MAHARASHTRA AGRICULTURAL UNIVERSITIES EXAMINATION BOARD, PUNE

SEMESTER END THEORY EXAMINATION

B.Sc. (Hons) Agriculture

Semester	: VI (New)	Term	: II	Academic year: 2021 – 22	
Course No	: HORT – 366				
Credits	: 2(1+1)	Title	: Post Harvest Management and Value Addition of Fruits and Vegetables		
Day & Date	:	Time (hrs)	: 2 hrs	Total Marks	: 40

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

(Model Answer Paper)

Q.1 Explain the importance of fruits and vegetables in India. **(4 Marks)**

Ans: Horticulture plays a significant role in Indian Agriculture. India is the second largest producer of both fruits and vegetables in the world (52.85 Mt and 108.20 Mt respectively). Fruits and vegetables are of immense significance to man. In India, the fruits have been given a place of honour on being offered to God at every festival and have also been mentioned in our epics like Mahabharata, Ramayana and writings of Sushrutha and Charaka. Being rich source of carbohydrates, minerals, vitamins and dietary fibres these constitute an important part of our daily diet. The dietary fibres have several direct and indirect advantages. Not only this, fruits and vegetables provide a variety in taste, interest and aesthetic appeal. Their significance in human life is being recognised increasingly in Western societies with the objective of minimizing the occurrence of the diseases related with an affluent life style. Their lesser recognized benefits relate to their role in kidney functions, prevention ofcancer and cardiac disorders through contribution of ascorbic acid, β-carotene and nonstarch polysaccharides besides the biochemical constituents like phenols, flavonoids and alkaloids.

A considerable amount of fruits and vegetables produced in India is lost due to improper post-harvest operations; as a result there is a considerable gap between the gross production and net availability. Furthermore, only a small fraction of fruits and vegetables are utilized for processing (less than 1%) and exported (Fruits – 0.5% and Vegetables – 1.7%) compared to other countries. Post harvest losses in fruits and vegetables are very high (20-40%). About 10-15% fresh fruits and vegetables shrivel and decay, lowering their market value and consumer acceptability. Minimizing these losses can increase their supply without bringing additional land under cultivation.Improper handling and storage cause physical damage due to tissue breakdown. Mechanical losses include bruising, cracking, cuts, microbial spoilage by fungi and bacteria, whereas physiological losses include changes in respiration, transpiration, pigments, organic acids and flavour.

Q.2 Define canning. Explain in brief the method of canning fruits and vegetables.

Ans: Def: The process of sealing food stuffs hermetically in containers and sterilizing them by heat for long storage is known as canning. **(1 Marks)**

Steps in canning: Selection of fruits/vegetables, Grading, Washing, Cooling, Blanching, Cutting, Peeling, Filling Syruping or Brining, Exhausting, Storage, Cooling, Processing, Sealing (brief explanation of this steps essential.) **(3 Marks)**

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Q.3 a) Define ripening and explain the changes during ripening. **(2 Marks)**

Ans: Def: Repining is a physiological change in which degradation of chlorophyll and synthesis of ethylene takes place which results in change in colour accompanied with softening of fruit.

Changes During Fruit Ripening

1.Cell Wall Changes 2. Change in starch 3. Change in Organic Acids 4. Change in colour 5. Flavouring Compounds 6. Ascorbic Acid 7. Phenolics 8. Amino acids and Proteins 9. Ethylene Production and Respiration (Brief explanation on these points essential.)

b) Explain the factors affecting rate of respiration. **(2 Marks)**

A. Internal Factors

1. Stage of Development: When fruits become bulky i.e at maturation stage degree of respiration rate decreases as compared to initial development stage. In climacteric fruit the rate of respiration is minimum at maturity stage but when ripening is about to start after harvest the respiration rate will increase to climacteric peak.

2. Moisture Content: If the moisture is more, respiration is less because of dimension of sugar content. Transpiration is more water loss is more so concentration of sugar is more which leads to higher respiration rate. More water loss lead to desiccation rather than more accumulation of sugar.

3. Sugar of Fruit: Small sized fruits have more expose surface compared to bulky fruits. So respiration rate is more in small fruits.

4. Coating on Surface of Fruits: More thickness of coating less the respiration rate.

5. Type of Tissue: Young tissues have more respiration rate.

B. External Factors

1. Temperature: The chemical reaction goes faster at a higher temperature, though, when the temperature is too hot, enzymes will break down and respiration will stop.

