S.N.	Name of Practical	Date	Remarks
1.	Identification of equipment, tools, and chemicals used in postharvest horticulture.		
2.	Preparation of potato chips and finger chips.		
3.	Preparation of jam, jelly and Marmalade		
4.	Determination of TSS by using refractometer.		
5.	Organoleptic evaluation and hedonic rating for different qualities		
6.	preparation of Tomato Ketchup.		
7.	Maturity indices of fruits and vegetables.		
8.	Determination of firmness		
9.	Artificial ripening of banana		
10.	Determination of titrable acidity (TA)		

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Practical No:-

Identification of equipment, tools and chemicals used in postharvest horticulture

Objectives:-

- To study about equipment, tools and chemicals used in postharvest horticulture
- To utilize the tools and chemicals in different practicals,

Theory:-

Postharvest horticulture involves a range of activities aimed at preserving the quality and extending shelf life of harvesting fruit and vegetables. This include proper harvesting, proper handling, storage, processing and transportation.

Instruments	Function
1. Knife:	- To cut the fruit and vegetable into pieces.
2. Chopping board	- Used as stable base during cutting operation.
3. Bucket	- Used for cleaning & holding the fruits & vegetables.

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4. Mixer Grinder - Used for grinding the fruit into pieces while preparing jam, jelly.
5. Steel bowl/bucket - Used in preparation of jam as a medium to heat the fruits.
6. Peeler - Used in peeling of skin of fruit & potato during preparation of respective products.
7. Wooden spoon - Used in stirring
8. Pressure cooker - Used in cooking tomato for ketchup preparation.
9. Mortar & Pestle - Used in grinding spices.
10. Polyethylene packet - Used for wrapping banana during ripening by ethylene
11. Muslin cloth - Used for separating juices from puree of tomatoes.
12. Penetrometer - Used to measure the total soluble solid in fruit & vegetables.

Chemical	Function
1. Ethral/Ethepon	- Used as ripening hormone for artificial ripening of fruits.

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2. Sodium hydroxide	- Used to neutralize the acid present in sample.
3. Phenolphthalein	- Used to signal the end point of titration.
4. Pot. hydrogen thalate	- Used to standardize the NaOH sol^n
5. Ethanol	- Used to dissolve certain sample.

Conclusion :

We knew various instruments, tools and chemicals used in posthanest horticulture.

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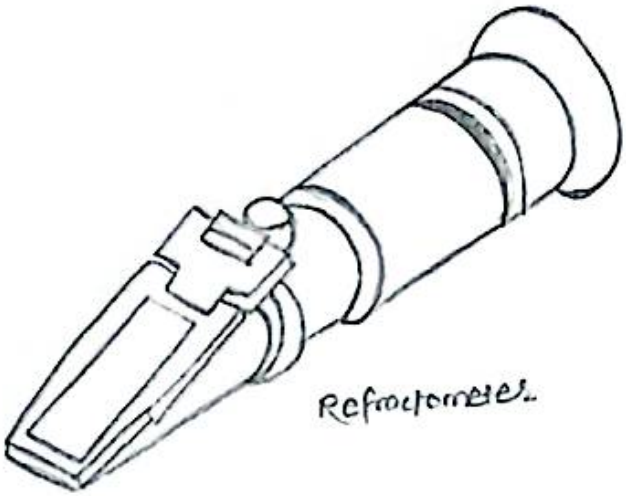


