

Lesson 18

JAM, JELLY AND MARMALADE

18.1 Introduction

In previous lesson (No.17), the role played by several functional ingredients in preparation of sugar preserved foods like Jam, Jelly and Marmalade were discussed. In this lesson the mode of preparation of these products and means to prevent any defect in such products will be taken into account.

18.2 Fruit Jam/Fruit Cheese

As per FSSAI, Jam means the product prepared from sound, ripe, fresh, dehydrated, frozen or previously packed fruits including fruit juices, fruit pulp, fruit juice concentrate or dry fruit by boiling its pieces or pulp or puree with nutritive sweeteners namely sugar, dextrose, invert sugar or liquid glucose to a suitable consistency. It may also contain fruit pieces and any other ingredients suitable to the products. It may be prepared from any of the suitable fruits, singly or in combination. It shall have the flavour of the original fruit(s) and shall be free from burnt or objectionable flavours and crystallization.

The specific requirements for Jam are as follows:

Total soluble solids (m/m) - Min. 65.0 %

The product shall be manufactured from minimum 45.0% by weight, of original prepared, fruit, exclusive of any added sugar or optional ingredients of finished product, except for Strawberry or Raspberry fruit, where it shall contain minimum 25.0% fruit.

As per FSSAI, Fruit cheese means the product prepared from pulp/puree of sound, ripe fruit (s), whether fresh, frozen or previously preserved or dry fruits, by cooking with salt, nutritive sweeteners to attain a thick consistency so that it sets on cooling. The fruit cheese shall be neither too soft nor too hard to chew. It may be prepared from any of the suitable fruits, singly or in combination. It shall have the flavour of the original fruit(s) and shall be free from burnt or objectionable flavours and crystallization.

The specific requirements of Fruit cheese are the same as specified for Fruit Jam.

18.2.1 Salient characteristics of jam

The amount of pectin in the gel is quite small (< 1.0% of the weight of jam); sugar content is very high (60-70%). Of the remainder, the bulk is water with a small amount of fibrous matter and seeds.

For a chunky texture, some pieces of fruit are added about 5 minutes before the cooking is finished. If a stiffer or sweeter jam is desired, more thickener or pectin, honey or sugar may be added.

18.2.2 Fruit or fruit combinations

Some fruits such as lemons and bitter oranges are rich in both acid and pectin and can be easily made into jam.

Some popular combinations include: pineapple and paw paw, orange and banana, apple and plum.

18.2.3 Sugar

55 parts of sugar is required for every 45 parts of fruit. With excess sugar, the jam becomes gummy and sticky.

The finished jam should have 30-50% invert sugar / glucose to avoid crystallization of cane sugar during storage.

18.2.4 Acid

Acidity can be supplemented by use of citric, tartaric or malic acid. The pH influences inversion of sugar and setting of the jam.

For pectin jam, pH of 3.3 gives a good set. For Apple and Plum jam, the pH range of 3.2-3.5 is desirable; optimum being 3.35.

18.2.5 Preparation of Jam

The process for preparing Fruit Jam is depicted in Fig. 18.1.

