Vegetable Crops – Post harvest Practices Practical

Practical (Laboratory) Syllabus:

1. Maturity selection and harvest, harvesting practices.
2. List and cost of equipment, utensils, and additives required for small scale processing industry.
3. Estimation of total carbohydrates (Anthrone method) in a stored vegetable and un- stored vegetable.
4. Estimation of protein (Lowry method) in a stored vegetable and un-stored vegetable.
5. Identification of packaging materials, containers for packaging.
6. Preparation of pickle from a vegetable.
7. Preparation of tomato sauce, ketchup and chutney.

Maturity selection and Harvesting, Harvesting Practices of Vegetable crops

M.V.V.S.GANGA BHAVANI
LECTURER IN BOTANY

1. Amaranthus

Maturity Selection:

Indicators: Young, tender leaves.

Methods:

Visual Inspection: Leaves should be large enough for consumption but still tender.

Calendar Days: Typically 25-40 days from sowing.

Harvesting Practices:

Preparation: Harvest in the morning when leaves are crisp.

Techniques: Cut the leaves or stems with a sharp knife or scissors.

PostHarvest Handling: Rinse with cool water, cool to 32-36°F (02°C), store with high humidity.

2. Palak (Spinach)

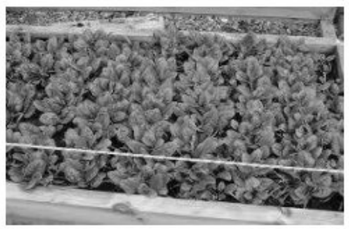
Maturity Selection:

Indicators: Full sized leaves before bolting.

Methods:

Visual Inspection: Leaves should be large and tender.

Calendar Days: Typically 40-50 days from sowing.



Harvesting Practices:

Preparation: Harvest in the morning to avoid heat stress.

Techniques: Cut leaves individually or cut the entire plant at the base.

PostHarvest Handling: Rinse with cool water, cool to 32-36°F (02°C), store with high humidity.

3. Hibiscus cannabinus (Kenaf)

Maturity Selection:

Indicators: Tender shoots and leaves.

Methods:

Visual Inspection: Shoots should be tender and leaves should be of appropriate size.

Calendar Days: Typically 45-60 days from sowing.

Harvesting Practices:

Preparation: Harvest in the morning when shoots and leaves are crisp.

Techniques: Cut shoots and leaves with a sharp knife or scissors.

PostHarvest Handling: Rinse with cool water, cool to 32-36°F (02°C), store with high humidity.

4. Fenugreek

Maturity Selection:

Indicators: Young, tender leaves.

Methods:

Visual Inspection: Leaves should be large enough for consumption but still tender.

Calendar Days: Typically 20-30 days from sowing.

Harvesting Practices:

Preparation: Harvest in the morning when leaves are crisp.

Techniques: Cut the leaves or stems with a sharp knife or scissors.

PostHarvest Handling: Rinse with cool water, cool to 32-36°F (02°C), store with high humidity.

5. Okra (Bhendi)

Maturity Selection:

Indicators: Tender pods, typically 35 inches long.

Methods:

Visual Inspection: Pods should be green and firm.

Calendar Days: Typically 50-60 days from sowing.

Harvesting Practices:

Preparation: Use clean, sanitized tools.

Techniques: Cut the pods with a sharp knife or scissors.

PostHarvest Handling: Rinse with cool water, cool to 45-50°F (710°C), store with high humidity.

6. Tomato

Maturity Selection:

Indicators: Fully colored but still firm; slight give when gently squeezed.

Methods:

Visual Inspection: Look for a uniform red, pink, or yellow color depending on the variety.

Calendar Days: Typically 60-85 days from transplanting.

Harvesting Practices:

Preparation: Use clean, sanitized tools. Harvest in the morning to reduce heat stress.

Techniques: Twist and pull gently or use scissors to cut the stem, leaving a small portion attached to the fruit.

PostHarvest Handling: Rinse with clean water, cool to 55-70°F (1221°C), store with high humidity.

7. Chillies

Maturity Selection:

Indicators: Fully colored and firm.

Methods:

Visual Inspection: Look for a uniform red, green, or yellow color depending on the variety.

Calendar Days: Typically 60-80 days from transplanting.

Harvesting Practices:

Preparation: Use clean, sanitized tools.

Techniques: Twist and pull gently or use scissors to cut the stem.

PostHarvest Handling: Rinse with clean water, cool to 45-50°F (710°C), store with high humidity.

8. Brinjal (Eggplant)

Maturity Selection:

Indicators: Firm and glossy skin.

Methods:

Visual Inspection: Look for uniform color and glossy skin.

Calendar Days: Typically 70-85 days from transplanting.

Harvesting Practices:

Preparation: Use clean, sanitized tools.

Techniques: Cut the fruit with a sharp knife or scissors, leaving a small portion of the stem attached.

PostHarvest Handling: Rinse with cool water, cool to 50-55°F (1013°C), store with high humidity.

9. Dolichos (Hyacinth Bean)

Maturity Selection:

Indicators: Pods are firm and wellfilled.

Methods:

Visual Inspection: Check pod size and fullness.

Calendar Days: Typically 60-70 days from sowing.

Harvesting Practices:

Preparation: Ensure clean and sanitized containers for collecting pods.

Techniques: Handpick pods by pulling gently from the plant to avoid damage.

