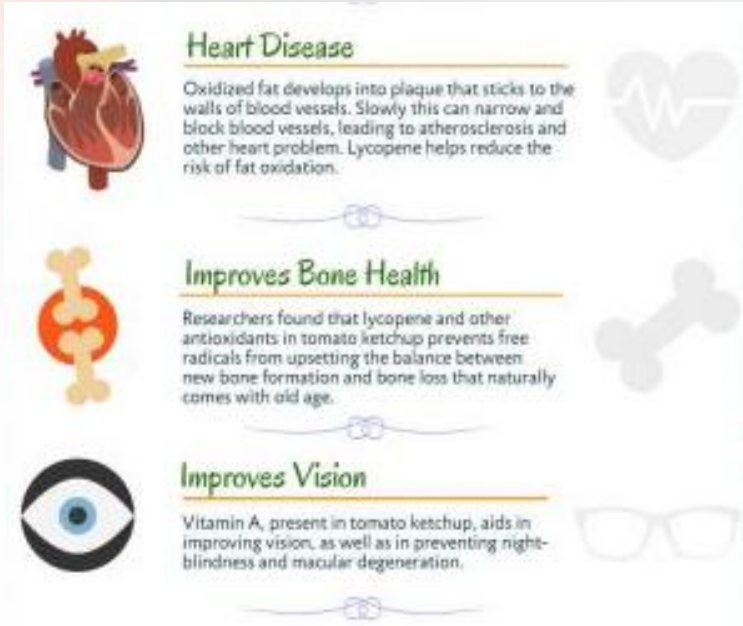
Tomato ketchup is something that we eat on a regular basis.

But are you familiar with its health benefits?

Let's find out…



3.4 Nutritional value of ketchup



IV. Tomato Processing—— Other Products

1. Canned tomato
2. Tomato juice
3. Candied tomato

4.1.Processing technology of canned tomato

Selecting→grading → stalk

removal → peeling → hardening

→ sorting → bottling → add

juice → acid adjustment →

exhaust → sterilization →

cooling → products

4.1.1.Selection

- Choose medium and small fresh tomatoes as raw materials.
- The fruit surface is required to be smooth and free of sink marks, bright in color, uniform from the top to the stalk, without cracks, and full maturity.
- Eliminate unqualified ones such as insufficient maturity, pest damage, spot scars, and rottenness.

4.1.2. Grading

Pour the selected tomatoes into a clean water tank, wash off the surface sediment, and then classify them according to size.

4.1.3. Stalk removal

After grading, dig out the pedicle with a knife.

4. Peeling

Pour the tomatoes into slightly boiling hot water and blanch them, then quickly put them in cold water to cool, peel off the skin, and trim the appearance of the fruit to remove the green or spotted parts.

4.1.5. Hardening

Put it in a calcium chloride solution, soak and harden, take it out and wash away the remaining liquid with water.

4.1.6. Sorting

Sort according to the diameter of the tomato.

4.1.7. Bottling

After sorting, the tomatoes are packed in cleaned and sterilized bottles.

4.1.8. Add juice

In addition, the ripe tomatoes are beaten with a beater into a raw juice with a soluble solid content of 5% to 7%. Then add salt water, sugar, and calcium chloride to the raw juice, mix well, heat up to above 90 ℃, and put it in a bottle.

4.1.9. Acid adjustment

If the acidity is insufficient, adjust the pH to below 4.5 with citric acid.

4.1.10. Exhaust

After filling the can, it is capped, but not tightly sealed, and sent to the hot water exhaust box. The temperature is raised to a core temperature of about 75 ℃ in hot water at 85-90 ℃, and the can is immediately sealed.

4.1.11. Sterilization

Sent to the sterilization cabinet and sterilized at 105 ℃ for 30 minutes. The heating time should not exceed 10 minutes.

