
EXPERIMENT 2 PRODUCTION OF FRUIT JAM, JELLY, MARMALADE, FRUIT BUTTERS, CONFECTIONARY AND CHEESE, PRESERVE AND CANDIES

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2.1 INTRODUCTION

Jam, jellies and preserves etc., are very common products made out of fruits and vegetables that permit consumers to taste the fruits of their liking even during lean periods or when the fresh produce is expensive. These products also permit the diversification of the fruit use to avoid distress sale during the production season and to minimize the post harvest wastages. These practices of preparing the processed products are simple and could be attempted at household levels even in rural settings if adequate food safety related precautions are put in place. Besides, there are several fruits that are not cultivated in large quantities to permit large scale processing. Still these fruits are novel enough to convert them into the processed products and present them to consumers as niche products.

Objectives

After going through this experiment, you should be able to:

- describe methods of preparation and preservation of jam, jelly and preserve etc.; and
- know the difficulties, precautions to be taken and technical know-how of the final product quality.

2.2 EXPERIMENT

2.2.1 Principle

Jam, Jelly and Preserve are prepared from fruit pieces or pulp and preserved by high sugar concentration/chemical preservative or by heat application.

2.2.2 Requirements

Raw materials, equipment and apparatus

1. Fruit/vegetable, sugar
2. Peeler
3. Pulper
4. Filter cloth / sieve
5. Pans of suitable size
6. Heaters
7. Thermometer
8. Crown corking / capping machine
9. Corks / caps
10. Sterilizer/Pasteurizer
11. Volumetric flask
12. Measuring cylinder
13. Weighing balance
14. Potable water

Chemicals and reagents

1. Hydrochloric acid
2. Citric acid / ascorbic acid
3. Potassium metabisulphite
4. Sodium benzoate

2.2.3 Procedure

a) Jam

- Jam is a product made by boiling fruit pulp with sufficient sugar to a reasonably thick consistency, firm enough to hold the fruit tissues in position. Apple, pear, sapota, apricot, loquat, peach, papaya, karonda, carrot, plum, strawberry, raspberry, mango, tomato, grapes and muskmelon are used for preparation of jams.
- It can be prepared from one kind of fruit or from multiple kinds. Commercial jams such as tutti-frutti can be prepared from pieces of fruit, fruit scraping and pulp adhering to cores of fruits, which are available in plenty in canning factories.
- Jam contains 0.5 - 0.6% acid and invert sugar should not be more than 40%.

Method of preparation

For the preparation of 10 kg of jam follow the procedure given below:

- Calculate the amount of fruit pulp required as per commercial specification

$$\text{Required pulp} = (45/100) \times 10 = 4.5 \text{ kg.}$$

- Measure the TSS using a refractometer (say the TSS is 50%)

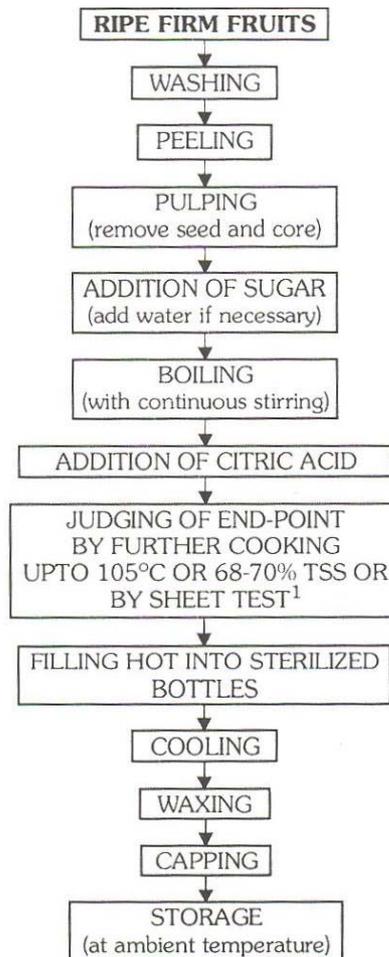
$$\text{Calculate the total solids content of the juice i.e. } 0.5 \times 4.5 = 2.25 \text{ kg.}$$

- The final required TSS content in the product is to be say 68%. The TSS required to be added to obtain the final product is $(0.68 \times 10 - 2.25) \text{ kg} = 4.55 \text{ kg.}$
- The amount of soluble solids in the form of citric acid and KMS is

Citric acid @ 0.5%, in the final produce is 50 g i.e. 0.05 kg.

