



Different methods of processing, preparation of processed products and minimal processing of fruits.

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Objective

- The main purpose of preservation of fruits is to protect foods against spoilage.
- Fresh fruits are highly perishable because they contain very high moisture and are biologically active i.e. they carry out all the life processes viz. respiration, transpiration, ripening etc.
- The fruits can be preserved either in the fresh form by adopting different techniques or preserved by making different fruit products



Principles of Food Preservation

The principles involved in different methods of preservation are broadly grouped under four different heads.

- **Preservation by application of heat**
- **Preservation by at low temperature**
- **Preservation by removal of moisture**
- **Preservation by addition of Chemical**



Preservation by Application of Heat:

- It is well-known that higher temperature above the optimum, are increasingly lethal to bacterial spores.
- Hence by raising the temperature of food materials and keeping them at the elevated temperature for the required length of time bacteria can be totally destroyed or their number may be reduced to any desired value.
- Enzymes are also heat sensitive and all the known enzymes lose their activity if heated to 80°C or above.
- Hence both the microbial and enzymatic spoilage can be well checked by application of heat.
- To reduce the chemical alterations, the foods must be heated just sufficiently to prevent microbial and enzymatic spoilage and heating is to be done in presence of as little of oxygen, as possible to arrest oxidative changes.
- The well-known methods of preservation by 'canning' and 'pasteurization' are based on the application of heat.



Preservation at low temperature :

- Low temperatures are not lethal to bacteria but growth and multiplication of bacteria are retarded as the temperature is lowered and may be practically stopped if the temperature is sufficiently low.
- Enzymatic and chemical reactions, particularly those responsible for destruction of vitamins, or alteration in colour and flavour, are also progressively retarded as the temperature is brought down.
- The physiological activities of fresh fruits such as transpiration, respiration and ripening also considerably slow down due to low temperature.



Preservation by removal of moisture:

- Removal of water also helps preservation of foods. Microbes cannot grow and multiply in absence of sufficient water in their environment.
- Many of the enzymatic reactions are hydrolytic in nature and require water as one of the reactants.
- Chemical reactions in food materials are slowed down when the reactions are in solid state.
- Hence by removing water from the foods it should be possible to preserve them by checking the important spoilage agents.
- This principle forms the basis for dehydrated food and where sugar acts as preservative.



Preservation by addition of chemical:

- Preservation of foods by chemicals has been practiced since the early days of food handling.
- Chemical preserves food by checking the microbial growth.
- The chemicals used must be carefully chosen so that in doses, they are effective; they may not prove injurious to the health of the consumers.
- Food laws regarding use of chemicals in foods are becoming increasingly strict in all countries.
- Only a few chemicals, of known biological effect are allowed to be added and that too only for a very limited number of food stuffs.
- Use of preservative chemicals in foods should always be discouraged.



Methods of Preservation

Canning:

- The temperature and time of heat processing depends on the pH value of the food. It is possible to classify foods to be canned on the basis of acidity and pH value.
- In general fruits are classified as high acid foods, while most of the vegetables fall in the category of low or medium acid group.
- Foods with pH values greater than 4.5 require relatively severe heat treatments.
- Most of the fruits are processed in boiling water (100° C) while vegetables are processed in steam under pressure (Temp. 115°-121° C).
- The canning operation is based on sterilization.
- This involves exposing the food to heat in order to destroy spoilage organisms, the food being protected against subsequent contamination by being enclosed in a hermetically sealed open top sanitary can.



Methods of Preservation

Drying:

- It is one of the oldest methods of food preservation and is widely used. Drying usually is accompanied by the removal of water.
- Moisture may be removed from foods by any of a number of methods from the practice of drying in ambient by the sun's ray to the modern artificial ones.
- Dried foods are more concentrated form of foods. Some pretreatments are required to produce good quality dried products.
- Proper packaging and storage condition play a vital role in dried products.

Freezing:

- Freezing is accomplished by exposing the food to very low temperatures resulting in converting the water molecules of food into ice crystals. Once the food is frozen it has to be stored under very low temperature.
- The freezing point of food is lower than that of pure water. Because of high content of water in most foods, most of them freeze solidly at temperature between 0° and - 3°C.
- The lower the temperature of freezing and its subsequent storage, better is the retention of colour, flavour, texture and nutrients.