PostHarvest Handling: Rinse with clean water, cool to 32-36°F (02°C), store with high humidity.

10. Cluster Bean (Guar)

Maturity Selection:

Indicators: Tender pods, typically 34 inches long.

Methods:

Visual Inspection: Pods should be green and tender.

Calendar Days: Typically 60-70 days from sowing.

Harvesting Practices:

Preparation: Use clean, sanitized tools.

Techniques: Cut the pods with a sharp knife or scissors.

PostHarvest Handling: Rinse with cool water, cool to 45-50°F (710°C), store with high humidity.

11. French Bean

Maturity Selection:

Indicators: Tender pods, typically 46 inches long.

Methods:

Visual Inspection: Pods should be green and firm.

Calendar Days: Typically 50-60 days from sowing.

Harvesting Practices:

Preparation: Use clean, sanitized tools.

Techniques: Handpick pods by pulling gently from the plant to avoid damage.

PostHarvest Handling: Rinse with clean water, cool to 32-36°F (02°C), store with high humidity.

12. Carrot

Maturity Selection:

Indicators: Desired diameter (typically 1.52 inches at the top), deep orange color.

Methods:

Visual Inspection: Check size and color.

Calendar Days: Typically 70-80 days from sowing.

Harvesting Practices:

Preparation: Loosen soil around roots using a fork or similar tool.

Techniques: Gently pull the carrots from the soil, handle carefully to avoid breakage.

PostHarvest Handling: Rinse to remove soil, cool to 32°F (0°C), store with high humidity.

13. Radish

Maturity Selection:

Indicators: Desired size (typically 12 inches in diameter), bright color.

Methods:

Visual Inspection: Check size and color.

Calendar Days: Typically 25-45 days from sowing, depending on the variety.

Harvesting Practices:

Preparation: Loosen soil around roots with a fork or similar tool.

Techniques: Gently pull radishes from the soil, handle carefully to avoid breakage.

PostHarvest Handling: Rinse to remove soil, cool to 32°F (0°C), store with high humidity.

14. Sweet Potato

Maturity Selection:

Indicators: Tuber size (typically 46 inches long), skin color.

Methods:

Visual Inspection: Check size and skin color.

Calendar Days: Typically 90-120 days from transplanting.

Harvesting Practices:

Preparation: Loosen soil around roots with a fork or similar tool.

Techniques: Carefully dig up the tubers, handle gently to avoid skinning or bruising.

PostHarvest Handling: Cure at 8085°F (27-29°C) with high humidity for 47 days, then store at 55-60°F (13-16°C) with moderate humidity.

15. Potato

Maturity Selection:

Indicators: Skin set (tough skin that doesn't rub off easily), desired size.

Methods:

Visual Inspection: Check skin and size.

Calendar Days: Typically 90-120 days from planting, depending on the variety.

Harvesting Practices:

Preparation: Loosen soil around the plants with a fork or similar tool.

Techniques: Carefully dig up the tubers, handle gently to avoid bruising.

PostHarvest Handling: Cure at 50-60°F (10-15°C) with high humidity for 12 weeks, then store at 40-45°F (47°C) with moderate humidity.

LIST AND COST OF EQUIPMENT, UTENSILS, AND ADDITIVES REQUIRED FOR SMALL SCALE PROCESSING INDUSTRY.

M.V.V.S.GANGA BHAVANI

LECTURER IN BOTANY

Equipment and Utensils

1. Cleaning Equipment:

- Vegetable Washer: ₹1,20,000 - ₹4,00,000

- Purpose: Removes dirt and contaminants from vegetables, ensuring cleanliness before further processing.

- SCRUB BRUSHES AND SCRUBBING STATIONS: ₹4,000 - ₹16,000

- PURPOSE: MANUAL CLEANING FOR DELICATE OR SPECIFIC VEGETABLE SURFACES.

2. Cutting and Peeling:

- Industrial Vegetable Cutter/Chopper: ₹80,000 - ₹2,40,000

- Purpose: Efficiently cuts or chops vegetables into uniform pieces for consistent processing.

- PEELING MACHINES: ₹60,000 - ₹2,00,000

- PURPOSE: REMOVES SKINS OR PEELS FROM VEGETABLES QUICKLY AND UNIFORMLY.

- KNIVES AND CUTTING BOARDS: ₹100 - ₹12,000

- PURPOSE: ESSENTIAL TOOLS FOR MANUAL CUTTING AND PREPARATION.

- **3. Blanching Equipment:**

- Blanching Tank/Unit: ₹1,60,000 - ₹4,80,000

- Purpose: Blanching stops enzyme activity that can cause spoilage and preserves color, flavor, and nutritional value.

- HEAT SOURCE (E.G., GAS BURNER): ₹16,000 - ₹6,40,000

- PURPOSE: PROVIDES THE NECESSARY HEAT FOR BLANCHING.

- 4. Drying Equipment:

- Dehydrator: ₹80,000 - ₹3,20,000

- Purpose: Removes moisture from vegetables to extend shelf life and make them suitable for storage.

- DRYING RACKS: ₹8,000 - ₹40,000

- PURPOSE: HOLDS VEGETABLES IN PLACE DURING DRYING, ENSURING EVEN EXPOSURE TO AIR.

5. Packaging Equipment:

- Sealing Machines (Vacuum or Heat Sealer): ₹40,000 - ₹1,60,000

- Purpose: Seals packages to protect against contamination and spoilage.

