

कृषि मन्त्र विद्यालय

31

# Practical Manual on Post Harvest Technology

Prepared by :

Dr. H.G. Sharma

Dr. S.N. Dikshit

Dr. Neeraj Shukla



**Department of Horticulture**

College of Agriculture

**INDIRA GANDHI KRISHI VISHWAVIDYALAYA**

Raipur (Chhattisgarh) 492 012

**Practical Manual**  
**on**  
**Post Harvest Technology**

**Prepared by:**

**Dr. H.G. Sharma**  
**Dr. S. N. Dikshit**  
**Dr. Neeraj Shukla**



**Department of Horticulture**  
**College of Agriculture**  
**INDIRA GANDHI KRISHI VISHWAVIDYALAYA**  
**Raipur (Chhattisgarh) 492 012**



**Citation:** Sharma, H.G., S. N. Dikshit and Neeraj Shukla. 2013. Practical Manual on Post Harvest Technology. Pages- 38.

**Inspired by**

Dr. S.K. Patil  
Hon'ble Vice Chancellor  
IGKV, Raipur (C.G.)

**Guidance by**

Dr. O.P. Kashyap  
Dean, Faculty of Agriculture  
College of Agriculture, Raipur (C.G.)

**Prepared by**

Dr. H.G. Sharma  
Dr. S. N. Dikshit  
Dr. Neeraj Shukla

**Course No. :** A Hort-311

**Course title:** Post Harvest Technology

**Published by :**  
College of Agriculture, IGKV, Raipur (C.G.)

**Publication year:** 2013

**No. of copies printed:** 2500

**Course No. :** .....

**Credit** .....

**Course Name :** .....

**Name of Students** .....

**Roll No.** .....

**Batch** .....

**Session** .....

**Semester** .....

**College of Agriculture** .....

## **CERTIFICATE**

This is to certify that Shri./Ku. ....  
Enrolment No./ID No..... has completed the practical of  
Course No. .... as per that syllabus of B.Sc. (Ag.) .....  
year..... semester in the respective lab/field of College.

Date:

**Course Teacher**



## CONTENTS

S. No.	Name of Practicals	Page No.
1.	Identification of processing equipments.	01-02
2.	Physico-chemical composition/ analysis of fruits and vegetables.	03-07
3.	Practice of judging the maturity and packaging of various fruits and vegetables.	08-13
4.	Bottling of Peas.	14-15
5.	Preparation of jam.	16-19
6.	Preparation of jelly and marmalade.	20-22
7.	Preparation of Tomato ketchup and sauce.	23-26
8.	Preparation of fruit squash, cordial and syrups.	27-30
9.	Preparation of preserve and candy.	31-33
10.	Preparation of chutney and pickles.	34-35
11.	Methods of drying and dehydration in vegetables.	36-37
12.	Visit to local processing unit.	38

## Practical No. 1

**Title:** Identification of processing equipments.

**Objectives:** 1. The students will be able to identify the processing equipments used for various purposes.

2. The students will be able to acquire the knowledge of operation of various equipments.

**Equipments and their Uses:-**

S.No.	Name of equipment	Uses
1.	Hand Refractometer	Used to measure the TSS (Total soluble solid) % of the fruit juice, ketchup, squash, jam, jelly and other products. This is available in three ranges i.e., 0-32%, 28-62% and 58-90% to measure the TSS of various products.
2.	Penetrometer / Tendrometer	Used to measure the softness / hardness of fruits and vegetables by penetration of needles.
3.	Crown-corking Machine (Hand, foot and power)- operated	This machine is available in three operation systems i.e., hand, foot and power-operating systems. This is used to seal the glass bottle with crown cork in air tight conditions.
4.	Corking machine	This machine is used to seal the glass bottles with cork in air tight conditions.
5.	Salinity tester	Used to measure the salt concentration in covering liquid of canning of vegetables, pickles etc.
6.	Screw type Fruit juicer (Hand & power)- operated	Used for extracting the juice. In this machine, a rotary screw is used to press fruit pieces in order to extract the juice. This can be operated by hand and power.
7.	Cone type fruit juicer	This juicer is available in two types i.e., hand and power operated systems and used for extracting the juice of citrus fruits.
8.	Basket and Hydraulic press	Used to extract the juice of various fruits by pressing the fruits.
9.	Autoclave	This is used to sterilize the bottles as well as processed products.
10.	Fruit and vegetable slicer	This is also available in two types i.e., hand and power- operating systems. Generally used to slice the fruits and vegetables before canning and bottling.
11.	Can sealer (Hand & power)- operated	Used for sealing of cans during canning of fruits/vegetables.
12.	Bottle washing machine	Used to wash the different type of bottles before sterilization.
13.	Crusher filter	Generally used to crush and filter the pulp in required thickness. It also remove seeds and peel from the pulp.
14.	Tray drier	This machine is used for dehydration of fruits and vegetables.
15.	Grinder	Both form of machine (hand and power - operated) is available and used to grind the spices and other material.
16.	Jelmeter	Used for determination of pectin content present in the water extract

		for jelly preparation. The amount of sugar is decided according to pectin content.
17.	Jelly Thermometer	To measure the boiling syrup temperature during preparation of jelly to determine the end point.
18.	Cooker	This is available as non-agitating cooker and agitating cooker and used to process the vegetables.
19.	Sulphuring box	To treat the fruits with sulphur before drying.
20.	Mixer-grinder	This Machine is used for the homogenization of pulp and to grind the spices.

**Questions:**

1. What is use of salinity tester?
2. Enlist the equipments used for juice extraction of fruits.
3. What is use of refractometer?
4. Write the use of Jelmeter.
5. Write the use of autoclave.
6. What is use of crusher filter?
7. What is use of jelly thermometer?



## Practical No. 2

**Title:** Physico-chemical composition/analysis of fruits and Vegetables.

**Objectives:** 1. The students will be able to learn the method of analyses of physical composition of fruits and vegetables.

2. The students will aware with various methods and reagents for the analysis of chemical composition of fruits and vegetables.

### (A) Physical composition

#### Fruit weight (g)

Randomly selected fruits and vegetables should be weighed on electronic balance and mean weight of fruit/vegetables is recorded for observation in gram.

#### Peel weight (g)

Peel weight of selected fruits/vegetables should be taken on electronic balance and mean value is recorded for observation in gram.

#### Peel per cent

Peel per cent is calculated by dividing the weight of peel by total weight of fruit or vegetables multiplied by 100.

#### Pulp weight (g)

After peeling and cutting of fruits and vegetables, the produce should be allowed for the extraction of pulp in a container and it should be weighed on electronic balance and mean value is recorded for observation in gram.

#### Number of seeds

The seeds of selected fruits/vegetables extracted manually are by the help of equipments and counted. The average number of seeds per fruit is recorded for observation.

#### Seed weight (g)

Seeds of randomly selected fruits/vegetables are weighed separately on electronic balance and average seed weight is recorded for observation in gram.

#### Seed per-cent

Seed per cent of fruits/vegetables is calculated by dividing the weight of seed by total weight of fruit multiplied by 100.

#### Weight of non-edible waste (g)

The weight of non-edible wastes is calculated by deducting the weight of pulp from weight of fruit or vegetables.

