

10.1.4 : Utilizes the knowledge on food preservation and postharvest losses for successful

13. Which step in the food supply chain is causing most loss in the developing countries?

MCQ

- Food preservation is based on the following three basic principles.
 - Preventing of entry of microorganisms into food (aseptic)
 - Prevention of the growth and activity of microorganisms in food.
 - Remove or killing of microorganisms in food.Preservation of fruit juice and prickles are based on which of the above principle/s?
(1) b and c (2) a and b (3) a and c (4) only b (5) only c
- Which of the following senesces incorrect regarding food preservation.
(1) Smoke is antimicrobial (2) EDTA is used as chemical preservative
(3) X rays and Gamma rays are used to preserve food.
(4) Fish are first dried in sunlight and then salted in preservation.
(5) Wheat, corn, oats rice and barley are left to dry to prevent spoilage.
- Which of the following methods is commonly used to prevent the entry of microorganisms into food during preservation? (1) Fermentation (2) Canning (3) Refrigeration (4) Pickling (5) Dehydration
- One of the primary reasons for postharvest losses in fruits and vegetables is due to the action of:
(1) Fungi (2) Dehydration (3) Mechanical damage (4) Excessive heat (5) Refrigeration
- In which method of food preservation are microorganisms killed by exposure to high temperatures?
(1) Fermentation (2) Canning (3) Pickling (4) Salting (5) Freezing
- What is the primary function of food preservation techniques like pickling and salting?
(1) Increase nutritional content (2) Prevent spoilage by microorganisms (3) Enhance flavor (4) Reduce moisture content (5) Increase shelf life by reducing oxidation
- A farmer observes significant postharvest losses due to microbial decay. Which of the following practices can most effectively minimize these losses?
(1) Sorting damaged produce (2) Washing with chlorinated water
(3) Cooling immediately after harvest (4) Irradiation of produce (5) All of the above
- Which method of food preservation is based on preventing the growth and activity of microorganisms in food?
(1) Freezing (2) Pasteurization (3) Canning (4) Smoking (5) All of the above
- Postharvest losses can occur due to metabolic activities of produce. Which of the following storage conditions can slow down these activities?
(1) Increasing oxygen levels (2) Maintaining low temperatures (3) Reducing light exposure (4) Dehydrating produce (5) High humidity storage
- Which of the following factors does not directly contribute to postharvest losses in agricultural products?
(1) Mechanical damage during transportation (2) Poor temperature control
(3) High humidity in storage (4) Genetic modifications of crops (5) Insect infestation
- Canning is an effective method of food preservation because it:
(1) Removes oxygen, preventing aerobic microbial growth (2) Increases food acidity
(3) Uses salt to inhibit microbial growth (4) Adds preservatives to food
(5) Enhances the nutritional value of food

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Applied Biology



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10.3 Food Preservation and Postharvest losses



Unit 10 Applied Biology

10.1.0 : Uses biological concepts and principles to promote the living standards

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processing could be reduced by following correct procedures. (eg: Harvesting at the right time), hygienic handling to prevent microbial contaminations and proper storage (to prevent attacks of insects, rodents, etc.).

Drying (paddy/rice & other cereals), drying after thermal treatment (jack fruit, etc.), pasteurization (milk), freezing (fish and meat are temporarily stored in freezer compartment of a refrigerator), chilling (fruits, vegetables, etc.), salting (lime, etc.), salting & drying (fish), sugaring (homemade jams), use of chemicals (pickles),

Learning outcomes:

1. What is food preservation?
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.....
2. Explain the importance of food preservation
.....
.....
.....
3. State the basis of three principles of food preservation
.....
.....
.....
4. Fill the following table regarding food preservation methods.

Type of preservation	Method and Principle used	Food items
Drying		
Thermal treatment		
Pasteurization		
Freezing and chilling		
Salting		
Salting and drying		
Addition of sugar		
Smoking		
Chemicals		
Preservation through radiation		
Bio-preservation		

- Eliminating avoidable losses
- Making more nutritive food items from low grade raw commodity using proper processing and fortification,
- Diverting a portion of food materials presently being fed to animals for human consumption by way of processing.
- Fortifying low grade food and organic wastes and by-products into nutritive animal feed.

Principles of Food Preservation

It is essential to prevent contamination of harvested food from damaging agents by hygienic handling, transportation and storage.

Three basic principles of food preservation

- Prevention of entry of microorganisms into food (aseptic)
- Prevention of the growth and activity of microorganisms in food.
- Remove or killing of microorganisms in food.

