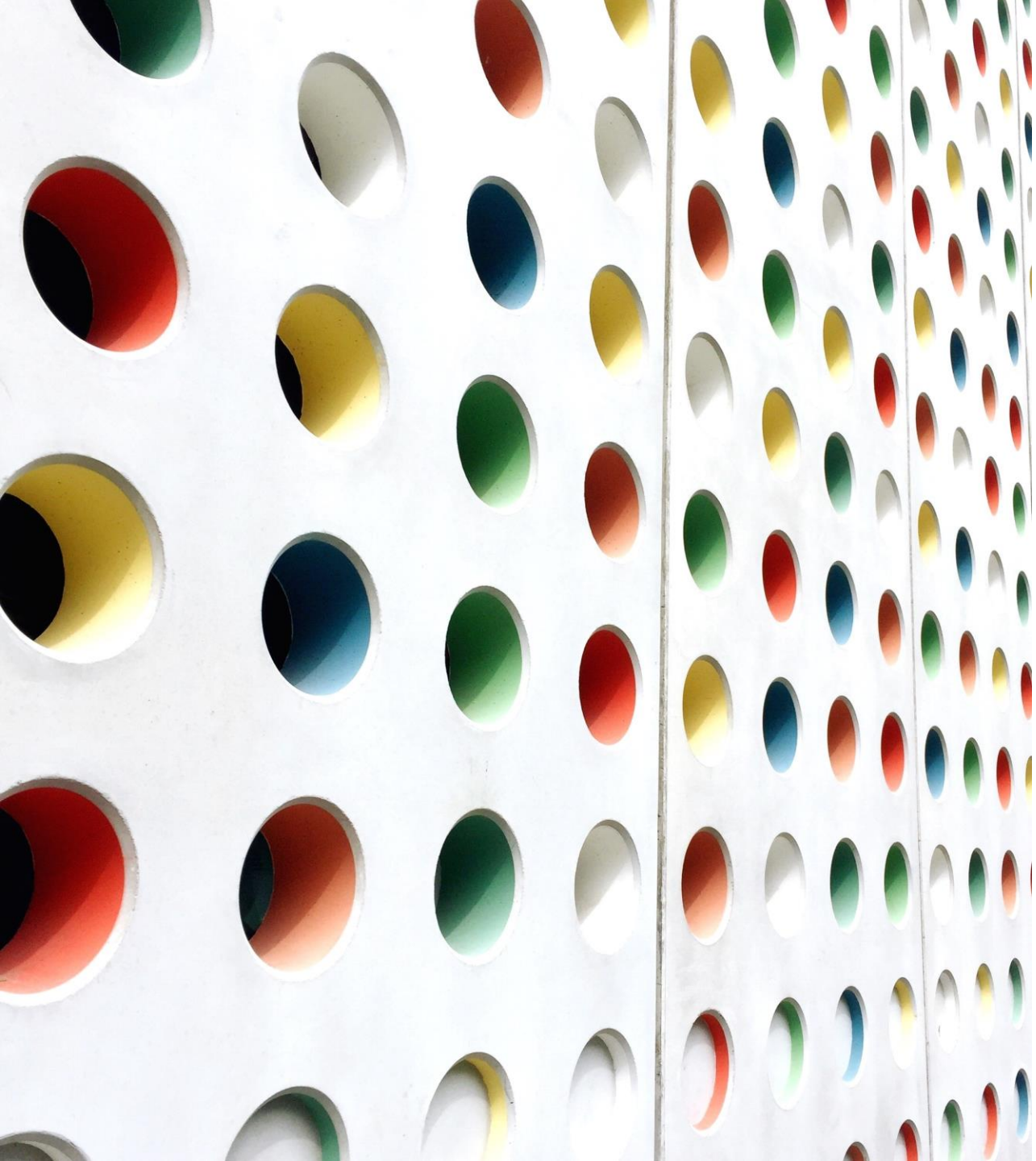

PHT –

TUTORIAL DISCUSSION – I, II and III

Lecture 01 - Post-harvest technology of fruits, vegetables and grains

Q1. I. What is post-harvest technology and it's important? (20%)

The treatment of agricultural produce after harvest

To ensure its protection, conservation, procession etc.

to meet the food and nutritional requirements of the consuming population

Importance: of PHT

Increase agricultural production.