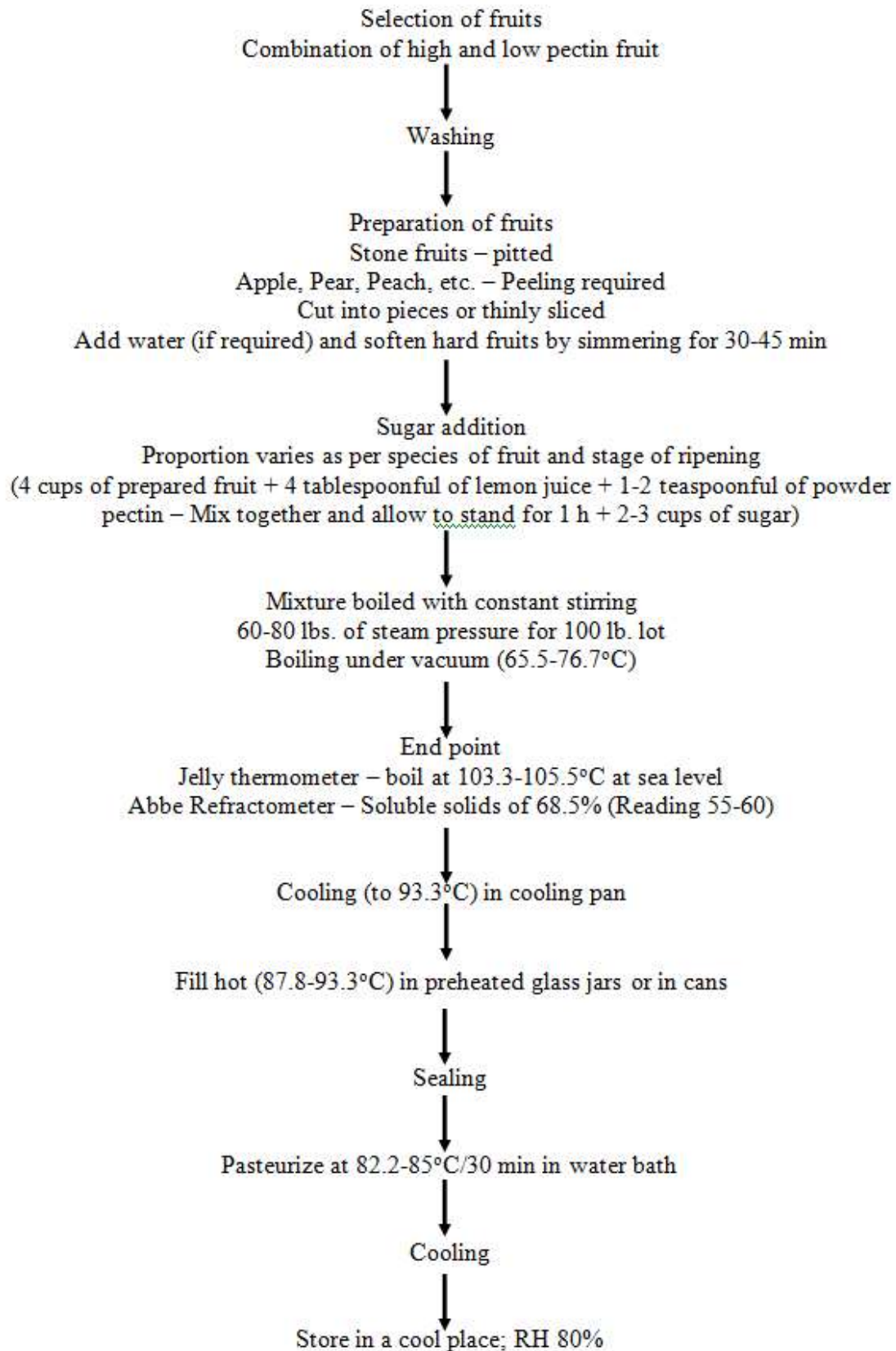


Figure 18.1 Flow chart for preparation of Jam

18.2.6 Judging the end-point or point at which boiling is stopped

18.2.6.1 Determining the boiling point with thermometer

Thermometers or thermocouples are used to indicate the temperature which should be approximately the boiling point of a 65% sugar solution (103.9-105°C), when the process is complete. A 65% solids boils at 104.8°C at sea level. It should be 8-9°C higher than the boiling point of water at that place.

18.2.6.2 Hydrometers

They help in determining the specific gravity of material.

18.2.6.3 Refractometer

We can determine the percentage solids i.e. TSS read directly on scale. Use Abe or Zeiss type refractometers and for dark colored jams/jelly, use projection type refractometer.

18.2.6.4 Sheeting or Ladle test

a) Cold plate test

A drop of boiling liquid from the pan is placed on a plate and allowed to cool. If the jelly is about to set, it will crinkle when pushed with a finger.

b) Sheet or Flake test

Some portion of a jelly is taken in a large spoon or wooden ladle and cooled slightly. When dropped, if it falls in the form of flake or sheet, the end point is reached. If the jelly drips like syrup, it is required to further concentrate.

18.2.6.5 Weighing

The boiling pan is weighed before and after putting the fruit extract and sugar in it. The weight of finished jelly should be 1.5 times the weight of sugar used. Industry uses specific gravity method, which gives a reliable indication of the point of readiness.

18.2.7 Storage of jam

The surface of jam is susceptible to mold growth; yeast cannot grow or thrive. There is risk of mold development and fermentation, with alteration in the taste. Permitted preservatives may be used at levels sufficient to inhibit the growth of yeast and molds.

Jam should be stored in a fairly cool place or else some moisture evaporates resulting in surface graining and shrinkage of jam. It should be stored in a place having RH of ~ 80%.