Weight of non-edible waste (g) = Weight of fruit or vegetable – Weight of pulp (g)

### Pulp recovery per cent (g)

The pulp recovery of fruit/ vegetables is obtained from the following formula

$$\text{Pulp recovery} = \frac{\text{Pulp weight}}{\text{Total weight of fruit}} \times 100$$

### Pulp/Seed ratio

The pulp/seed ratio is calculated by dividing the weight of pulp by weight of seed.

**Table 1: Physico-chemical properties of fruit and vegetables during storage**

S. No.	Crop (in Days)	Weight of fruit (g)				TSS (%)				Freshness*			Colour*			Organoleptic test*			
		0	2	4	6	0	2	4	6	2	4	6	2	4	6	0	2	4	6
1.																			
2.																			
3.																			

\*Calculate by 9 point Hedonic rating test

### (B) Chemical analysis

Chemical analysis of juice/ pulp, extracted from different fruits or vegetables are analyzed after extraction/preparation.

#### 1. Acidity (%)

**Method:** The acidity of the pulp/ juice and products of fruits and vegetables are determined by the procedure given by Ranganna (1997). Total acid content is estimated by titrating 10 g of sample against 0.1 N NaOH using phenolphthalein as an indicator. The end point appears as light pink colour. Acidity is calculated by the titre value with the help of following formula:

$$\text{Acidity (\%)} = \frac{\text{Titre} \times \text{Normality of alkali} \times \text{Volume made up} \times \text{Equivalent weight of acid} \times 100}{\text{Volume of sample taken for estimation} \times \text{Weight or volume of sample taken} \times 1000}$$

#### 2. Total soluble solids (%)

Total soluble solids (TSS) of pulp/ juice and products of fruits and vegetables are determined with the help of Hand Refractometer, which is based on the principle of total refraction.

#### 3. Sugars

Sugars are determined by the method of Lane and Eynon as described by Ranganna (1997).

**Apparatus:** Volumetric flask 100 ml, Conical flask 250 ml, Burette 50 ml, Pipette and Water bath/heater.

**Reagents**



1. Fehling's solution A: Copper sulphate 69.28 g and volume made upto one litre.
2. Fehling's solution B: Potassium sodium tartrate 346 g and sodium hydroxide (NaOH) 100 g and volume made upto one litre.
3. Methylene blue indicator: methylene blue 1% aqueous.
4. Neutral lead acetate (45 %) solution.
5. Potassium oxalate (22 %) solution.
6. Standard invert sugar solution: AR sucrose 9.5 g and concentrate HCl 5 ml and volume up to 100 ml.

This solution is allowed to stand for further three days at 20-25<sup>0</sup>C for inversion to take place and can be used for several months during analysis.

**Method:** Twenty five ml of invert sugar solution is taken in a flask and add 50 ml distilled water, then neutralize with 20% NaOH in the presence of phenolphthalein indicator until the solution turn into pink colour. Then, acidify with 1N HCl till pink colour disappears. The volume is made upto the mark with distilled water.

#### (a) Reducing sugar

##### **Method:**

The reducing sugar is estimated by taking twenty five ml of filtered juice into 250 ml volumetric flask and 100 ml of distilled water is added and this is neutralized with 1 N NaOH. Then, 2 ml of lead acetate solution is added in it. It is shaken well and is stand for 10 minutes. Thereafter, 2 ml of potassium oxalate solution is added. The volume is made up with water and filtered. This process is necessary to get clarified solution.

Five ml of the Fehling's solution A and B is taken in a 250 ml conical flask and burette is filled with the clarified sugar solution. Conical flask is heated in an open flame. Two to four ml sugar solution is poured and 1-2 drop methylene blue indicator is added. Now, this solution is kept for heating and sugar solution is added to it. The end point appears with brick-red colour. The reducing sugar is expressed in per cent and calculated by the following formula:

$$\text{Reducing sugar (\%)} = \frac{\text{Invert sugar (mg)} \times \text{Dilution} \times 100}{\text{Titre} \times \text{Wt or volume of the sample} \times 1000}$$

#### (b) Total sugar

Fifty ml aliquot of clarified and delead solution is transferred to a 250 ml flask. Five ml of HCl is added and it is allowed to stand at room temperature (20° C or above) for 24 hours. This is neutralized with 25 % of NaOH solution and make up the volume to 250 ml. Titrate it and total sugar is calculated by the following formula:



$$\text{Total sugar (\%)} = \frac{\text{Invert sugar (mg)} \times \text{Dilution} \times 100}{\text{Titre} \times \text{Wt. or volume of the sample} \times 100}$$

**(c) Non - reducing sugar**

Non - reducing sugar is determined by subtracting the value of reducing sugar from total sugar.

$$\% \text{ Non reducing sugar} = \% \text{ Total invert sugar} - \% \text{ Reducing sugar originally present}$$

**(C) Organoleptic evaluation**

The juice/pulp of fruits or vegetables and their beverages prepared from the different recipes are subjected to sensory evaluation by the panel of five judges in hedonic rating test as described by Ranganna (1997). The products are evaluated for colour, aroma, appearance, taste and overall acceptability.

The overall acceptability is based on the mean scores obtained from all the characters studied under the organoleptic test. The products which score seven or more for overall acceptability are considered as acceptable. The mean scores obtained for different products is calculated. The acceptability of the products is based on the points gains in hedonic rating scale. The final rating is based upon scores of overall acceptability.

**HEDONIC RATING TEST FOR JUDGES**

Name: .....

Date: .....

Product: .....

Taste the sample and check how much you like or dislike. Use the appropriate scale to show your attitude by checking at the point that best describes your feeling about the sample. Please give a reason for this attitude. Remember you are the only who can tell what you like. An honest expression of your personal feeling will help in the evaluation.

Grading	Points	Colour	Appearance	Aroma	Taste	Overall acceptability
Like extremely	9					
Like very much	8					
Like moderately	7					
Like slightly	6					
Neither like nor dislike	5					
Dislike slightly	4					
Dislike moderately	3					
Dislike very much	2					
Dislike extremely	1					

**Precautions:**

- Do not taste any chemical.
- Mix the reagent carefully.
- Make a record.
- Store reagents carefully & properly.

**Questions:**

1. What do you mean by T.S.S.?
2. Name any five physical properties of fruits & vegetables.
3. Why pulp and peel analysis is important?
4. What do you mean by reducing and total sugar?
5. What is organoleptic evaluation?
6. What do you mean by Hedonic Rating Test?

### Practical No. 3

**Title:** Practice of judging the maturity and packaging of various fruits and vegetables.

**Objectives:** 1. The students will be able to know the maturity indices commonly used in India and abroad.

2. The students will aware with the various methods and techniques used for packaging of fruits and vegetables.

**Maturity:**

The stages of fruit growth comprised three major phases- growth, development and maturation. The irreversible increase in size and shape of the fruit and vegetable is called growth. Development refers the series of process involved right from initiation of growth till death of fruits and vegetables. Physiological maturity is the stage of development where fruit and vegetables should be harvested to meet the consumer need. There are number of physiological indices followed to judge the harvest maturity in different Horticultural crops.