• Prevent extensive post-harvest losses.

• Advanced nutrition.

• Improve the quality of produce.

• Generate employment.

• Reduce poverty.

• Stimulate the growth of other related economic sectors.

II. How post-harvest losses affect to small scale farmers? (10%)

Post harvest lost to small scale farmers are very significant since nearly 40% loss occur during handling of fruits and vegetables.

However, the small scale farmers recover the loss by determining a high price to the produce and that is ultimately afforded by consumers.

iii. Discuss about quantitative and qualitative loss. (20%)

Post-harvest loss can be defined as the loss from the stage of harvesting to the stage of consumption which occurs as a result of quantitative loss, qualitative loss, and the food waste.

Quantity losses, are common in developing countries, occur as a result of weight loss, spillage of crops, attack by moulds and pests and uneconomic collection, loading and unloading.

Quality losses, are common in developed countries, occur as a result of nutrient loss, undesirable change in taste, shape and texture, presence of excreta of birds and rodents and

contamination by mycotoxins.

Q2. i. Explain about factors affecting post-harvest losses. (60%)

Primary Factors affecting post-harvest losses

- Mechanical loss
- Microbial action
- Environmental factors

Secondary Factors affecting post-harvest losses

- Inadequate harvesting methods.
- Incomplete drying before threshing.
- Inadequate storage facilities.
- Longer shipment.
- Longer distribution period.
- Lack of market access and policies.

ii. Discuss about type of post-harvest losses. (40%)

Types of post-harvest losses

- Direct or indirect loss.
- Weight loss.
- Food loss.
- Seed viability loss.
- Commercial loss.
- Irreducible loss.

Q3. i. **Write causes for post-harvest losses.**

a. Causes of post-harvest loss at harvesting (60%)

Inappropriate harvesting methods lead to huge losses of fresh produce.

- Almost all South Asian countries harvest their produce manually.
    - Harvesters cause injuries and cuts in fresh produce through the misuse of harvesting tools, damage from pressing produce with fingers and nails, and bruising by dumping or throwing the produce into field containers. Overfilling of containers.
    - Rough picking by pulling, detaching, and cutting the peduncle.
    - Harvesters often do not consider the maturity of fruits.
    - Lack of information regarding best harvesting practices for avoiding damage.

b. Causes of post-harvest loss at packaging, storage, transport etc.

ii. Discuss above causes and ways to minimize that losses.
iii. How manage post-harvest losses.
(40%)

•Harvesting should be done at the correct maturity state.

• Fresh produce should be washed with sanitized water.

• Water which is used for the irrigation purpose must not be too cold, otherwise, there may occur spoilage.

• Mechanically injured products should be discarded to prevent the entry of pathogenic microorganisms.

Proper handling of produce during harvesting

Storage place with good sanitization, proper ventilation and cleaning to avoid growth of microorganisms

Awareness programmes to the farmers to minimize the PH losses

Adequate drying grains and storing of them under low moisture content storage

Effective guidelines from government or policy maker to reduce the PH losses

Follow the effective and appropriate crop calendar and harvesting at the proper maturity stage

Use of appropriate transporting containers and avoiding vibration or shaking to the produce during transport

most of the environmental conditions controllers in storage centers are depend on tha electricity . nowadays we have power problem . therefore if we can introduce renewable power solutions such as solar panels ..we can reduce post harvest losses in our country.

Improve research and innovation to find more ways to reduce PH losses

extending shelf-life of produce by maintaining appropriate temperatures

- Harvesting should be done in cooler temperature.
- Threshing of grains should be handled properly.
- The grains should be dried completely before storage.
- The storage areas should be highly sanitized with proper ventilation and cleaning.
- The packaging of the product must obey the quality standards.
- Proper transportation to the market to avoid food spillage, and decay of the food product.

