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# UNIT 11 PICKLES, CHUTNEYS, SAUCES AND TOMATO PRODUCTS

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## Structure

- 11.0 Objectives
- 11.1 Introduction
- 11.2 Pickles
  - Pickling Process
  - Fermentation with Dry Salting
  - Fermentation in Brine
  - Salting Without Fermentation
- 11.3 Various Pickles
  - Preservation with Salt
  - Preservation with Vinegar
  - Preservation with Oil
  - Preservation with Salt, Vinegar, Oil and Spices
- 11.4 Containers used for Pickling
- 11.5 Keeping Quality
- 11.6 Causes of Spoilage
- 11.7 Chutneys
  - Preparation of Chutney
- 11.8 Sauces
  - Thin Sauces
  - Thick Sauces
- 11.9 Soups and Other Mixes
- 11.10 Tomato Products
  - Tomato Juice
  - Tomato Puree
  - Tomato Paste
  - Canned Tomato
  - Tomato Sauce
  - Tomato Ketchup
  - Dried Tomato/Tomato powder
  - Tomato Soup
  - Chilly Sauce
  - Tomato Pickle
  - Tomato Chutney
  - Tomato Cocktail
- 11.11 Microbiology of Raw & Finished Products
- 11.12 Problems in Tomato Processing and Means to Avoid Them
  - Tomato Juice
  - Tomato Paste and Puree
  - Tomato Sauces
- 11.13 Quality Standards
- 11.14 Let Us Sum Up
- 11.15 Key Words
- 11.16 Answers to Check Your Progress Exercises
- 11.17 Some Useful Books

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## 11.0 OBJECTIVES

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By the time you have studied this unit, you should be able to describe:

- various methods of pickling and their keeping quality;
- preparation of chutney and sauces;

- preparation of various tomato products viz., Tomato Juice, Tomato Puree, Tomato Paste, Tomato Cocktail, Tomato Ketchup, Tomato Sauce, Tomato Soup; and
- quality standards, packaging and storage aspects of finished products.

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## **11.1 INTRODUCTION**

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In the previous unit, you have learnt about the sugar based products from fruits and vegetables. Now we will see the preservation technique using salt, vinegar, spices, oil etc. Pickles, chutney and sauces are pleasant preserves of mainly fruits and vegetables and are good accompaniment of Indian as well as continental foods. These products improve the taste of food, stimulate the appetite and enhance digestion. Besides providing the diet with a variety, these products also make a nutritional contribution to the food and save time in a busy household schedule.

In this unit, we will study the pickling by different methods, their shelf life and causes of spoilage. An attempt has also been made to illustrate the different processing methods of chutney and sauces. Detailed processing steps of various tomato products and the quality aspects of the finished products are also included.

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## **11.2 PICKLES**

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Pickle is an edible product preserved in a solution of common salt and vinegar. It is one of the most ancient method of preserving fruits and vegetables. Pickles are good appetizers and add to the palatability of meal. They stimulate the flow of gastric juice and thus help in digestion. Several kinds of pickles are sold in Indian market. Mango pickle ranks first. Pickles can also be prepared from fruits and vegetables like lemon, amla, onion, cauliflower, cabbage, beans, cucumber, bitter gourd, jackfruit, turnip etc. These are commonly made in homes as well as commercially prepared and exported. Fruits are generally preserved in sweetened and spiced vinegar, while vegetables in salt.

### **11.2.1 Pickling Process**

The preservation of food in common salt or in vinegar is called pickling. Pickling may also be the result of fermentation by lactic acid forming bacteria, which are naturally present in large numbers on the surface of fresh vegetables and fruits. These bacteria can grow in acid medium and in the presence of 8-10% salt solution, whereas the growth of majority of undesirable organisms is inhibited. Lactic acid bacteria are most active at 30°C, so this temperature should be maintained, as far as possible, in the process of pickling. Pickling is done in two stages.

Stage I can be done by any of the three following methods:

- i) Fermentation with dry salting,
- ii) Fermentation in brine, or
- iii) Salting without fermentation.

Stage II is finishing and packing.

### 11.2.2 Fermentation with Dry Salting

In this method, the vegetable is treated with dry salt. The salt extracts the juice from the vegetables and forms the brine, which is fermented by lactic acid bacteria. The method of dry salting in general is as follows:

The vegetable is washed, drained, weighed for preparing pickles. Several alternate layers of the prepared vegetable and salt (20-30 g of dry salt/ kg vegetables) are kept in a vessel which is covered with a cloth and a wooden board and allowed to stand for 24 hrs. During this period brine is formed by osmosis. As soon as the brine is formed, the fermentation process starts and the CO<sub>2</sub> begins to evolve. When fermentation is over, gas formation stops. Under favourable conditions fermentation is completed in 8-10 days, however in cold weather it may take 2 to 4 weeks. When sufficient lactic acid has been formed, lactic acid bacteria stops to grow and no further change takes place in vegetables. However, precaution should be taken against spoilage by aerobic microbes, because in the presence of air “pickles scum”, a kind of wild yeast, is formed which brings about putrefaction and destroys the lactic acid. Therefore the product may be preserved and kept by excluding air.

### 11.2.3 Fermentation in Brine

Steeping of the vegetables in a salt solution of pre determined concentration for a certain length of time is called brining. When vegetables are placed in brine, it penetrates in the tissues of the vegetables and soluble material present in vegetable diffuses into the brine by osmosis. The soluble material includes fermentable sugars and minerals. The sugars serve as food for lactic acid bacteria, which convert them into lactic and other acids. The acid brine thus formed acts upon vegetable tissues to produce characteristic taste and aroma of pickle.

The amount of brine required is usually half the volume of vegetables. Brining is the most important step in pickling. The growth of the majority of spoilage organisms is inhibited by brine containing 15% salt. Lactic acid bacteria, which are salt-tolerant, can thrive in brine of 8-10% strength though fermentation takes place fairly well even in 5 % brine. In a brine containing 10 % salt, fermentation proceeds somewhat slowly. Fermentation takes place to some extent up to 15 % but stops at 20% brine strength. It is, therefore, advisable to place the vegetables in 10 % salt solution for vigorous lactic acid fermentation. After fermentation process, the salt content is now increased gradually, so that by the time pickle is ready, salt concentration reaches 15%.

### 11.2.4 Salting Without Fermentation

Vegetables are washed, prepared and is mixed with salt (250 g/kg of prepared material). This high salt concentration will inhibit the fermentation. Vegetables packed with large amount of salt get cured. Then, they are drained and excess of salt is removed by soaking them in cold or warm water. Thereafter, the vegetables are stored in plain vinegar of 10% strength for several weeks. Vegetables can also be stored in sweetened and spiced vinegar. The spices can be added in the ground form or essential oil of spices may be added to impart the spice flavour.