Methods of Food Preservation

Food preservation methods aim to prevent contamination in the first place and to remove or reduce the numbers of contaminants. Preservation of food is achieved by application of physical, chemical and/or biological methods. The techniques may be applied separately or in combination. Microorganisms need a source of food and water, and they also need a suitable pH and temperature to grow; one or several of the living conditions needed for the growth of microorganisms have to be removed by the food preservation technique.

Drying

One of the oldest methods of food preservation is drying. Food is dried mostly in the sun and drying reduces water activity of the food sufficiently to prevent or delay microbial growth allowing food to keep for weeks. Most types of grains are dried to increase shelf life. Wheat, corn, oats, rice, rye, and barley are left to dry to prevent spoilage. Hams are a great example of meats preserved through drying in ovens.

Thermal (heat) Treatment

Heating food is an effective way of preserving it because the great majority of harmful pathogens are killed at temperatures close to the boiling point of water. In this respect, heating is a form of food preservation. A preliminary step in many other forms of food preservation, especially forms that make use of packaging, is to heat the food to temperatures sufficiently high to destroy pathogens. In many cases, food is actually cooked prior to their being packaged and stored.

Pasteurization (preserving fresh milk, refer unit 9)

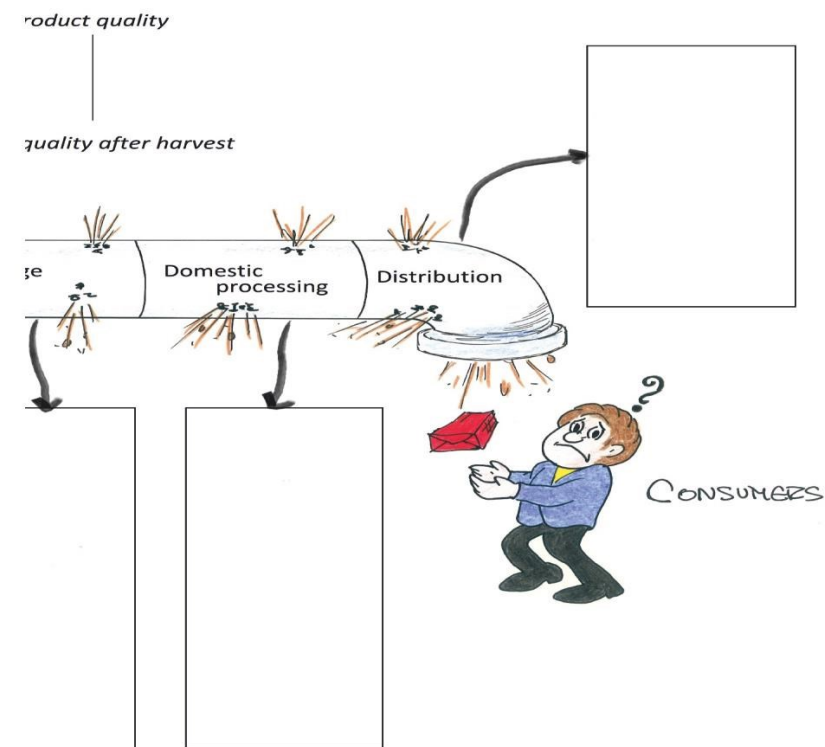
Freezing and chilling

Freezing is perhaps the most common of all modern food preservation methods both commercially and domestically. Commercially freezing is done in different types of freezers under extremely fast freezing or fast freezing (bringing the temperature of fish/meat down to a value between -18 to -30°C within 15 minutes to 2 hours) to preserve the quality. Frozen products are stored in cold rooms (at -18 to -30°C) until distributed in order to prevent the growth and spreading of spoilage microorganisms (the extreme cold prevents microbial growth). Storage of food (fruits, fruit juices, vegetables, fish, meat, etc.) in refrigerators at low temperatures (chilling at 4 to 7°C) reduces the growth and activities of spoilage microorganisms, preserving food for a short period (for 10 to 14 days).

Provision of proper storage infrastructure could prevent/reduce the losses that occur during storage of paddy/milled rice. Uncontrolled changes of temperature could encourage spoilage microorganisms to grow faster spoiling the stored produce (fruits and vegetables). Storage of fruits and vegetables should be done in properly chilled rooms to reduce the rate of spoilage.