S. No.	Harvest indices	Crops
1.	Elapsed days from full bloom to harvest	Apple, Pear
2.	Mean heat unit during dev. (degree days)	Apple, Grapes
3.	Development of Abscission layer	Apple, Mango, Melons
4.	Surface morphology and structure	- Cuticle formation of Grape berries - Development of wax on some fruits.
5.	Size	All fruit & vegetables
6.	Specific gravity	All fruits
7.	Shape	Full cheeks of Mango Angularity in Banana
8.	Firmness	Apple, Pear, Stone fruits
9.	External colour	All fruits and most of the vegetables
10.	Starch content	Apple, Pears
11.	Sugar content	Apple, Pear, Stone fruits, Grapes, Melons
12.	Sugar/Acid ratio	Pomegranate, Citrus fruits, Papaya, Kiwi fruit and Melons
13.	Juice content	Citrus fruits
14.	Oil content	Avocados
15.	Tannin content	Persimmon, Dates



### 1. Computation:

Computation refers the time taken between flowering and fruit being ready for harvesting. This time is always quite constant. In tropical fruits and vegetables, this may vary to little extent. The computation time of some fruits in India and other countries is given below.

S. No.	Name of crops	Days taken from flowering to harvest
1.	Pine apple – India	150-160 days after flowering
2.	Sapota – India	300 days after flowering
3.	Papaya – India	145-165 days after flowering
4.	Jackfruit – India	100-120 days after flowering
5.	Pear – India	135-145 days after flowering
6.	Banana – India	15 week after fruit set
7.	Rambutan – Thailand	90-120 days after full bloom
	- Thailand	90-100 days after full bloom
	- Malaysia	100-130 days after full bloom
8.	Kiwi fruit – New Zealand	23 weeks after flowering

### 2. Size:

The changes in size of a horticultural crop during development is used to determine the harvest maturity. In banana, the width of individual fingers can be used for determining their harvest maturity. In litchi, fruit size of 70 mm is the standard size for the harvest the crop in South Africa.

### 3. Specific gravity:

The specific gravity of the fruits increases with the advancement of maturity. This can be used to determine the harvest indices of many fruits. In Indian condition, the mango with a specific gravity of 1.0 to 1.02 is considered to be a optimum stage of maturity for the best storage and harvesting.

### 4. Shape:

The shape of horticultural crop can be used as a characteristic to determine the harvest maturity. For example, banana fruit should become more rounded in cross-section and less angular as they develop on the plant.

### 5. Firmness:

The horticultural crops rapidly become softer during maturation especially during ripening. This textural change may be detected by touch. In other cases, it is tested by device called "Pressure tester" which gives a numerical value that is used to determine the harvesting of a particular fruit.

## **6. Skin Colour:**

Skin colour is commonly used for determination of harvest maturity in almost all the horticultural crops. The skin colour changes when the fruit, vegetable ripen or mature. Change in colour depends on the particular area, where the crops are grown, the varieties and climatic conditions at the time of fruit development and maturation. For example, papaya turns yellow or orange - red from green colour during ripening.

## **7. Aroma:**

Many of the horticultural crops synthesize volatile chemicals during ripening. This characteristic 'odour producing' of crop can be used to determine the maturity of the Horticultural crop. For example, guava and banana have strong aroma which develop during ripening.

## **8. Sugars:**

This method is used to determine the harvest maturity in a large number of fruits and vegetables. To judge the maturity, the soluble solids are measured in the juice. This is performed with a suitable refractometer, which provides an easy method for maturity assessment. For example, in grapes the total soluble solids should be at least 16 per cent at maturity.

## **9. Acidity:**

The acidity of many fruits and vegetables changes during maturation and ripening. In many fruits and vegetables, acidity progressively reduces as the fruit mature on the tree.

## **10. Juice content:**

The juice content of many fruits increases as they mature on the tree. This characteristic of the horticultural crops can be used to determine the maturity indices. In different citrus fruits, minimum value for juice content can be 30% for navel oranges, 35% for other oranges and grapefruit, 25% for lemons and 33% for mandarins.

## **11. Oil Content:**

Oil content of the fruits may be used as maturity indices for the many fruits. In avocado, oil content of the fruit is directly proportional to moisture content. In South Africa, the fruit harvested for export purposes should have the minimum moisture content from 70-80%.

## **Packaging of Fruits and Vegetables:**

Due to perishable nature, the losses to the extent of 20-50% has been reported for various horticultural produce till reaching to the consumers from the point of the production. The type of packaging both during transportation and storage is most important to reduce the post harvest losses of various horticultural produce. An ideal packaging should be able to withstand various type of adverse conditions so as to protect the packaged produce, hence resulting in minimum



losses. The packaging should protect the material from high/low temperature, shock and compression during transit and moisture losses due to drought as well as microbial spoilage.

#### **Size and shape of packages:**

Packages should be of a size which can be easily handled and which is appropriate to the particular marketing system. The size should be no larger and is compatible with these requirements, especially with wooden boxes. The ratio of weight of the container to the produce is also very important. Where transport charges are calculated on a weight basis, heavy packaging can contribute significantly to the final cost of the sellable product.

The shape of packages is also significant because of the loading factor. The load is positioned on the transport vehicle for maximum capacity and stability. Round baskets, whether cylindrical or tapered, hold considerably less produce than the boxes occupying the same space. A cylindrical basket occupies only 78.5 per cent by volume compared with a rectangular box holding the same space.

#### **Need for ventilation in packages:**

Suitable packaging for any product will consider the need to keep the contents well ventilated to prevent the buildup of heat and carbon dioxide. The ventilation of produce in containers is a requirement at all stages of marketing, but particularly during transport and storage. Ventilation is necessary for each package, but there must also be an adequate air flow through stacked packages. A tight stack pattern is acceptable only if packages are designed to allow air to circulate through each package and throughout the stack. Sacks and net bags must be stacked so that air can circulate through the contents. The effectiveness of ventilation during transport also depends upon the air passing through the load.

#### **Types of package materials:**

A variety of packaging materials are available to pack the horticultural produce. All the packages must have some amount of ventilation in order to prevent physiological breakdown.

##### **(i) Jute Material:**

The sac/bags have poor dimensional stability as well as staking strength. Yet they are the prime packaging material for fruit and vegetables in India. Now, jute materials are replaced by the other packaging materials.

##### **(ii) Wooden/Bamboo Materials:**

The wooden and bamboo baskets and boxes are used for the packaging of Horticultural produce and bins for storage. With the help of cushioning material, these packaging material protect the produce during transportation with good stacking strength. The disadvantage of these material are heaviness which add to freight cost. Secondly, extensive use of wooden/bamboo boxes deplete the forest wealth.

##### **(iii) Plastic materials:**



Plastics in form of crates, trays, pouches, thermoformed tubes, bags in box and tetra packs are finding tremendous acceptance for the packaging of fruits, vegetable and processed products.

**(iv) Corrugated Fibre Board (CFB) Boxes:**

CFB packaging is available in boxes and trays for cell packaging. CFB boxes required two to three times less wood to manufacture the boxes as compared to wooden boxes. In advance countries, CFB boxes already replaced the wooden boxes packaging to their own advantages such as light in weight, cause less damage to produce, easy to handle, reduce freight cost and prepared from the cheaper wood.