## 11.3 VARIOUS PICKLES

At present, pickles are prepared with salt, vinegar, oil or with a combination of above ingredients with spices. These methods are discussed below:

### 11.3.1 Preservation with Salt

Salt improves the taste and flavour and hardens the tissue of vegetables and controls fermentation. Salt content of 15% or above prevents microbial spoilage. This method of preservation is generally used only for vegetables, which contains very little sugar. Since the sugar content is less, sufficient lactic acid cannot be formed by fermentation to act as preservative. However, some fruits viz., mango, lemon, etc. are also preserved with salt. An example for pickle preparation with salt is shown in Figure 11.1.

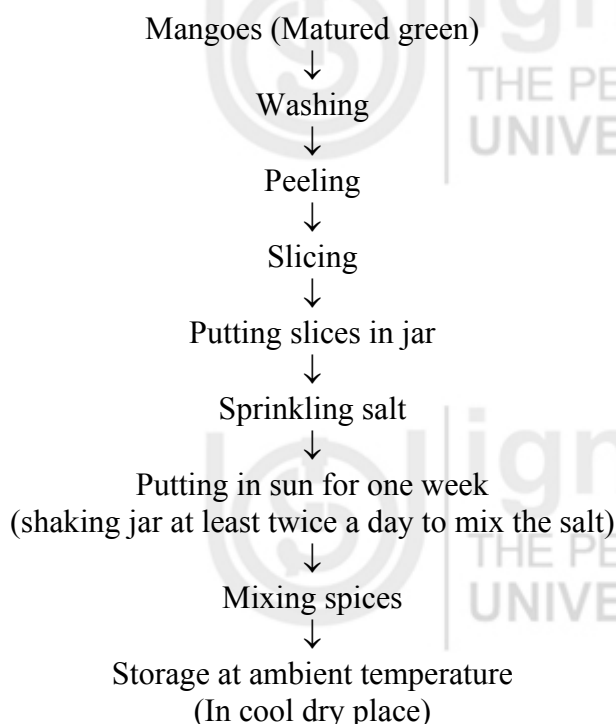


Figure 11.1: Flow chart of mango pickle

### 11.3.2 Preservation with Vinegar

This technology is based on the addition of food grade vinegar which has a bacteriostatic action in concentrations up to 4% acetic acid and bactericidal action in higher concentrations. Vegetables preserved in vinegar need to reach a final concentration of 2-3% acetic acid in order to assure their preservation. To achieve this final concentration, a 6-9% acetic acid vinegar is used, as related to the specific ratio of vinegar: vegetable. This higher concentration treatment helps to expel the gases present in the intercellular spaces of vegetable tissue.

In vinegar pickles, salt (2-3%) and sometimes sugar (2-5%) are also added. If the vinegar concentration is lower than 2%, vinegar pickles need to be submitted to a pasteurization in order to assure their preservation. Mango, garlic, chilies, etc. are preserved as such in vinegar. Vinegar pickles are the most important pickles consumed in other countries. Figure 11.2 shows the schematic flow chart of onion pickle by using vinegar as preservative.

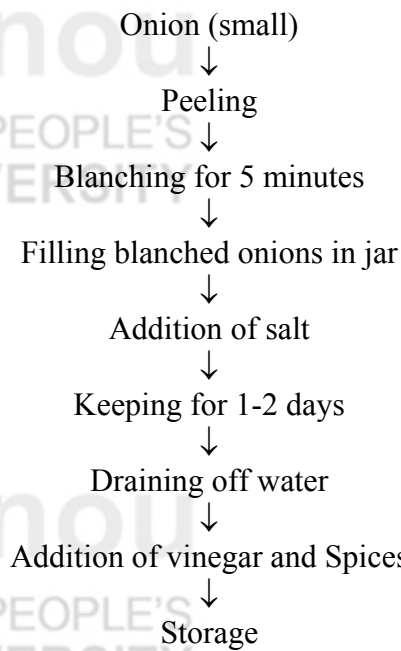


Figure 11.2: Flow chart of onion pickle

### 11.3.3 Preservation with Oil

Oil pickles are highly popular in India. They are highly spiced. In India, mustard oil, rapeseed oil, sesame oil are generally used. The fruits or vegetables should be completely immersed in the edible oil. Cauliflower, lime, mango and turnip pickles are the most important oil pickles. The pickle remains in good condition for one to two years if handled properly. A schematic flow chart of lemon pickle by using oil as preservative is shown in Figure 11.3.

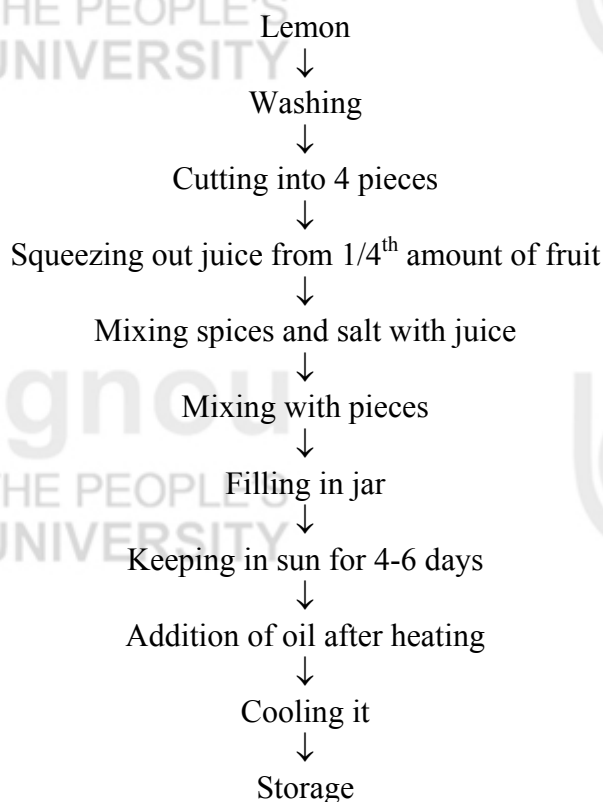


Figure 11.3: Flow chart of lemon pickle

### 11.3.4 Preservation with Salt, Vinegar, Oil and Spices

This method combines the advantages of fermentation action of salt and the preservation action of both vinegar and oil. The flavouring property of spices is also made use of. The spices are usually fried in oil and mixed to the prepared fruit/ vegetable before the addition of vinegar. The spices can be added separately or in the form of spice vinegar. A schematic flow chart of tomato pickle by using salt, vinegar, oil and spices as preservative is shown in Figure 11.4.