- Amount of solids to be added in the form of sugar is $4.55 - 0.05 = 4.5$ kg.
- Add the calculated amount pulp and sugar to about 2 lts of water and boil it to 105°C so that the sugar dissolves completely. Add citric acid and juice to the sugar syrup and judge the end point by measuring its TSS or using sheet test.

Flow sheet



1. **Sheet or flake test:** A small portion of jam is taken out during boiling, in a spoon or wooden ladle and cooled slightly. It is then allowed to drop. If the product falls off in the form of a sheet or flakes instead of flowing in a continuous stream or syrup, it means that the end-point has been reached and the product is ready, otherwise, boiling is continued till the sheet test is positive.

b) Jelly

- A jelly is a semi-solid product prepared by boiling a clear, strained solution of pectin-containing fruit extract, free from pulp, after the addition of sugar and acid.

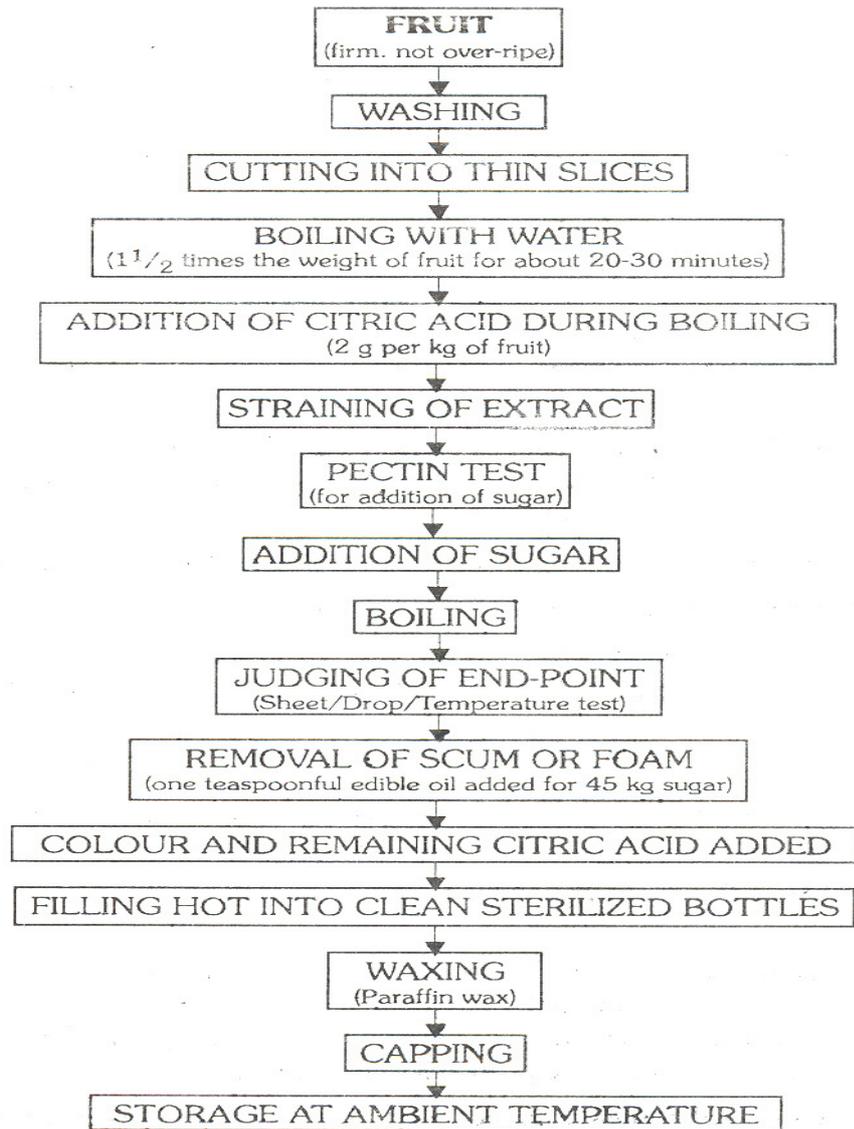
- A perfect jelly should be transparent, well-set, but not too stiff, and should have the original flavour of the fruit. It should be of attractive colour and keep its shape when removed from the mould. It should be firm enough to retain a sharp edge but tender enough to quiver when pressed.
- It should not be gummy, sticky or syrupy or have crystallized sugar. The product should be free from dullness, with little or no syneresis (weeping), and neither tough nor rubbery.
- Guava, sour apple, plum, karonda, wood apple, loquat, papaya, and gooseberry are generally used for preparation of jelly. Apricot, pineapple, strawberry, raspberry, etc., can be used but only after addition of pectin powder, because these fruits have low pectin content. Its acid content should be 0.5-0.75%.