**Procedure:**

**Selection of fruits/vegetables:**

Produce selected for packaging should be graded well and ensure that fairly good quality fruits should be allowed for further operations.

**Washing:**

Washing of produce should be done through running water using a galvanized tank. If any produce floats in water that should be removed by hand or by using equipments.

**Drying:**

The washed produce (fruits/vegetables) first treated with fungicides and then dried before the packaging for the purpose, packaging house can be used. This can be done on a drying rakes or table made up of wooden slats.

**Packaging:**

Fruits and vegetables are packed as per need of the market. For the local market, produce can be packed in bamboo basket or trays as per the product. Plastic crates can also be used for this purpose. If produce is to be marketed to distance market, wooden baskets can be used. Presently, CFB boxes are used to pack the horticulture produce for the distance market using appropriate cushioning material.

**Precautions:**

The following points should be kept in mind while packaging the horticultural produce for marketing during transit.

1. Always use an expensive liner material to protect the produce from damage during handling.
2. Never use un-perforated plastic bags for the packaging of horticultural produce.
3. It is very important to keep produce cool to enhance the shelf life of the produce.

**Questions:**

1. What is computation?
2. How specific gravity is important to judge maturity?
3. What is firmness?
4. What do you mean by aroma of fruits?
5. What is the role of juice content to judge maturity?
6. What do you mean by CFB boxes?

## Practical No. 4

**Title :** Bottling of Peas.

**Objectives:** 1. The students will be able to learn the procedure of bottling of pea in the laboratory.

2. To preserve the seasonal vegetables in the bottles.

**Material required:** Peas, Vinegar, Salt, Muslin cloth, Sugar, Utensils (Ganj), Can/bottle.

**Procedure:**

<b>Selection of crop</b>	Freshly harvested and fully mature pod of peas should be selected for canning/bottling of the pea. Diseased and undersized peas should be discarded. Mechanically injured peas should also be rejected for the processing.
<b>Washing</b>	The pods of pea should be washed thoroughly to remove the pesticide residues and dust as well as micro organism from the pods by washing in running water.
<b>Peeling</b>	The pods are subjected to peel with the objective to remove the outer layer and get the tender grains of pea. Pea is generally peeled by hand.
<b>Grading</b>	After getting the tender grains of from the pods, these grains are graded to obtain bigger and uniform size. This is done by suitable grader or by water. When grains are dipped in water, undersized or light-weighted grains float on the water while heavy or bigger grains set in the lower side under the water.
<b>Blanching</b>	The graded grains are allowed to boil in water (at 180 <sup>0</sup> F to 200 <sup>0</sup> F) for two minutes and immediately cooled by immersing in cold water. This blanching treatment inactivates most of the plant enzymes and microbes, which causes many adverse quality and responsible for decay of the vegetable.
<b>Filling</b>	Lacquered cans are generally used for the canning of peas. Before filling, the cans are thoroughly washed with hot water and properly sterilized. These sterilized cans are used to filling the peas. In India, generally hand filling is the common practice to fill the cans with the product. After filling, these cans are covered with sugar syrup and brine solution. A solution of sugar in water is called syrup. Strained and hot syrup of 2.5% concentration is poured with the brine solution (2%). The sugar and brine solution should be filtered through a thick cloth before filling, hot solution should be used for covering peas and is filled at 79 to 82 <sup>0</sup> C leaving a head space of 0.3 to 0.5 cm.



<b>Exhausting</b>	The process of removal of air from cans and bottle is known as exhausting. The cans are passed through a hot water tank (82 to 87 <sup>0</sup> C) in such a manner that level of water should be 4-5 cm below their top. The exhaust box is heated till the temperature of water reaches 82-100 <sup>0</sup> C to ensure that cans show a temperature of about 79 <sup>0</sup> C. It will take 6 to 10 minute. If glass bottles are used at the start of exhausting, the lids are left loose and when exhausting is over the mouth of bottles and jars should be immediately closed tightly.
<b>Sealing</b>	Can sealer is used to seal the cans and crown cork or cork is used to seal and air tight be bottles. Cans or bottles should be sealed immediately after exhausting.
<b>Processing</b>	The sealed cans are placed in hot water of 115 <sup>0</sup> C for 45 minute for processing.

**Question:**

1. What is blanching? Write the advantages of blanching.
2. What is lacquering?
3. Define sterilization.
4. What do you mean by pasteurization?
5. What is lye-peeling?
6. What is brining and syruping?
7. What is exhausting?

## Practical No. 5



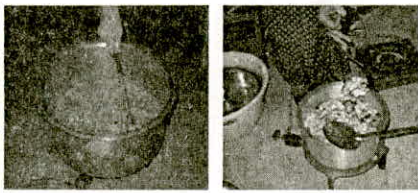
**Title:** Preparation of Jam.

**Objectives:** 1. To impart the knowledge of jam preparation to the students.  
2. To assess the economics of product preparation.




**Material required:** Fruits, knife (pitting coring, peeling and cutting) sugar, citric acid, vessels, spoons and Jars (glass).

**Procedure:**




It is a product prepared by cooking of fruit pulp with sugar and acid with a reasonable time to make it thick consistency. Jam contains 65-68% TSS ,0.5-0.6% acidity and appropriate colour and essences of the fruit.

<b>Selection of fruit</b>		Pectin rich fruits should be selected for Jam preparation. Fruits should be fully matured but not over ripe. Diseased, over ripe, injured and damaged fruits, should be discarded.
↓		
<b>Washing</b>		Fruits should be washed thoroughly to remove the adhering dirt, pesticide residues and other chemical residues.
↓		
<b>Peeling and cutting</b>		Fruits should be peeled and cut in desired size and pieces. Before peeling, it should be cored and remove the peel in pits by pitting knife. If possible, seeds should also be removed in this stage.
↓		
<b>Pulping</b>		After peeling, cutting, coring and pitting, the pieces are allowed to make pulp either mechanically or by cooking with hot water. The pulp should be strained with the help of suitable sieve.



<p><b>Addition of sugar</b></p>		<p>The sugar should be added in the fruit pulp and kept it for the boiling on the gas burner. The quantity of sugar varies with the kind of fruit. The recipes for different fruit is given in the Table 2.</p>
<p><b>Addition of citric acid</b></p>		<p>As soon as boiling starts, the recommended quantity of citric acid should be added in the boiling pulp and it should be cooked till jam is prepared.</p>
<p><b>Judging of End point</b></p>		<p>The cooking mixture of fruit pulp, sugar and citric acid should be cooked till the end point of jam preparation. The following methods are adopted to judge the end point.</p> <ol style="list-style-type: none"> <li>1. <b>Thermometer test:</b> When the temperature of cooking mixture raise to 105<sup>0</sup>C, it means the cooking mixture reaches the end point and jam is ready.</li> <li>2. <b>Refractometer test:</b> Take a drop of boiling mixture in refractometer and observe the reading. If reading ranges between 68-70<sup>0</sup> Brix, it means jam is ready.</li> <li>3. <b>Sheet test:</b> A small portion of cooking jam is taken out in a spoon and cooled slightly and then allowed to drop. If the product falls in a continuous stream or syrup, it shows that it require more cooking. If the product falls in the form of a sheet or flakes, it means that the end point has been reached and the jam is ready.</li> </ol>



