

# CHAPTER 13

## PACKING, STORAGE AND VALUE ADDITION OF FRUITS

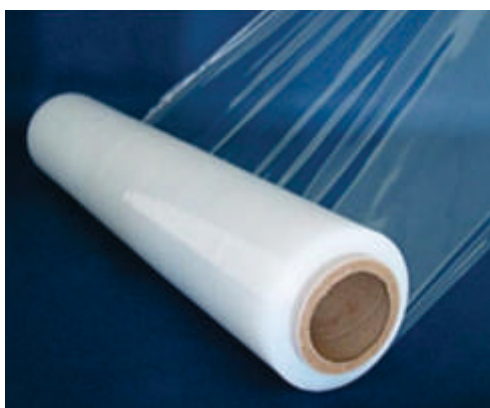
### OBJECTIVES

After reading this chapter, students will be able to:

- Understand the importance of packaging of fruits
- Know the characteristics of a modern package
- Explain different storage structures used for the storage of fruits
- Know the importance of value addition of fruits
- Know about the processed products which can be prepared from fruits

### INTRODUCTION

In your previous class, you have read about handling of fruits. After harvesting, different operations are necessary before the product is packed. Packing of fruits is an important aspect of postharvest operation, after which fruits are transported for marketing or stored for some time. Similarly, when there is very high production of fruits or when markets rates are very down, fruits can be processed in to several value added products to fetch good price in future. In this chapter, you will learn about packaging, transportation, storage and value addition of fruits.



Heat shrinkable film



Apples packed in CFB boxes

### Packing of fruits

After grading, the produce is packed, for which different containers like polyethylene bags, plastic field boxes, wooden field boxes, CFB boxes, muslin cloth bags, bamboo baskets, nylon nets etc. Nowadays, CFB boxes are mainly used for bulk packing. However, different attractive consumer packs have been developed and are commercially used in India as well. Shrink wrapping is becoming quite popular in India as well. Modern packaging must comply with the following requirements:

- The package must have sufficient mechanical strength to protect the contents during handling, transport, and stacking.
- The packaging material must be free of chemical substances that could transfer to the produce and

become toxic to man.

- The package must meet handling and marketing requirements in terms of weight, size and shape.
- The package should allow rapid cooling of the contents.
- The permeability of plastic films to respiratory gases should be ideal for the commodity to be packed.
- It should be easily printable.
- Its mechanical strength should be largely unaffected by moisture content (when wet) or high humidity conditions.
- The package must either exclude light or be transparent.
- The package should be appropriate for retail presentations.
- The package should be designed for ease of disposal, re-use, or recycling.
- The cost of the package should be as low as possible.

### Transportation of fruits

After packing, the produce has to be sent to market for sale. This is the most neglected area in our country because very less attention is paid for transporting of fruits from the production sites. In our country, fruits are transported by loading in the rickshaws, carts, rails, trucks, ship or by air. As a result, bulk of produce is lost during transportation. However, now producers are paying attention on this aspect and even refrigerated vans are used for transporting fresh horticultural produce.



Apples loaded on a truck

### Storage of fruits

The marketable life of most fresh fruits can be extended by prompt storage in an environment that maintains product quality. The desired environment can be obtained in facilities where temperature, air circulation, relative humidity, and sometimes atmosphere composition can be controlled. Storage rooms can be grouped accordingly as those requiring refrigeration and those that do not. Storage rooms and methods not requiring refrigeration include: *in situ*, sand, coir, pits, clamps, cellars, barns, and evaporative cooling units. The following methods are commonly used for storage of fruits in India.

**In situ:** This method of storing fruits and vegetables involves delaying the harvest until the crop is required. It can be used in some cases with root crops, such as cassava, but means that the land on which the crop was grown will remain occupied and a new crop cannot be planted. In colder climates, the crop may be exposed to freezing and chilling injury.

**Sand or coir:** This storage technique is used in countries like India to store potatoes for longer periods of time, which involves covering the commodity underground, with sand. Pits or trenches are dug at the edges of the field where the crop has been grown. Usually pits are placed at the highest point in the field, especially in regions of high rainfall. The pit or trench is lined with straw or other organic material and filled with the crop being stored, then covered with a layer of organic material followed by a layer of soil. Holes are created with straw at the top to allow for air ventilation, as lack of ventilation may cause problems with rotting of the crop.