Method of preparation

For the preparation of 10 kg of jelly follow the procedure given below:

- Take about 10 kg of fruit and boil in 15 lts of water for 20 – 30 min.
- Add to it about 20 g (@ 2g/kg) of citric acid and strain it.
- Determine the pectin content using alcohol or Jelmeter test.
- Add the required amount of sugar (1:1 for extracts rich in pectin; 1:0.75 for extract moderate in pectin; and 1:0.5 for extract poor in pectin.
- Boil the mixture judge the end point using sheet test as mentioned in the preparation of jam.
- Add the calculated amount pulp and sugar to about 2 lts of water and boil it to 105°C so that the sugar dissolves completely. Add citric acid and juice to the sugar syrup and judge the end point by measuring its TSS or using sheet test.

Flow sheet



c) **Preserve and its Method of Preparation**

- A mature fruit/vegetable or its pieces impregnated with heavy sugar syrup till it becomes tender and transparent is known as a preserve.
- Aonla, bael, apple, pear, mango, cherry, karonda, strawberry, pineapple, papaya, etc., can be used for making preserves.
- It can be prepared using 1 kg of fruit, 1 litre of water and 1 kg of sugar. A little quantity of acid (citric or tartaric) is added during the preparation to prevent crystallization of the syrup.

Method of preparation

The following steps are required in a good preserve:-

1. Pre-treatment
 2. Leaching
 3. Pricking
 4. Penetration of Sugar
 5. Finishing
1. Pre-treatment

After selecting good fruit, it is washed and given pretreatment for the following functions

- a) To reduce bitterness
- b) Softening and Maturity
- c) Hardening the tissues
- d) Storing for long period
- e) Reducing the shrinkage of fruit

2. Leaching

Leaching is carried out in the following functions:

- a) To remove salty taste from fruit
- b) To soften the fruit so that penetration is quick
- c) To remove bitterness in intercellular space

3. Pricking

- a) Pricking is carried out for facilitating of the penetration of sugar.
- b) This is usually done by piercing fork needles or stamp having painted nails or needle.

4. Penetration of Sugar

This is done to achieve the following:

- a) Uniform penetration
- b) Retention of natural colour and flavour
- c) Retention of nutrition
- d) Method should be quick