Lecture 02 - Biological and environmental factors involved in deterioration (15%)

1. **What are the biological factors involved in deterioration?**

- Respiration
  - Ethylene production
  - Compositional change
  - Growth and development
  - Transpiration
  - Physiological breakdown
  - Physical damage

- Pathological breakdown

ii. How composition change affect the food? (30%)

Description for changes in pigmentation and carbohydrates content

iii. What are the environmental factors involve in deterioration and discuss how they contribute to deterioration? (10%)

- Temperature
- Relative humidity
- Atmospheric composition
- Ethylene
- Light

Lecture 03 - Maturation and maturity indices

i. What is the maturity and discuss the types of maturity? (30%)

The stage at which a commodity has reached a sufficient stage of development that at the time of harvesting and postharvest handling (including ripening) its quality will be at least the minimum acceptable to the ultimate consumer.

a. Physiological maturity
b. Harvest maturity
c. Commercial/ horticultural maturity

ii. List out the characteristic of maturity index. (25%)

- Must be simple.
- Readily performed in the field.
- Require relatively inexpensive equipment.
- Should be objective (measurement) rather than subjective (evaluation).
- Consistently relate to the quality and postharvest life of commodity for all growers, districts and years.
- Should be non-destructive.

iii. Assess the crop maturity.

Colour, size, shape, aroma, leaf changes etc.

Lecture 04 - Post- harvest technology procedure

01. What are the principles behind the cooling system? (15%)

- Vital heat released from the commodity should be considered in a temperature management programme. Field heat

· Product temperature is a determinant of respiratory rate.

· Each 10 0C temperature reduction reduces respiratory activity by a factor of 2-4.

· Good cooling and temperature management practices are important to reduce physiological deterioration.

· Extends the shelf-life of horticultural commodities.

ii. What are the cooling methods? (10%)

- Room cooling,
- forced-air cooling,
- hydro-cooling, package
- icing, vacuum cooling,
- top icing, channel-icing
- mechanical refrigeration in transport vehicles

iii. What is half cooling or 7/8 cooling? (15%)

- Users are concerned with the time to ‘complete cooling’.
- Times are referred as half-cooling OR 7/8 cooling.
- Half-cooling is the time to cool the product halfway from its initial temperature to the temperature of the cooling medium.
- 7/8 cooling is the time required to cool the product 7/8 of the way from its initial pulp temperature to the temperature of the cooling medium.

iv. What are the advantages of pre-cooling? (<10%)

- Inhibition of growth of decay causing organisms.
- Restriction of enzyme activity.
- Reduction of water loss from the commodity.
- Reduction of rate of respiration and ethylene liberation.

v. Write short notes on the following. (50 – 60%)

A. Room cooling

B. Forced air cooling

C. Vacuum Cooling

D. Package icing

E. Hydro cooling

Lecture 05, 06, 07 - Harvesting systems

i. Briefly explain about harvesting of fruits and vegetables. (20%)

· Harvesting is the act of removing a crop from where it was growing and moving it to a more secure location for processing, consumption or storage.

· Maturity of the crop determines the time of harvest.

· Weather, availability of harvest equipment, pickers, packing and storage facilities, and transport are important considerations.

· Harvesting can be separated into three steps.

1. Plant part of interest must be identified.

2. It should be detached from the rest of the plant.

3. Detached plant parts must be collected in suitable containers for transport from the field.

· The harvesting of all major agronomic crops has been mechanized.

· Most horticultural crops are hand harvested for the fresh market and some are mechanically harvested.

ii. Discuss the relevant factors with preparation of harvested produce for packing. (50 – 60%)

A. Preparation for packing – delivery to the packer

B. Preparation for packing – cleaning

C. Preparation for packing – sorting

D. Preparation for packing – grading

E. Preparation for packing – special treatments

Lecture 08 and 08 a - Fruits and Vegetables Packaging

i. What are the importance of a packaging material? (20%)

 Packages are important units in marketing and distribution of horticultural crops.

 Packages protect the contents against the damage during distribution.

 These facilitate rapid cooling of the content from warm field temperature to low storage and transport temperatures.

 Packages must allow continual removal of heat produced by the contents.

 They must be attractive to the consumer.

ii. List out (at least 10) of the quality of a good packaging material. (20 – 30 %)

· Its capacity should be suited to market demands.

· Its dimensions and design must be suited to the available transport in order to load neatly and firmly.

· It must be cost-effective in relation to the market value of the commodity for which used.

· It must be readily available, preferably from more than one supplier.

· Its capacity should be suited to market demands.

· Its dimensions and design must be suited to the available transport in order to load neatly and firmly.