-LABELING MACHINES: ₹24,000 - ₹80,000

- PURPOSE: APPLIES LABELS FOR IDENTIFICATION AND COMPLIANCE WITH REGULATORY REQUIREMENTS.

PACKAGING MATERIALS (BAGS, BOXES, ETC.): ₹8,000 - ₹40,000

- PURPOSE: CONTAINS AND PROTECTS THE FINAL PRODUCT.

- 6. Storage and Refrigeration:

- - Cold Storage Units/Refrigerators: ₹1,60,000 - ₹4,80,000

- - Purpose: Keeps vegetables fresh and preserves quality during storage.

- STORAGE CONTAINERS/BINS: ₹8,000 - ₹40,000

- - PURPOSE: ORGANIZES AND STORES VEGETABLES EFFICIENTLY.

7. Quality Control and Testing:

- pH Meter: ₹8,000 - ₹24,000

- Purpose: Measures pH levels to ensure proper acidity and product safety.

- HYGROMETER (FOR MOISTURE CONTENT): ₹4,000 - ₹12,000

- PURPOSE: MEASURES MOISTURE LEVELS IN DRIED VEGETABLES TO ENSURE QUALITY AND SHELF LIFE.

8. Cleaning and Sanitation:

- Sanitizing Stations/Solutions: ₹4,000 - ₹16,000

- Purpose: Ensures equipment and surfaces are free from contaminants.

- CLEANING SUPPLIES (SPONGES, DETERGENTS): ₹4,000 - ₹12,000

- PURPOSE: REGULAR CLEANING OF TOOLS AND EQUIPMENT TO MAINTAIN HYGIENE.

9. Miscellaneous:

- Weighing Scales: ₹8,000 - ₹40,000

- Purpose: Measures the weight of vegetables for processing and packaging.

- WORK TABLES: ₹16,000 - ₹80,000

- PURPOSE: PROVIDES A CLEAN AND ORGANIZED WORKSPACE FOR PROCESSING VEGETABLES.

Additives

1. Preservatives (if needed):

- Ascorbic Acid (Vitamin C): ₹4,000 - ₹12,000 per kg

- Purpose: Acts as an antioxidant to prevent spoilage and preserve color.

- Citric Acid: ₹1,600 - ₹4,800 per kg

- Purpose: Used to adjust pH and enhance preservation.

2. Flavor Enhancers:

- Natural Spices/Herbs: ₹800 - ₹4,000 per kg (depending on type)

- Purpose: Enhances the flavor of processed vegetables.

3. Packaging Additives:

- Oxygen Absorbers: ₹1,600 - ₹8,000 per 100-pack

- Purpose: Prevents oxidation and extends shelf life by removing oxygen from packaging.

Estimation of Total Carbohydrates by Anthrone Method for both stored and un-stored vegetables

Aim:

To estimate the total carbohydrate content in a stored vegetable and an un-stored (fresh) vegetable using the Anthrone method.

Materials Required:

- Fresh (un-stored) vegetable sample- Stored vegetable sample- Mortar and pestle or blender- 80% Ethanol- Anthrone reagent (0.2% Anthrone in concentrated sulfuric acid)- Glucose standard solution (100 µg/mL)- Distilled water- Test tubes- Pipettes- Boiling water bath- Ice bath- Centrifuge- Colorimeter/Spectrophotometer (at 620 nm)- Whatman No. 1 filter paper- Volumetric flasks (50 mL and 100 mL)

Procedure:

1. Preparation of Samples:

a. Un-stored (Fresh) Vegetable:

- Take about 2 g of the fresh vegetable.
- Crush the sample using a mortar and pestle or a blender.
- Add 10 mL of 80% ethanol to extract soluble carbohydrates.
- Filter the extract using Whatman No. 1 filter paper.
- Collect the filtrate for carbohydrate analysis.

b. Stored Vegetable:

- Similarly, take about 2 g of the stored vegetable.
- Follow the same steps as for the fresh sample (crushing, extraction, and filtration).

2. Preparation of Glucose Standard:

- Prepare a glucose standard solution by dissolving 100 mg of glucose in 100 mL of distilled water.
- Take aliquots of 0.2 mL, 0.4 mL, 0.6 mL, 0.8 mL, and 1.0 mL into different test tubes and make up the volume to 1 mL using distilled water.
- These serve as the standard glucose solutions for the calibration curve.

Prepare different concentrations of glucose standard solutions as follows:

Volume of Glucose (100 µg/mL)	Final Glucose Concentration (µg/mL)
0.2 mL	20 µg/mL
0.4 mL	40 µg/mL
0.6 mL	60 µg/mL
0.8 mL	80 µg/mL
1.0 mL	100 µg/mL

- These solutions will be used to create a standard curve, which helps determine the carbohydrate concentration in your vegetable samples.

3. Preparation of Anthrone Reagent:

- Prepare fresh Anthrone reagent by dissolving 0.2 g of Anthrone in 100 mL of concentrated sulfuric acid.
- This reagent should be freshly prepared as it is unstable.

4. Estimation Procedure:

a. Take 1 mL of the filtrate (vegetable extract) in a test tube.

b. Add 4 mL of Anthrone reagent to the test tube.

c. Heat the mixture in a boiling water bath for 8–10 minutes.

d. Cool the tubes rapidly in an ice bath to stop the reaction.

e. Measure the absorbance of the green color developed at 620 nm using a colorimeter or spectrophotometer.