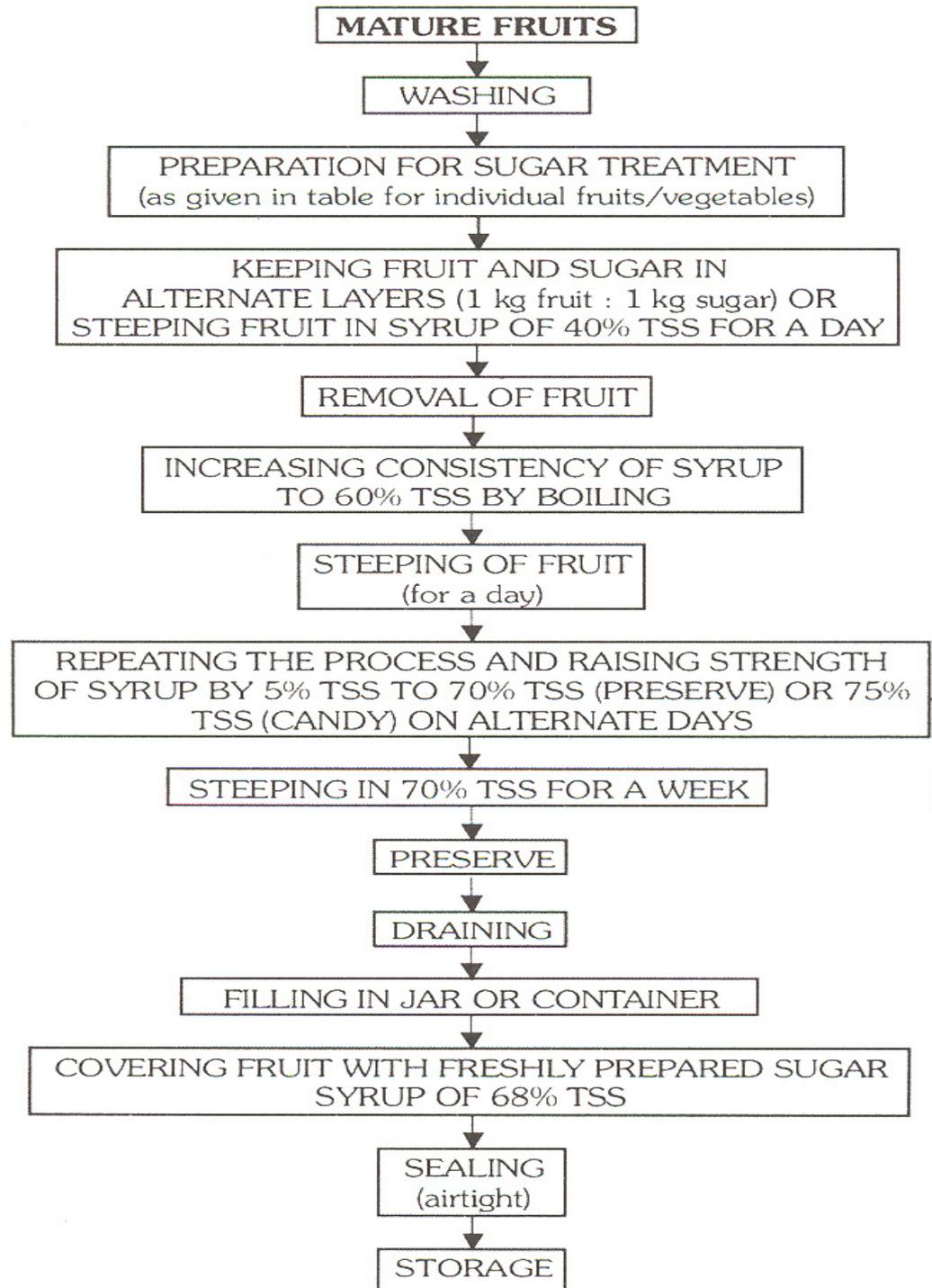
5. Finishing

Generally preserve is packed along with syrup covering 45% portion in the container.

For the preparation of 10 kg of jelly follow the procedure given below:

- Take about 10 kg of fruit and prepare it for sugar treatment as mentioned in the table in the following section.
- Make 10 lts of sugar solution of 40% TSS (Dissolve 4 kg of sugar in about 5 lts of water and make up the volume to 10 lts.).
- Dip the fruit in the sugar syrup for 24 hrs. Remove the fruit and boil the sugar solution to increase its consistency to 60%. Again steep the fruits in it for 24 hrs.
- Repeat the process on alternate days raising the TSS % of the sugar solution by 5% up to 70%. Steep the fruits in 70% TSS sugar solution for a week and the preserve is ready.
- The preserve should be stored in air tight jars with adequate sugar solution of 68% TSS to cover the fruits.

Flow sheet



Preparation of fruits and vegetables for preparing preserve

Fruit/ vegetable	Steps of Process			
	Step I	Step II	Step III	Step IV
1	2	3	4	5
Aonla	Prick with fork, needle or gooseberry pricker (avoid iron needle as it causes browning due to tannin in fruit)	Steep in 2% salt solution for 24 hours to remove astringency	Wash and dip in 2% alum solution for 24 hours then wash thoroughly	Blanch until soft but segments do not break or crack
Apple and pear	Peel, prick with needle or fork (do not remove core and stem of whole fruit to be used otherwise peel and cut into halves or quarters, remove core and prick)	Steep in 2% salt solution for 24 hours to prevent browning and disintegration of fruit tissues during blanching	Wash and dip in 2% alum solution for 24 hours and wash again	Blanch in water containing small quantity of potassium metabisulphite to bleach or in water containing edible deep green or red colour
Bael	Remove shell, slice peeled fruit crosswise into 2.5 cm thick pieces and wash with water, prick on both sides	Steep in cold water for 24 hours	-	Blanch in water containing edible red colour until soft and sufficient colour absorbed
Ber	Prick whole fruit	Steep in 2% salt solution containing 0.2% potassium metabisulphite for a week and wash thoroughly	-	Blanch until soft
Mango	Peel and remove green portion (because it turns black during subsequent operations), cut fruit lengthwise into large pieces	-	-	Blanch until soft and then prick pieces
Karonda and Cherry	Cut into two pieces and remove seeds	Steep in 2% salt solution containing 600 ppm sulphur dioxide (in form of potassium metabisulphite) for 24 hours to bleach, thereafter wash and prick with fork	-	Blanch in water containing 0.05% erythrosine and 0.25% citric acid to soften sufficiently and fix the artificial colour