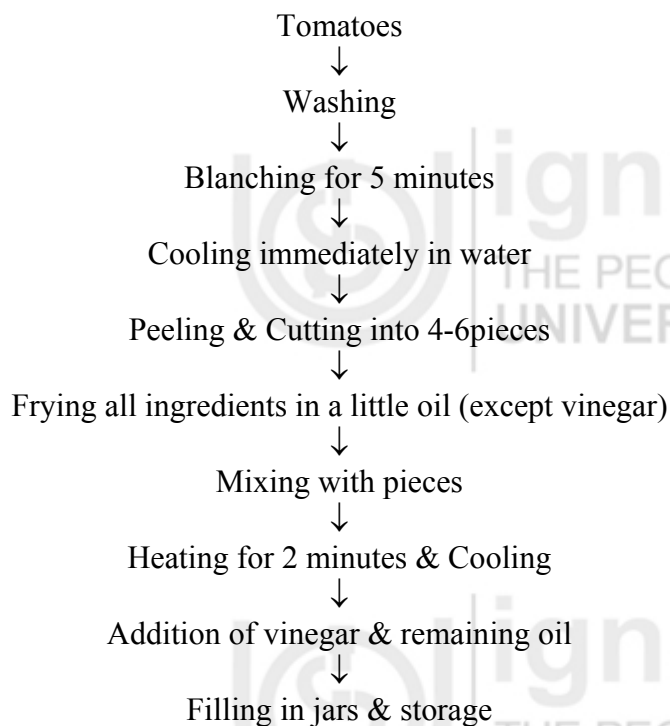


Figure 11.4: Flow chart of tomato pickle

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## 11.4 CONTAINERS USED FOR PICKLING

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Metallic vessels should be non corrodible. Usually, wide mouthed jars are used as they are easy to clean. The container should not impart any colour, taste, and flavour of its own to the pickle. Glass vessels, stainless steel, monel metal and aluminum containers are generally used as cooking utensils. The ladles, spoons and measuring vessels should also be of non corrosive materials.

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## 11.5 KEEPING QUALITY

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Properly brined vegetables will keep well in vinegar for a long time. The duration of brining is of utmost importance. If the vegetables are soaked for a short time of about 12 hrs only, the curing of the vegetable tissues will be incomplete with the result that the pickle will not have proper texture and taste. Brining has, therefore, to be controlled properly. On curing, the vegetables becomes semi translucent, and their colour changes from green to dark olive green or yellowish green. This is an indication of correct curing. This usually takes 4-5 weeks. By this method the vegetables can be kept more or less for an indefinite period, provided the right storage conditions are maintained. If the vegetable is kept in brine of 10% or less, all air should be excluded from the containers. During curing, the vegetables lose their 'raw' flavour and become firm and crisp.

**Shelf life of fermented products:** Some vegetables can be stored for years in high concentration of salt solution without a serious loss in quality though they are not stored for more than a year normally. The brine fermented products can be further processed with or without mild heat processing. During fermentation in bulk containers, microbial action influences the shelf stability. Complete conversion of fermentable carbohydrate to lactic acid and other end products renders the packaged products stable to subsequent fermentation. This is due to the presence of residual sugar, which leads to gas pressure and brine turbidity in the final package as a result of yeast and lactic acid bacterial growth. Preservatives like sodium benzoate, benzoic acid, sorbic acid and potassium bi-sulphate may be added to the product to enhance the keeping quality. Microorganisms (e.g. mould) producing softening enzymes should be excluded as they are active at pH values at which the packaged products are held.

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## 11.6 CAUSES OF SPOILAGE

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Different kinds of spoilage occur in pickles. They are as follows:

**Bitterness:** Use of strong vinegar or excess spice or prolonged cooking of spices imparts a bitter taste to the pickle.

**Blackening:** This is caused by iron which enters through the brine or from the equipment. Some times specific organisms also cause blackening.

**Blemishes in pickled onions:** Blemishes may sometime occur in the pickles and especially in onion pickles in vinegar. In the case of onions, white blotch is sometimes seen under the first layer of the skin. This appears to be owing either to some kind of fermentation or non removal of all the brine prior to the final pickling of the cured onion in the vinegar.

**Cloudiness:** When vegetables are placed in vinegar, it is generally presumed that the products will not spoil. In the case of onion and some other vegetables, however, sometimes the vinegar become cloudy turbid, there by spoiling the appearance of the pack. These raw materials being of a very solid structure, the acetic acid in the vinegar may not penetrate deep enough to prevent the activity of bacteria or other microbes that may be present in them. Hence the fermentation starts from inside rendering the vinegar cloudy. This activity of microbes can only be checked by proper brining. Cloudiness may also be caused by the use of a vinegar of inferior quality or imitation vinegar, or possibly by chemical action between the vinegar and the impurities such as calcium, magnesium and iron compounds that may be present in the salt used. This may also be caused by the reaction between the vinegar and minerals naturally present in the vegetable itself.

**Dull and faded product:** This is due to use of inferior quality materials or insufficient curing.

**Scum formation:** When vegetables are placed in the brine for curing a white scum is invariably formed on the surface owing to the growth of wild yeast. This scum may be thin or thick in appearance, varying from an almost imperceptible film to a thick wrinkled layer. It retards the formation of lactic acid. As this action may help in the growth of putrefactive bacteria, which causes the vegetable to become soft and slippery, it is essential to remove the scum as soon as it is formed. Addition of about 1% acetic acid helps to prevent the growth of wild yeast on the brine, without in any way hindering the

formation of lactic acid. For this reason some manufacturers add a small amount of vinegar to the brine in the initial stage.

**Shrivelling:** This occurs when vegetables (e.g. cucumber) are placed directly in a very strong solution of salt or sugar or vinegar, Hence, a dilute solution should be used initially and its strength gradually increased.

**Softness and slipperiness:** This is the most common form of spoilage and caused by the action of bacteria. It is invariably owing to inadequate covering with brine or owing to the use of a weak brine. By using a brine of proper strength and by keeping the pickle well below the surface of the brine, this kind of spoilage can be eliminated.



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### Check Your Progress Exercise 1

**Note:** a) Use the space below for your answer.  
b) Compare your answers with those given at the end of the unit.

1. What is the principle of pickling?

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2. What is the need for a higher initial vinegar concentration in vinegar pickling?

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3. What are the causes of pickle spoilage?

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## 11.7 CHUTNEYS

A chutney is basically a mixture containing fruit or vegetable, spices, salt and/or sugar, vinegar, etc. The method of preparation is similar to that adopted in the case of jams except that spices and vinegar are added. Chutney of good quality should be reasonably smooth, palatable, appetizing and have the true single flavour of the fruit or the vegetable used for the preparation.

### 11.7.1 Preparation of Chutney

Ripe fruit or vegetable is selected, cut into slices or pieces of suitable size and are softened by boiling in water. These are then, slowly cooked at a temperature below boiling point. Onion and garlic are added at the start to mellow their strong flavours. Spices are coarsely powdered before they are added to the product. Whole spices, if used, are bruised and tied loosely in muslin cloth before adding to the mixture and removed before bottling. Vinegar, sugar, and spices are added just a little before the final stage of boiling. This prevents the loss of some essential oils of spices and vinegar due to volatilization.

Long cooking of sugar darkens the colour of the chutney. For the preparation of dark colour chutney brown sugar is usually preferred, where as, white sugar is preferred for white colour chutneys. Spiced vinegar gives high quality product. Chutneys usually get thickened on cooling. The chutneys are bottled, while hot, in clean and warm jars which are then, adequately sealed and sterilized. A schematic flow chart of chutney production is shown in Figure 11.5.