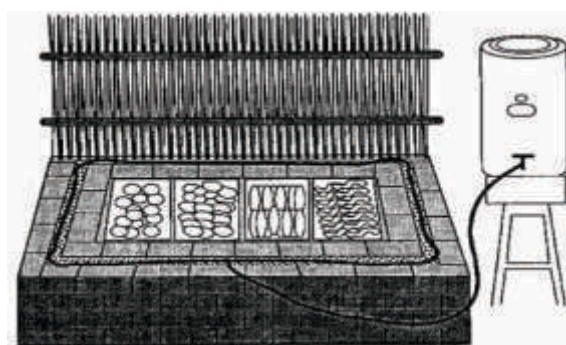
**Clamps:** This has been a traditional method for storing potatoes in some parts of the world, such as Great Britain. A common design uses an area of land at the side of the field. The width of the clamp is about 1 to 2.5 m. The dimensions are marked out and the potatoes piled on the ground in an elongated conical heap. Sometimes

straw is laid on the soil before the potatoes. The central height of the heap depends on its angle of repose, which is about one third the width of the clump. At the top, straw is bent over the ridge so that rain will tend to run off the structure. Straw thickness should be from 15-25 cm when compressed. After two weeks, the clamp is covered with soil to a depth of 15-20 cm, but this may vary depending on the climate.

**Cellars:** These underground or partly underground rooms are often beneath a house. This location has good insulation, providing cooling in warm ambient conditions and protection from excessively low temperatures in cold climates. Cellars have traditionally been used at domestic scale in Britain to store apples, cabbages, onions, and potatoes during winter.

**Barns:** A barn is a farm building for sheltering, processing, and storing agricultural products. Although there is no precise scale or measure for the type or size of the building, the term barn is usually reserved for the largest or most important structure on any particular farm. Smaller or minor agricultural buildings are often labeled sheds or outbuildings and are normally used to house smaller implements or activities.

**Cold storage:** Fruits are also stored in cold stores maintained at specific temperature. Temperature for cold storage of fruits has been standardized. For some fruits (e.g., apple, pear, peach, plum, apricot etc.) lower temperature (nearly 0 or 1°C) is suitable, whereas some fruits are stored safely at higher temperature because such fruits (e.g., mango, avocado, pineapple, banana etc.) develop chilling injury at lower temperature. Hence, every care must be taken while storing the fruits in cold storage.



A design of Pusa Zero Energy Cool Chamber

**Evaporative cooling:** When water evaporates from the liquid phase into the vapour phase energy is required. This principle can be used to cool stores by first passing the air introduced into the storage room through a pad of water. The degree of cooling depends on the original humidity of the air and the efficiency of the evaporating surface. If the ambient air has low humidity and is humidified to around 100% RH, then a large reduction in temperature will be achieved. This can provide moist conditions during storage.

**Controlled atmospheric storage:** This is modern technique of storage of fruits. Controlled atmospheres are made of gastight chambers with insulated walls, ceiling, and floor. They are increasingly common for fruit storage at larger scale. Depending on the species and variety, various blends of  $O_2$ ,  $CO_2$ , and  $N_2$  are required. Low content  $O_2$  atmospheres (0.8 to 1.5%), called ULO (Ultra Low Oxygen) atmospheres, are used for fruits with long storage lives (e.g., apples). Now several such structures have been developed in India as well for storage of high value fruit crops like apple.

#### Points to remember

- Pusa Zero Energy Cool Chamber (PZECC) was developed at IARI, New Delhi.
- It works on the principle of evaporative cooling.
- It is highly useful for on-farm storage of fruits, vegetables and flowers.
- It can be made from locally available material.
- It can be used for pre-cooling of produce.
- It works well in areas having high temperature and low humidity.



CA Store for apples

## Value addition in fruits

India is the 2<sup>nd</sup> largest producer of fruits and vegetables in the world. However, about 30-40% of this produce is lost during improper postharvest handling. Moreover, several fruits are seasonal in nature, which results in price fluctuations, thereby growers get low price of their produce. Therefore, to prevent losses, and avoid glut of fruits, the processing of fruits in to stable value added and processed products is required.

### Benefits of value addition in fruits

Conversion of perishable fruits in to various value added products, apart from reducing the post-harvest losses considerably, avoids losses to grower by avoiding distress sale and minimizing the effect of glut during the seasons. It also ensures optimum utilization of perishables and also helps in better and full use of countries resources. Apart from all these benefits, setting up of processing unit generates employment both in rural or production areas. It also helps in improving the foreign exchange earnings of the country through exports.

### Different value added products from fruits

#### Fruit beverages

Fruit juices are rich sources of vitamins, particularly vitamin-C and minerals. These are easily digestible, highly refreshing and invigorating, thirst quenchers and far superior to most aerated drinks, which have practically no food value. They are beneficial against a number of ailments and tonics for heart and brain and serve as cold drinks in hot summer. Fruit juices are preserved in different forms such as pure juices, squashes, cordials, and fermented juices etc. These are broadly classified as under:



Fruit juices

**Pure fruit juice:** This is the natural, unfermented juice processed out of the fruit and remains practically unaltered in its composition during preparation and preservation. Fruit juices can be prepared from almost types of fruits.