18.3 Fruit Jelly

As per FSSAI, Fruit Jelly means the product prepared by boiling fruit juice or fruit(s) of sound quality, with or without water, expressing and straining the juice, adding nutritive sweeteners, and concentrating to such a

consistency that gelatinization takes place on cooling. The product shall not be syrupy, sticky or gummy and shall be clear, sparkling and transparent.

The specific requirements are as shown below:

Total soluble solids (m/m) - Min. 65.0 %

The product shall be manufactured from minimum 45.0%, by weight, of original prepared fruit, exclusive of any added sugar or optional ingredients of finished product.

18.3.1 Manufacture of jelly

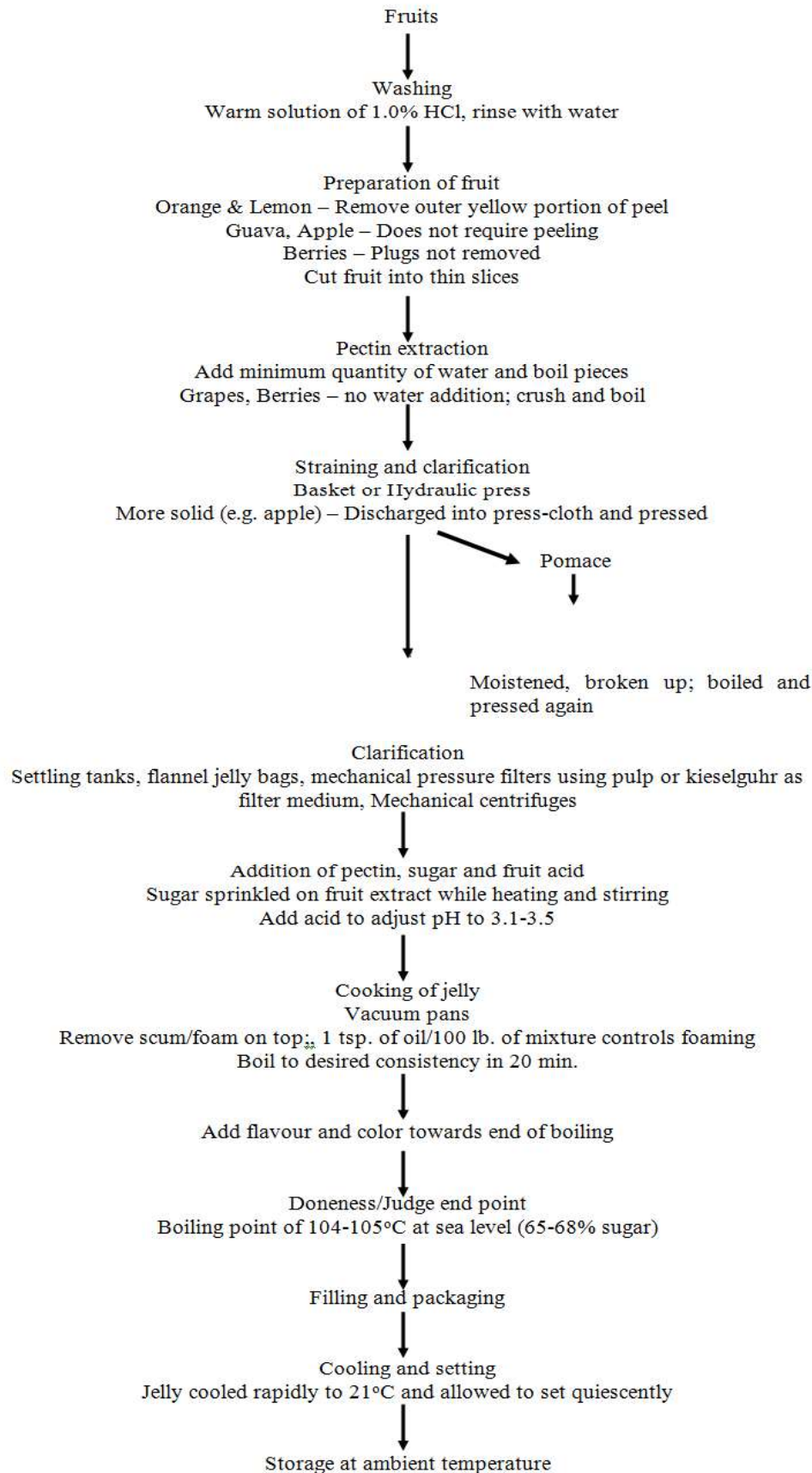


Fig. 18.2 Flow chart for preparation of jelly

18.3.2 Defects in jelly

18.3.2.1 Crystals in Jelly

Sugar crystallization may result from:

- (a) Too much sugar
- (b) Too little acid
- (c) Overcooking of jelly
- (d) Too long a delay in sealing the container of jelly.