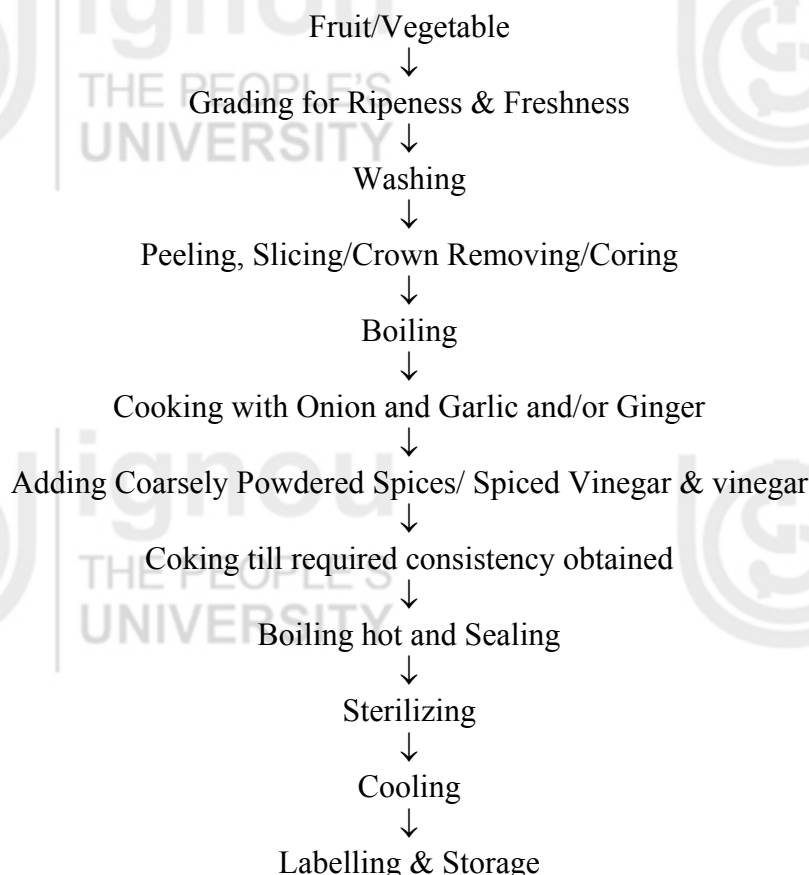


Figure 11.5: Flow chart of chutney production

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## 11.8 SAUCES

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Sauces and chutneys are usually made from the same raw materials, spices and flavours, however, difference is that, all sauces are sieved and as a result, are thinner and of smoother consistency than chutneys. The sieving is done to remove the skin, seeds and stalks of fruits, vegetables, and spices and to give a smooth consistency. Here the cooking process is longer compared to the chutney due the use of fine pulp or juice.

Sauces are generally of two kinds, and they are the thin sauces and the thick sauces. A good sauce whether thin or thick, have a continuous flow with no skin, seeds and stalks of the fruit and/ or vegetables and spices used for its preparation, and possesses pleasant taste and aroma. The details of thin and thick sauces are given below:

### 11.8.1 Thin Sauces

Thin sauces mainly consist of vinegar extract of various flavouring materials like, spices and herbs. Their quality depends mostly on the piquancy of the material used. Some sauces are matured by storing them in wooden barrel or casks. During storage they develop flavour and aroma. Freshly prepared products have often a raw and strong taste and they should, therefore, be matured by storage.

**Preparation:** For the preparation of thin sauces of high quality, the spices, herbs, fruits, and vegetables are macerated in cold vinegar. Some times, they are also prepared by boiling them in vinegar. The sauce is filtered through a fine or coarse mesh sieve of non corrodible metal, according to the quality desired. The skin, seeds and stalks of fruits, vegetables and spices used, should not be allowed to pass through the sieve as they spoil the appearance of the sauce. The usual commercial practice is to prepare vinegar extracts of each kind of spice and fruit separately, either by maceration or by boiling in vinegar and then blending these extracts suitably before filling the sauce into barrels for subsequent maturation.

Soya sauce made from soybeans and Worcestershire sauce made from tamarind are examples of thin sauces. The Worcestershire sauce is utilized in the preparation of cocktail also. Figure:6 shows a schematic flow chart of thin sauce production.

## Preparation of Thin Sauce

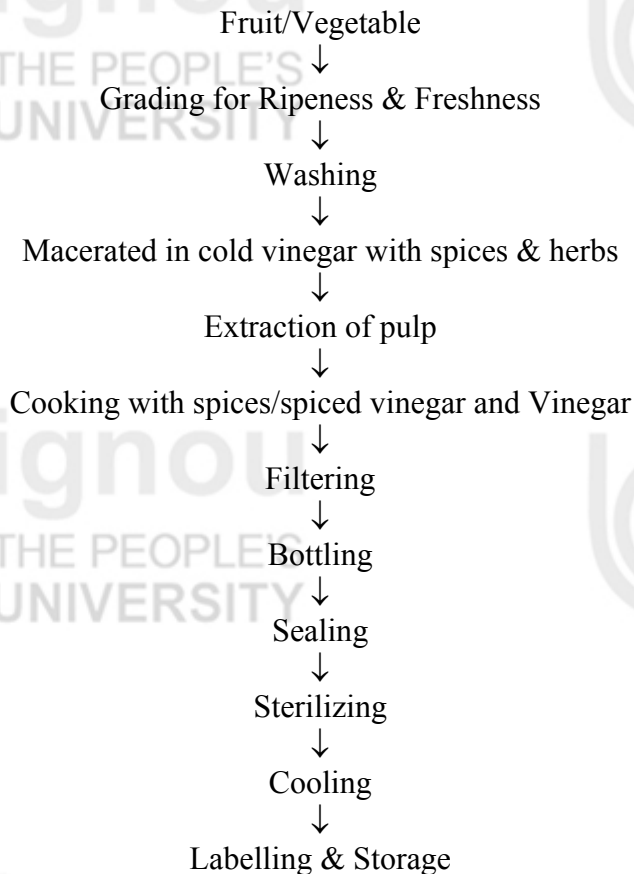


Figure 11.6: Flow chart of thin sauce production

### 11.8.2 Thick Sauces

A sauce which does not flow freely and which is highly viscous is called a thick sauce. On the other hand thin sauces are less viscous in consistency. Thick sauces also contain more of sugar and less of acid. Generally spices and colouring added are practically similar to those in the case of thick ketchups and sauces. It should contain at least 3% acetic acid to ensure its keeping quality. The acidity should not however, exceed 3.4% as otherwise the sauce would taste sharp. The sugar content may usually varied from 15-30% according to the kind of sauce made. Usually malt vinegar is used. In addition to contributing to acidity of the sauce, it also improves its flavour. The sweetness is derived partly from dates, raisin, apple and tomato and partly from the sugar added. The colour of the sauces varies with the raw material use. Some times a little caramel is added.