<b>Addition of colour</b>		<p>To make the product attractive artificial and permitted colour should be added. In apple jam raspberry red colour is added to make attractive product</p>
<b>Filling</b>		<p>Jam should be filled hot and with least distance in jam bottles up to the brim to avoid air bubbles in the product within the jar.</p>
<b>Cooling and waxing</b>		<p>Jam poured bottles should be cooled naturally. As soon as bottles cooled, a layer of wax should be poured over the jam in bottle to keep the bottle air tight.</p>
<b>Capping &amp; storage</b>		<p>As soon as waxing completed, the bottles should be capped properly and these bottles can be stored at room temperature for longer days.</p>

**Table 2: Recipe of Jam preparation from fruits:**

S. No.	Name of fruit	Fruit pulp ( kg)	Sugar (kg)	Citric acid (g)	Water (ml)
1.	Mango	1.0	1.0	5	500
2.	Apple	1.0	1.0	5	500
3.	Papaya	1.0	1.0	10	500
4.	Aonla	1.0	1.0	-	500
5.	Sapota	1.0	1.0	10	500

**Questions:**

1. Write the criteria for selection of fruits for jam preparation.
2. Explain thermometer test for judging the end point of jam preparation.
3. Jam should be poured into the bottle with least distance, why?
4. Why apple is not peeled during jam preparation?
5. Give the ingredients of mango jam.
6. What is the importance of waxing the jam bottles?

## Practical No. 6

**Title:** Preparation of Jelly and Marmalade.

**Objectives:** 1. To impart the knowledge of jelly preparation to students.  
2. To calculate the economics of product preparation.

**Material required:**

Pectin rich fruits, sugar, wax, citric acid, muslin cloth or jelly bag, jelmeter, refractometer, knives, vessels and glass bottles with cap.

A jelly is a transparent solid product made from pectin rich fruits, well-set and should have the original flavour of the fruit and its own natural colour. Pectin is the most important constituent of jelly and present as calcium pectate as connecting tissue. The pectin rich fruits are Sour Apple, Unripe bananas, Guava, Lemon, Oranges, Plum, Jamun, Sour Cherry, Pear, Orange, Grapefruits, Wood apple and Karonda.

**Procedure:**

↓	
<b>Selection of fruit</b>	Pectin rich fully mature and firm fruits should be selected. Immature over ripe, brushy, damaged and injured fruits should be discarded.
↓	
<b>Washing</b>	Selected fruits should be washed thoroughly to remove adhering dust particles and pesticide residues. Flow water containing detergent is the best method for washing the fruits.
↓	
<b>Cutting</b>	After washing, the fruits should be peeled, cored and cut into thin slices so that the pieces easily become tender to make pulp.
↓	
<b>Preparation of water extract</b> <b>(a) Boiling with water</b>	Jelly is prepared from the water extract of fruit pulp. For the purpose, the water is added 1.5 times the weight of fruits and boil the fruits pieces with water for 20-30 minute to prepare fruit pulp. During boiling, citric acid @ 2g/kg of fruit should be added to get more recovery of pectin in water extract.
↓	
<b>(b) Straining of extract</b>	The pulp obtained from the boiling of fruit and water should be strained properly. Jelly bag is most appropriate method for straining of water extract. If jelly bag is not available, muslin cloth should be used for straining the extract. Extract should be strained naturally and it should not be extracted by pressing with hands or any means.
↓	
<b>Pectin test</b>	The quantity of sugar to be added for jelly preparation depends upon the quantity of pectin present in water extract. Therefore, determination of pectin in water extract is must. Pectin content is determined by the following two methods.



<b>(a) Alcohol or spirit test</b>	<p>One tea spoon full of water extract is taken in a beaker and three teaspoon full of methylated spirit or alcohol is poured gently using beaker walls and allowed to stand for few minute. If a single transparent lump is formed, it shows that the extract is rich in pectin and equal quantity of sugar is to be added in water extract.</p> <p>If the clot look like fragmented or in pieces, the water extract contains moderate amount of pectin and three fourth amount of sugar is to be added.</p> <p>If numerous small granular clots are seen, it shows less pectin in water extract which require one half amount of sugar.</p>
-----------------------------------	---

<b>(b) Jelmeter test</b>	<p>The jelmeter should be held in left hand and the bottom is closed with little finger. The water extract is poured into jelmeter with the help of spoon till it is fully filled. The little finger is removed from the bottom of jelmeter and water extract as allowed to drop for one minute. After one minute the bottom of jelmeter again closed with little finger. The reading of jelmeter is noted. The reading shows the quantity of sugar to be added for one liter of water extracts.</p>
--------------------------	--

<b>Addition of sugar</b>	<p>As per pectin test, the required quantity of sugar should be added in the water extract and heated to dissolve the sugar in extract. As soon as boiling starts, the required quantity of citric acid (if needed) should be added and boil till end point of jelly preparation. The quantity of sugar and citric acid for different fruits are given in table 3.</p>
--------------------------	--

<b>Judging of end point</b>	
<b>Drop test</b>	<p>Take a plate with full of water and a drop of cooking jam is poured with the help of spoon into the plate containing water. If the drop is settled down without disintegration, which shows the jam is ready. If the drop is dissolved into the water, the concentrated mass need more cooking.</p>
<b>Temperature Test</b>	<p>When boiling mixture of Jam shows the temperature of 105<sup>0</sup>C, it means the concentrated mass is ready to set into the Jel.</p>
<b>Refractometer Test</b>	<p>A drop of boiling concentrate is taken in the refractometer and take the reading. If the reading shows 65<sup>0</sup> Brix, it means jelly is ready to set.</p>

<b>Sheet Test</b>	Same as in Jam.
-------------------	-----------------

<b>Filling</b>	<p>The hot prepared jelly should be poured into sterilized glass bottles upto the brim.</p>
----------------	---

**Table 3: Recipe for preparation of Jelly**

S. No.	Name of Fruits	Fruit extract (litre)	Sugar (kg)	Citric acid (g)
1.	Guava	1.0	0.750	5
2.	Karonda	1.0	0.750	-
3.	Wood apple	1.0	1.000	-
4.	Mature papaya	1.0	0.750	7

**Marmalade:**

Jam or jelly prepared from fruits or slices of fruits in which peel is suspended is known as marmalade. The marmalade is of two types.

- i) Jam marmalade
- ii) Jelly marmalade

During the preparation of jam or jelly, shredded peel of citrus fruits is to be added in the pulp or fruit extract at the rate of 62 g per kg of pulp/fruit extract. The product should be prepared as the method involved in the jam or jelly.

**Questions:**

1. Give an ideal ratio of pectin: sugar and acid for jel formation.
2. What is pectin test? Why it is performed?
3. Explain sheet test of jelly to determine the end point.
4. Give the recipe of Guava jelly.
5. Calculate the economics of product preparation.

## Practical No. 7

**Title:** Preparation of tomato ketchup and sauce.

**Objectives:** 1. To impart the knowledge of sauce/ketchup preparation among students.


2. To see the economic feasibility of product preparation.

**Material required:** Knives, mixer grinder, pulper, crusher filter, steel vessels, muslin cloth, glass bottle, tomato fruits, spices, vinegar, sugar etc.

