MAHARASHTRA AGRICULTURAL UNIVERSITIES EXAMINATION BOARD, PUNE
MODEL ANSWER SET FOR SEMESTER END THEORY EXAMINATION
B. Sc. (Hons.) Agriculture

Semester	: VI (New)	**Term**	: Second	**Academic year**	: 2022-23
Course No	: HORT - 366	**Title**	: Post-Harvest Management and Value Addition of Fruits and Vegetables		
Credits	: 2 (1 + 1)				
Day & date	:	**Time**	: 2 hrs	**Total marks**	: 40

Note
1. Solve ANY EIGHT questions from SECTION 'A'
2. All questions from SECTION 'B' are compulsory
3. All questions carry equal marks
4. Draw neat diagrams wherever necessary

SECTION 'A'

Q. 1 **Write the scope for postharvest management and value addition of fruits and vegetables with suitable examples.**

Ans. **Scope of PHM and value addition of fruits and vegetables**

1. Postharvest management that deals with all the operations right from harvesting or even the pre harvest practices till the commodity reaches consumer, either in fresh (mango, tomato, etc.) or processed form (juice, ketchup) and utilization of the wastes (pomace, peel, seed, skin etc.)
2. Reduction of postharvest losses – way of increasing production of agriculture and horticultural crops,
3. Reduction of cost of production
4. Reducing malnutrition
5. Economic loss reduction
6. Availability of commodity throughout the year
7. Employment generation
8. Export earnings.

(Each point with suitable examples 1 mark)

Q. 2 **Explain zero energy cool chamber storage of fruits and vegetables with diagram.**

Ans. **Zero energy cool chamber storage of fruits and vegetables** – Principle, advantages and disadvantages of zero energy cool chamber, construction and diagram (each point 1 marks).

Q. 3 Define ripening. Write in brief about important physico-chemical changes occurring during ripening.

Ans. **Ripening** – Stage that begins with the last stages of maturation and lasts till the beginning of senescence. (1 mark)

The following changes may take place during the ripening of fruits. (3 marks)

Maturation of seed/seed colour. Changes in fruit skin colour/development of carotenoids. Loss of chlorophyll. Development of actinomycins. Formation of abscission layer. Changes in respiration rate. Changes in ethylene production. Softening. Changes in carbohydrates, starch, sugar, acid, pectin, ascorbic acid, flavour changes.

Q.4 Enlist modern methods of storage for fruits and vegetables. Write in brief about working of controlled atmospheric (CA) storage, its advantages and disadvantages.

Ans. **Methods of storage** (1 mark)

1. Room temperature or ambient temperature storage
2. Cold storage/Refrigerated storage
3. Controlled atmospheric storage
4. Hypo-baric storage
5. Modified atmospheric storage
6. Cool chamber storage (ZECC).

Controlled Atmospheric storage:- (1 mark)

Controlled Atmospheric storage is the storage of fruits and vegetables under condition wherein the concentration of O_2 & CO2 (sometimes N) are controlled within ± 1. The proportion of O_2 lowered, while CO_2 increased. Controlled Atmospheric storage is the most important innovation in fruit & vegetable storage since the introduction of mechanical refrigeration.

This method if combined with refrigeration, marked retards respiratory activity and may delay softening, yellowing, spoilage and other breakdown processes by maintaining an atmosphere with more CO_2 and O_2 less than normal air.

Advantages of Controlled atmospheric storage:- (1 mark)

Control all types of microorganisms. Reducing weight losses, discolouration, sprouting and fiber formation. Automatic and simultaneous treatment of oxygen and carbon dioxide is made possible. No chilling injury & other physiological disorder. Taste and aroma of

fruits retained. Increase in shelf life of product

Disadvantages of Controlled atmospheric storage:- (1 mark)

Accurate maintenance of CO_2, O_2 & N levels is required, CO2 injury in apples, Black heart in potatoes, Cost of equipments and operation is more

Q.5 Enlist different pre-harvest factors affecting post-harvest quality of fruits and vegetable and elaborate impact of environmental factors on post-harvest life with example.