5. Blank Preparation:

- For the blank, take 1 mL of 80% ethanol and follow the same steps (adding Anthrone reagent, heating, cooling, and measuring absorbance).

6. Standard Curve Preparation:

- Measure the absorbance of the glucose standards at 620 nm.
- Plot the standard curve by using absorbance values on the Y-axis and the concentration of glucose (µg) on the X-axis.

Glucose Concentration (µg/mL)	Absorbance at 620 nm
20	
40	
60	
80	
100	

7. Calculation:

- From the standard curve, determine the amount of glucose present in the vegetable samples.
- Calculate the total carbohydrate content using the formula:

$$\text{Total Carbohydrate (mg/g)} = \frac{\text{Carbohydrate content from graph (µg/mL)} \times \text{Dilution Factor}}{\text{Weight of sample (g)}}$$

Observations and Results:

- Record the absorbance for the un-stored and stored vegetable samples.
- Compare the carbohydrate content between stored and un-stored vegetables and discuss the possible reasons for any differences (such as starch breakdown during storage).

Estimation of Protein by Lowry Method in stored and un-stored vegetables

Aim:

To estimate the total protein content in a stored vegetable and an un-stored (fresh) vegetable using the Lowry method.

Materials Required:

- Fresh (un-stored) vegetable sample
- Stored vegetable sample
- Mortar and pestle or blender
- 10% Trichloroacetic acid (TCA)
- 0.1N NaOH (for protein extraction)
- **Lowry reagent:**
  - Alkaline copper solution (Reagent C): 50 mL of 2% sodium carbonate in 0.1N NaOH + 1 mL of 0.5% copper sulfate + 1 mL of 1% potassium tartrate
  - Folin–Ciocalteu reagent (diluted 1:1 with distilled water)
- Bovine Serum Albumin (BSA) standard solution (1 mg/mL)
- Test tubes
- Pipettes
- Centrifuge
- Boiling water bath
- Colorimeter/Spectrophotometer (at 660 nm)
- Volumetric flasks (50 mL and 100 mL)

Procedure:

1. Preparation of Samples:

a. Un-stored (Fresh) Vegetable:

- Take about 2 g of the fresh vegetable.
- Homogenize the sample using a mortar and pestle or blender.
- Add 10 mL of 0.1N NaOH to the homogenized sample to extract proteins.
- Centrifuge the homogenate at 10,000 rpm for 10 minutes.
- Collect the supernatant for protein estimation.

b. Stored Vegetable:

- Similarly, take about 2 g of the stored vegetable.
- Follow the same steps as for the fresh sample (homogenization, extraction, centrifugation).

2. Preparation of BSA Standard:

- Prepare a Bovine Serum Albumin (BSA) standard solution (1 mg/mL) by dissolving 100 mg of BSA in 100 mL of distilled water.
- Take aliquots of 0.2 mL, 0.4 mL, 0.6 mL, 0.8 mL, and 1.0 mL into different test tubes and make up the volume to 1 mL using distilled water. These serve as standard protein solutions for the calibration curve.

3. Lowry Reagent Preparation:

- Alkaline copper reagent (Reagent C): Mix 50 mL of 2% sodium carbonate in 0.1N NaOH with 1 mL of 0.5% copper sulfate and 1 mL of 1% potassium tartrate.
- Folin–Ciocalteu reagent: Dilute the Folin–Ciocalteu reagent in a 1:1 ratio with distilled water just before use.

4. Estimation Procedure:

a. Take 1 mL of the vegetable protein extract (supernatant) in a test tube.

b. Add 5 mL of Reagent C (alkaline copper reagent) to the test tube.

c. Allow the mixture to stand at room temperature for 10 minutes.

d. Add 0.5 mL of Folin–Ciocalteu reagent to the test tube and mix well.

e. Incubate the tubes at room temperature for 30 minutes for color development.

f. Measure the absorbance of the blue color developed at 660 nm using a colorimeter or spectrophotometer.

5. Blank Preparation:

- Prepare a blank by taking 1 mL of 0.1N NaOH and following the same steps (adding Reagent C, then Folin–Ciocalteu reagent, and measuring absorbance).

6. Standard Curve Preparation:

- Measure the absorbance of the BSA standard solutions at 660 nm.
- Plot the standard curve by using absorbance values on the Y-axis and the concentration of protein (µg) on the X-axis.

7. Calculation:

- From the standard curve, determine the protein content of the vegetable samples.
- Calculate the total protein content using the formula:

$$\text{Total Protein (mg/g)} = \frac{\text{Protein content from graph (µg/mL)} \times \text{Dilution Factor}}{\text{Weight of sample (g)}}$$

Observations and Results:

- Record the absorbance values for the stored and un-stored vegetable samples.
- Compare the protein content between the stored and un-stored vegetables and discuss any observed differences, potentially due to protein degradation or enzymatic activity during storage.

PACKING MATERIALS FOR VEGETABLES & FRUITS

PACKING/PACKAGING

- Packing of fruits and vegetables and also their processed products plays a vital role in day to day life.
- Packaging can be defined as;" Techno-economic" function arrived at minimizing cost of delivery while maximizing sales
- Packaging plays a vital role in the conservation, preservation and transport.