4.1.12.Cooling

After sterilization, use water at 75℃, 55 ℃, and 35 ℃ to quickly cool down to below 40 ℃ in sections within 15 minutes, take out the dried water, and after the sample is qualified, label it.

4.1.13.Product

4.2.Processing technology of tomato juice

Selection→seed removal →

preheating → beating → batching →

degassing → homogenization →

sterilization → cooling → products

4.2.1.Selection

Choose tomatoes with moderate maturity, strong fragrance, bright red color, soluble solids above 5%, suitable sugar and acid, and no spoilage. Remove the stems and wash them.

4.2.2.Seed removal

Crush the tomatoes with a seed remover to remove the seeds.

4.2.3.Preheating and Beating

- Heat the crushed and de-seed tomatoes quickly to above 85℃ to kill microorganisms.
- The preheated tomatoes are put into the beater to be beaten to obtain the juice.

4.2.4.Degassing and Homogenization

- Spray the tomato juice into the vacuum degasser and degas for 3-5 minutes.
- Use a high-pressure homogenizer to homogenize under a certain pressure.

4.2.5.Sterilization and Cooling

- Sterilize in boiling water after sealing, then cool to 38℃ in cold water.

4.2.6.Products

4.3.1.Processing technology of candied tomatoes

selection→ peeling → squeezing

juice → hardening → washing →

candied → drying → product

4.3.1.1.Selction

Use thick fleshy fruits with less juice, full red color, but ripeness, and eliminate unqualified fruits with insufficient maturity, diseases and insect pests, and rottenness.

4.3.1.2. Peeling

Wash the tomatoes and pre-cook them in boiling water for one minute, cool them immediately, and peel off the skins of the tomatoes.

4.3.1.3. Squeezing juice

- Cut the pedicle and seam at the fruit handle, and gently squeeze out the juice.

4.3.1.4. Hardening

- Soak the tomatoes in 0.3% calcium chloride solution for 2 hours.

4.3.1.5. Washing

- Wash the hardened tomatoes with clean water, remove and drain the water.

4.3.1.6. Candied

- soaked in 30% sugar solution 0.3% citric acid
- pour into the pot and slowly heat up
- cool the tomato and sugar solution
- repeat cooking and cooling
- until the sugar concentration reaches 65%

4.3.1.7. Drying

Put the drained tomato on the baking tray and bake at 60-65 ℃ to make the water content reach about 18% and the soluble solid content reach 70%.

4.3.1.8. Product

4.3.2.Processing technology of candied tomatoes

Selection→washing→peeling → slicing

→ sweetening → cooling → product

4.3.2.1.Selction

Pick tomatoes with good ripeness and bright colors. Eliminate unqualified tomatoes such as insufficient maturity, pest damage, spot scars, and rotten tomatoes.

4.3.2.2.&3.Washing and Peeling

Wash the tomatoes with water. Peel the skin directly, if it is not easy to peel, use chopsticks to scrape the skin and peel it.

4.3.2.4. Slicing

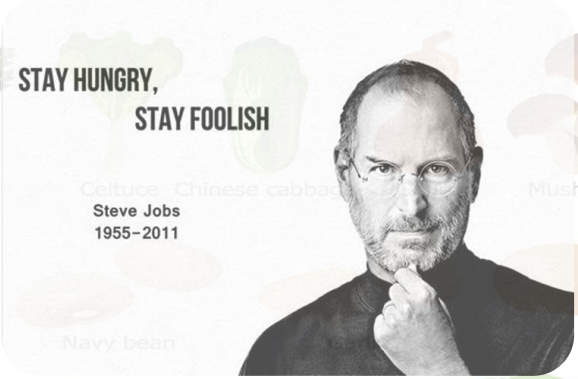
Cut the tomato into thin slices.

4.3.2.5. Sweetening

Sprinkle a layer of sugar on the surface of the tomatoes, the amount is more or less according to personal taste.

4.3.2.6. Cooling

Refrigerate the tomatoes for more than one hour.



You Are What You Eat