Ans. A. Environmental factors – Temperature, light, rainfall, relative humidity, wind velocity and hail. (1 mark)

B. Cultural factors – Mineral nutrition, growth regulators, rootstock, irrigation, pruning, training, girdling, diseases and pests, pesticides, maturity and mechanical injury. (1 mark)

Effect of environmental factors on post-harvest quality of fruits and vegetables (2 marks)

Temperature – High & low temperature affects maturity, colour, sugar, acidity etc. of the fruits and vegetables. High temperature reduces the quality e.g. citrus, radish, spinach, cauliflower, etc. and low temperature causes chilling and freezing injury.

Light:- Essential for anthocyanin formation. Exposed to sunlight develop lighter weight, thinner peel, lower juice, acids and higher TSS than shaded fruits, e.g. citrus, mango, etc. Exposure of potato to light causes greening (solanine formation), which has toxic properties. High sunlight intensity causes sunscald in citrus and tomatoes and reduces the pure white colour of cauliflower. Low light intensity causes thin and large leaves in leafy vegetables.

Rainfall- Causes cracking in grapes, dates, pomegranate, lime lemon, tomato etc. It reduces appearance and sweetness. Increases incidence and intensity of fungal diseases and pests.

Relative humidity- High humidity reduces the colour and TSS and increases acidity in citrus, grapes, tomato, etc., but on other hand it is needed for better quality of banana, litchi and pineapple.

Wind- Causes bruising, scratching and corky scar on the fruit.

Hail- several hail injuries to fruits like apple, grapes, banana, guava etc.

Q. 6 **Write short notes on (ANY TWO)**

1. **Importance of packaging material**
2. **Methods for hastening and delaying ripening process**
3. **Modified Atmosphere Packaging**

Ans. **1. Importance of packaging material -** Packaging can be viewed as a convenience in achieving orderly marketing. The package is convenient unit for transporting the produce from place of production to point of sale or production. It reduces their losses; maintain firmness, freshness, succulence & attractiveness. Packaging enhances quality for longer period. It helps in minimizing deterioration during handling, transporting & marketing. Adequate packaging protects the fruits and vegetables from physiological, pathological and physical deterioration. In India, packaging of fruits and vegetables is not done properly and hence it acts as a major cause of post harvest losses. The packages must have sufficient mechanical strength to protect the contents during handling and transport. It serves as an efficient unit for customers and dealers. The quality of fruits & vegetables should be protected from mechanical damage. It should reduce the wastage or moisture loss during transport and storage. It should keep the fruits & vegetables in clean and hygienic manner. It should be convenient to transportation & distribution service. (2 marks)

2. Methods for hastening and delaying ripening process - 1) Temperature regulation 2) Altering O2 and CO2 atmosphere 3) Ionizing radiation 4) Chemical regulators – Kinins and kinetins, gibberellins, some auxins, growth retardants, metabolic inhibitors, waxing etc.

Ethylene absorbent: Ethylene is responsible for decreasing shelf life. Putting $KMNO_4$ @ 100 ppm soaked filter paper can minimized ripening and increase shelf life. In Banana this method is very useful.

Antifungal Agents: SOPP: Sodium orthophenyl phenate, Diphenyl wraps protection against moulds, stem-end rot, Dibromoletra chloro ethane and esters give better flavour.

Use of Inhibitors Treatment: Post harvest in Mango, MH 1000-2000 ppm and After fruit formation in Apple, 2-Dimethyl-hydrazide 10,000 ppm.

Auxin is used to advance in ripening and may increase shelf life

2,4-D	5 ppm	Grape	Pre-harvest
2,4,5-T	25 ppm	Fig	Pre-harvest
2,4,5-T	100 ppm	Mango	After harvesting

Vegetables can be preserved by lactic acid and may increase the shelf life. Post-harvest dipping of papaya fruits either in l00 ppm GA_3 or $CaCl_2$ al 2% extended shelf life up to 9 days without any decline in quality.

3. Modified Atmosphere Packaging (MAP): A technique used for prolonging the shelf-life period of fresh or minimally processed foods. In this preservation technique, the air surrounding the food in the package is changed to another composition. This way the initial fresh state of the product may be prolonged. Shelf-life is prolonged with MAP since it slows the natural deterioration of the product. MAP is used with various types of products, where the mixture of gases in the package depends on the type of product, packaging materials and storage temperature. Meat and fish need very low gas permeability films so for non-respiring products (meat, fish, cheese etc.) high barrier films are used. Fruits and vegetables are respiring products where the interaction of the packaging material with the product is important. If the permeability (for O_2 and CO_2) of the packaging film is adapted to the products respiration, an equilibrium modified atmosphere will establish in the package and the shelf life of the product will increase. Instead of preserving foods through the extremes of heat (sterilization) or cold (freezing), MAP utilizes "minimal processing" - preserving food with the absolute least amount of damage to quality, texture, taste and nutrition. MAP has been in existence for the last several decades. Several technologies have been developed with an aim to replace the existing headspace gas mixture with the ideal ratio of oxygen and carbon dioxide to preserve the produce until it is consumed by the user. Some of the most common MAP systems are: Micro perforation of PE packaging film and Incorporation of inorganic particles along with micro perforated PE film.

