1.	Smoke has both antimicrobial and antioxidant properties in food preservation.	
2.	In fish preservation, fish are first dried in sunlight and then salted.	
3.	Freezing is perhaps the most common of all modern food preservation methods both commercially and domestically.	
4.	Storage of food in refrigerators at 4 to 7°C can preserve food for 20-25 days.	
5.	Salt preserves food through the process of osmosis by removing moisture.	
6.	Sugar is only used in syrup form for food preservation	
7.	High sucrose concentration produces osmotic stress on microorganisms	
8.	X-rays, gamma rays, and accelerated electrons are all used in food preservation through radiation.	
9.	Chemicals like sodium benzoate, EDTA, and acetic acid are used as preservatives	
10.	Wheat, corn, oats, rice, and barley are left to dry to prevent spoilage.	
11.	Postharvest losses only occur during storage and transportation.	
12.	Commercial freezing is done between -18 to -30°C within 15 minutes to 2 hours.	
13.	In Southeast Asia, 2-10% losses occur during handling and transportation of rice.	
14.	Poor storage infrastructure prevents rice from absorbing excess moisture.	
15.	Fruits and vegetables should be transported only during daytime in tropical countries.	
16.	Delayed harvesting of paddy cannot affect seed viability.	
17.	High moisture content in grains makes them susceptible to mold growth and insect infes- tation	
18.	Storage plays a minor role in the food supply chain.	
19.	The aroma in smoked food comes from hydrocarbons of burning wood.	
20.	Temperature changes during storage have no effect on spoilage microorganisms.	



Unit 10 Food Preservation & Postharvest Losses

Most kinds of foods are readily

spoiled



10.1.4 : Utilizes the knowledge on food preservation and postharvest losses for successful applications in day to day life

Number of Periods : 05

Importance of food preservation

Most kinds of foods are readily spoiled unless they are preserved using suitable methods of preservation. Food preservation ensures that food could be stored for a particular period. During some seasons over production of certain food occurs and the excess production could be preserved (using suitable methods) and stored to be used later. Food preservation protects the food that is available for human consumption reducing the "food loss".

Food preservation

Food preservation is the process of treating and handling food to stop or greatly slow down spoilage (loss of quality, edibility or nutritive value) caused or accelerated by micro-organisms.

Food could be preserved before undergoing spoilage using suitable techniques which could prevent unnecessary wastage and contribute greatly to meet food requirement of growing human population by,

30. Storage losses can be prevented by:

(1) Keeping in open area (2) Allowing moisture absorption (3) Ignoring pest control(4) Providing proper storage infrastructure (5) Increasing temperature

17. Smoking preserves food by:

(1) adding flavor (2) Being antimicrobial and antioxidant (3) adding color (4) adding smokiness(5) improving texture

18. The aroma in smoked food comes from:

(1) Added flavors (2) Chemical additives (3) Hydrocarbons of burning wood (4) Natural enzymes(5) Bacterial action

- 19. Which chemicals are used in food preservation?(1) Sucrose (2) Hydrocarbons (3) Sugar syrup (4) Antibiotics(5) Sodium benzoate, EDTA, acetic acid, and brine solution
- 20. Food preservation through radiation uses:
 - (1) Gamma rays, X-rays and UV (2) Only X-rays (3) Gamma rays, UV and accelerated electrons
 (4) Gamma rays, X-rays and accelerated electrons (5) Gamma rays, X-rays and IR
- 21. Which of the following is NOT a type of postharvest loss?(1) Weight loss (2) Quality loss (3) Seed texture loss (4) Seed viability loss (5) Commercial loss
- 22. What defines postharvest losses?
 - (1) Losses along food supply chain in storage and transportation
 - (2) Losses along food supply chain from handling until consumption
 - (3) Losses along food supply chain from harvesting until consumption
 - (4) Losses along food supply chain from processing until consumption
 - (5) Losses occur in harvesting or consumption
- 23. When should paddy be harvested?
 - (1) At ant time considering species (2) At the best time considering variety(3) During morning hours (4) Only during dry season (5) Only at night
- 24. What happens if paddy is harvested too early?