**Ready-to-serve (RTS) :** This prepared from fruit juice. It contains minimum of 10% fruit and 10% sugars. It not diluted before serving.

**Fruit juice beverage:** This is a fruit juice, which is considerably altered in composition before consumption. It may be diluted before it is served as a drink.

**Fermented fruit beverage:** This is a fruit juice, which has undergone alcoholic fermentation by yeast. The product contains varying amounts of alcohol. Grape wine, apple ciders, berry wines etc., are typical examples for this kind of beverages.



Fruit Squashes

**Fruit juice squash:** This consists essentially of strained juice containing moderate quantity of fruit pulp to which sugar is added for sweetening. Fruit squash can be prepared from mango, lemon, orange etc.

**Fruit juice cordial:** Sparkling, clear, sweetened fruit juice from which all the pulp and other suspended materials have been completely eliminated (e.g. lime juice cordial, guava).

**Sherbet or Syrup:** Clear sugar syrup, which has been artificially flavoured.

**Fruit juice concentrate:** Fruit juice, which has been concentrated by the removal of water either by heat or freezing. Carbonated beverages and other products can be made from this.

**Fruit juice powder:** Fruit juice which has been converted into a free-flowing, highly hygroscopic powder to which natural fruit flavour in powder form is incorporated to compensate for any loss of flavour in concentration, dehydration etc. Freeze dried fruit juice powders makes the best quality products. The powders are reconstituted to yield readily full strength, full fruit, fruit juice drinks..



**Preparation:** Fruit juices have their best taste, aroma and colour when they are freshly extracted and used for product making. The important steps in beverage making are selection and preparation of fruits, extraction of juice, de-aeration, straining, filtration, clarification and preservation.



Marmalade



Apricot butter

### Jams, jellies and marmalades

**Jam :** Jam is a concentrated fruit pulp, possesses a fairly heavy body and is rich in natural fruit flavour. Pectin in the fruit gives it a good set and high amount of sugars (more than 68.5 %) facilitates its preservation. It is prepared by boiling the fruit pulp and juice with sufficient quantity of sugar to get thick consistency. A good jam must have bright colour, rich typical fruit flavour, stiff but should not be sticky or crystallization of sugar.

**Jelly:** It is a semi-solid product prepared by concentrating essentially a clear fruit extract with sugar. In jelly making, pectin is the most essential constituent. Good jelly should be transparent, attractive in colour, give strong flavour of the fruit and firm enough to retain a sharp edge when cut. Pectin from cell wall of fruits, sugar, acid and water combine together when cooked to form jelly. Guava jelly is very popular in all parts of the world.

**Marmalade:** It is usually made from citrus fruits and consists of jellies or jam of the concerned fruit containing shreds of peels suspended in them. Usually citrus peel is used for making shreds in marmalade.

### Fruit butter, cheese and toffees

**Fruit butter:** It is a thick product but soft enough to spread easily. The butters can be prepared from any fruit but, most commonly used fruits are apple, pear, plum, peaches, apricot and grapes.

**Fruit cheese:** This product is commonly prepared from fruits like guava, apple and pear.

**Fruit toffee:** It is prepared by using fruit pulp, sugar, glucose, skimmed milk powder, butter and essence.



Fruit cheese

### Preserves (murrabbas) and candies

**Preserves (Murrabbas) :** It is a matured whole or in large pieces of fruit in which sugar is impregnated till it becomes tender and transparent. It retains the shape of the fruit and does not break or pulp. The preserve should have enough sugar (more than 68% TSS). Murabba can be prepared from amla, apple, mango, petha, grapes, muskmelon, and watermelon.

**Candied fruit:** A fruit impregnated with sugar, drained and dried is named as candied fruit. They are not sticky and are plump, tender and exceedingly sweet with high flavour.



Murabbah of Aonla

**Glazed fruit:** A candied fruit dipped for a moment in boiling syrup to impart a glossy finish to it, drained and dried- is called glazed fruit.

**Crystallized fruit:** Candied fruit drained, dried and rolled in crystal sugar is called a crystallized fruit.



Glazed fruit candy

### Canning and bottling of fruits

Canning is a process of preserving the fruits by application of heat high enough to destroy essentially all microorganisms present together with sealing the food in air-tight sterilized cans to prevent recontamination and to preserve the food in the condition in which it is ready to eat or cook. When glass jars are used as containers in place of cans, the process is called bottling. Tin cans are most commonly used because they are unbreakable, easy to handle, strong to withstand heat processing, light in weight, permit quicker heat penetration and can be cooled quickly. Cans require can sealer or seamer for hermetic sealing.