Methods of Preservation

Aseptic Processing

- Aseptic processing is the process by which a sterile (aseptic) product (typically food or pharmaceutical) is packaged in a sterile container in a way that maintains sterility.

Addition of sugar

- The fruit products like jam, jelly, marmalade, candied fruit etc. are preserved by addition of sugar which results in the reduction of available moisture to a level where the development of microorganism is prevented.
- The total amount of water in a product is not necessarily a true indication of its susceptibility to mould growth.
- The controlling factor is the availability of water to the mould. In general the relative humidity for mould growth varies from 75-95 per cent.



Methods of Preservation

Addition of salt

- The concentration of salt necessary to inhibit the growth of microorganism in food is related to many factors, including the water content, type of infection, pH, temperature, protein content and presence of inhibitory substances such as acids.
- The water content is obviously of major importance, since it is the concentration of salt in water phase and not the amount in the food as a whole which is significant.
- The preserving action of salt on bacteria increases with decreasing temperature.
- It has been found that 15-20 per cent concentration of sodium chloride prevents the growth of some strains of food-poisoning bacteria while 20 to 25 per cent has a definite lethal effect.



Methods of Preservation

Addition of acids:

- In the preservation of food, acetic and lactic acids are most commonly employed. The effect of acids in preventing the development of microorganism may be due to the hydrogen ion concentration.
- The yeasts and moulds are very much less susceptible to the effect of high hydrogen ion concentration than bacteria.



Methods of Preservation

Chemical preservatives:

- They are substances capable of inhibiting, retarding or arresting the process of fermentation, acidification or other decomposition of food.
- This excludes salt, sugar, organic acids, spices, alcohols, essential oils and herbs.
- The permitted preservative used in this country are sodium benzoate and potassium metabisulphite.
- The activity of a preservative is primarily dependent on its concentration. If present in adequate concentration the effect on microorganisms is lethal.



Methods of Preservation

Fermentation:

- Fermentation is a process of anaerobic or partially anaerobic, oxidation of carbohydrates.
- Sodium chloride is useful in a fermentation process of foods by limiting the growth putrefactive organisms and by inhibiting the growth of large number of other organisms.
- Microorganisms are used to ferment sugar by complete oxidation, partial oxidation, alcoholic fermentation, lactic acid fermentation and other minor fermentative actions.
- Lactic acid fermentations are of great importance in food preservation.



Processed Products

Canned fruits

- In this method, Fruit pieces/slices are placed in cans and covered with sugar syrup, hermetically sealed, heat process and cooled.
- The most popular canned products are pineapples, litchi, mango-slices etc.

Dried Fruits

- In case of drying fruits original water content is removed either through exposure to sun or mechanical drying.
- The quality of dry fruit can be improved by exposing it to sulphur fumes before drying.
- The most popular dry fruits are raisins, dates etc.

Frozen fruits

- Fruit are frozen in syrup containing ascorbic acid to prevent browning induced by the enzyme.
- Quick freezing is the best method to retain the quality of the fruits. Most of the fruits are acceptable in the frozen form.



Processed Products

Fruit Juice/pulp

- This is a natural juice /pulp extracted from the fruit and remains practically unaltered in its composition during its preparation and preservations

Ready to Serve (RTS)

- This is a type of fruit beverage which contains at least 10 percent fruit juice and 10 percent total soluble solids besides about 0.3 percent acid.
- It is not diluted before serving.

Nectar

- This is a type of fruit beverage which contains at least 20 percent fruit juice/pulp and 15 percent total soluble solids besides about 0.3 percent acid.
- It is not diluted before serving.



Processed Products

Squash

- This is a type of fruit beverage which contains at least 25 percent fruit juice/pulp and 40-50 percent total soluble solids, commercially.
- It also contains about 1.0 percent acid and 350 ppm sulphur dioxide or 600 ppm sodium benzoate.
- It is diluted before serving.
- Mango, orange and pineapple are used for making squash commercially.
- It can also be prepared from lemon, bael, papaya, etc. using potassium metabisulphite (KMS) as preservative or from jamun, passion-fruit, peach, plum, raspberry, strawberry, grapefruit, etc. with sodium benzoate as preservative.