2. Oxygen concentration: The reaction needs oxygen, so if there is no oxygen, no respiration occurs. In general, less oxygen leads to a slower reaction rate.

3. Carbon dioxide concentration: The influence of carbon dioxide concentration depends strongly on the fruit or vegetable. Some might increase in respiration rate, whereas with others more carbon dioxide might lead to slower reactions.

4. Stress in a vegetable: Vegetables can be stressed, for instance if they are cut or damaged. This will initiate all sorts of reactions, including those that accelerate respiration.

5. Ripening: Some fruits and vegetables continue to ripe after they have been harvested (climacteric fruits). During ripening the respiration rate might increase or decrease, depending on the product. This can also be linked with ethylene concentrations.

6. Fruit Injury: This mechanical injury is also responsible for stimulating respiration rate.

7. Ethylene: Application of ethylene can shift the time as to reach climacteric peak

Q.4 Explain the various steps involved in post harvest handling of fruits and vegetables. **(4 Marks)**

Ans: Various steps involved in post harvest handling of fruits and vegetables

Pre-cooling: In addition to removal of field heat from commodities, pre-cooling also reduces bruise damage from vibration during transit. Cooling requirement for a crop vary with the air temperature during harvesting, stage of maturity and nature of crop. There are many methods of pre-cooling Viz, cold air (room cooling, forced air cooling), cold water (hydro-cooling),

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direct contact with ice (contact icing), evaporation of water from the produce (evaporative cooling, vacuum cooling) and combination of vacuum and hydro-cooling (hydrovac cooling).

2. Washing, Cleaning and Trimming: Chlorine in fresh water is often used as disinfectant to wash the commodity. Some fungicides like Diphenylamine (0.1 - 0.25%) or ethoxyquin (0.2 - 0.5%) may be used as post harvest dip to control the disorders. Many vegetable need trimming, cutting and removal of unsightly leaves or other vegetative parts.

3. Sorting, Grading and Sizing: Sorting is done by hand to remove the fruits which are unsuitable to market or storage due to damage by insects, diseases or mechanical injuries. The remainder crop product is separated into two or more grades on the basis of the surface colour, shape or visible defects. For e.g. in an apple packing house in India 3 grades viz. Extra Fancy, Fancy and standard may be packed for marketing. The fourth cull grade is meant for processing. After sorting and grading, sizing is done either by hand or machine.

4. Curing: Curing is an effective operation to reduce the water loss during storage from hardy vegetables viz, onion, garlic, sweet potato and other tropical root vegetables. The curing methods employed for root crops are entirely different than that from the bulbous crops (onions and garlic). The curing of root and tuber crops develops periderms over cut, broken or skinned surfaces wound restoration. It helps in the healing of harvest injuries, reduces loss of water and prevents the infection by decay pathogens.

5. Waxing: Waxes are esters of higher fatty acid with monohydric alcohols and hydrocarbons and some free fatty acids. Waxing generally reduces the respiration and transpiration rates, but other chemicals such as fungicides, growth regulators, preservative can also be incorporated specially for reducing microbial spoilage, sprout inhibition etc.

6. Packaging: Proper or scientific packaging of fresh fruits and vegetables reduces the wastage of commodities by protecting them from mechanical damage, dirt, moisture loss and other undesirable physiological changes and pathological deterioration during the course of storage, transportation and subsequent marketing. Packaging cannot improve the quality but it certainly helps in maintaining it as it protects produce against the hazards of journey. Gunny bags, grasses and stem leaves used so far for packaging are now being replaced by a variety of containers such as wooden boxes, baskets woven from bamboo or twigs, sack/jute bags and corrugated fibre board (CFB) boxes.

7. Storage: A number of storage techniques (ground storage, ambient storage, refrigerated storage, air cooled storage, zero energy storage, modified atmospheric storage, hypobaric storage and controlled atmosphere storage) are being used for fruits and vegetables depending upon the nature of the commodity and the storage period intended.