(1) Nutritional loss (2) Will not ripe (3) More moisture content and mold growth
(4) Less insect infestation (5) Spoil quickly

- 25. In Southeast Asia, rice losses during handling and transportation are: (1) 1% (2) 2-10% (3) 15-20% (4) 25-30% (5) 35-40%
- 26. For transporting fruits/vegetables, what is recommended?
 - (1) Using uncovered vehicles (2) Using straw between layers in crates (3) Transport in sacs(4) Transportation during day time (5) Random stacking
- 26. How should harvested fruits/vegetables be handled?
 - (1) Store in metal containers (2) Keep in direct sunlight
 - (3) Keep in plastic cartons in shade temporarily (4) Mix all varieties together
 - (5) Store at room temperature
- 28. What is a major storage problem with rice in poor infrastructure?
 (1) Too dry conditions (2) Excess moisture absorption leading to pest infestation
 (3) Too much ventilation (4) Excessive light (5) Low temperature
- 29. How should fruits and vegetables be stored?
 - (1) In open areas (2) At room temperature (3) In properly chilled rooms (4) In direct sunlight(5) Without temperature control

- 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 offish/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 prevent 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).

- 5. Food preservation is based on the following three basic principles:
 a. Prevention of entry of microorganisms into food (aseptic)
 b. Prevention of the growth and activity of microorganisms in food
 c. Remove or killing of microorganisms in food
 Which principle/s applies to preservation of fruit juice and pickles?
 (1) b and c (2) a and b (3) a and c (4) only b (5) only c
- 6. Essential principle/s for food preservation include:
 (1) Prevention of contamination by hygienic transportation and storage
 (2) Prevention of contamination by hygienic handling and storage
 (3) Prevention of contamination by hygienic handling
 (4) Prevention of contamination by hygienic handling, transportation and storage
 (5) Prevention of contamination by hygienic handling and transportation
- 7. Incorrect regarding food preservation method:
 (1) Prevent contamination in first place and remove or reduce number of contaminants.
 (2) Can achieve by application of physical, chemical and biological methods.
 (3) Techniques may be applied separately or in combination.
 (4) One or several living conditions needed for growth of microorganisms have to be removed
 (5) Addition of sugar is a biological method of food preservation.
- 8. Which foods are commonly preserved by drying?
 (1) Hams (2) Jam, ash pumpkin (3) Wheat, corn, oats, rice, and barley (4) Spices ground meat
 (5) Vegetables, Fish, Meat
- 9. In thermal treatment:

(1) Pathogens are killed at temperatures close to boiling point (2) No packaging is needed(3) It only works for liquids (4) Low temperatures are used (5) It doesn't affect microorganisms

- 10. Commercial freezing temperature range for fish/meat is: (1) 0° C to -10° C (2) -18° C to -30° C (3) -5° C to -15° C (4) 4° C to 7° C (5) 2° C to 5° C
- 11. Chilling preservation in refrigerators uses temperature range: (1) -18°C to -30°C (2) -5°C to -15°C (3) 4°C to 7°C (4) 8°C to 12°C (5) 15°C to 20°C
- 12. Food preservation through chilling at 4 -7°C lasts for: (1) 2-5 days (2) 5-8 days (3) 10-14 days (4) 20-25 days (5) 30-35 days
- 13. Salting preserves food by:
 (1) Killing microorganisms directly
 (2) Sucking moisture through osmosis
 (3) Increasing temperature
 (4) Adding nutrients
 (5) Changing colour
- 14. In fish preservation, which process is correct?(1) First drying then salting (2) First salting then drying in sun (3) salting (4) drying (5) Radiation
- 15. Sugar preservation works by:
 - (1) Killing microorganisms directly(2) Producing osmotic stress on microorganisms(3) Degrading food(4) Decreasing food quality(5) Due to chemical change of food
- 16. Sugar is used in preservation as:

(1) Powder form (2) Liquid form (3) Syrup form for fruits and crystallized form for some foods (4) Glazed (5) Crystal form

12.	Write the precautionary measures carried out to prevent losses during handling of harvest of a. paddy b. fruits/vegetables
11.	Write the ways how loss can be done during the transport of paddy.
12.	In what ways the loss of harvest of paddy can be minimized during transport?
13.	Which step in the food supply chain is causing most loss in the developing countries?