Crystals may sometimes be found in jelly because during the boiling, syrup spatters on the side of the pan and dries up. In subsequent pouring of the finished product, these crystals (act as seed material) are carried into the glasses of jelly.

18.3.2.2 Cloudy jelly

Usually occurs with the red juices. It is caused by imperfect straining. Restraining of juice without pressure brings a lower yield, but ensures a clear product.

18.3.2.3 Failure to gel

a) Causative factors

Improper balance of pectin, acid, sugar and mineral salts, which may come about in several ways:

- Fruit used may lack sufficient pectin or acid or both.
- Overcooking may destroy so much pectin that a gummy mass is formed.
- Undercooking, due to insufficient concentration.
- Too much water used for extraction of juice, so that the proportion of sugar is too great for the pectin and the long time required for evaporation may destroy some of the pectin.

18.3.2.4 Tough Jelly

The jelly becomes tough or stringy when too little sugar is used for the quantity of fruit juice used or when boiling is continued after the jelling point has been reached.

18.4 Marmalade

As per FSSAI, Marmalade means a product prepared by boiling sound fruits with peel, pulp and juice, with or without water, added nutritive sweeteners and concentrating to such a consistency that gelatinization takes place on cooling of the product. It shall not be syrupy, sticky or gummy and shall be clear and transparent. The photograph of Marmalade is furnished in Figure 18.3.



Fig. 18.3 Photograph of packaged marmalade

The specific requirements are as follows:

- (i) Total soluble solids (m/m) - Min. 65.0 %
- (ii) Fruit content except peel (m/m) - Min. 45.0 %
- (iii) Peel in suspension - Min. 5.0 %

The container shall be well filled with the product and shall occupy not less than 90% of the net weight of the container, when packed in the rigid containers.

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Lesson 19

FRUIT PRESERVES

19.1 Introduction

Fruits are seasonal in nature. Further, it has got limited shelf life. Sugar has got the ability to increase the shelf life of fruit products through its osmotic pressure action on microorganisms. Preparation of fruit preserves is one novel method of preserving the seasonal fruit for use in non-season or to make available the 'fruit of choice' for the consumers to enjoy throughout the year.

19.2 Preserves

They are whole fruits or large pieces of fruit in thick sugar syrup, often slightly jellied. Preserves are made from practically all fruits including peaches, pears, plums, aonla, strawberries, grapes, muscadines, quinces and tomatoes.

The fruit for preserving should be in a firm-ripe rather than a soft-ripe stage. By using up to 25.0% of firm-ripe fruit, the tartness is increased and less pectin is required in the formula. The fruit should be uniform in size and uniform pieces so as to cook evenly.

The examples of Preserves include Fig preserve, Watermelon rind preserve, etc.

19.3 Preliminary Processing

The fruit should be washed thoroughly. If the fruit had been sprayed with insecticide to check blight, it should be washed with dilute HCl, especially if the peel is not removed from the fruit for preparation of the preserve.

The preliminary treatment varies with the variety of fruit taken. For instance, apples and pears are just peeled and pricked if they are to be kept whole, otherwise they are peeled, halved or quartered, cored and punctured. Mangoes are peeled, sliced and pricked. Peaches are destoned and lye peeled. Apricots, cherries are only pitted and destoned. Oranges, lemons, grape fruits and citrus fruits are halved and the pulpy portions removed from the cut fruit. Pumpkins are sliced, peeled, pricked and placed in dilute lime water for few hours to harden the texture. Strawberries and Raspberries are used as such, without any preliminary treatment.

The fruit is first cooked slightly in water to make it soft enough to absorb sugar. Cooking of the fruit in syrup is rather a difficult process, because the syrup is to be maintained at a proper degree of consistency so that it can permeate the entire body of the fruit, without causing it either to shrink or to toughen. The fruit should be boiled initially in water before transferring it to the syrup or cooked first in a dilute syrup with low sugar concentration. Highly juicy fruits may, however, be placed directly in a thick syrup at the very outset, because the excess of juice present in the fruit would serve to dilute the syrup.