**Table 4: Recipe of ketchup for 10 kg of tomato pulp**

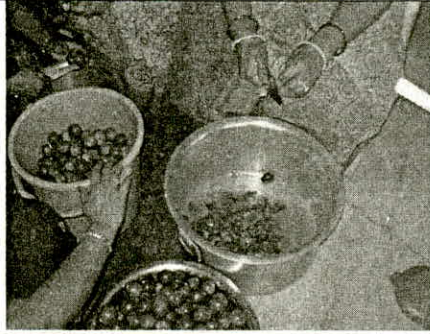
Tomato pulp	10 kg	Clove	2 g
Sugar	750 g	Cumin seed	5 g
Salt	130 g	Cardamom (Large)	8 g
Garlic Chopped	25 g	Mace	2 g
Onion chopped	250 g	Cinnamon	10 g
Ginger	25 g	Vinegar (6%)	600 ml
Red chilli powder	10 g	Sodium benzoate	2 g

**Procedure:**

<p><b>Selection of fruits</b></p>		<p>Fully ripe and even red coloured fruits should be selected for sauce/ketchup preparation. Green, shriveled and diseased tomatoes should be discarded.</p>
<p>↓</p>	<p><b>Washing of fruits</b></p>	<p>Fruits are properly washed with running water to remove adhering dust, field residues and to minimize the micro-organism presence.</p>



### Cutting of fruits



For the preparation of sauce/ketchup, tomato fruits should be cut into 3-4 equal pieces so that pulp can be easily extracted.

### Pulping



The pulp of tomato fruits can be extracted either by pulping machine or by boiling the fruit pieces in a vessel over the gas stove. The cooked pieces are crushed by the crusher filter to remove the seed and peel from the pulp. The uniform tomato pulp without seed and peel is collected in a steel vessel for further cooking to prepare sauce or ketchup.

### Preparation of spice bag





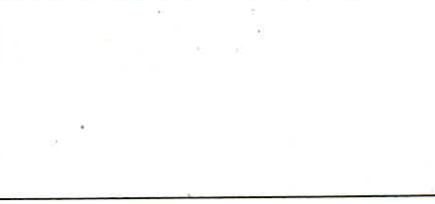


Generally, two type of spices are used to get the spicy taste in the ketchup or sauces i.e., dry and wet. Both spices are crushed by mixer grinder and take into the muslin cloth. These crushed spices are tied with muslin cloth. Care should be taken that muslin cloth bag should be enough loose.

### Cooking with spice bag



This spice bag is poured into the cooking pulp of tomato in a steel vessel. This bag is occasionally pressed to get blended the extract of spices with tomato pulp. The pulp is cooked till the one third volume of original pulp volume. The spice bag should be squeezed in the tomato pulp to obtain maximum quantity of spice extract in the pulp.



<p><b>Removal of spice bag</b></p>		<p>The spice bag should be removed after the proper impregnation of spice extract in the pulp. A strong aroma of spices in cooking pulp can be felt at this stage.</p>
<p><b>Addition of sugar, salt and vinegar</b></p>		<p>As soon as spice bag is removed from the cooking pulp, required quantity of sugar, salt and vinegar should be added and cooked till end point.</p>
<p><b>Judging of end point</b></p>		<p>As soon as the volume of cooking pulp remains one third of its original volume, it shows that the ketchup is ready at this stage. Refractometer shows the reading of 28<sup>0</sup>Brix .</p>
<p><b>Filling hot into the bottles</b></p>		<p>Prepared ketchup is filled hot into the sterilized glass bottles upto the brim and the bottles should be corked immediately.</p>
<p><b>Pasteurization</b></p>		<p>These bottles are allowed for pasteurization at 85-90<sup>0</sup>C for 30 minutes, so that the exhausting of bottles can be done in proper ways.</p>

**Sealing and storage**



After pasteurization, bottles are corked properly or air tight and cooled enough. These bottles can be stored at room temperature in cool dry places.

**Preparation of Sauce:**

Ketchup or sauce prepared from tomato fruits contains more or less same ingredients and method of preparation of sauce is similar to preparation of ketchup. The both differ in respect to consistency and the ketchup is more thicker as compared to sauce.

**Precautions:**

1. Do not add salt, sugar and acetic acid in the beginning of ketchup/sauce preparation.
2. Care should be taken that the spice bag should loose enough so that extract can be mixed properly.
3. Sugar, salt and vinegar should be added after removal of spice bag.

**Questions:**

1. Why spice bag is used?
2. How long ketchup bottles should be pasteurized?
3. Why hot ketchup/sauce mixture is poured in the bottle?
4. Describe the end point for sauce and ketchup preparation.



## Practical No. 8



**Title:** Preparation of fruit squash, cordial and syrups.

**Objectives:** 1. To disseminate the procedure of beverages preparation among students.

2. To see the economic feasibility of product in the market.

**Material Required:** Fruits, citric acid, sugar, fruit juicer, mixer grinder, knife, bottles.

### Procedure (Squash):

<p>↓</p> <p><b>Selection of fruits</b></p>		<p>Mature and fully ripe fruits with excellent taste and aroma should be selected for the preparation of squashes. Brushy, damaged or mechanically injured or injured fruits should be discarded.</p>
<p>↓</p> <p><b>Washing</b></p>		<p>Fruits should be washed thoroughly to remove the adhering dirt or residues of pesticides. For the purpose, running water washing is appropriate method of washing the fruits.</p>
<p>↓</p> <p><b>Peeling and cutting</b></p>		<p>The fruit should be peeled after pitting and coring if necessary. Some fruits need respiration of juice sacs after peeling. Peeling should be done in such manner so that minimum nutrient loss should be taken place.</p>
<p>↓</p> <p><b>Juice extraction</b></p>		<p>Juice of fruits should be extracted immediate after peeling and cutting the fruits. Care should be taken that juice should be utilized immediately after the extraction from the fruit to avoid browning of the juice. The juice should be extracted either manually or by juice extracting device.</p>

**Straining**



The juice should be properly strained by suitable strainer or by the muslin cloths. For the preparation of cordial, the juice should be stored for 10-15 days in a glass container for clarification or to remove the soluble substances or suspended matter in the juice. As a result, a sparkling and clear juice will be obtained after siphoning of the supernatant clear juice. After that, the juice should be again strained for the preparation of cordial.

**Preparation of sugar syrup**




The sugar syrup is an important component for the preparation of any beverages. Sugar syrup should be prepared as per recipe given in Table 5. The calculated quantity of sugar and water should be taken in stainless steel vessel. Stir it to dissolve the sugar and get it heated. As soon as boiling starts, citric acid in determined quantity should be added and sugar syrup should be strained immediately in hot condition.

**Mixing the juice and sugar syrup**



The strained juice of fruits is mixed with sugar syrup prepared for the squash preparation. The syrup should be cooled enough before mixing it with juice.