IMPORTANCE OF PACKING

- Food packaging is an integral part of food processing and it is link between food processor and consumer.
- Packaging protects the contents against dehydration, oxidation, light, flavour loss,environmental factors and mechanical damage. It serves as a processing aid.
- Package is a convenience item for the consumer, can also be cost saving device.
- Package provides handling facilities for loading, transport, storage for long for both the processor and consumer.

PACKING MATERIALS FOR FRESH FRUITS AND VEGETABLES

- The packages for fresh fruits and vegetables can be classified as
- (1)Consumer/Retail packs and
- (2) Transport/Bulk packs.

FLEXIBLE PLASTIC FILMS

- Different types of flexible plastic films LDPE (low
- density poly ethylene), PVC (poly vinyle chloride), PP (poly propylene) and cellulose acetate films are used for packing.
- These films are mostly used as pouches with holes punched at regular intervals to allow respiration.
- They are available in wide range of thickness and grades and can be used to control the environmental gases inside the pouch.
- LDPE is the most widely used material

FLEXIBLE PLASTIC FILMS

TRAY WITH OVER WRAP

- The trays used are usually made of moulded pulp tray or plastic material like PVC and PP.
- The produce is placed in individual cavities so that abrasion and bruising is avoided during transportation. The trays also provide cushioning effect to the produce.
- The over wrap film is a transparent see through food grade, odourless plastic film with the property of clinging to the product packed when stretch wrapped.
- This film can be applied without application of heat. This film is usually made of LDPE or PVC.
- The films are semi-permiable and allow exchange of gases for respiration of the product.

TRAY WITH OVER WRAP

PLASTIC PUNNET

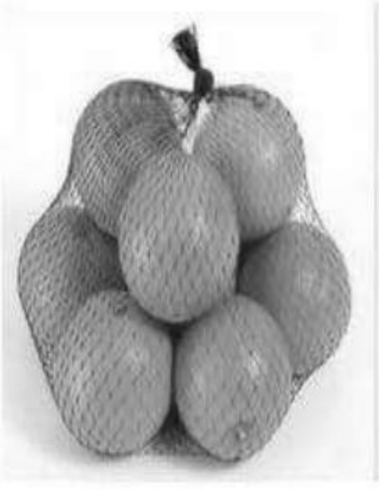
- These are strong, versatile. clear, bright containers which offer product visibility and are provided with holes for ventilation, which keeps the produce fresh.
- These containers are food grade, odourless.light weight, stackable and recyclable and give good presentation.
- These are either made of PET (poly ethylene
- terephthalate), PVC or PP.

PLASTIC PUNNET

PLASTIC NET BAGS

- The plastic net bags have the feature to stretch and accommodate all sizes and shapes of produce.
- These bags are available in roll form or in precut lengths with the stretch width of 200mm – 400mm.
- By allowing air to circulate in and around the produce; the net bags prolong the freshness and shelf life of the product.
- These also eliminate pack condensation there by preventing spoilage and wastage.
- They make a colourfull point of sale display allowing clear visibility of the contents, enhancing the natural colours of fresh produce.
- These are generally made of HDPE or PA (poly amide).

PLASTIC NET BAGS



FOAM SLEEVE

- This is a plastic tubular film made of polyethylene foam available in different colours, diameters and lengths.
- It can be easily slipped over the individual fruits in a snug fit form.
- It provides a cushioning effect and protects the fresh produce against abrasion and scratches during transport.
- It is hygienic,non-toxic and odourless.

FOAM SLEEVE

SHRINK FILM WRAPS

- Films such as Polypropelene, polysterine, Polyetheylene and rubber hydrochloride can be converted into shrink films by molecular orientation methods.
- After the shrink film is applied to the filled trays or in tubular or heatsealed wrap form, the packages are sent through a heat tunnel to shrink the film cover.
- This immobilizes the commodity to reduce the possibility of physical damage during handling.

SHRINK FILM WRAPS

TRANSPORT/BULK PACK

- Transport or bulk packages are designed for lon distance transportation in capacities ranging from 4-5 kg to 20-25 kg.
- These packs must withstand impacts, compression and vibration during transport.
- Packaging material for transport or bulk packing can be broadly categorized as rigid containers made of wood (wooden crates), corrugated fiber board boxes, plastic crates and flexible containers such as sacks made of plastic.
- Along with these materials some traditional materials used are jute (jute sacks) and baskets made of woven strips of leaves, bamboo, plastic etc.

NATURAL MATERIALS

- Baskets and other traditional containers made from bamboo, rattan, straw, palmleaves, etc.,are used throughout the developing world.
- Both raw materials and labour costs are normally low, and if the containers are well made they can be reused.
- Dis- advantages:
- 1) They are difficult to clean when contaminated with decay organisms.
- 2) They lack rigidity and bend out of shape when stacked for long distance transport.
- 3) They load badly because of their shape
- 4) They cause pressure damage when tightly filled.
- 5) They often have sharp edges or splinters causing cut and puncture damage.