MCQs

- Not a purpose of food preservation is to:

 Ensure food could be stored for a particular period (2) Eliminate avoidable losses
 Divert portion of food feed to animals to human consumption (4) To increase nutritive value
 Fortify low grade food and organic waste for human consumption
- 2. Which of the following statement incorrect?

(1) Most food readily spoiled unless they are preserved.

(2) During some seasons, excess food production occur and excess need to be preserved.

(3) Process of treating and handling food to stop or greatly slow down spoilage

(4) Hygienic handling, transportation and storage prevent contamination of harvested food from damaging organisms

(5) Food loss can be improved through food preservation

- Food preservation helps to meet food requirements by:
 (1) Eliminating avoidable losses (2) Making more nutritive food items
 (3) Diverting animal food to human consumption (4) Fortifying low grade food
 (5) All of above methods
- 4. The three basic principles of food preservation are:
 - (1) Salting, smoking, and radiation (2) Drying, freezing, and heating
 - (3) Prevention of entry, growth, and removal/killing of microorganisms
 - (4) Chemical treatment, Irradiation (5) Salting, Drying and thermal treatment

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 microrganisms (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 disinfestation and elimination of food borne pathogens and parasites. (Eg. packets of spices, ground meat, etc.).



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 significant commercial losses. In addition,

5.	Define post-harvest losses.
6.	States causes for postharvest loss.
7.	What are the factors which affect the product quality at harvest?
0	
8.	write the possible types of post harvest losses.
0	
9.	Paddy should be harvested at the time (considering the variety of paddy).
	Delayed harvesting of paddy may result in,,
	and commercial loss. These losses could be further increased if paddy
	fields are flooded due to just before harvesting. If paddy is harvested
	earlier, it requires more (drying cost), and grains with high moisture con-
	tent are susceptible to growth and infestation result-
	ing in broken grains and milling yield with significant commercial loss-
	es. In addition, depending on the method of harvest, part of the paddy crop may be left
	and ploughed in to soil which is a loss. Fruits and vegetables also should be
	harvested at the 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
	/matured enough and if harvested too late it may quickly
	leading to quality loss and nutritional loss, finally resulting losses. Harvest-
	ing of fruits and vegetables should be done without allowing /
	mechanical damages to occur; if damages occur quality and storage life will be reduced
	as spoilage microorganisms will quickly invade through areas.
10.	Write the losses possible due to delayed harvesting of paddy.
	1 , 5 , 5 , ,

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:

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1. What is food preservation?

3.

2. Explain the importance of food preservation

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State the basis of three principles of food preservation

4. Daw arrows to show relationship between preservation technique and food type.

Preservation Method	Food Items
Drying	Fish, Meat
Thermal Treatment	Fruits, Fruit juices, Vegetables, Fish, Meat
Freezing	Wheat, corn, oats, rice, barley, Hams
Chilling (4-7°C)	Food before packaging
Salting	Fruit juice (preservatives), Pickles (sodium benzoate, EDTA, acetic acid, brine solution)
Addition of Sugar	Raw meat, Fish (anchovy, tuna), Lime
Smoking	Packets of Spices, Ground meat
Chemicals	Fruits, Ginger, Orange peel, Jam, toffees with ash pumpkin
Radiation	Meat, Fish

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 voided to prevent possible damages to the produce. Uncontrolled changes of temperature and excessive shaking could do great damages to the produce during transport. 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 har-vesting/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.

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 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.).