**Preparation:** The manufacturing process is the same as for chutneys. Thickening agents are also added to prevent or retard sedimentation of solid particle in suspension in the sauce. In this country apple pulp is often used for this purpose. The starch obtained from maize, potato, arrow root, sago and rye are also used as thickening agents. Indian gum, gelatin, Irish moss, pectin and other similar substances can also be used subject to the food laws of our country. Tomato sauce and apple sauce are some of the examples for thick sauce. Preparation of tomato sauce is explained under the section 3.10.5.

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## 11.9 SOUPS AND OTHER MIXES

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Ready to serve soups such as tomato soup, mushroom soup, mixed vegetable soups, especially dried vegetable mixtures for quick preparation of soups at home, are gaining popularity in these days. Liquid soups are generally canned. They are warmed at the time of serving. The preparation and bottling of tomato soup is explained under tomato processing (3.10.8).



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### Check Your Progress Exercise 2

**Note:** a) Use the space below for your answer.  
b) Compare your answers with those given at the end of the unit.

1. Differentiate between thin sauce and thick sauce.

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2. How is ketchup different from sauce?

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3. What is the percentage of sugar in sauce & ketchup? What will happen to the product if the whole quantity of sugar is added initially?

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## 11.10 TOMATO PRODUCTS

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Tomato is grown in our country in abundance, in all seasons. The farmer will get a very low profit during the peak-harvesting season and nearly 25% of the

produce is spoiled due to improper post harvest practices. Such losses can be avoided by converting tomatoes into delicious products. Tomato can be processed to a variety of products like; canned tomato, paste, puree, juice, ketchup and sauce. In India tomato sauce and ketchup are very popular and are being manufactured on an increasingly large scale.

### 11.10.1 Tomato Juice

This product is characterised not only by its organoleptical properties (taste, colour, flavour) but also by its vitamin content close to those of fresh tomatoes. Modern technology is oriented to a maximum maintenance of organoleptic properties and of vitamin content.

At same time, it is important to assure juice uniformity by avoiding cellulosic particle sedimentation. A good quality juice should contain about 0.4 % acid (in terms of citric acid), 0.5% salt, and 1 % sugar. Juice stability is assured by a flash pasteurization, which assures the destruction of natural micro-flora, while keeping the initial properties. The modern technological flow sheet covers the following main operations:

#### Preparation of Tomato Juice

**Pre-washing and washing:** Pre-washing is carried out by immersion in water, cold or heated up to 50°C (possibly with detergents to eliminate traces of pesticides). Then washing is performed with water sprays.

**Sorting:** Only sound ripe red coloured tomatoes are used for the juice preparation. This is done on rolling sorting tables. This enables the removal of non-standard tomatoes – with green parts, yellow coloured, etc.

**Crushing and pulping:** Crushing is carried out in a special equipment. Fluted wooden roller crushers are utilized for this purpose. The crushed tomatoes can be pulped by the hot process or by the cold process. In hot pulping, crushed tomatoes are boiled in their own juice in steam jacketed stainless steel pans or in aluminium pans for 3 to 5 minutes. This process facilitates the extraction, dissolves pectic substances and contributes to the maintaining of vitamins and natural pigments. In some modern installations, this step is carried out under vacuum at 630-680 mm Hg and in very short time. Whereas in cold pulping, the tomatoes are crushed in cold and as such passed through a pulper. Here the extraction of juice is difficult and yield will be less compared to hot process.

**Extraction:** Extraction of juice and part of pulp (maximum 80%) is performed in special equipment / tomato extractors with the care to avoid excessive air incorporation. In some installations, as an additional special care, a part of pulp is removed with continuous centrifugal separators.

**Deaeration and Homogenization:** The air from the extracted juice is removed by using a deaerator under high vacuum. Homogenization is done for mincing of pulp particles and is mandatory in order to avoid future potential product "separation" in two layers.

**Filling and bottling:** After flash pasteurization at 130-150°C for 8-12 second, the juice is cooled at 90°C. This cooled juice is filled in receptacles (cans or bottles) at the same temperature (90°C). The receptacles are then closed followed by their inversion for about 5 to 7 minutes. Cooling has to be carried out intensely. Full cans do not need further pasteurization because the bacteria

that have potentially contaminated the tomato juice during filling are easily destroyed at 90°C due to natural juice acidity.

For bottles, it may be possible to avoid further sterilization if the following conditions can be strictly adhered: washing and sterilizing of receptacles, cap sterilization (with formic acid), filling and capping under aseptic conditions, in a space with UV lamps. Since this is quite difficult to achieve, it may be necessary to subject the bottles for pasteurization in water baths.

### **11.10.2 Tomato Puree**

Tomato pulp without skin or seeds, with or without added salt, and containing not less than 9.0% of salt free tomato solids is known as “Medium tomato puree”. It can be concentrated further to ‘heavy tomato puree’, which contains not less than 12% solids.

**Preparation of tomato puree:** Manufacturing steps fall into three successive categories: (i) obtaining tomato juice from the raw materials; (ii) juice concentration and (iii) tomato puree pasteurization. Tomato pulp and juice extraction is done from ripe tomatoes in the same manner as tomato juice preparation.

Concentration of the pulp is carried out either in an open cooker or in a vacuum pan. In open cooking, most of the vitamins are destroyed and the product becomes brown. On the other hand, use of vacuum pans, nutritive value is preserved and browning is also reduced. However this method is quite expensive. Ordinarily tomato juice can be concentrated to lower range in an open cooker, but for obtaining higher concentrations a vacuum pan is required. The end point is judged by determining the TSS. This is done by using either a specific gravity hydrometer or by a refractometer.

Tomato puree pasteurization assures the microbiological stability of the product. For this purpose, the puree coming out from concentration equipment is passed continuously and in a “forced” mode through a tubular pasteurizer from which it emerge, at a temperature of 90-92° C. The pasteurized puree is then filled hot in to cans or in glass receptacles.

### **11.10.3 Tomato Paste**

The product with highest production volumes among concentrated products is tomato paste, which is manufactured in a various range of concentrations, with a minimum of 25% and up to 44% refractometric extract. The product is very similar to tomato puree except that the solid concentration is more. Tomato paste is the product obtained by removal of peel and seeds from tomatoes, followed by concentration of juice by evaporation under vacuum. Good quality tomato paste is a homogenous mass, with a high density, without foreign bodies (seeds, peel, etc.), with a red colour, and an agreeable taste and smell, close to those of fresh tomatoes.

Preparation procedure is also similar to that of tomato puree. Here the tomato juice obtained is further concentrated so that it contains not less than 25% tomato solids. This is known as tomato paste. On further concentration to 33% or more of solids, it is called concentrated tomato paste. Paste of good quality must have a volatile acidity of maximum 0.15% as lactic acid. An 8% salt addition is accepted. The end point is judged by using a refractometer. The

product with required TSS is then pasteurized and filled into receptacles in the same way as explained under tomato puree.