NATURAL MATERIALS

WOODEN BOX/CRATES

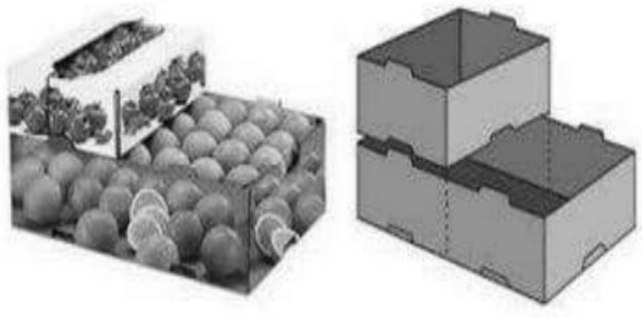
- The conventional baskets have been replaced by wooden boxes as they give better protection to the fresh produce against transportation hazards.
- They have high puncture resistance, good tensile strength.
- Wooden boxes are rigid and reusable and if made to a standard size, stack well on trucks.
- However, the use of wooden boxes is discouraged now a days as it promotes deforestation.

WOODEN BOX/CRATES

CARD BOARD/CORRUGATED FIBRE BOARD BOX

- Containers are made from solid or corrugated card board.
- The types closing with either fold over or telescopic (separate) tops are called boxes or cases.
- Shallower and open topped ones are called trays.
- Boxes are supplied in collapsed fore that is flat and
- are set up by the user.
- The setting up and closing of boxes requires tapping, gluing, stapling or the fixing interlocking tabs.
- Are used for tomato, cucumber, and ginger transport.
- They are easy to handle, light weight, come in different sizes, designs and strengths and come in a variety of colours that can make produce more attractive to consumers

CARD BOARD/CORRUGATED FIBRE BOARD BOX



MOULDED PLASTIC CRATES

- Re-usable boxes moulded from high density polythene are widely used for transporting produce.
- They can be made to almost any specifications .They are strong, rigid, smooth ,easily cleaned and can be made to stack when full of produce and nest when empty in order to conserve space.
- Dis-advantages:
- 1) They can be produced economically only in large numbers but are still costly.
- 2) They have to be imported into most developing countries, adding to the cost and usually requiring foreign currency for their acquisition
- 3) They often have many alternative uses (as wash tubs) and are subject to high pilferage rates.
- 4) They require a tight organization and control for use in a regular go and return service
- 5) They deteriorate rapidly when exposed to sunlight (especially in the tropics)
- unless treated with an ultraviolet inhibitor, a factor adding to the cost.

NATURAL AND SYNTHETIC FIBRE

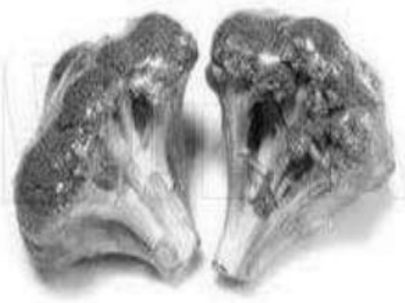
- Sacks or bags for fresh produce can be made from natural fibres like jute or sisal or from synthetic polypropylene or polyethylene fibres or tapes.
- 'Bags' usually refers to small containers of up to about 5 kg capacity.
- They may be woven to a close texture or made in net form.
- Nets usually have a capacity of about 15kg.
- Bags or sacks are mostly used for less easily damaged produce such as potatoes, sweet potatoes, onions, but even these crops should have careful handling to prevent injury.

NATURAL AND SYNTHETIC FIBRE

PAPER /PLASTIC FILM

- Paper or plastic film is often used to line packing boxes in order to reduce water loss of the contents or to prevent friction damage.
- Paper sacks can have walls up to six layers of Kraft (heavy wrapping) paper.
- They can have a capacity of about 25 kg and are mostly used for produce of relatively low value.
- Closure can be done by machine stitching across the top (recommended for large scale crop production) or in the field by twisting wire ties around the top by means of a simple tool.

PAPER /PLASTIC FILM



Presentation On :

PREPARATION OF MANGO PICKLE

Definition of Pickle

Its is the process of preserving mangoes by anaerobic fermentation in brine to produce lactic acid, or marinating and storing it in an acid solution, usually vinegar (acetic acid). The resulting product is called a MANGO PICKLES.

Introduction

- Mango pickle is a traditional Indian condiment made with raw mangoes, spices and oil.
- It is made from unripe green mangoes that are fermented with lactic acid bacteria.
- It is eaten with dal-rice, dal-roti, parathas & even with many breakfast dishes.
- Mango Pickles are known to impart flavour and taste to the food.

Benefits of Mango Pickle

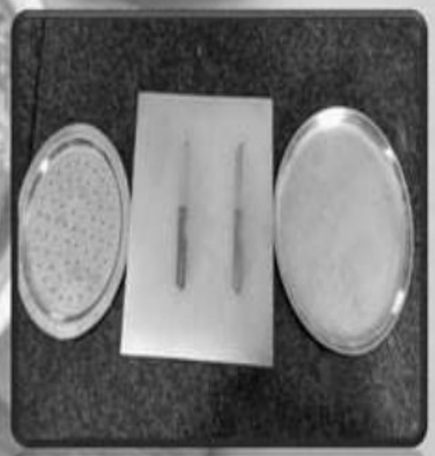
1. Improves digestion.
2. Helps in weight loss.
3. Enhances taste of food .
4. Excellent antioxidant content
5. Rich with nutrients.
6. Boosts immunity.
7. Maintains blood pressure.
8. Rich in Vitamin C

Ingredients

- Green mango
- Common salt
- Turmeric powder
- Chilli powder
- Oil
- Fenugreek
- Mustard seed
- Black pepper
- Pickle masala
- Asafoetida

Tools and Equipment

- Knife
- Chopping table
- China pot
- Tray
- Stainless steel plates



Flowchart

Selection of mangoes

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Washing

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Cutting lengthwise into 4 pieces

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Removal of Kernel

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Dipping pieces into 2% salt solution

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Draining of water

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Drying in shade for few hours

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Heating and then cooling oil

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Mixing pieces with spices powder

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Filling in jar

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Addition of remaining oil

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Storage and Packaging

Selection of Mangoes

- Select fresh, mature , but unripe fruits.
- The best varieties to use are those with an acidic taste.
- Discard ripe, damaged or mouldy fruits.

