PRACTICAL MANUAL

Post Harvest Management and Value Addition of Fruits and Vegetables

(Course No. APH 376) Credits: 2(1+1)

[For B. Sc. (Hons.) Agriculture 6th Semester Students]

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2018

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Syllabus:

Applications of different types of packaging, containers for shelf life extension. Effect of temperature on shelf life and quality of produce. Demonstration of chilling and freezing injury in vegetables and fruits. Extraction and preservation of pulps and juices. Preparation of jam, jelly, RTS, nectar, squash, osmotically dried products, fruit bar and candy and tomato products, canned products. Quality evaluation of products -- physico-chemical and sensory. Visit to processing unit/ industry.

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Exercise- 1

Objective: Packaging of fruits and vegetables.

Packaging:……..……...……

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Function of Packaging:……...……..……

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Packaging Methods:..……..……

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Advantages of Packaging:……

Q: Define role of packaging?

Exercise- 2

Objective: Modified atmosphere packaging on ripening and shelf life of fruits.

Modified Atmosphere Packaging:……

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Materials Required:……

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Observation: Fruits kept in polyethylene bags with different ventilation levels at ambient temperature

Treatment ventilation	Observation				
	1st day	3rd day	6th day	9th day	Shelf life (days)
1st lot					
2nd lot					
3rd lot					
Control (without treatment)					

Conclusion:……

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Q 1: Elaborate modified atmosphere packaging.

Exercise- 3

Objective: Determination of physiological loss in weight (PLW) during storage.

PLW:……..……...……...……

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Observation:

Sl. No.	Crop	Initial weight		Final weight in storage		PLW (%)in storage	
		1st day	4th day	4th day	8th day	4th day	8th day

Calculation:

$$\text{PLW (\%)} = \frac{\text{Initial weight (g)-final weight (g)}}{\text{Initial weight (g)}} \times 100$$

Conclusion:…..……..

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Q 1: What is PLW and how it determined?

Exercise: 4

Objective: Preparation of jam.

Jam:……………………………………………………………………………………………

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Sl. No.	Fruit/ Vegetable	Ingredients for one kg pulp		
		Sugar (kg)	Citric acid (g)	Water (ml)
1	Aonla	0.75	-	150
2	Apple	0.75	2.0	100
3	Apricot	0.60	1.0	100
4	Carrot	0.75	2.5	200
5	Grapes	0.70	1.0	50
6	Guava	0.75	2.5	150
7	Karonda	0.80	-	100
8	Loquat	0.75	1.0	100
9	Mango	0.75	1.5	50
10	Musk melon	0.75	2.5	50
11	Plum	0.80	-	150
12	Peach	0.80	3.0	100
13	Pear	0.75	1.5	100

Elaborate Procedure:

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Ripe firm fruits
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Washing
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Peeling
↓
Pulping (remove seed and core)
↓
Addition of sugar (add water if necessary)
↓
Boiling (with continuous stirring)
↓
Addition of citric acid
↓
Judging of end point by further cooking upto 105°C or 68-70% TSS or by Sheet test
↓
Filling hot into sterilized bottles
↓
Cooling
↓
Waxing
↓
Capping
↓
Storage (at ambient temperature)

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Precaution:……

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Sheet or Flake test:……

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Problems in jam production:

i) **Crystallization:**…… ……

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Sticky or gummy jam:.....……

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Premature setting:..……

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Surface gaining and shrinkage:……

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Microbial spoilage:……

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Exercise: 5

Objective: Preparation of jelly from guava/apple/jackfruit.

Jelly:……

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Sl. No.	Fruit	Ingredients for one litre extract	
		Sugar (kg)	Citric acid (g)
1	Guava	0.75	3.0
2	Sour apple	0.75-1.00	2.0
3	Gooseberry	0.80	-
4	Karonda	0.75	-
5	Jamun	0.75	1.0
6	Wood apple	1.00	-
7	Plum	0.75	2.5
8	Loquat	0.80	2.0
9	Papaya	0.75	3.0

Elaborate Procedure:

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Fruits (firm not over ripe)

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Washing

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Cutting into thin slices

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Boiling with water (1^{1}/2 times the weight of fruit for about 20-30 min.)