#### 11.10.4 Canned Tomato

The process of sealing tomatoes hermetically in containers and sterilizing them by heat for long storage is known as canning. The principle of canning is the destruction of spoilage microbes within the sealed container by thermal processing, i.e., by means of heat. Schematic representations of the unit operations are shown in Figure 11.7.

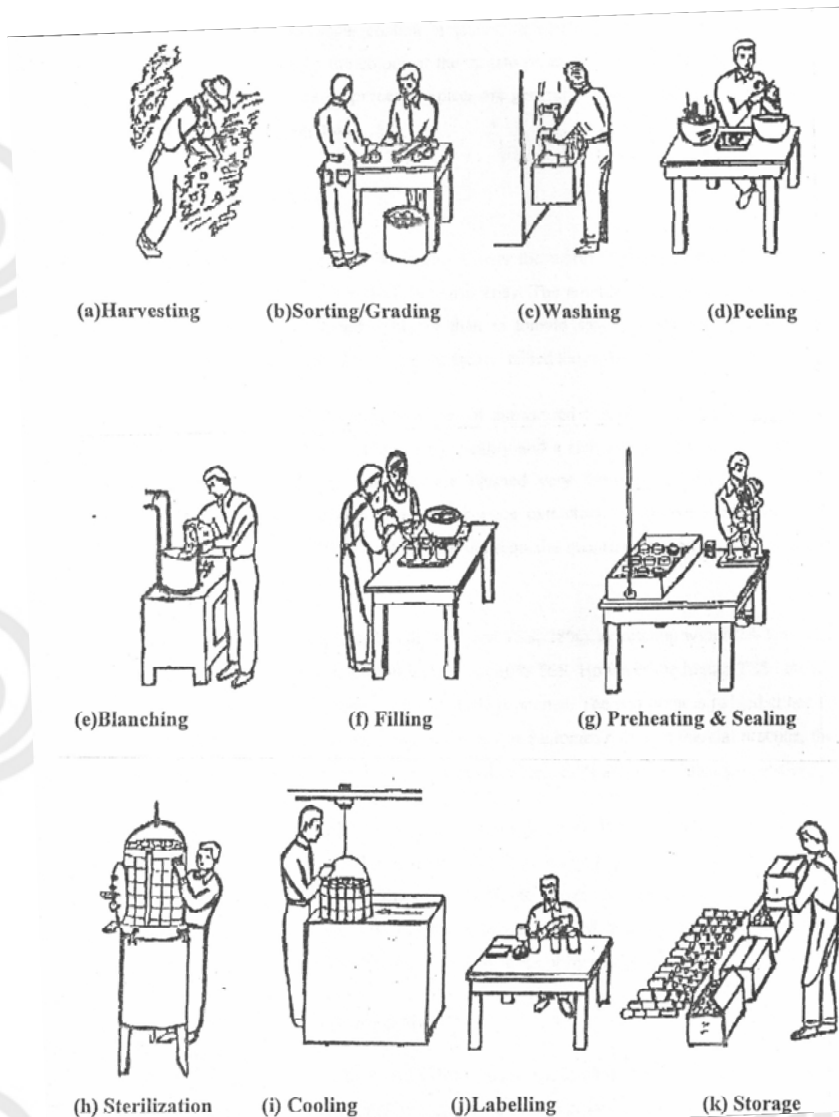


Figure 11.7: Schematic representation of fruit canning unit operations

**Canning process:** Canning involves the pre-treatments like selection of sound fruits and vegetables, grading, washing, peeling, cutting, blanching and cooling. The blanched tomato pieces are filled in plain cans and tomato juice is used as covering liquid. The filled cans are now subjected to exhausting for the removal of air and are then sealed immediately. The sealed cans are then thermally processed at high temperature (100°C) for about 25-30 minutes. After thermal processing, the cans are cooled rapidly to about 39°C to stop the cooking process and stored after labelling.

### 11.10.5 Tomato Sauce

Tomato sauce is the concentrated product prepared from the liquid extract from mature, sound, whole tomatoes to which is added salt, spices, sugar, vinegar, with or without onion, garlic, or other vegetable flavouring ingredients. The final concentrated product contains not less than 12% tomato solids and 25% TSS. FPO specifications are given under quality standards.

Sauces can be obtained from fresh tomatoes or from concentrated products (tomato paste or concentrated tomato juice), those from fresh tomatoes being of superior quality. Technological processing covers the following steps: concentrated juice processing, addition of flavour/taste ingredients (salt, sugar, vinegar, spices, etc.), boiling, fine sieving, filling of receptacles, closing and pasteurization (45 min at 85°C).

**Special care:** About one third of the sugar required is added at the time of commencement of boiling to intensify and fix the red tomato colour. If the whole quantity of sugar is added initially, the cooking time will be longer and the quality of pulp will be adversely affected. Generally the sugar content in sauces/ ketchups varies from 10- 26 %. On the other hand, salt bleaches the colour of the tomato product. It is therefore desirable to add towards the end of cooking process. Spices are generally added in powdered form to the product by spice bag method.

### 11.10.6 Tomato Ketchup

Tomato ketchup is a popular condiment all over the world. Tomato ketchup is similar to tomato sauce except that it is thick in consistency. The amount of spices added in case of tomato ketchup is considerably higher than in tomato sauce. Thick sauces made from fruits and vegetables other than tomatoes are not called ketchups.

**Preparation:** Clean, wholesome tomatoes of intense red colour and of meaty, not watery texture are used for sauce making. High acidity and a rich tomato flavour are additional desirable qualities. Sound tomatoes are washed very thoroughly, cored, sliced, heat crushed and pulped (through a pulper or juice extractor) to remove seeds and skins. Tomato pulp or paste is then cooked with the requisite quantities of spices, onions, garlic, sugar, salt and vinegar.

The whole mass is concentrated to the required TSS (28%). A ketchup with a 28-30% TSS has a better flavour than those with more than 30% TSS. However the higher TSS ketchup generally keep for a long time, once the bottle is opened. The end point is judged either by means of a specific gravity hydrometer or by a refractometer. In commercial practice, the juice is concentrated to one third of its original volume as determined with a gauge stick.

**Bottling:** The mass is finally passed through the finisher, fitted with a very fine sieve, to remove any tomato fibre, and other impurities. The sieved ketchup is filled into clean, dry bottles. The ketchup should be filled hot (88°C) to prevent browning and loss of vitamins during subsequent storage. Bottles are cleaned, labelled and packaged for marketing. Preservation is assured either by use of preservatives or by pasteurization.



### 11.10.7 Dried Tomato/Tomato Powder

Dried tomato is used for the production of flakes and tomato powder. For the preparation of dried product, tomatoes should be ripe, of good red colour and should be firm. Tomato pigments are stable because they are rich in carotene; therefore, pre-processing, such as blanching and sulphiting, is not necessary. Alternatively the slices may be dipped for 3 min in a solution containing 0.7%  $K_2S_2O_5$  (KMS) plus 10% salt.