Cordial

- This is a sparkling, clear, sweetened fruit juice from which pulp and other insoluble substances have been completely removed.
- It contains at least 55 percent fruit juice and 30 percent total soluble solids.
- It also contains about 1.5 percent acid and 350 ppm sulphur dioxide or 600 ppm sodium benzoate.
- Lime juice cordial is very popular and suitable for blending with alcoholic drink.



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Processed Products

Fruit Juice Concentrates

- A fruit juice concentrate is prepared by removing moisture by vacuum concentration or by freezing.
- Carbonated beverages are prepared from this.
- They contain pure juice with at least 32 percent total soluble solids.

Fruit Juice Powder

- Fruit juice can be converted in to a free flowing, highly hygroscopic powder by puff-drying, freeze drying, vacuum drying or drum drying.



Processed Products

Candied fruits

- A fruit impregnated with cane sugar or glucose syrup, and subsequently drained free of syrup and dried, is known as candied fruit.
- The most suitable fruit for candying are aonla, karonda, pine apple, cherry, papaya, apple, peach and peels of orange, lemon, grape fruit and citron, ginger etc.

Fruit Leather

- Fruit leather is made by drying thin layers of fruit pulp
- Sulphur dioxide (potassium metabisulphite) is added to the pulp in the fruit leather to act as preservative.
- They are relatively light in weight, easy to prepare and a good way to use left-over canned fruit and slightly over-ripe fresh fruit.
- Fruit leathers can be eaten directly, or made into a beverage by combining 5 parts water with 1 part leather in a food blender.



MINIMAL PROCESSING:

- If the fruits are available in ready to consume form a large number of working women in metro cities will be greatly benefited.
- One should keep in mind that while supplying minimally processed fruits the maintenance of quality and hygiene must be of topmost priority.
- The demand for minimally processed fruits in metro cities is likely to multiply significantly in the coming years.
- Rapid urbanization, breakdown of joint family system, increase in the cost of household labour, increasing number of working women, rise in per capita income etc. have all contributed to the rapid growth and change in demand patterns.



Processed Products

Jam

- Jam is prepared by boiling the fruit pulp (45 Kg) with sufficient quantity of sugar (55 Kg) to a reasonably thick consistency, firm enough to hold fruit tissues in position with the help of pectin.
- It should not normally contain less than 68.5 per cent soluble solids and 0.5-0.6 percent acid.
- Good jam has a soft even consistency without distinct pieces of fruit, a bright color, a good fruit flavor and a semi-jellied texture that is easy to spread but has no free liquid.

Jelly

- A jelly is a semi-solid product prepared by boiling a clear fruit extract free from pulp containing pectin with 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.

Marmalade

- Marmalade is a fruit jelly in which slices of the citrus fruit or its peels are suspended.
- Marmalades are generally made from citrus fruits like oranges and lemons in which shredded peels are suspended.
- Citrus marmalades are classified into jelly marmalade, and jam marmalade.

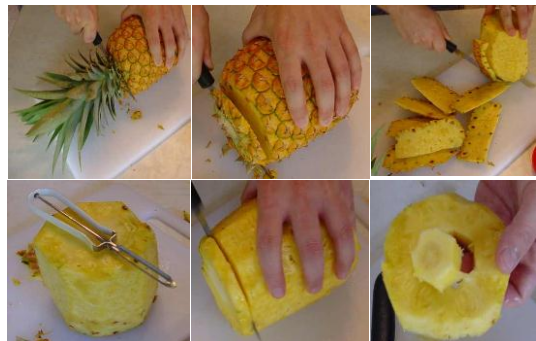


MINIMAL PROCESSING:

- Minimal processing in other words are pre-cut fruits which are packed in suitable packaging material that permits suitable shelf life and fresh like characters.
- Minimally processed fruits are cleaned, peeled, cut, sliced, packaged and/or lightly processed. These foods are in great demand because of their convenience.
- All fruits need not be minimally processed. It is very often not convenient for the consumer with a small family to purchase commodities like pineapple, jackfruit, watermelon, etc.
- Therefore if it is suitably sliced, peeled and packed consumer will be more inclined to buy it.
- In addition it generates a considerable amount of waste (30%) that creates disposal problems for the housewives.
- In metro cities minimally processed fruits can solve one of the greatest problems of garbage disposal.