Domestic processing

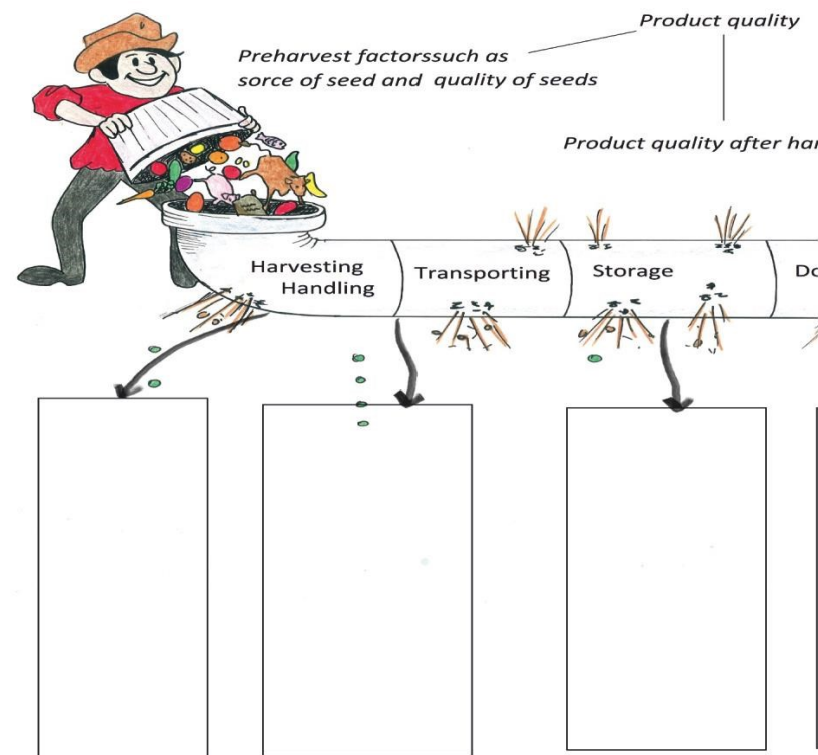
In domestic processing of different food types at different areas of Sri Lanka following methods are used. The postharvest loss of food processing could be due to early harvesting, improper handling, etc. Postharvest losses that could occur during domestic



In tropical countries, if transportation is carried out at night time produce could be protected by high temperature of the day time.

Storage

Storage plays a vital role in the food supply chain, although losses occur at each stage of the supply chain from production to consumer level, storage losses are considered most critical in developing countries as maximum losses occur during the storage. Generally, after harvesting/milling, grains are stored for short or long periods of storage as food reserves, and as seeds for next season. Poor storage infrastructure allows, rice to absorb excess moisture, rice grains with excess moisture to be infested easily by insects pests followed by invasion of spoilage microorganisms, rice to be attacked by rodents and other pests.



Salting

Salting also is an older form of preserving raw foods. Salt has an ability to suck the moisture out of food through the process of osmosis. When the food is totally dry from salting, growth of microorganisms are inhibited. Meat is commonly preserved through salting.

Salting and drying

In preparation of dried fish (anchovy, tuna, etc.) fish are first salted and then dried in sun. Addition of salt makes the removal of water fast and the salt inhibits microbial growth on fish even though some moisture is still remaining in flesh.

Addition of Sugar (Sugaring)

Sugar is used in syrup form to preserve fruits and in crystallized form to preserve some food items like ginger and orange peel. Some fruits are glazed with sugar syrup for the fruits to get a superficial, protective coating. Some fresh finits are cooked with sugar and then dried. High sucrose concentration produces osmotic stress on microorganisms and protects the food from microbial spoilage.

Eg. Jam, Sugared toffees made with ash pumpkin (Alu Puhul)

Smoking

Smoking is the process that cooks, flavours and preserves food exposing it to the smoke from burning wood. Smoke is antimicrobial and antioxidant and most often meats and fish are preserved by smoking. The aroma generated by hydrocarbons of burning wood enhances the taste, flavour and adds smokiness to the meat/fish while preserving