Refractometer

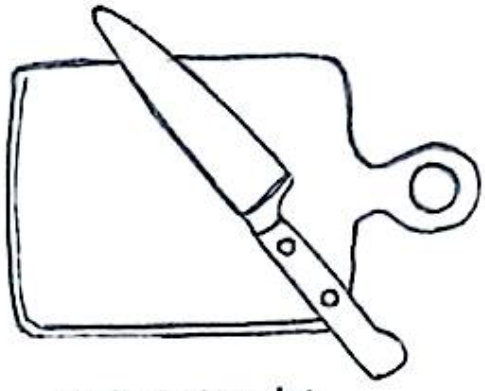
Peeler

Grinder

Mortar & pestle

Weighting Balance

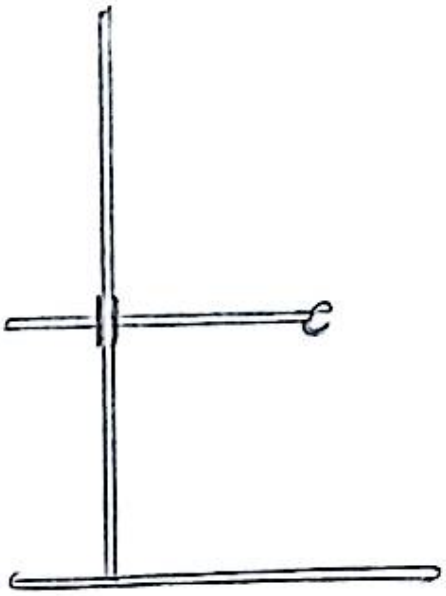
Steel bowl



Knife & chopping board

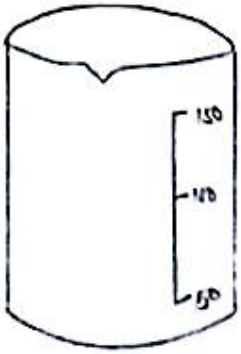
Burette

pipette



Burette stand

Conical flask



Beakers

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Practical No:-

Preparation of potato chips & finger chips

Materials required :-

- Fresh potatoes (4-5 medium sized)
- salt
- oil for frying
- spices, herbs & seasonings

Objectives :-

- To learn the technique of preparing & frying potatoes to a perfect crispiness.
- To explore variations in flavor using seasoning.

Preparation of potato chips :-

- Wash the potatoes thoroughly & peel them
- cut the potatoes into thin, even slices using a knife
- Soak the slices in water for about 30 minutes to remove excess starch.
- Drain and pat the slices dry with a clean muslin towel
- Heat oil in a frying pan or deep fryer to around 180°C (350°F)
- Carefully add the potatoeslices to the hot oil in small batches, frying until golden brown & crispy.
- Take them out with a slotted spoon & drain on paper towels. Season with salt & optional spices while still hot.

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Preparation of finger chips:

- Wash the potatoes and peel them.
- Cut the potatoes into long, thin strips resembling fingers (about 0.5 cm thick)
- Soak them in water for about 30 minutes to reduce starch content.
- Dry & drain the strips.
- Heat oil in a frying pan to approximately 180°C (350°F)
- Fry the strips in batches until they are golden & crispy.
- Take out of pan and drain on paper towel.
- Season with salt & desired spices.

Conclusion:

The key takeaway during the process was the significance of eliminating excess starch to achieve the perfect color & crispy texture in both type of snacks. We successfully prepared both potato chips and finger chips to a perfect crispiness.

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Practical No:

Preparation of Jam, Jelly and Marmalade

Objectives:

- To study about Jam, Jelly and marmalade and its methods of preparation

Materials required:

Fruit, sugar, lemon juice, pectin, Pan, stainer, knife, bowl

Theory:

Jam, Jelly and marmalade are popular fruit preserved made to enhance the shelf life of fruits while retaining their flavor, color, and nutritional value. Each product is distinguished by its texture: Jam is made with fruit pulp, Jelly with fruit juice, and marmalade with citrus fruit including the peel. These methods utilise sugar, pectin, and heat to create products that are both delicious and long lasting.

Jam making:

Ingredients:

- Fresh fruits (e.g. mango, strawberry, or guava)
- Sugar (equal to the weight of the fruit pulp)
- Lemon juice (as a source of natural pectin)

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Procedure :

→ Wash the fruits thoroughly, peel if necessary, and chop them into small pieces.
→ Cook the fruit with a small amount of water until it softens into a pulp.
→ Add sugar to the fruit pulp and cook on medium heat while stirring continuously to prevent sticking.
→ Add lemon juice to enhance gel formation and flavor
→ Check for doneness using the plate test : drop a small amount onto a cold plate ; if it sets without running, the jam is ready.
→ Pour the hot jam into sterilized jars, seal tightly, and allow to cool.

Jelly making :

Ingredients :
- Fresh fruit juice (e.g. apple, grape, or pomegranate)
- Sugar (equal to the volume of juice)
- Pectin (if the fruit has low natural pectin)

Procedure :
→ Extract clear juice by boiling fruits in water and straining the liquid through muslin or cheesecloth. Avoid squeezing the pulp to keep the juice clear.