Q.5 Enlist various methods of preservation of food and explain in brief chemical method of food preservation. **(2 Marks)**

Ans: A) Physical Methods

a) By Removal of Heat (Preservation by cold)

i. Refrigeration ii. Freezing Preservation iii. Dehydro freezing preservation iv. Carbonation

b) By Addition of Heat i. Stationary Pasteurization ii. Agitating pasteurization/Sterilization iii. Flash pasteurization /HTST processing etc.

c) By removal of water (evaporation or dehydration)

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i. Sun drying ii. Dehydration iii. Low temperature evaporation or concentration iv. Freeze-drying v. Accelerated freeze-drying vi. Foam-mat drying vii. Puff drying etc .

B) Chemical Methods

a) By Addition of acid such as vinegar or lactic acid b) By salting or bringing c) By adding of sugar and heating d) By addition of chemical preservatives

C) By Fermentation: Alcoholic and acetous fermentation as in the cases of fruit wines, apple cider, vinegar etc. **(2 Marks)**

Preservation By Chemicals: A preservative is defined as only substance which is capable of inhibiting, retarding or arresting the growth of microorganisms. Microbial spoilage of food products is also controlled by using chemical preservatives. The inhibitory action of preservatives is due to their interfering with the mechanism of cell division, permeability of cell membrane and activity of enzymes. Pasteurized squashes, cordials and crushes have a cooked flavour. After the container is opened, they ferment and spoil within a short period, particularly in a tropical climate.The preservative used should not be injurious to health and should be non-irritant. It should be easy to detect and estimate.

Two important chemical preservatives are permitted to beverages according to the FPO

1. Sulphur dioxide 2. Benzoic acid

Sulphur dioxide: Used for preservation beverages and other products. Protects against bacteria and moulds and inhibits enzymes, etc. In addition, it acts as an antioxidant and bleaching agent. These properties help in the retention of ascorbic acid, carotene and other oxidizable compounds. It also retards the development of non enzymatic browning or discolouration of the product. It is generally used in the form of its salts such as sulphite, bisulphate and metabisulphite. Potassium metabisulphite is commonly used as a stable source of So_2.

Benzoic acid: It is only partially soluble in H_2O hence its salt, sodium benzoate is used. One part of sodium benzoate is soluble in 1.8 parts of water at ordinary temperature, whereas only 0.34 parts of benzoic acid is soluble in 100 parts of water. Sodium benzoate is thus nearly 170 times as soluble as benzoic acid, pure sodium benzoate is tasteless and odourless. The anti bacterial action of benzoic acid is increased in the presence of Co_2 and acid e.g. *Bacillus subtilis* cannot survive in benzoic acid solution in the presence of Co_2. Benzoic acid is more effective against yeasts than against moulds. It does not stop lactic acid and acetic acid fermentation.

Q.6 Enlist the methods of storage and explain in short controlled atmosphere storage .

Ans: Various methods of storage are as follows: **(2 Marks)**

1. ZECC (Zero Energy Cool Chamber) 2. Cold storage 3. Modified atmosphere packaging (MAP) Storage 4. Controlled Atmosphere (CA) storage 5. Hypobaric System

Controlled Atmosphere (CA) storage **(2 Marks)**

It is based, on the principle of maintaining an artificial atmosphere in storage room, which has higher concentration of CO_2 and lower concentration of 02 than normal atmosphere. This reduces the rate of respiration and thus delays aging. This method of storage is very effective when combined with low temperature storage.

Q.7 Write short notes (Any Two) **(2 Marks for each)**

Ans: a) Dehydration: Its is the process of removing water from fruit by circulating hot air through it, which prohibits the growth of enzymes and bacteria. In this process a single layer of fruits (or) vegetables, whole or cut into pieces (or) slices are spread on trays which are placed inside the dehydrator.The initial temperature of the dehydrator is usually 43°C which is

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gradually increased to 60 66°C in the case of vegetables and 50-71°C for fruits. **Advantages:** Dried foods are in more concentrated form than foods preserved in other ways. Due to reduction in bulk of the product, it requires less storage space. The weight of a product is reduced to 1/4th to 1/9th its original (or) fresh weight and thus the cost of its transport is reduced

b) **Value addition concept:** Value is added by changing their form, colour and other such methods to increase the shelf life of perishables. There are various methods of preservation of food including thermal processing, fermentation, pickling, dehydration, freezing etc. Value addition to food products has assumed vital importance in our country due to diversity in socio-economic conditions, industrial growth, urbanization and globalization. Value is added by changing their form, colour and other such methods to increase the shelf life of perishables.

c) **Non fermented beverages:** Fruit juices which do not undergo alcoholic fermentation are termed as **non fermented beverages**. They include natural and sweetened juices, RTS, nectar, cordial, squash, crush, syrup, fruit juice concentrate and fruit juice powder are some of the non fermented beverages.