Q. 7 What are the FPO specifications of tomato ketchup? Write the procedure for preparation of tomato ketchup.

Ans. FPO specifications :

Minimum TSS 25% and minimum acidity as acetic acid 1.0% (1 Mark)

Procedure of tomato ketchup: (3 Marks)

Raw material required- Tomato fruits, sugar, salt, vinegar, spices etc.

i. Selection of fruits
ii. Preparation of fruits
iii. Extraction of juice
iv. Addition of sugar, salt, spices and vinegar
v. Cooking
vi. Determining the end point: volume test, TSS test, blotting paper test
vii. Addition of chemical preservative
viii. Filling and sealing

(Brief information on above points expected)

Q.8 Describe the procedure for preparation of jelly from guava fruits.

Ans. Guava Jelly

The procedure should include following steps

1. Selection of fruit
2. Preparation of fruit
3. Extraction of pectin
4. Pectin test
5. Addition of sugar and acid
6. Cooking the mixture
7. Determining the end point
8. Filling and sealing
9. Labeling and storage
10. FPO specifications of jelly

Q. 9 Give flow sheet for preparation of grape wine.

Ans. Grape Wine (Flow chart) (4 marks)

Selection and washing of ripe fruits
↓
Crushing of fruits
↓
Filling jar up to 3/4
↓
Addition of sugar (20 to 24 % TSS)
↓

Adjustment of pH (0.6 to 0.8 % acid)

↓

Addition of preservative (KMS 1.5g/10kg grapes)

↓

Keeping for an hour

↓

Addition of wine yeast (*Saccharomyces cerevisiae*)

↓

Fermentation (for 2 Days)

↓

Filtration

↓

Fermentation(for 10 Days)

↓

Racking (siphoning off clear liquid)

↓

Fining and filtration (bentonite)

↓

Aging (maturation) 6 to 8 months

↓

Pasteurization at 85^0C for 2 min

↓

Bottling

↓

Crown corking

↓

Pasteurization at 82^0C for 20 min

↓

Cooling and storage

Q.10 Enlist different methods of preservation of fruits and vegetables? Describe preservation by salt.

Ans. Methods of preservation (2 marks)

1. Temporary preservation **2. Permanent Preservation**

1. Temporary preservation:- Asepsis (Absence of infection), Use of low temperature of refrigeration, Exclusion of moisture, Pasteurization, Mild antiseptics (sugar, salt, acids, oils and spices)

2. **Permanent Preservation:-** Sterilization, Permanent preservation by antiseptics (sugar

and salts and acetic acid), Chemical preservation, Preservation by drying, Preservation by carbonation, Preservation by irradiation

3. Preservation by sugars, 4. Preservation by oils and spices. 5. Preservation by salt.

Preservation by salts: - (2 marks) Salts at concentration of 15-20% are sufficient to preserve most of the products. It inhibits enzymatic browning and discolouration and also acts as an antioxidant. Example Pickles. Salt exerts preservative action by-causing high osmotic pressure resulting in the plasmolysis of microbial cells, dehydrating foods as well as microorganisms by drawing out and tying up the moisture by ion hydration, ionization to yield the chloride ion which is harmful to microorganisms, etc.

SECTION 'B'

Q. 11 Fill in the blanks

1. Ethylene is produced from an essential amino acid named as **Methionine**
2. MOFPI means **Ministry of Food Processing Industry.**
3. An ideal fruit for making jelly should be rich in **Pectin**
4. **KMS or Sodium Benzoate** is example of class II preservative used for preservation in fruit products

Q. 12 Spell out the Abbreviations

1. CFTRI **Central Food Technological Research Institute**
2. RTS **Ready to Serve**
3. PLW **Physiological Loss in Weight**
4. IIP **Indian Institute of Packaging**

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