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→ Mix the juice with sugar in a 1:1 ratio and boil the mixture on medium heat.
→ Add pectin if necessary and continue boiling until the jelly reaches the gel stage (confirmed using the plate test)
→ Pour the hot jelly into sterilized jars, leaving minimal air space, and seal immediately.

Marmalade Making

Ingredients:

- Citrus fruits (e.g. oranges & lemons ...)
- Sugar
- Water

Procedure:

→ Wash the citrus fruits, peel them, and slice the peel thinly.
→ Remove seeds and slice the fruit pulp into small pieces.
→ Boil the peel in water until it softens, then add the fruit pulp.
→ Mix sugar into the peel and pulp mixture, and cook on medium heat while stirring.
→ Cook until the mixture thickens, checking doneness using the plate test.
→ Pour the hot marmalade into sterilized jars, seal tightly, and allow to cool.

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Conclusion :-

The preparation of jam, jelly, and marmalade is an excellent way to utilize fruits efficiently while creating flavorful and versatile products. By following the proper procedures, these preserves can maintain their quality for months.

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Practical NO :-

Determination of Tss by using refractometer

Objectives :-

- To study about total soluble solid.
- To determine Tss of citrus fruit.

Materials required :

- citrus fruit
- Refractometer
- Water

Theory :-

Total soluble solid may be determined by means of refractometer. Brix is a measure of Tss in the case of pure sucrose solution. Generally fruit juice contain more sugar than other soluble constituents.

A refractometer is an optical instrument that measures the refractive index of a solution, which changes according to the concentration of dissolved solids. The refractive index is then converted to Tss (°Bx) using a calibrated scale.

Working principle of Refractometers :

A refractometer operates on the principle of refraction, where light changes direction as it passes from one medium to another with a different density. When light passes through a

a liquid sample, the angle of refraction is determined by the refractive index of the sample. The refractive index is directly proportional to the concentration of dissolved solids in the liquid. The instrument uses this relationship to display the TSS value in degree Brix (°Bx). The reading is obtained by viewing a calibrated scale or digital display.

Procedure:-

1. Clean the refractometer's prism with distilled water and dry it with a lint-free cloth.
2. Calibrate the refractometer to 0°Brix using distilled water.
3. Prepare the sample by ensuring it is homogenous and free of solid particles.
4. Place a few drops of the sample on the prism using a dropper.
5. Close the lid gently to spread the liquid evenly without air bubbles.
6. Observe the reading on the scale.
7. Record the TSS (°Bx) value.
8. Clean the prism with distilled water and dry it after use.

Observation:

Sample Name	TSS (°Bx)	Observations
Eg: Orange juice	12.5	Sweet, fresh aroma

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Conclusion :-

The total soluble solids (TSS) content of the given sample was successfully determined using a refractometer. The observed TSS value provides an estimate of the concentration of dissolved solids, primarily sugars, in the sample.