Washing

- Wash the mangoes with clean running water to remove dust and bacteria.
- Wipe the fruits with dry cloth .

Cutting

- Cutting mangoes lengthwise into 4 different pieces of uniform /even size

Removal of Kernel

- Remove the kernel from mango pieces and then clean the pieces with cloth.

Dipping in Salt Solution

- Mix the mango pieces with salt and turmeric.
- Holding the fruit pieces in salt solution to prevent browning of surface

Draining and Shading

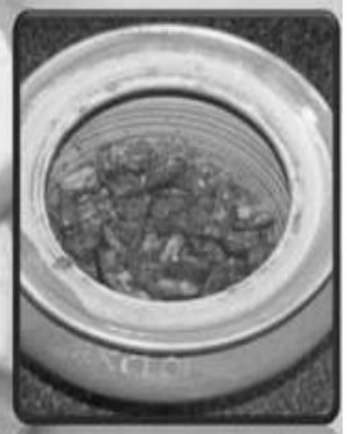
- Drain out additional water from pieces and dry in shade for few hours

Heating and Cooling Oil

- Heat the pan and roast the spices on light flame until become light browned and stirring frequently to prevent burning .
- Grind the spices to extract the intense flavours and powerful aromas
- Heat the oil and kept it for cooling

Mixing and Filling

- Mix the roasted , grinded spices and all ingredients with mango pieces
- Fill the pickle in clean china pot /HDPE jar



Addition of Oil

- Add sufficient oil to leave a thin layer at the top

Packing and Storage

- Pack the jar and store the pickle in dry place away from direct sunlight

Specifications

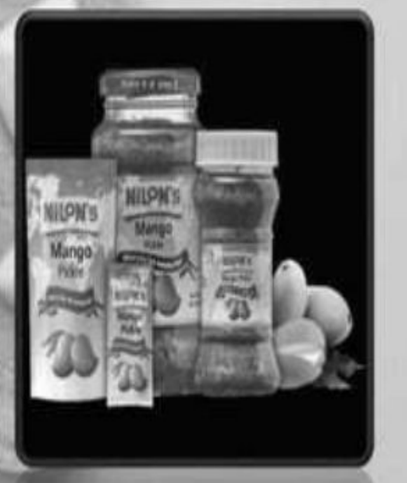
- Salt : over 12 per cent, best is 15 per cent
- Acidity : >2 per cent of which minimum 0.5 per cent should be acetic acid
- pH : below 3.5
- Moisture : below 50%
- Oil : to cover the top completely

Nutritional Information
(per 100 gm approximately)

Energy Value	201kcal
Protein	3.01 gm
Fat	14.39 gm
Saturated fat	4.38 gm
Trans fat	0.0 gm
Carbohydrates	13.88 gm
Sugars	2.02gm
Vitamin c	16.60%

Packaging

- China pot
- HDPE jars
- PET jars



Practical No. 7

Title: **Preparation of tomato ketchup and sauce.**

Objectives: **1. To impart the knowledge of sauce/ketchup preparation among students.**

2. To see the economic feasibility of product preparation.

Material required: Knives, mixer grinder, pulper, crusher filter, steel vessels, muslin cloth, glass bottle, tomato fruits, spices, vinegar, sugar etc.

Table 4: Recipe of ketchup for 10 kg of tomato pulp

Tomato pulp	10 kg	Clove	2 g
Sugar	750 g	Cumin seed	5 g
Salt	130 g	Cardamom (Large)	8 g
Garlic Chopped	25 g	Mace	2 g
Onion chopped	250 g	Cinnamon	10 g
Ginger	25 g	Vinegar (6%)	600 ml
Red chilli powder	10 g	Sodium benzoate	2 g

Procedure:

Selection of fruits		Fully ripe and even red coloured fruits should be selected for sauce/ketchup preparation. Green, shriveled and diseased tomatoes should be discarded.
Washing of fruits		Fruits are properly washed with running water to remove adhering dust, field residues and to minimize the micro-organism presence.

Cutting of fruits		For the preparation of sauce/ketchup, tomato fruits should be cut into 3-4 equal pieces so that pulp can be easily extracted.
Pulping		The pulp of tomato fruits can be extracted either by pulping machine or by boiling the fruit pieces in a vessel over the gas stove. The cooked pieces are crushed by the crusher filter to remove the seed and peel from the pulp. The uniform tomato pulp without seed and peel is collected in a steel vessel for further cooking to prepare sauce or ketchup.
Preparation of spice bag	 	Generally, two type of spices are used to get the spicy taste in the ketchup or sauces i.e., dry and wet. Both spices are crushed by mixer grinder and take into the muslin cloth. These crushed spices are tied with muslin cloth. Care should be taken that muslin cloth bag should be enough loose.
Cooking with spice bag		This spice bag is poured into the cooking pulp of tomato in a steel vessel. This bag is occasionally pressed to get blended the extract of spices with tomato pulp. The pulp is cooked till the one third volume of original pulp volume. The spice bag should be squeezed in the tomato pulp to obtain maximum quantity of spice extract in the pulp.