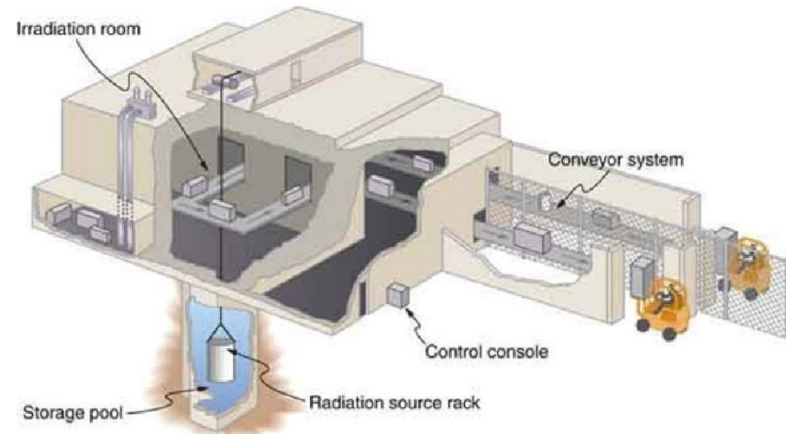
Chemicals

Chemicals inhibit growth and activity of microorganisms while some chemical compounds can kill the microorganisms (Eg. Preservation of fruit juice and production of pickels using chemicals such as sodium benzoate, EDTA, acetic acid, and brine solution).

Preservation of Food through radiation

The type of radiation used in processing food materials is limited to radiations from high energy gamma rays, X-rays and accelerated electrons. Processing of food by radiation involves exposure of food to short wave radiation energy to achieve a specific purpose such as extension of shelf-life, insect disinfection and elimination of food borne pathogens and parasites. (Eg. packets of spices, ground meat, etc.).





Postharvest Losses

Food losses that occur along the food supply chain from harvesting of a crop until its consumption is defined as postharvest losses.

Product quality at harvest is influenced by when and how the harvest is done; pre-harvest factors such as source of seed and quality that has been set during growth also contribute for the product quality at harvest. Product quality at harvest could be lost further during harvesting, handling, transporting, storage, domestic processing and distribution.

The postharvest losses can broadly be categorized as,

- Weight loss due to spoilage,
- Quality loss,
- Nutritional loss
- Seed viability loss and
- Commercial loss.

Postharvest losses in production of cereals (Eg. paddy) fruits and vegetables

During Harvesting - Untimely harvesting

Paddy should be harvested at the best time (considering the variety of paddy). Delayed harvesting of paddy may result quality loss, nutritional loss, seed viability loss, weight loss commercial loss. Those losses could be further increased if paddy fields are flooded due to heavy rains just before harvesting.. If paddy is harvested earlier it requires more drying (drying cost), grains with high moisture content are susceptible to mold growth & insect infestation resulting broken grains and low milling yield with signifi-

cant commercial losses. In addition, depending on the method of harvest, part of the paddy crop may be left and ploughed in to soil which is a commercial loss. Fruits and vegetables also should be harvested at the best time (could vary with the variety) to have maximum quality and to obtain the highest quantity; If harvested too early, the crop will not be ripe/matured enough and if harvested too late it may spoil quickly leading to quality loss and nutritional loss, finally resulting economical losses. Harvesting of fruits and vegetables should be done without allowing physical/mechanical damages to occur. If damages occur quality and storage life will be reduced as spoilage microorganisms will quickly invade through damaged areas.

During Handling

High shattering loss of paddy seed could occur which is a commercial loss. Harvested paddy should be dried, bagged and stored temporarily without allowing the paddy seed to absorb moisture and greater attacks by insects and rodents. In order to protect the quality, harvested fruits and vegetables should be handled hygienically kept in plastic cartons which could be kept in a shade temporarily. Harvested fruits/vegetables should be sorted to remove damaged, infested, moldy and over-ripe fruits / over-matured vegetables; sorting will reduce spoilage during transport and storage.

Transportation

Poor road infrastructure along with improper and poorly maintained modes of transportation results in large spillage of paddy seed and high contamination. Multiple movements of crop is another major reason for high transportation losses. Sometimes bagged paddy is loaded and unloaded from vehicles several times before it is milled. During each movement some grains are lost as spillage. During handling and transportation of rice, 2 - 10% losses occur in Southeast Asia. Those losses could be minimized using well planned, better mode of transportation with an efficient bulk handling system.

During the transportation of fruits/vegetables arranged at the bottom of stacked crates could be damaged by the weight of the produce kept above; use of crates that could be stacked without putting the weight on produce at the bottom would solve this issue. Use of straw or something soft in between layers of produce within a crate will reduce the damages due to rubbing. Rough handling of crates containing produce should be avoided to prevent possible damages to the produce. Uncontrolled changes of temperature and excessive shaking could do great damages to the produce during transport.