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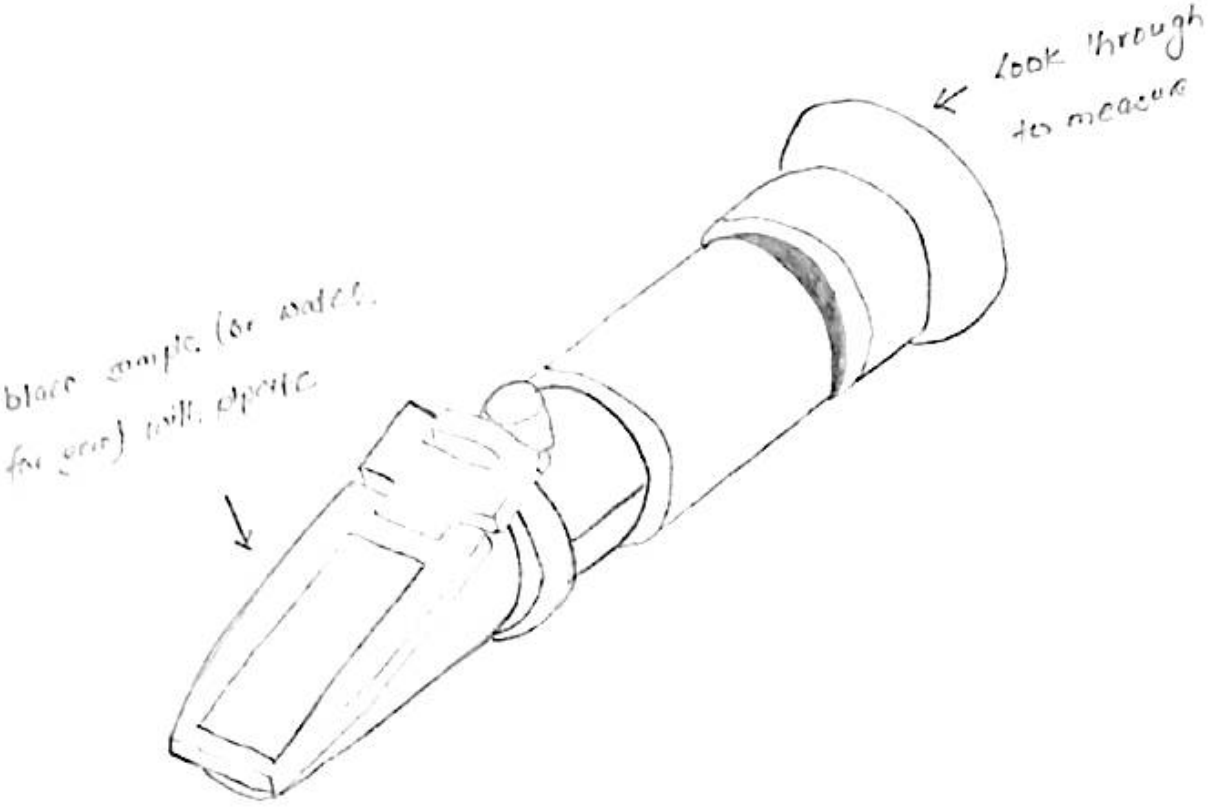

Fig:- Refractometer & schematic summary of its mode of use.

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Practical No:

Organoleptic evaluation and Hedonic rating for different qualities

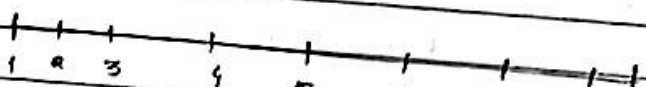
Objectives:

- To study about organoleptic evaluation and hedonic rating and perform for different qualities.

Theory:

Organoleptic testing involves the assessment of flavor, odour, appearance and mouthfeel of a food product or commodity. Generally this test is done by different individuals on the basis of visual observation and tasting it.

A hedonic scale of 1-9 can be used for rating the quality of a commodity.



(least acceptable) → (Highly acceptable)

The following points are considered while doing organoleptic test.

→ Person should not be taste blind.

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→ The person should not be hungry or have enough food recently.
→ The room should be neat and clean.
→ The person should not know about variety of food he/she is going to taste.
→ Mouth should be rinsed after each test.
→ peson should have aquaintance with product quality.

Procedure:
→ 3 variety A, B, and C of apple were kept in 3 plates.
→ 5 students from the group were taken as panelist.
→ Then each student started tasting the 3 variety of apple.
→ After each test, mouth was rinsed properly.
→ Numbering was given (On hegonic scale) based on the quality.
→ The average score was calculated.

Observation:
- Variety A scored 37.5 points.
- Variety B scored 36.5 points
- Variety C scored 33.5 points.

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Conclusion:

On the basis of the observation, variety A (fuji) was rated highest during organoleptic test and rating on hedonic scale.

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Practical No:-

Preparation of Tomato ketchup

Objectives :-

- To study about preparation of tomato ketchup

Materials required :

- Tomato, sugar, salt, Onion, ginger, garlic, chilli, black pepper, cardamom, cinamom, cumin, vinegar, gas & stove, pan

Theory :

Ketchup is a viscous condiment typically made from ripe tomatoes, vinegar, sugar, salt and a blend of spices and flavoring agents The preparation process involves :

1) Selection of Raw materials :
   - High quality, fully ripe tomatoes are selected for their rich flavor & natural color.

2) Pulping & filtering :
   - Tomatoes are finely chopped & pulp is removed
   - The mixture was simmered for 30-40 minutes until the tomatoes become soft.