Minimally processed pineapple





Minimally processed pineapple



Slices,
Chunks,
Tidbits &
Dices or
Cubes

Juices



Minimally processed Jack Fruit



Minimally processed Jack Fruit



Training / Demonstration -2

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Low Cost Technique of Storage

Zero Energy Cool Chamber

- The Pusa zero energy cool chamber (Pusa ZECC) works on the principles direct evaporative cooling.
- The greatest importance of this technology is that it does not require any electricity or power.
- The materials required to make the cool chamber are available easily, cheaply and locally.
- Even unskilled labor can build the chamber, as it does not require any specialized skill.
- Bricks and most of the raw materials used in the cool chamber are also reusable.
- The cool chamber is kept saturated with water either by sprinkling of water once in the morning and once in the evening or fixing a drip system in order to maintain temperature and humidity.
- The cool chamber can reduce the temperature by 10-15°C and maintain high humidity of about 95% throughout the year (See diagram Pusa ZECC).



Construction:

- Select an-upland having a nearby source of water supply.
- Make floor with brick 165 cm x 115 cm.
- Erect the double wall to a height of 67.5 cm leaving a cavity of 7.5 cm.
- Drench the chamber with water.
- Soak the fine river bed sand with water.
- Fill the 7.5 cm cavity between the double walls with this wet sand.
- Make a frame of top cover with bamboo (165 cm x115 cm) frame and 'sirki' straw or dry grass.
- Make a thatch/tin shed over the chamber in order to protect it from direct sun or rain or snow.

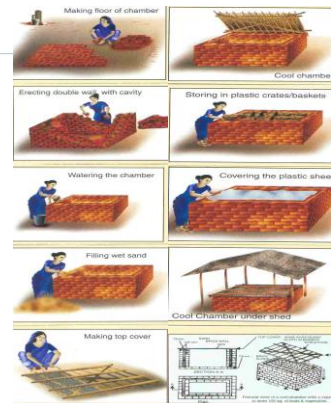


Operation:

- Keep the sand, bricks and top cover of the chamber wet with water.
- Water twice daily (morning and evening) in order to achieve desired temperature and relative humidity.
- Alternatively fix a drip system for watering with plastic pipes and micro tubes connected to an overhead water source.
- Store the fruits in this chamber by keeping in perforated plastic crates. Cover these crates with a thin polyethylene sheet.
- The cool chamber should be reinstalled once in 3 years with new bricks utilizing the old bricks for other purposes.



DIAGRAM FOR CONSTRUCTION OF ZECC



APPROXIMATE COST OF COOL CHAMBER (100 Kg. capacity)

COST OF COOL CHAMBER (100 Kg Capacity Chamber)	
Brick (400 Nos)	Rs.2000.00
Sand	Rs. 500.00
Bamboo, Khas Khas, etc. for top cover	Rs. 500.00
Corrugated tin shed	Rs. 1500.00
Water tank, pipes, tubes poly sheet etc.	Rs. 1000.00
Plastic Crates (6 Nos)	Rs.1200.00
Total	Rs. 6000.00

DEMONSTRATION OF CONSTRUCTION OF ZECC



On Farm Pre-Cooling & storage : Zero Energy Cool Chambers (ZECC)



- Based on the principle of direct evaporative cooling zero energy cool chambers have been developed.
- It is a double brick-wall structure, the cavity is filled with sand and walls of the chamber are soaked in water.
- Even unskilled labour can build the chamber, as it does not require any specialized skill.
- Cool chambers can reduce temperature by 10-15°C and maintain high humidity of about 95% that can increase shelf life and retain quality of horticultural produce.
- Small and marginal farmers can store a few days' harvest to avoid middlemen since cold storage facilities are not easily available to them.



Storage of fruits in cool chamber

Crop	Cool chamber		Room temperature	
	Shelf life (days)	PLW (%)	Shelf life (days)	PLW (%)
Aonla	18	1.72	9	8.70
Banana	20	2.50	14	4.80
Grape fruit	70	10.20	27	4.94
Guava	15	4.00	10	13.63
Kinnow	60	15.3	14	16.10
Lime	25	6.00	11	25.00
Mango	9	5.04	6	14.99
Sapota	14	9.46	10	20.87



Comparative study : Pictorial View



Kinnows stored at Cool Chamber (60-80 days)



Enhance lycopene development (20 days)