Q.8 Mention the different types of packaging materials and give the advantages of corrugated fiber board boxes.

(2 Marks)

Ans: 1. Consumer/Retail packs: Consumer packages are small in size and designed to hold ½ dozen-1 dozen fruits or ½ kg to 2 kg of vegetables. The most commonly used packages are listed below:

a) Flexible Plastic Films b) Trays with Overwrap c) Plastic Punnets d) Plastic Net bags (Extruded & Woven) e) Foam Sleeve f) Light Weight Plastic Crates g) Shrink Wrap h) CFB Boxes Corrugated Fiber Board Boxes/Cartons i) Metals j) Glass k) Paper l) Plastic

2. Transport Packs: Transport packages are designed for long distance transportation in capacities ranging from 4-5 kgs to 20 - 25 kgs. These packs must withstand impacts, compression and vibration during transport.

(2 Marks)

Advantages of corrugated fiber board boxes. : They are light weight crates. The perforations provide ventilation and keep the produce fresh. The crates are stackable and have high compression strength and therefore provide adequate protection to the fresh produce packed inside. These crates are hygienic, clean, and reusable and can be recycled.

Q.9 Write the various products prepared from tomato and give the FPO standards for tomato juice.

(2 Marks)

Ans: Tomato Products 1. Tomato Paste 2. Tomato Sauce 3. Tomato Ketchup 4. Tomato Chutney 5. Tomato Soup 6). Dehydrated Tomato 7. Tomato powder etc. 8. Tomato Cocktail 9. Tomato Puree etc.

FPO Standard of tomato juice: **(2 Marks)**

1. The colour of juice is deep red in colour.
2. The juice should possess the characteristics of taste and flavor of tomatoes.
3. The acidity of the juice as citric acid is about 0.4%.
4. The vitamins like beta carotene present in fresh tomatoes should go into the juice during its preparation.
5. Selection of tomatoes should be from one stock for uniformity in colour.
6. The only substances that may be added are salt (1.5%W/W), sugar, dextrose, malic acid,

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ascorbic acid, citric acid and permitted colour.
7. The minimum total soluble solids free of salt shall be 5% (W/W)
8. The mould count shall not exceed 30% of the field examined.
9. Harmful poisonous metals in tomato juice shall not be more than 1ppm(lead), 100ppm (copper on the dried tomato solid basis) 2ppm (arsenic), 250ppm (tin) and 19ppm (Zinc).

Q.10 Define chilling and freezing injury. Explain in brief the management of chilling injury **(1 Mark)**

Ans Def: Chilling injury: It is damage that occurs when stored below 41^0 F or (5^0C) but above freezing point for long than 5-6 days. **(1 Mark)**

Freezing injury: It is the damage that occurs to plant tissues when temperature is below 32^0F or 0^0C **(2 Marks)**

Management of chilling injury

Maintaining critical temperature - The safest way to manage chilling injury is to determine the critical temperature for its development in a particular produce and then not expose the commodity to temperatures below that critical temperature (Eg. Safe storage temperature for apple is 0-20C and care should to taken to not to store apple below this critical temperature to avoid chilling injury). However, it has been found that exposure for a short period to chilling temperatures with subsequent storage at higher temperatures may prevent the development of injury. This conditioning process has been effective in managing black heart in pineapple, woolliness in peach and flesh browning in plum.

2. **Modified atmosphere storage** may also reduce chilling injury in some commodities.
3. **Maintaining high RH** - both in storage at low temperature and after storage can minimize expression of chilling injury symptoms, particularly pitting (e.g. film-wrapped cucumbers).

SECTION 'B'

Q.11 Do as directed. **(1 mark each)**

a) 10% juice, 10% TSS and 0.3% acidity are FPO specification of RTS
b) Sodium benzoate is used for storage of coloured beverages
c) Marmalade is prepared from orange fruit
d) CIPHET: Central Institute of Post Harvest Engineering and Technology

Q.12 Fill in the blanks. **(1 mark each**

a) Oenology
b) Potassium permanganate
c) Strawberry
d) Evaporative cooling

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