Pineapple	Peel, cut into 1cm slices, remove core and eyes, prick slices on both sides	Steep in 2% salt solution for 24 hours	Wash and steep in cold water for 12 hours	Blanch until soft
Papaya	Peel, cut into rectangular pieces 4 cm long and 0.5-1.0 cm thick, remove seeds and prick	Steep in 2% salt solution for 24 hours	Wash thoroughly	Blanch until soft
Strawberry and Raspberry	Remove stems	-	-	Blanch for a minute
Petha (Ash gourd)	Cut lengthwise into large pieces, remove fluffy portion, peel, prick and cut into pieces of suitable size	Soak in dilute lime water for 24 hours to harden texture	Wash and soak in 2% alum solution for 24 hours and a wash again	Blanch (until tender) in water containing little potassium metabisulphite to bleach
Ginger	Scrape off skin from tender, fibreless, large sized rhizomes, and cut into pieces	-	-	Boil for an hour with 0.5% citric acid solution (to improve colour) in pressure cooker, then prick and wash
Carrot	From tender carrot having soft pith, scrape off thin peel and green leafy portion, prick and cut into suitable sized pieces	-	-	Blanch until soft
Citrus peel	Remove the rags from thick rind orange, citron, pummelo, etc.	Dip in 2% hot sodium bicarbonate solution for 30 minutes, then wash and prick	-	Blanch until tender and to remove bitterness

CANDIES – Glaced and Crystallized

Principles

Candy is fruit penetrated with sugar and dried to give a sugar coated solid fruit pieces. The glazed candy are coated with a thin transparent layer of heavy sugar syrup, while crystallized candy are derived from coating pure white crystallized sugar. In preparing candies all steps are same as that up preserve except that of finishing.

Fruit butters

This product is prepared by boiling the fruit pulp with or without the addition of sugar, fruit juices and spices to a semi-solid mass of homogeneous consistency. It differs from jam in being of higher concentration and finer consistency. It is usually heavily spiced. The appearance and texture look like butter. They are packed in can and sterilized in boiling water.

Fruit confections

This is a general term used to describe candies in which fruits are used. They are on the market a large number of products of the character which vary greatly in appearance, texture, flavour and the proportion of fruit used in their manufacture.

Guava jelly and cheese

Guava are available plenty and cheap during the season all over India. It is rich source of Vitamin C. You can prepare jelly and thereafter cheese from residue of fruit. Jelly is prepared from the extract of the fruit.

Recipe in cheese

Pulp 1 kg	Cook sugar and pulp till it becomes very thick add salt,
Sugar 1.25 kg	butter and continue cooking till it does not stick to bottom
Salt 3g	of the vessel. Smear a tea spoon of ghee on tray and spread
Butter 20g	cooked guava pulp. When it is cold roll out glass jar to
	make surface smooth. Next day cut into small pieces and
	wrap them into Butter paper.

2.2.4 Observations

Determine TSS, acidity, pectin (alcohol method/jelmeter test) and consistency of gel (sheet/flake test).

Note: The procedure for the calculation of TSS, acidity, pectin (alcohol method/jelmeter test) and consistency of gel (sheet/flake test) can be seen in the practical manual of Course III 'Food Chemistry and Physiology' and theory of course IV 'Food Processing and Engineering – I'.

2.2.5 Result

Acidity of the given jam, jelly, preserve	=	% (w/v)
TSS of the given jam, jelly, preserve	=	%

2.3 PRECAUTIONS

- All equipment used in the preparation of fruit juices and squashes should be rust and acid proof.
- Copper and iron vessels should be strictly avoided as these metals react with fruit acids, and cause blackening of the product.