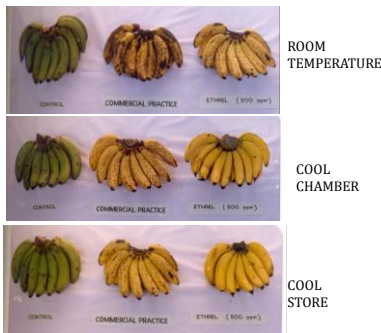
Spinach stored in cool chamber (3 days)



Potato stored in cool chamber (90 days)



Storage study of banana : At the end of 12 days



Demonstration of different packaging and cushioning material

- The main objective of packaging is to keep the fruits in good condition until it is sold and consumed.
- Good packaging gives more choice to consumers in terms of food availability and encourages the customers to purchase the product.
- Packaging also enhances the income of rural producers from surplus produce.
- Post-harvest losses are occurring in the period between harvesting and consumption.
- The term losses include all types of losses for the farmers, traders and consumer.
- There is an urgent need to adopt proper post harvest management practices by adopting improved packaging, handling and efficient transportation methods.



Appropriate Packaging :

Plastic crates with liners



Film wrapping:

- Reduces weight loss,
- Induces controlled atmosphere
- Extends shelf-life
- Acceptable to consumer



AMITY UNIVERSITY **Preparation & Preservation**

Minimal Processing :

- It is more easy to eat an apple than a pineapple or pomegranate.
- Consumer will be more inclined to buy Pomegranate if it is sold in a ready to eat form packet.

AMITY UNIVERSITY **MINIMAL PROCESSING OF POMOGRANATE**



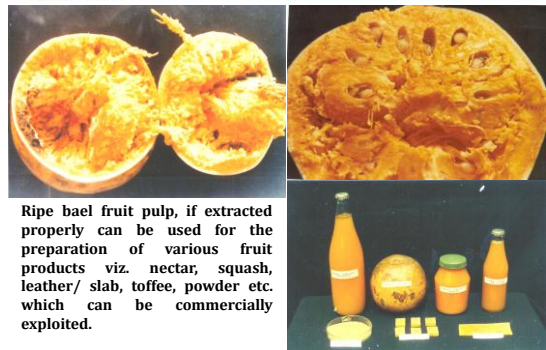
AMITY UNIVERSITY **Bael fruit (*Aegle marmelos*)**

The tree is very hardy and can grow under adverse agroclimatic condition. It is abundantly available in the forest areas

- The fruits are highly nutritive and are very rich in riboflavin and polyphenolics, a source of antioxidants
- Fruit is difficult to eat out of hand
- The ripe fruit is a tonic, restorative, astringent, prevents constipation and good for heart and brain.
- The unripe fruit is a digestive and stomachic and is prescribed for diarrhoea and dysentery, etc.

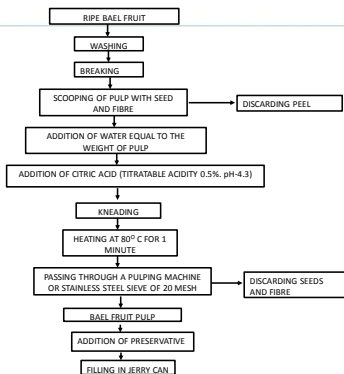


AMITY UNIVERSITY **Processing of Bael Fruit**



Ripe bael fruit pulp, if extracted properly can be used for the preparation of various fruit products viz. nectar, squash, leather/ slab, toffee, powder etc. which can be commercially exploited.

AMITY UNIVERSITY **Flow Sheet for the Extraction of Bael Fruit Pulp**



AMITY UNIVERSITY **Extraction of Bael Pulp**





Processed Bael Products



Advantages of Minimal processing

- Consumers are increasingly demanding convenient, ready to use/eat fruit with a fresh like quality and containing only natural ingredients.
- Pre-packaging allows for more efficient portion control.
- Solid waste disposal problems are reduced.
- Demand on limited refrigerated storage space are reduced.
- If the fruits are available in ready to eat form a large number of working women in metro cities will be greatly benefited.
- One should keep in mind that while supplying minimally processed fruits the maintenance of quality and hygiene must be of topmost priority.
- Rapid urbanization, breakdown of joint family system, increase in the cost of household labour, increasing number of working women, rise in per capita income etc., have all contributed to the rapid growth and change in demand patterns.
- In metro cities minimally processed fruits can solve one of the greatest problems of garbage disposal