### Fermented products

**Wine:** Wine is made by fermenting grape juice with the help of yeasts. Wine can also be prepared by fermentation of other fruit juices such as mango, pineapple, guava, plum, kiwi, apple etc., which will be referred to as wine of that specific fruits (mango wine, pineapple wine etc.). Wine represents a non-toxic healthful beverage, which provides calories, vitamins, minerals and other nutrients.



Wine



Cider



Vinegar

**Vinegar:** The product made from carbohydrates obtained from different fruits by acetic fermentation is called vinegar. It can be manufactured as a byproduct from the pomace after extracting the juice from fruits. Fruit vinegars will have a unique flavour of the fruits used. Vinegar can be made from apple, grape or other fruits.

### Pickles and chutneys

**Pickles:** The preservation of food in common salt or vinegar is called pickling. Spices and oil may also be added in pickles. Pickles are good appetizer aid to digestion and add to the palatability of the meal. In oil pickles, oil provides protection against outside infection. In other pickles, 15 to 20 % common salt is added to prevent spoilage caused by microbes. Moulds and even lactic acid forming bacteria do not grow at this high salt concentration, as a results pickle remains safe for several months.

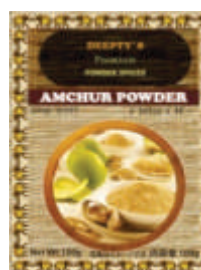


World famous  
Pachanga pickle

**Chutneys:** In general, hot and sweet chutneys are relished by all. Mostly acidic fruits are employed for preparing chutneys. A good chutney is smooth and has a mallow flavour and is spicy. Chutney is mostly prepared from mango.

### Dried products of fruits

It is an oldest and cheapest form of preservation of fruits. Drying can be carried out either in sun or by artificial heat (dehydration). Sun drying is practiced in tropical and sub-tropical regions where there is plenty of sunshine. However, nowadays, drying is done by mechanical dryers because of faster rate of drying and hygiene. Several fruit are used in dry form.



Amchur



Anardana

**Anardana:** It is a form of dried sour pomegranate arils used as a souring agent in food preparations. Anardan is prepared from a special wild form of pomegranate, which are highly acidic.

**Amchur:** It is a product obtained by powdering dry unripe mango pieces of sour nature. It is used as souring agents in food preparations.

**Fruit bar:** Fruit bar can be prepared from the pulp extracted from fully ripe fruits. Fruit pulp dried with suitable quantity of sugar and citric acid along with specified level of chemical preservatives. This product is called as intermediate fruit product but commonly called as leather/papad in our country.



Apple leather



### ||| ACTIVITIES/EXERCISES |||

- Visit some unit in which all packing-houses operations are done mechanically.
- Keep some fruits of tropical origin (e.g., mango, sapota, banana etc.) in your refrigerator. Observe the changes in skin colour, symptoms of chilling and quality after a week.
- Go to a bakery shop. Make a list of products, which are made from fruits. Try to differentiate between jam, jelly and marmalade.

### CHECK YOUR PROGRESS

1. Why packing of fruits is important? Write characteristics of a modern packing material.
2. Why storage of fruits is required? Write briefly different storage systems adopted for fruits.
3. What is value addition? Write different dried products which you have seen in the market.
4. Describe briefly different fermented products which can be prepared from fruits.
5. Differentiate between candied, glazed and crystallized fruit.
6. Differentiate between jam and jelly

### FILL IN THE BLANKS

- i) *Anardana* is a dried product prepared from pomegranate.
- ii) For jelly making, fruit should be rich in vitamin C.
- iii) For preparation of marmalade, shreds of citrus are used.
- iv) RTS is diluted before serving.
- v) Fruit bar is also called as intermediate moisture product.
- vi) Vinegar is a fermented product.
- vii) Cider is prepared from plums.
- viii) Jam and jelly are preserved by citric acid.
- ix) Petha is prepared from *aonla*.
- x) Zero Energy Cool Chamber works on the principle of evaporative cooling.

### **SUGGESTED FURTHER READINGS**

- Sharma, S.K. (2010). Postharvest management and processing of fruits and vegetables. NIPA, New Delhi.
- Siddappa, G. and Tandon, D.K. (1998). Preservation of fruits and vegetables. ICAR, New Delhi
- Srivastava, R.P. and Kumar, S. (2001). Fruit and vegetable preservation: Principles and practices. International Book Distributing Co., Lucknow, India.

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# Pomology-II

## Student Handbook



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