19.4 Cooking in Syrup

There are three ways of cooking the fruit in a syrup. These are: (i) Open Kettle one period process, (ii) Open kettle slow process and (iii) vacuum cooking process.

19.4.1 Open kettle one period process

The concentration of the starting sugar syrup for cooking the fruit should be low. Boiling should be continued with gentle heating until the syrup becomes sufficiently thick. Rapid boiling will make the fruit tough, especially when heating is done in large shallow pans with a small quantity of syrup. Soft fruits such as strawberries and raspberries require little boiling for softening, unlike hard fruits like apple, pear, peach, etc. which require prolonged heating. The final concentration of sugar syrup should not be less than 68°Brix, which corresponds to a boiling point of 106°C at sea level.

19.4.2 Open kettle slow process

The fruit is first cooked in water to make it tender. Sugar equal to half the weight of fruit is added to the boiled fruit in alternate layers in a vessel and the mass is allowed to stand for 24 h. During this period, the fruit gives out excess water, and the sugar goes into solution resulting in a syrup of ~ 38°Brix. More sugar is added to raise the strength of the syrup to about 60°Brix. A small quantity of citric or tartatic acid (62-125 g per 100 kg of sugar initially taken) is added to invert a portion of the cane sugar. The whole mass is then boiled for 4-5 min and kept for 24 h. On the 3rd day, the strength of syrup is raised to ~ 68°Brix by adding sugar and the mass is boiled again for 4-5 min. The fruit is then left in the syrup for 3-4 days. Finally, the strength of the syrup is raised to 70°Brix and the preserve, in finished condition, is then packed in containers.

19.4.3 Vacuum cooking

Preserves made by cooking under vacuum retain the flavor and colour better than those made in open kettles. In vacuum cooking process, the fruit is initially softened by boiling and then placed in the syrup, which should be about 30-35°Brix. The fruit syrup blend is then transferred to a vacuum pan and concentrated under reduced pressure to ~ 70°Brix. Hard fruits like apples and pears require slow boiling to facilitate penetration of sugar, while soft fruits can be boiled briskly.

19.5 Cooling and Packing

If the preserve is to be stored in bulk, it should be cooled quickly after the first boiling to avoid any discolouration of the product. The fruit is drained from the syrup and filled into dry containers. Freshly prepared boiling syrup of 68°Brix is then poured into the containers such as in A 2.5 size cans, which are exhausted for 8-10 min at about 100°C in steam, and then hermetically closed.

If the preserve is packed scalding hot in dry cans, subsequent sterilization of the cans may be omitted. A 2.5 size (can hold 28.5 fluid ounce i.e. 843.6ml) can may be preferably sterilized for about 25 min at 100°C and cooled immediately thereafter.

19.6 Typical Examples

The examples of sugar preserves include Aonla preserve, Apple preserve, Bael preserve, Carrot preserve, Cherry preserve, etc. The process of manufacturing two such preserve is discussed herein.

19.6.1 Aonla preserve

Aonla preserve is a highly valued product in India as it is associated with valuable therapeutic properties.

Select large fruit (Benarasi variety preferred) for making the preserve. Wash the fruit in water. Prick them with a needle of bamboo/wood/stainless steel. Place the pricked fruits in 2.0% common salt solution. Raise the strength of the salt solution progressively by 2.0% on subsequent days, until the final concentration reaches about 8.0%. Wash the fruit in water and place them in freshly prepared 8.0% brine for about a week. This treatment removes most of the astringency in the fruit. Wash the fruit again. Blanch the fruit in 2.0% alum solution until they become sufficiently soft, taking care to see that the segments do not break or crack in the process. They are then passed through several stages of syrup treatment just as for apples. The final product should be packed in lacquered cans.

19.6.2 Apple preserve

Specifically two varieties namely the Sweet and the Sour ones are preferred for preparing Apple preserve and Apple candy.

Peel the apples thinly, but do not remove the stem and core. Prick the peeled fruit with a stainless steel needle or fork. Place the sweet variety of apple in 2-3% common salt solution and the sour variety in plain water to prevent browning and disintegration of the fruit during subsequent blanching. Transfer them next to dilute lime water (2 parts of lime water and 1 part of water) and leave them for 24 h. Prepare 2-3% alum solution and bring it to boil in a pan. Now transfer the apples to this boiling solution. Add a small quantity of sodium bisulphate to whiten the colour of the apple. Continue boiling until the fruit become soft. Take out the fruit and place them in cold water, discarding the blanching solution. Prepare fresh alum solution separately for each batch. The cooled apples are now ready for the syrup treatment.