<p><b>Addition of colour essence and preservative</b></p>		<p>As soon as the fruit juice mixed with the sugar syrup, the determined quantity of edible and permitted food colours and essence should be added to improve the quality of product. The permitted preservative should also be added to enhance the shelf life of the product.</p>
---	---	---

<p><b>Filling and capping</b></p>		<p>Prepared solution of squash/cordial/syrup should be filled in sterilized glass bottles. The solution should be filled in glass bottles leaving a head space of 1 to 2 cm. The bottles should be tight enough or air tight by capping and sealing with wax. Now the product is ready to store.</p>
-----------------------------------	---	--

**Table 5: Recipe of squash for 1kg of Juice/Pulp:**

S. No.	Fruit Juice (kg)	Sugar (kg)	Water (litre)	Citric acid(g)	Preservative
1.	Bael	1.80	1.0	25	2.0 g KMS
2.	Guava	1.80	1.0	20	2.0 g KMS
3.	Orange	1.75	1.0	20	2.0 g KMS
4.	Lime	2.0	1.0	--	2.0 g KMS
5.	Pineapple	2.0	1.0	20	2.0 g KMS
6.	Mango	1.75	1.0	20	2.0 g KMS
7.	Phalsa	1.75	1.0	5	2.0 g KMS
8.	Jamun	1.75	1.0	15	2.0 g S.B.
9.	Water melon	0.50	0.25	10	2.0 g S.B.

KMS=Potassium meta -bi sulphite, S.B. = Sodium benzoate

**Cordial:**

Cordial is made from sparkling and clear juice of citrus fruits from which pulp and other suspended matters are completely removed and clear juice is used for the preparation of squashes. This way prepared squash is known as cordial.



**Syrup:**

Generally syrup can be classified in three major groups:

1. Fruit Syrup: This type of syrup contains at least 25% fruit juice or pulp, 65% TSS and 1.3 to 1.5 per cent acid and is diluted before serving.
2. Syrups from extracts: Syrups containing extracts of rose, sandal, kewda, mint and almonds are known as syrups from extracts.
3. Synthetic Syrups: This type of syrup never contains fruit juice, pulps or extracts and heavy sugar strength (70-75 %) is used as base of the synthetic syrups. They are added by artificial colour and essence for enhance the visual quality i.e. colour and flavor of the products.

**Table 6: Recipe for preparation of Fruit syrup**

S. No.	Name of Fruits	Fruit Juice (kg)	Sugar (kg)	Water (litre)	Citric acid (g)	Preservative
1.	Orange	1.0	2.0	0.50	10	2.0 g KMS
2.	Lime	1.0	2.0	0.50	-	2.0 g KMS
3.	Phalsa	1.0	2.0	0.50	10	2.0 g KMS
4.	Aonla	1.0	2.0	0.50	05	2.0 g KMS
5.	Mango	1.0	2.0	0.50	5	2.0 g KMS

**Questions:**

1. What are the ingredients of squash?
2. How cordial differs from squash?
3. What is syrup?
4. Name the preservative used in jamun squash.
5. Name two chemical preservatives used in beverage preparation.



## Practical No. 9

**Title:** Preparation of Preserve and Candy.

**Objectives:** 1. To get acquainted with the procedure of preserve and candy preparation.  
2. To assess the cost economics of preserve and candy preparation.

**Material required:** Aonla fruits, Sugar, Citric acid, Knife, Pricker and Stainless steel vessel.

**Procedure:** (common for all fruits)

Selection of fruits		Fully mature but unripe fruits should be selected to prepare Aonla preserve or candy.
Washing		Fruits should be washed thoroughly with running water.
Pricking of fruits		Fruits should be pricked in such a manner that fruits could not rupture.
Salt treatment		Pricked pieces of fruits should be kept in 2% salt solution for 24 hrs to remove the excess tannin present in the fruits. The treatment improves the fruits appearance and quality of product. The concentration of salt solution should be increased every day @ 2% per day upto the strength of 8% salt concentration. Fruits should be removed from salt solution and kept in ordinary water for at least 12 hrs to remove the excess salt from the fruits.



## Sugar treatment



Before sugar treatment, fruits should be blanched to make it soft enough and absorb water. These fruits should be blanched for 5-10 minutes in boiling solution of Alum (2% concentration). Immediately after blanching, fruits should be spread over cloth to remove excess water from the fruits.

For one kg of fruits, 1.5 kg sugar is required for preserve preparation. Generally preserve can be prepared by the following three methods:

1. Rapid Process
2. Slow Process
3. Vacuum Process

- 1. Rapid Process:** In rapid process, fruits are cooked in low sugar syrup. Boiling should be continued with gentle heating until the syrup become sufficiently thick. The final concentration of sugar should not be less than 68% which corresponds to a boiling point of  $106^{\circ}\text{C}$ .
- 2. Slow Process:** In this method as soon as blanching is completed, the fruits and required quantity of sugar is kept in a stainless steel vessel in alternate layers of fruits and sugar for 24 hrs. During the period the water within the fruits comes out due to osmotic pressure and converts into the solution with sugar. Next day, syrup is boiled and strength is raised up to 60 per cent by adding sugar. On the third day, the strength is raised up to 65% by adding sugar and boiling the solution and fruits are left in the syrup for 24 hrs. Finally, the strength of syrup is raised to 70% total soluble solids and fruits are left for a week. Now, the preserve is ready for packing.
- 3. Vacuum method:** In this method, fruits are first blanched and then placed in 30-36% TSS sugar solution. The syrup is transferred to a vacuum pan and concentration under reduced process to 70 per cent total soluble solids. Preserve made by this process showed excellent quality of flavor and colour. Thus, prepared preserves can be filled in sterilized glass bottles/ jars and sealed them air tight.



**Preparation of Candy:**

The fruits/vegetable impregnated with higher percentage of sugar and subsequently drained free of syrup and dried is known as candied fruits/vegetable. The method of preparation of candied fruits is similar to the preserve. The only difference is that the fruit is impregnated with syrup having a higher percentage of sugar and then dried.

**Questions:**

1. Explain candy.
2. What is preserve?
3. What is salt treatment?
4. Why sugar is added in split doses during preserve preparation?
5. Explain vacuum method of preserve preparation.

## Practical No. 10

**Title:** Preparation of Pickles and Chutney.

**Objectives:** 1. To impart the knowledge of procedure of pickle and chutney preparation to students.

2. To see the economic feasibility of the product.

### (A) Pickles

**Material required:** Lime-1kg, Salt -250 g, Chilli powder-20 g, Cinnamon – 10-15 g, Cumin -20 g, Cardamom-20 g, Black pepper-10 g, Clove-1g and Glass Jars.

#### Procedure:

<b>Selection of Fruit</b>	Fully ripe healthy and fresh fruits should be selected for the preparation of pickles. Shrinked, diseased and brushy fruits should be discarded.
<b>Washing</b>	Washing with flow water should be done to remove the adhering dirt, pesticides residues and microbes.
<b>Cutting</b>	The lime fruits should be cut into equal four pieces so that appearance of the pickle should be enough well.
<b>Preparation of spices and mixing</b>	All the spices should be roasted lightly and grinded with the help of mixer grinder or any other means. These grinded spices should be mixed with lime pieces along with determined quantity of salt. Stir well to proper mixing of spices with lime pieces.
<b>Filling</b>	As soon as spices mixed with lime pieces, it should be filled in sterilized glass jar specially made for the pickles and keep the air tight with the help of lid.
<b>Keeping in sun-light</b>	The jars filled with lime pieces and spice mixture should be exposed to sun light for at least one week and during these days jars should be shacked at least twice a day. After one week of sun light treatment, the pickles will be ready to consume.
<b>Storage</b>	These glass jars should be kept or stored at ambient temperature in a cool dry place for suitable periods.