Removal of spice bag		The spice bag should be removed after the proper impregnation of spice extract in the pulp. A strong aroma of spices in cooking pulp can be felt at this stage.

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Addition of sugar, salt and vinegar		As soon as spice bag is removed from the cooking pulp, required quantity of sugar, salt and vinegar should be added and cooked till end point.

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Judging of end point		As soon as the volume of cooking pulp remains one third of its original volume, it shows that the ketchup is ready at this stage. Refractometer shows the reading of 28^0Brix .

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Filling hot into the bottles		Prepared ketchup is filled hot into the sterilized glass bottles upto the brim and the bottles should be corked immediately.

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Pasteurization		These bottles are allowed for pasteurization at 85-90^0C for 30 minutes, so that the exhausting of bottles can be done in proper ways.

Sealing and storage		After pasteurization, bottles are corked properly or air tight and cooled enough. These bottles can be stored at room temperature in cool dry places.

Preparation of Sauce:

Ketchup or sauce prepared from tomato fruits contains more or less same ingredients and method of preparation of sauce is similar to preparation of ketchup. The both differ in respect to consistency and the ketchup is more thicker as compared to sauce.

Precautions:

1. Do not add salt, sugar and acetic acid in the beginning of ketchup/sauce preparation.
2. Care should be taken that the spice bag should loose enough so that extract can be mixed properly.
3. Sugar, salt and vinegar should be added after removal of spice bag.

Questions:

1. Why spice bag is used?
2. How long ketchup bottles should be pasteurized?
3. Why hot ketchup/sauce mixture is poured in the bottle?
4. Describe the end point for sauce and ketchup preparation.

Preparation of Tomato Chutney

M.V.V.S.GANGA BHAVANI
LECTURER IN BOTANY

Objective:

To prepare tomato chutney as a value-added product from harvested tomatoes.

Materials and Equipment:

- - Fresh ripe tomatoes (1 kg)
- - Onions (200 g)
- - Garlic (20 g)
- - Ginger (20 g)
- - Green chilies (5-6)
- - Mustard seeds (5 g)
- - Cumin seeds (5 g)
- - Turmeric powder (5 g)
- - Red chili powder (optional, 2 g)
- - Salt (10 g)
- - Sugar or jaggery (50 g)
- - Vegetable oil (30 ml)
- - Vinegar or lemon juice (15 ml)
- - Fresh coriander leaves (optional)
- - Cooking utensils (knife, cutting board, grater, measuring spoons, pan, spoon, etc.)
- - Storage jars or containers

Procedure:

1. Selection and Preparation of Ingredients:

- - Select fresh, ripe, and firm tomatoes to ensure quality chutney.
- - Wash the tomatoes thoroughly under running water to remove any dirt or pesticide residues.
- - Peel and finely chop the onions.
- - Peel and mince the garlic cloves.
- - Peel and grate the ginger.
- - Wash and chop the green chilies.

2. Cutting and Chopping:

- - Cut the tomatoes into small, even-sized pieces to ensure uniform cooking.
- - Ensure all ingredients are prepared and measured before starting the cooking process.

3. Tempering:

- - Heat 30 ml of vegetable oil in a large pan over medium heat.
- - Add 5 g of mustard seeds and 5 g of cumin seeds to the hot oil. Allow them to splutter for a few seconds.

4. Sautéing:

- - Add the finely chopped onions to the pan and sauté until they turn golden brown.
- - Add the minced garlic and grated ginger. Sauté for another minute until they release their aroma.

5. Adding Spices:

- - Add the chopped green chilies, 5 g of turmeric powder, and 2 g of red chili powder (if using). Mix well to coat the onions and garlic with the spices.

6. Cooking Tomatoes:

- - Add the chopped tomatoes to the pan. Stir well to combine all the ingredients.
- - Cook the tomatoes on medium heat, stirring occasionally, until they become soft and mushy. This process may take 10-15 minutes.

7. Seasoning:

- - Add 10 g of salt and 50 g of sugar (or jaggery) to the mixture. Mix thoroughly.
- - Continue to cook on low heat until the mixture thickens and the oil begins to separate from the chutney. This ensures all excess moisture is evaporated, and the chutney has a good shelf-life.

8. Final Touches:

- - Add 15 ml of vinegar or lemon juice to the chutney. Mix well and cook for an additional 2-3 minutes. This step acts as a preservative and enhances the flavor.

9. Cooling and Storage:

- - Remove the pan from heat and allow the chutney to cool to room temperature.
- - Once cooled, transfer the chutney into clean, dry glass jars or containers with airtight lids.
- - Store the chutney in the refrigerator. Properly stored chutney can last for 1-2 weeks.

Garnishing (Optional):

- - If desired, garnish the chutney with freshly chopped coriander leaves before serving.

Conclusion:

- The preparation of tomato chutney from post-harvest tomatoes not only adds value to the produce but also provides a delicious and preservable product. This process helps in utilizing surplus tomatoes and reduces post-harvest losses.