Take sugar equal to half the weight of prepared apples. Usually 74-76 kg of sugar is required for every 100 kg of the whole apple, prior to peeling. Place the sugar and apples in alternate layers in a vessel and leave the mass undisturbed for 24 h. During this period, the fruit will give out sufficient water to dissolve the sugar. Ordinarily, the resulting syrup will be of 36-38°Brix. Next, boil the mass for a few minutes and raise the strength of the syrup to ~ 60°Brix by adding more sugar. Next, add a small quantity of citric or tartaric acid, or invert sugar or corn syrup to the extent of 25% by weight. After boiling for a few minutes, let the apples remain in the syrup for another 24 h. On the 3rd day, raise the strength of the syrup to 70°Brix and let the product stand for a week. Now, the preserve is ready for packing in jars or cans.

If the preserve is to be candied, the Brix of the syrup should be raised to 75°Brix and again allowed to stand for another week, before it is ready for candying.



Lesson 20 GLAZED AND CRYSTALLIZED FRUIT

20.1 Introduction

A fruit impregnated with cane sugar and glucose, and subsequently drained and dried, is called a *Candied fruit*. Candied fruit covered or coated with a thin transparent coating of sugar, which imparts to it a glossy appearance, is called *Glazed fruit*. When candied fruit is coated with crystals of sugar, either by rolling it in finely powdered sugar or by allowing the sugar crystals from a dense syrup to deposit on it, it becomes what is called *Crystallized fruit*.

20.2 Candied Fruit

The process is similar to the one employed in preparing fruit preserves, but here the fruit is impregnated with a higher percentage of sugar or glucose; the total sugar content is about 75.0%. A certain amount of invert sugar or glucose is substituted in place of cane sugar.

The fruits suitable for such preparation are those that possess pronounced flavor, such as pineapple, peach, peels of orange, lemon, grapefruit, citrus, cherry, etc. Use of slightly underripe fruit helps in preventing formation of jam-like consistency in the syruping process.

The sweeteners used maybe Confectioner's glucose (corn syrup, crystal syrup or commercial glucose), dextrose, invert sugar, etc.

20.2.1 Syruping treatment

The prepared fruit or peel is boiled in a sugar syrup of 30°Brix containing 3 parts of cane sugar and 1 part of corn syrup and then left in the syrup for about 24 h. The strength of syrup is raised to 40°Brix by adding a mixture of cane sugar and glucose syrup. The process is repeated and the strength of syrup is raised by 10°Brix to 65°Brix and then by 5°Brix on alternate days, until the final concentration of sugar reaches about 75°Brix, when the process is complete.

It is desirable to have cane sugar and invert sugar in the final syrup in nearly equal proportion. The acidity should be maintained at 0.1% by adding a small dose of acid daily along with added sugar, to ensure adequate inversion.

20.2.2 Draining and drying

After syrup treatment is over, the fruit is removed from the syrup and drained for about half an hour. The fruit or peel is wiped with a wet sponge. Sometimes it is dipped for a moment in boiling water to remove the adhering syrup. This is followed by slow drying in the shade, or in a drier at about 66°C for 8-10 h. Candied citrus peel needs drying for 10-12 h.

20.3 Examples of Candied Fruit Products

20.3.1 Candied citrus peels

Candied citrus peels are highly popular for festive occasions like Christmas, Diwali, etc. They are manufactured and sold in large quantities in several parts of the world. They are useful as flavouring materials in cakes, puddings, etc. Citrus peels, especially orange peels, are waste products in the manufacture of orange juice, squash, segments, etc. Thick rinds of citrus fruits like orange, lemon, grape fruit, citrus, and pummelo are used for candying.

After the peels are prepared, they are covered with a cold syrup of 30°Brix in a vessel and left for 48 h. On the 3rd day, the strength will be less than 30°Brix, which is raised by 10°Brix and the peels boiled in this syrup for about 5 min. The process is repeated until the strength reaches 60°Brix. At this stage, citric or tartaric acid is added at the rate of 1.25 g for every kg of peels. Alternatively, glucose or invert syrup may be added up to a maximum of 50.0% of the cane sugar used. The strength of the syrup is then raised to 75°Brix by 5°Brix every succeeding day. The peels are then left in this syrup for 2-3 weeks. Finally, they are taken out from the syrup and dried on wire mesh trays at room temperature until they are no longer sticky. They may also be dried at 49°C for 2-3 h in a drier.