· It must be cost-effective in relation to the market value of the commodity for which used.

· It must be readily available, preferably from more than one supplier.

· Package weight should be compatible enough with hand lifting.

· Must tolerate exposure to high relative humidity often for long periods.

iii. Explain the different characters that should be associated with a good packaging material. (50%)

A. Packing must facilitate temperature management

B. Packing must provide protection from water loss

C. Packing must facilitate special treatments

iv. Briefly explain the Modified Atmospheric Packing (MAP) (30%)

1. MAP of fresh produce relies on the modification of the atmosphere inside the package.

Interaction between the respiration of the product and the transfer of gases through the packaging.

2. MA potentially reduces respiratory rate, ethylene sensitivity and production, ripening, softening and compositional changes, decay and physiological changes.

3. The initial atmosphere in the package can either be air or a gas mixture.

4. Atmosphere modification within the package depends on film permeability, commodity respiration rate, gas diffusion characteristics of commodity and weight of commodity, surface area, initial free volume and atmospheric composition within the package.

5. Temperature, relative humidity and air movement around the package influence the permeability of the film.

6. Objective : To maintain the equilibrium concentration of O2 and CO2 constant within the desired level required for the maximum possible storage life of the commodity.

7. MAP extends the storage life of perishables and reduces spoilage and decay.

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8. A food preservation method that maintains the natural quality of products.

9. MAP is a technique used for prolonging the shelf-life of fresh and minimally processed food by changing the composition of the air surrounding the food in the package.

10. MAP reduces the respiration rate and activity of insects and microorganisms, and provides control of product ripening, retardation of senescence, browning of cut produce and prolongs the shelf-life.

v. Giving examples, explain the Desirable characteristics of films for MAP (20%)

- Nontoxic and chemically inert.
- Soft, non-fogging and durable.
- Non-reactant with produce.
- Good thermal and ozone resistant.
- Good weatherability.
- Commercial suitability.
- Ease of handling.
- Ease of printing for labelling.

- Plasticized PVC
- Polyethylene
- Polypropylene
- Polyvinyleden chloride
- Polyester
- Ethylene vinyl acetate
- Polybutylene
- polystyrene

vi. Discuss the advantages and disadvantages of MAP (30%)

- Advantages:

Maintains freshness and extends shelf-life.

- Slows vital biological reactions (respiration) and prolongs the maintenance of post-harvets quality.
- Delay ripening.
- Reduction of weight loss, desiccation and shriveling.
- Reduction of physiological injury, disorder and pathological deterioration.
- Retards softening and compositional change.
- Little or no chemical preservatives are used.
- Alleviation of chilling injury.
- Improved presentation and clear visibility of the product all around the package.
- Quality advantages like colour, moisture, flavour and maturity retention occurs.

Disadvantages

- Requirement of additional investment in machinery and labour in packing line.
- Spoilage of product due to improper packing and temperature abuse.
- Risk of microbial safety due to possible development of anaerobic pathogenic flora.
- Plastic films may be environmentally undesirable if not recycled.
- Still unavailable for most produce.

Lecture 09 - Storage systems

01. What do you mean by food storage?

The process in which both cooked and raw materials are stored in appropriate conditions for future use without any entry or multiplication of microorganisms

02. Discuss about goals of food storage.

To slow biological activities of product by maintaining the lowest temperature and controlling atmospheric composition.

· To slow growth and spread of microorganisms by maintaining low temperatures and minimizing surface moisture on the product.

· To reduce product moisture loss by reducing the difference between product and air temperature and maintaining high humidity in the storage room.

3. What are the purposes of food storage?

Preserve crops to consume out of season.

- Keep products in good conditions.
- Slow down aging.
- Protect from frost.
- Provide even supply.
- Avoid excesses.
- Prevent shortages.
- Obtain high prices.
- Enabling a better balanced diet throughout the year

Preparedness for catastrophes, emergencies and period of food scarcity and famine.

- Religious reasons.
- Protect from animal and theft.

04. How temperature can be managed during food storage?

05. How Humidity can be managed during food storage?

Lecture 10 - Refrigeration

1. List out the effectiveness of Mechanical refrigeration.

Most storage facilities use mechanical refrigeration to control storage temperature.

· Liquid absorbs heat as it changes to a gas.