3) Cook :
   - Gently cook the ketchup base, add sugar, salt, vinegar and chilli powder to the puree.

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4) Adding preservatives :

- After the puree reached the desired consistency, allow it to cool.
- Sodium benzoate (a preservative) is dissolved in a small amount of warm water & added to the ketchup to increase the shelf life.

5) Bottling :

- The prepared ketchup is poured into steriliged glass bottles while still hot.
- The bottles are sealed tightly to prevent contamination and then labelled.

Conclusion :

Hence, this is a complete process for preparation of flavorful & thick ketchup and preservation method for longer storage.

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Practical No:-

Maturity indices of fruits and vegetables

objectives:

- To understand and identify the maturity indices of various fruits & vegetables to determine the appropriate stage of harvesting

Materials required:

- Various fruit & vegetable samples
- Knife or cutting tools
- Refractometer
- Ethylene tester
- Vernier callipes
- Weighing scale
- Color charts

Theory:

Maturity indices are critical parameters used to determine the right stage of harvesting fruits & vegetables. These indices are essential for ensuring optimum quality, shelf life & nutritional value. Maturity can be physiological or commercial various physical, chemical and physiological attributes are used to access maturity indices.

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Types of Maturity :

*. Horticultural Maturity / commercial maturity :

stage at which a commodity is ready for harvest for marketing purpose.

* Physiological maturity :

When a fruit or vegetable has reached its maximum development.

Maturity indices parameter :

physical : Size, weight, color, shape

chemical : Total Soluble Solid (TSS), starch content, acidity

physiological : Respiration rate, ethylene production.

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Procedure:

- Collect the samples of different fruits & vegetables at various stages of development from the farm.
- Measure the size, weight and external colors.
- Extract the juice & measure TSS using a refractometer.
- Test for starch content using iodine solution (for bananas).
- Measure respiration rate using a closed container & CO_2 sensor.
- Test ethylene production if equipment is available.
- Compare with the standard maturity indices of fruits.

Eg:

Crops	Maturity indices.
⊙ Mango	- Change in skin color (green to yellowish-green) - TSS ≥ 10 - 14 % - Specific gravity : 1.01 - 1.02 g/cm^3
⊙ Banana	- Fruit angularity i.e TS of mature banana is more or less circular. - Skin color turns to yellow. - 100-120 Days after flowering.

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⊙ Apple
- Fruit detaches easily from the tree with a twist
- starch test indicates conversion to sugar.
- skin color changes to variety-specific red, green or yellow.

⊙ Tomato
- Changes in skin color from green to breaker stage (slight pink appearance)
- Firmness decreases slightly
- TSS ≥ 4.5 %

⊙ Pineapple
- Skin color changes from green to golden yellow
- Internal flesh color turns pale yellow
- TSS ≥ 12-14 %

Conclusion :

Understanding & utilizing maturity indices are critical for determining the right time to harvest fruits & vegerables.

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Practical No:-

Determination of firmness

Objective:-

- To determine the firmness of horticultural commodity.

Materials required:-

- Penetrometer
- Fruit

Theory:-

The firmness of horticultural commodities, such as fruits and vegetables, is a crucial quality parameter that reflects their ripeness, texture, and suitability for consumption or processing. A penetrometer is a widely used instrument for assessing firmness by measuring the force required to penetrate the tissue of a commodity.

Principle:-

The penetrometer operates on the principle of mechanical resistance, where the firmness is directly proportional to the force required to insert a probe or plunger of known size into the sample. This force is

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influenced by factors such as cell wall strength, turgor pressure, and the composition of fruit or vegetables.

Procedure :-

- An apple and a penetrometer was taken.
- A portion of apple skin was peeled out.
- The penetrometer was turned ~~off~~ on and the tip was inserted on the fruit.
- Reading was taken as 5.96 kg/cm^3

Conclusion:-

A reading of 5.96 kg/cm^3 suggests that the apple is relatively firm, which is typical for apples at the early stages of ripening.