20.3.2 Petha (Candied ash gourd)

Take fully, mature petha (Ash Gourd) and cut longitudinally into fairly large piece. Remove the fluffy portion from inside of the slices and peel each side separately. Soak the peeled slices for about 30 min in lime water, diluted with three times the quantity of water. Prick the pieces with a stainless steel needle or fork and cut the slice into pieces of suitable size. Keep the pieces in lime water again and let it stand overnight. Prepare 2-3% alum solution and bring it to boil. Boil the pieces in this solution till they become tender. Drain and cool them in running cold water. Sodium sulphite may be used while cooking the slices, to render the pieces white. Arrange the prepared slices in alternate layers with sugar (half their weight) in a vessel and allow standing for 24 h. During this period, the pieces will give out sufficient water for the sugar to dissolve. The syrup will be about 36-38°Brix. Add sugar to raise the strength of syrup to 59-60°Brix. Add citric/tartaric acid at the rate of 0.62 g/kg of sugar used. Alternatively, add 25% by weight of invert sugar or corn syrup to raise the syrup strength. Boil the slices in syrup for 10 min and set then aside for 24 h. Later on, increase the strength of the syrup by 5°Brix on every alternate day till it reaches 70°Brix. Allow the pieces to remain in this syrup for 4-6 weeks.

For candying, bring the whole mass of petha and syrup to a boil and while still hot, drain the syrup. Roll the drained pieces in finely powdered sugar and dry them on trays at room temperature.



Fig. 20.1 Dry petha from ash gourd

20.4 Glazing of Fruit

The syrup needed for glazing process is made by boiling a mixture of cane sugar and water in the proportion of 2:1, in a steam pan at 113-114°C and skimming the impurities as they surface. Heat is stopped and the syrup cooled to 93°C. Granulation of the sugar is achieved by rubbing the syrup with a wooden ladle on the side of the pan. Dried candied fruit are passed through the granulated portion of the syrup, one by one, by means of a form, and then placed on trays that are kept in a warm, dry room. To hasten the process, the fruit may be dried in a drier at 49°C for 2-3 h. When it becomes crisp, it is packed in air-tight containers.

20.5 Crystallized Fruit

In this case syrup of 70°Brix is employed. It is placed in a large deep vessel and allowed to cool to room temperature. To avoid premature granulation of sugar, a sheet of waxed paper is placed on the surface of the syrup. The candied fruit is placed on a wire mesh tray, which in turn is placed in a deep vessel. The cooled syrup is then gently poured over the fruit so as to cover it entirely. To prevent the fruit from floating, another wire-mesh tray is placed on it and a sheet of waxed paper is placed on the surface of the syrup. The whole mass is left undisturbed for 12-18 h, at the end of which a thin crust of crystallized sugar is formed. The tray containing the fruit is then removed carefully from the pan, and the surplus syrup drained off. The drained fruit are spread in a single layer on wire mesh trays and allowed to dry at room temperature or in driers at about 49°C.



Fig. 20.2 Glazed fruit

20.5.1 Improved mechanization of preparing glazed and crystallized fruit

Vacuum concentration process of Cruess is an improvement over the conventional one. The fruit and the syrup are maintained at 60°C and the concentration of sugar is raised at the rate of 1°Brix per hour; a part of the syrup is continuously withdrawn and concentrated in a Cascade or Calandria type of evaporator.

Using modified technique, the syrup strength could be raised from initial 30° to 70°Brix in 40 h. The ash gourd and apple preserves made by this method are highly satisfactory.

20.5.2 Spoilage of glazed and crystallized fruit

There is a likelihood of spoilage occurring due to fermentation, especially in the initial stages of preparation of preserves and candies when the concentration of sugar in the syrup is low. This can be controlled by boiling the product at proper intervals. If the candied and crystallized fruit are stored under humid conditions, they throw off some of their sugar owing to absorption of moisture from the air. Later on, they become mouldy, if they are packed in wet rather than dry containers. The danger of mould infestation may accrue if such fruit is not sufficiently dried.