· Controlled release of liquid nitrogen or liquid carbon dioxide in the storage area is the simplest method.

· Common mechanical refrigeration systems ammonia or halide fluids as refrigerants.

ii. Discuss the alternative refrigeration sources

1. Evaporative cooling

- Energy efficient and economical.
- Produces air with RH greater than 90%.
- Water for the cooling system comes from domestic sources.

2. Nighttime cooling

- Nighttime ventilation is used as a source of refrigeration.
- Commonly used for unrefrigerated storage of potato, sweet potato, onion and pumpkin.

3. Well water

· Can be an effective source of refrigeration.

· The temperature of the ground water greater than 2m below the surface is equal to the average annual air temperature.

4. Naturally formed ice

· Natural ice harvested during winter has been used as a source of refrigerant during spring and summer

5. High altitude cooling

· Air temperature decreases by 1°C with every 100m increase in altitude.

· This cool air cannot be taken to ground level as it gets heated due to compression.

· Store commodities at high altitudes in mountainous areas..

6. Underground storage

· Cellars, abandoned mines and other underground spaces can be used to store fruits and vegetables.

· Good for storing already cooled commodities.

· Soil has a poor ability to transfer heat.

iii. Explain the characteristic features of a storage building.

- Must be sized to handle peak amounts of products.
- Should have adequate room for passageways for easier forklift handling.
- Maximum storage can be increased by using shelves or racks.
- Multistory structures are not used.
- The floor perimeter should have a square shape.
- Entrances, storage area and exits should be in a way that moves products in one direction.
- Availability of good utility services.
- Good drainage and room for future expansion.
- Enough space for smooth movement of large trucks.

- Vapour barriers are installed in floor and foundation.
- Walls and ceiling are insulated using rigid foam boards.

iv. What are advantages and disadvantages of using CA? (https://www.youtube.com/watch?v=WDurgHfLyiM)

https://www.industrialpackaging.com/blog/what-is-modified-atmosphere-packaging

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Utilizes O2 and CO2

concentrations of about 1-5% for each gas.

· This causes;

 Reduction in senescence and other related biochemical and physiological changes.

Reduction of commodity sensitivity to ethylene.

Alleviation of certain physiological disorders.

Affects post-harvest pathogens, decay incidence and severity (Botrytis rot on strawberry).

Useful tool to control insects in some commodities.

· Potential harmful effects include;

- Initiation / aggravation of certain physiological disorders.
- Irregular ripening of fruits.

- Off-flavour and off odour development due to anaerobic respiration.
- Susceptibility to decay may increase.

v. Discuss Control Atmospheric (CA) modification

The slowest method is by natural respiration of product.

· Respiration increases CO2 levels above the requirement.

· Bags of hydrated lime are used to absorb excess CO2

· CO2 can also be controlled by activated carbon absorption systems, molecular sieves, or brine pumped over evaporator coils.

· Scrubbers using activated charcoal are currently the most popular.

- Some operations purge the CA room with nitrogen.
- Some operations use either molecular sieve process or semipermeable membrane to remove oxygen.
- Some use machines to remove oxygen by combustion of natural gas or propane.

Lecture 11 - Post-harvest pest and disease of selected commodities

01. How pathogen cause to disease in harvested materials?

02. What are the steps of infection process?

03. Describe the infection process of post-harvest materials.

Lecture 12 - Traditional methods of food preservation

01. What is food preservation?

Food preservation is an action designed to maintain foods at a desired level of quality.

· Novel preservative techniques are developed to satisfy current demands of market and consumer satisfaction in safety, nutritional and sensory aspects.

ii. Why food preservation is importance?

- Vital for the continuous supply of food during season and off-season.
- To produce value-added products and to provide variety in diets.
- Minimize the food deterioration by environmental factors

(temperature, humidity, O_2 and light) as well as from microbial effects.

- Preserve quality and nutritive value of food.
- Eliminate wastes.

Assignment III

01. Discuss how food preserve by heat treatment

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02. Write short notes on the following methods of food preservation.

A. Low water activity

B. Low pH and Organic acids.

C. Carbon dioxide and Sulphite

D. MA and CA

E. Irradiation

F. Low Temperature

03. Briefly explain about novel methods of food preservation.