### (B) Chutney:

Mango chutney is an important product liked by the Indians as well as foreigners. The mango chutney is exported from India to many countries. The method of preparation of chutney is similar to that of jam except that spices, vinegar and salt are added.

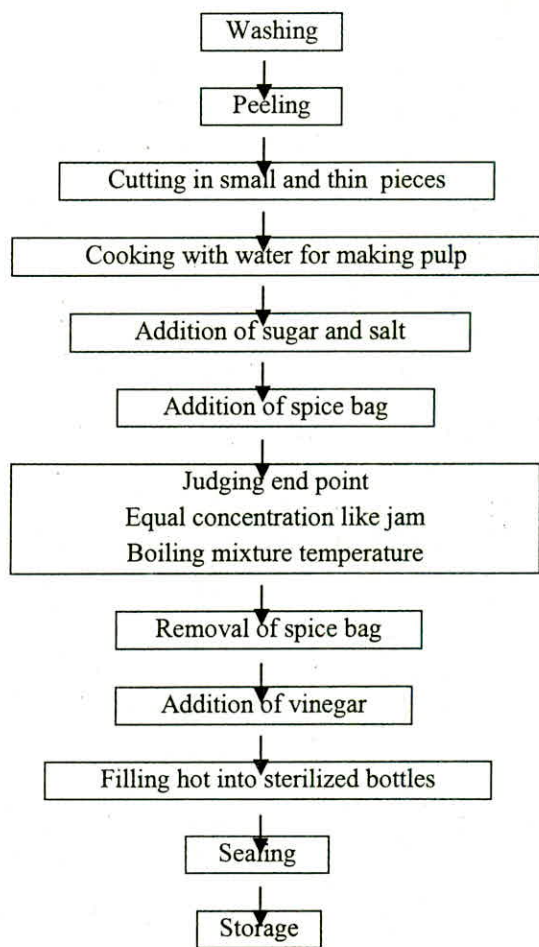
#### Recipes for Chutney:

The common recipe for the preparation of chutney is given below:

**Table 7: Recipe for the preparation of mango Chutney**

Mango/ Slice	1 kg	Garlic (Chopped)	25 g
Sugar	1 kg	Ginger (chopped)	25 g
Salt	50 g	Red Chilli powder	20 g
Onion (Chopped)	50 g	Cinnamon	10 g
Cardmom (large)	10 g	Aniseed powder	10 g
Cumin	10 g	Vinegar	150 ml
Clove (headless)	1 g		

**Flow sheet for the preparation of Mango Chutney is given below**



**Questions:**

1. Give the concentration of salt when it act as preservative.
2. Name two liquid chemical preservatives.
3. Why oil is added in the pickles?
4. Why vinegar is added in chutney?
5. Give the flow sheet of chutney preparations?



## Practical No. 11

**Title:** Methods of drying and dehydration of fruit and vegetables.

**Objectives:** 1. To acquire the knowledge of drying and dehydration of fruit and vegetables.

2. To see the economic feasibility of the product.

The products which are dried in sun, the word “drying” is used and which are dried by dehydrators comes under dehydration.

**Procedure:**

<b>Selection of raw material:</b>	Select mature and sound fruit and vegetables of good quality.
↓	
<b>Washing, peeling and slicing:</b>	Fruit and vegetables should be washed thoroughly by running water. The raw material is properly peeled and sliced into specific or as desirable size.
↓	
<b>Blanching:</b>	All the vegetables require blanching while fruit do not need blanching. The vegetables are taken into loose bag of muslin cloth and dipped in to boiling water for 3-5 minutes and just after blanching they should be immediately cooled by dipping in cold water.
↓	
<b>Sulphuring:</b>	Generally fruits are treated with sulphur fumes to maintain their colour and avoid spoilage by micro-organism during drying. Vegetables are not sulphured and it is mostly done in fruits. The whole or slices of fruits are placed into sulphur box for sulphuring and it takes 15-60 minutes. Excess sulphuring causes toxicity.
↓	
<b>Drying</b>	The fruits and vegetables or their pieces should be thinly and evenly spread on the trays or floor and exposed to the full sun for drying.
↓	<b>Or</b>
<b>Dehydration:</b>	The fruits and vegetables or their pieces should be kept in thin layer and evenly spread on trays and filled trays should be places into dehydrator. The temperature gradually increases to 65 <sup>0</sup> C for fruits and 65-71 <sup>0</sup> C for vegetables. During drying, the pieces stirred by fingers to encourage drying uniform. The fruit can be considered dry when they leave no sign of moisture when gripped in hand and whereas, vegetables can be considered when they become brittle.
↓	
<b>Packing and storage:</b>	Dried fruits and vegetables should be packed in air tight condition and stored in warm and dry places.

**Table 8: Recipe for drying or dehydration of fruits and vegetables**

<b>Fruit Crops</b>	<b>Stage of crop</b>	<b>Step-1</b>	<b>Step-2</b>	<b>Step-3</b>	<b>Final product</b>
Mango	Mature	Slicing	Blanching for 3-5 min.	Sun drying / Dehydration & Grinding	Mango powder
Mango	Ripe	Slicing	Sulphuring for 30 min.	Sun drying/ Dehydration	Dried ripe flakes
Mango	Ripe	Pulping and sugar addition	Spread in trays	Sun drying/ Dehydration	Mango leather
Apple	Ripe	Slicing	Sulphuring for 20-30 min.	Sun drying/ Dehydration	Dried ripe flakes
Brinjal	Tender	Slicing	Blanching for 3min.	Sun drying/ Dehydration	Dried flakes
Cauliflower	Mature	Slicing	Blanching for 3 min.	Sun drying/ Dehydration	Dried flakes

**Questions:**

1. What is sulphuring?
2. Explain sulphiting.
3. Differentiate between drying and dehydration.
4. What is slicing?
5. Write the name and use of chemical used for drying.



## Practical No. 12

**Title :** Visit to local Processing Unit.

**Objectives:** 1. To see the arrangement and layout of the unit.

2. To know the operation of different equipments installed in the processing unit.

The following points should keep in mind during visit of local processing unit:

1. Trade Name of Processing unit.-----
2. Address of processing unit.-----
3. Capacity of the unit.-----
4. Annual expenditure of unit -----
5. Expected out come from unit -----
6. Number of Technical workers -----
7. Name of products to be prepared in the unit -----
8. Procurement of raw products -----
9. Marketing area of the products -----
10. Capital investment -----
11. Difficulties -----

कृषि मन्त्र विद्यालय

31

# Practical Manual on Post Harvest Technology

Prepared by :

Dr. H.G. Sharma

Dr. S.N. Dikshit

Dr. Neeraj Shukla



**Department of Horticulture**

College of Agriculture

**INDIRA GANDHI KRISHI VISHWAVIDYALAYA**

**Raipur (Chhattisgarh) 492 012**