Washing and sorting are followed by cutting in halves lengthwise to eliminate the liquid and the seeds. Empty the tomatoes and then cut them lengthwise into slices of 6 to 8 mm thickness and place them in dryers. The tomatoes are dry when the raw material / dry product ratio is about 25:1. On an average, 40 g of dried products are obtained from 1 Kg of fresh tomatoes. The yield depends on the dry tomato residue and the degree of drying.

The dried slices may be reduced to flakes by rubbing through a sieve of about 10 mm mesh. This gives a better-looking product, which is easy to handle. The product may also be ground into powder but this will tend to cake and the colour is less appealing than the flakes. The product is then cooled (half an hour at room temperature), bagged and labelled for storage. The product must be kept in a dark place to reduce infestation by photophilic insects.

### 11.10.8 Tomato Soup

Soup is becoming very popular in India. Stored soup is warmed at the time of serving. The main constituents of the soup are tomato juice, butter or cream, spices, flour or starch (for thickening), onion, etc.

**Preparation:** In its preparation the first step is the preparation of tomato pulp just as in the case of tomato juice. Neutralize about  $1/6^{\text{th}}$  of the acidity of the juice by adding a thin paste of sodium bicarbonate in water. The juice is then concentrated in a boiling pan. While it is being concentrated, add the spices in a cloth bag as in the case of tomato ketchup. In the meantime, mix the flour/starch and butter/cream with one portion of juice (usually 10 to 15% of the total juice) to form a smooth paste. When the juice in the pan has been sufficiently concentrated, add this paste to it. Continue boiling to the desired consistency. Stirring is done continuously to prevent clotting of the starch. At the end, add sugar and salt and boil the mixture for about two minutes to dissolve them.

**Bottling:** The tomato soup is filled into cans and closed them properly for sterilization. Sterilization is carried out at  $115^{\circ}\text{C}$  for 40- 45 minutes. The sterilized cans are cooled and stored in ambient temperature in a cool and dry place.

### 11.10.9 Chilly Sauce

It is highly spiced product made from ripe, peeled and crushed tomatoes and salt, sugar, spices, vinegar, with or without onion and garlic. The method of preparation is similar to that for tomato sauce except that the total unstrained pulp is used and the seeds are not removed. Hot product is filled in bottles or cans and processed in water at  $85-90^{\circ}\text{C}$  for 30 minutes.

#### 11.10.10 Tomato Pickle

Tomato pickles can be produced by using a combination of preservatives like salt, oil, spices and vinegar. The detailed method of the pickling process and flow chart for the same is explained under the section 3.3.4.

#### 11.10.11 Tomato Chutney

Tomato chutney is produced from tomato pulp, and other ingredients like sugar, salt, vinegar, spices, onion, ginger, garlic, etc. The preparation of tomato chutney is similar to that of the chutney produced from other fruits and vegetables. The method of preparation is explained under the section 3.7.1.

#### 11.10.12 Tomato Cocktail

Tomato cocktail is gaining popularity in many of the high-class hotels and restaurants. It is prepared just before serving and some times is also served from stock. In the later case, the cocktail is preserved by pasteurization in bottles. Although the recipes vary, the main constituent is tomato juice to which common salt, vinegar, Worcestershire sauce (Sauce from tamarind), lemon juice, etc. are added in different proportions to suit the palate.

The preparation of tomato juice is done in the similar way as explained in earlier products. Fresh or canned juice can be used for the cocktail production. Boil the tomato juice with the spices loosely tied in a cloth bag for about 20 minutes in a covered vessel. Then add the limejuice, vinegar and common salt. Only crystal clear limejuice should be used, because any sediment in it will impart an undesirable flavour.

**Bottling:** When all the ingredients have been mixed and the cocktail is ready for bottling, heat the cocktail to 82°C to 88°C and fill it into bottles, which have been sterilized and kept hot for filling. Close the bottles and keep them immersed in boiling water (100°C) for 30 minutes and then cool them.

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### 11.11 MICROBIOLOGY OF RAW & FINISHED PRODUCTS

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When tomatoes of poor quality are used in the preparation of tomato products, excessive amount of moulds, yeast, bacteria and fragments of insects lower the quality of the product. There are some prescribed limits for the mould, yeast and bacteria count permitted in the tomato products. Of these, mould count is the most important as it is the sure and positive indication of the condition of the tomatoes used. The insect fragment count is also highly indicative of gross contamination of the fruit and unhygienic conditions during handling and preparation of the raw material and finished products.

A minimum of 10 minutes heating of the sauce with 0.5% acetic acid could ensure the destruction of spore formers and addition of 750 ppm of sodium benzoate to the sauce would prevent microbial spoilage during storage.

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## 11.12 PROBLEMS IN TOMATO PROCESSING AND MEANS TO AVOID THEM

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### 11.12.1 Tomato Juice

- “Separation” in layers is due to not enough homogenisation or low / insufficient viscosity. In the first case it is necessary to intensify homogenisation; and in second to increase the pre-heating temperature to 60° C in order to obtain protopectine hydrolysis and pectolytic enzymes inactivation.
- Moulding of the juice is brought about by significant infection of raw materials, inadequate washing and control or by use of contaminated packages. The preventive measures should be decided after cause analysis. Good pasteurization can destroy all moulds but the bad juice taste remains.
- Fermentation of juice is manifested by a significant development of gases. Prevention methods are the same as for moulding.
- Tomato juice turns sour, without the formation of gases; this defect is initiated by thermophil and thermo-resistant bacteria; the juice acquires a vinegary taste. Prevention: maintenance of flash pasteurization temperature at 130-135°C.
- Excessive vitamin C losses are due to a simultaneous action of heating and oxygen from air. It can be prevented by blocking air going into crusher and extractor, close receptacles in vacuum and assure an intensive de-aeration (vacuum degree 700 mm Hg) at a temperature of at least 35-40°C.
- Weak colour of tomato juice can be avoided by the utilisation of mature tomatoes and with a pulp of as red a colour as possible.

### 11.12.2 Tomato Paste and Puree

- Presence of sand is caused by inadequate washing or by a significant contamination of raw material; this can be prevented by a more intensive pre-washing and washing of tomatoes.
- There may be mould especially at the surface of tomato paste packed in drums. This can be prevented by accurate pre-washing and washing, following pasteurization instructions, packing in clean drums or receptacles, and closing receptacles immediately after filling.
- Fermentation is manifested by a weak alcohol smell or by a weak vinegar taste; when the fermentation is more advanced there is gas production in the product mass. Prevention: as for moulding prevention.

### 11.12.3 Tomato Sauces

Surface of the product turns black at the contact zone with air; this is due to the action of iron on the tannins from spices, tomato seeds, etc. Prevention is by avoiding iron equipments, avoiding crushing of tomato seeds and by sealing the receptacles under vacuum.