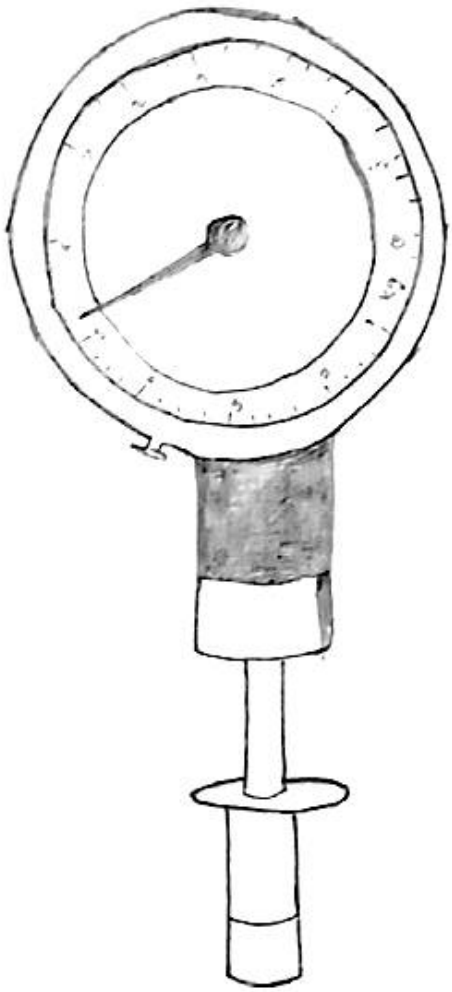

Fig:- Fruit penetrometer.

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Practical No:

Artificial ripening of banana

Objective

- To study about artificial ripening.
- To perform artificial ripening of banana.

Materials required:

- Etheral / ethephon
- Bucket & water
- polythene bag.

Theory.

Ripening is a complex physiological process that transforms unripe fruits into mature, consumable, produce through biochemical and structural changes. In banana, this process involves significant metabolic transformations triggered primarily by the plant hormone ethylene. During ripening, bananas undergo a series of systematic changes including starch conversions to sugars, cell wall softening, chlorophyll degradation, angularity of banana (i.e, TS of banana is more or less circular upon maturity), and color transformation from green to yellow.

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Artificial ripening using ethylene (ethephone) involves controlled exposure of green bananas to specific concentrations of ethylene gas under regulated temp. and humidity condition. Typically, bananas are placed in sealed chamber where ethylene concentration ranges between 10-100 parts per million, maintained at temp. of 15-20°C with relative humidity around 85-90 %.

Procedure:

- 1.5 ml of ethephone was dissolved in 1 lit of water in a bucket.
- The bananas were dipped on the solution.
- After straining the excess solution, they were packed in polythene bag & placed at 15°C & 85-90% RH.

Conclusion:

We observed ripend bananas after 48 hrs.

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Practical No:

Determination of Titrable Acidity (TA)

Objectives:

- To know about titrable acidity & calculate TA of fruit.

Materials required.

- Beaker
- Burette
- Base of known concentrate (NaOH)
- phenolphthalein
- Sample

Theory:

Titrable acidity (TA) refers to the total vol amount of titrable acids present in a sample, typically measured by neutralization with a standard base to a specific endpoint, usually indicated by a pH or a color change of an indicator.

Principles of Titrable Acidity:

Titrable acidity involves titrating a known volume of a sample with a standard alkaline solution (usually NaOH) until the endpoint is reached.

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Procedure:

→ A burette was taken and filled with 0.1N NaOH and placed in the stand.
→ The sample juice was extracted from fruit. (eg. lemon)
→ 2g/ml or 10 g/ml (as desired) of juice was measured and placed in a conical flask.
→ Equal amt. of distilled ~~amount~~ water was added along with few drops of phenolphthalein.
→ Then titration was initiated by mixing up with 0.1N NaOH.
→ End point was determined by observing color change.
→ Used volume of NaOH was recorded.

Calculation:

$$\text{Titrable acidity (\% citric acid)} = \frac{V_{NaOH} \times \text{Normality} \times \text{Eq. wt of citric acid}}{\text{Vol. of sample}} \times 100$$

$$= \frac{15 \times 0.1 \times 64.04}{2} \times 100$$

$$= 9.803\ \%$$

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Conclusion:

The calculated titrable acidity (TA) of 4.809% indicates that the lemon juice sample has a typical level of acidity that makes it suitable for culinary & preservative purpose.

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