### 11.13 QUALITY STANDARDS

The importance of quality and its considerations has been discussed in detailed in Unit 1. Now we will see the FPO specifications for the products discussed in the present unit. FPO specifications for tomato products, pickles, chutneys and sauces are as follows:

Sl. No.	Product	Minimum TSS (%)	Mould count
1.	Tomato juice	5.00	Not in excess of 30% of the field examined.
2.	Tomato soup	7.00	
3.	Tomato puree	9.00	Not in excess of 60% of the field examined
4.	Tomato paste	25.00	
5.	Tomato ketchup/ sauce	25.00(minimum acidity as acetic acid 1%)	Not in excess of 40% of the field examined
6.	Sauces other than tomato and soybean	15.00(minimum acidity as acetic acid 1.2%)	Not in excess of 40% of the field examined

#### Permissible limits of preservatives in fruit beverages

Sl. No.	Food product	Preservative	Parts per million (ppm)
1.	Pickles and chutneys made from fruits and vegetables	Benzoic acid or Sulfur dioxide	250 100
2.	Tomato and other sauces	Benzoic acid	750
3.	Dehydrated vegetables	Sulfur dioxide	2000
4.	Tomato puree and paste	Benzoic acid	250

#### Some important considerations:

- In case of oil pickles the name of the fruit or vegetable used shall be declared on the label.
- When more than one vegetable is used in vinegar pickle the product shall be labeled as 'mixed pickles'.
- In case of sauces other than tomato and soybean, the names of fruits, vegetables or dried fruits used shall be declared on the label.
- In case of fruit chutney, the names of fruits may not be declared on the label, However, in case of mango chutney or other chutneys the content shall be declared on the label.

- Permissible limit of Copper (a toxic element) in tomato ketchup is 50 ppm, where as the same can be up to 100 ppm in tomato puree, paste, juice powder and cocktails.

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**Check Your Progress Exercise 3**



- Note:** a) Use the space below for your answer.  
b) Compare your answers with those given at the end of the unit.

1. What are the various unit operations in tomato juice preparation?

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2. List out the problems in tomato juice processing.

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3. How can we prevent microbial spoilage in tomato product?

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4. What are the three major steps in tomato puree and paste preparation?

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## 11.14 LET US SUM UP

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Chutney, sauce and pickle are various processed products from fruits and vegetables prepared by using preservatives like salt, vinegar, oil, spices etc. In making such products, the major objective is to provide consumer with more variety among the processed foods and to provide convenience to have fast food. Apart from extending the shelf life of fruits and vegetables, these products enhance sensory properties and nutritive value of food

You must now be well versed with the methods of pickling and chutney and sauce preparation. We have also seen how to obtain diversified products from tomato fruit. Finally, the keeping quality, standards, packaging and storage aspects of the finished products are also explained in this section.

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## 11.15 KEY WORDS

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<b>Brine</b>	:	Solution of common salt.
<b>Brining</b>	:	Steeping of the vegetables in a salt solution of pre determined concentration for a certain length of time.
<b>Vinegar</b>	:	It is a liquid obtained by alcoholic and acetic fermentation of material containing sugar. It contains about 4% acetic acid.
<b>Chutney</b>	:	It is an unstrained, concentrated product, which contains a mixture of fruit or vegetable, spices, salt and/ or sugar, vinegar.
<b>Sauce</b>	:	It is a strained, concentrated product, which contains a mixture of fruit or vegetable, spices, salt and/ or sugar, vinegar. These are thinner and smoother in consistency than chutneys.
<b>Tomato paste</b>	:	It is a concentrated and strained tomato product and contains not less than 25% tomato solids.
<b>Tomato puree</b>	:	It is a concentrated and strained tomato product but thinner than the paste and containing not less than 9.0 % of salt free tomato solids.
<b>Spice bag</b>	:	Bruised spices tied loosely in muslin cloth
<b>Ketchup</b>	:	Thick sauces made from tomato



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## 11.16 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

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### Check Your Progress Exercise 1

1. The preservation of fruit or vegetable in common salt or in vinegar is called pickling. Pickling is the result of fermentation by lactic acid forming bacteria, which are generally present in large numbers on the surface of fresh vegetables and fruits. These bacteria can grow in acid medium and in

the presence of 8-10% salt solution, whereas the growth of a majority of undesirable organisms is inhibited.

2. Vegetables preserved in vinegar need to reach a final concentration of 2-3% acetic acid in order to assure their preservation. To achieve this final concentration, a 6-9% acetic acid vinegar is used, as related to the specific ratios vinegar: vegetables. This higher concentration treatment also helps to expel the gases present in the intercellular spaces of vegetable tissue.
3. Different kinds of spoilage occur in pickles. They includes: bitterness, blackening, blemishes in case of onion pickles, cloudiness, dull and faded product, scum formation, shrivelling and the most common one is, softness and slipperiness.

### **Check Your Progress Exercise 2**

1. Thin sauces mainly consist of vinegar extract of various flavouring materials like, spices and herbs. Their quality depends mostly on the piquancy of the material used. Where as thick sauce does not flow freely and is highly viscous. Thin sauces are less viscous in consistency. Thick sauces also contain more of sugar and less of acid.
2. Thick sauces made from tomato are known as ketchup. It is similar to sauce except that it is thick in consistency. The amount of spices added in case of ketchup is considerably higher than in sauce. Thick sauces made from fruits and vegetables other than tomatoes are not called ketchups.
3. Generally the sugar content in sauces/ ketchups varies from 10- 26%. If the whole quantity of sugar is added initially, the cooking time will be longer and the quality of pulp will be adversely affected. About one third of the sugar required is added at the time of commencement of boiling to intensify and fix the red tomato colour.

### **Check Your Progress Exercise 3**

1. The various unit operations in tomato juice production include: Pre-washing, washing, sorting, crushing, pulping, extraction of the juice, de-aeration, homogenization, filling and bottling. The filled juice is subjected to flash pasteurization and intensively cooled to ambient temperature for storage.
2. The various problems in the production of tomato juice are as follows: i) Separation in layers due to improper homogenization, ii) Moulding of the juice, iii) Fermentation of juice, iv) Souring of tomato juice, v) Excessive vitamin C losses, and vi) Weak colour of tomato juice.
3. A minimum of 10 minutes heating of the sauce with 0.5% acetic acid could ensure the destruction of spore formers and addition of 750 ppm of sodium benzoate to the sauce would prevent microbial spoilage during storage.
4. The major manufacturing steps of tomato puree and paste fall into three, which includes: i) obtaining tomato juice from the raw materials, ii) juice concentration, and iii) tomato puree preservation by pasteurization.

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## 10.17 SOME USEFUL BOOKS

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1. Dauthy, M.E. (1995). Fruit and vegetable processing, FAO Agricultural Service Bulletin 119, Food and Agriculture Organization of the United Nations, Rome.
2. Girdhari Lal, Siddappa, G.S. and Tandon, G.L. (1995). Preservation of Fruits and Vegetables, ICAR, New Delhi.
3. Verma, L.R. and Joshi, V.K. (2000). Post harvest Technology of Fruits and Vegetables: Handling, processing, fermentation and Waste management, Volume-2, Technology, Indus Publishing company, New Delhi.