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Addition of citric acid during boiling (2g/kg of fruit)

↓

Straining of extract

↓

Pectin test (for addition of sugar)

↓

Addition of sugar

↓

Boiling

↓

Judging of end point (Sheet/Drop/Temperature test)

↓

Removal of scum or foam (one teaspoonful oil added for 45kg sugar)

↓

Colour and remaining citric acid added

↓

Filling hot into clean sterilized bottles

↓

Waxing

↓

Capping

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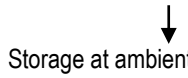

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Determination of pectin content:

i) Alcohol test:……..……..

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ii) Jelmeter test:……..

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Judging of end point:

i) Sheet or Flake test: ……..……..

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ii) Drop test: ……..……...

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iii) Temperature test: ……..

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Problems in jelly making:……..……..……

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Q 1: Distinguish between jam and jelly.

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Exercise: 6

Objective: Preparation of RTS (ready to serve) from lime/lemon/mango.

RTS (Ready to serve):……………………………………………………………………………………………

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Sl. No.	Fruit	Juice (ltr)	Sugar (kg)	Citric acid (g)	Water (ltr)
1	Bael	1.0	1.20	28	7.7
2	Lemon/lime	0.5	1.30		8.2
3	Guava	1.0	1.25	28	7.7
4	Mango	1.0	1.25	28	7.7
5	Ginger	0.25	1.30	30	8.4
6	Aonla blend (aonla juice: lime juice: ginger juice 10:2:1)	1.3	1.60	22	10.0

Elaborate procedure:

Fruits
↓
Washing & trimming
↓
Cutting or grating, and removal of seed
↓
Juice extraction
↓
Straining
↓
Juice measuring
↓
Mixing with strained syrup solution (sugar + water + acid, heating just to dissolve)
↓
Homogenization
↓
Bottling
↓
Crown corking
↓
Pasteurization (at about 90^{O}C) for 20 minutes
↓
Cooling
↓
Storage

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Precaution:……

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Q 1: As a strainer, muslin cloth is essential or not for processing unit.

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Exercise: 7

Objective: Preparation of squash.

Squash:…………………………………………………………………………………………………

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Sl. No.	Fruit	Ingredient for one litre pulp/juice			
		Sugar (kg)	Water (ltr)	Citric acid (g)	Preservative (g)
1	Orange	1.75	1.0	20	2.5 KMS
2	Mango	1.75	1.0	20	2.5 KMS
3	Lime, lemon	2.00	1.0	-	2.5 KMS
4	Bael	1.80	1.0	25	2.5 KMS
5	Litchi	1.80	1.0	25	2.5 KMS
6	Pineapple	1.75	1.0	20	1.9 KMS
7	Guava	1.80	1.0	20	2.0 KMS
8	Papaya	1.80	1.0	25	2.5 KMS
9	Karonda	1.80	1.0	5	4.0 SB
10	Phalsa	1.80	1.0	5	4.0 SB
11	Jamun	1.80	1.0	15	3.0 SB
12	Plum	1.90	1.0	10	4.0 SB
13	Water melon	0.50	0.25	10	1.5 SB
KMS- Potassium meta-bisulphite, SB- Sodium benzoate					

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Recipes of squash:

Elaborate Procedure:

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Fruits
↓
Washing & trimming
↓
Cutting or grating, and removal of seed
↓
Juice extraction
↓
Straining
↓
Juice measuring
↓
Preparation of syrup (sugar + water + acid, heating just to dissolve)
↓
Straining of syrup
↓
Mixing with juice
↓
Addition of preservative (0.6g KMS or 1.0g SB/ltr Squash)
↓
Bottling
↓
Capping
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Storage

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Precaution:…..……

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Q 1: Distinguish between squash and RTS.

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Q 2: How many types of squash are seen in the market?

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Exercise: 8

Objective: Preparation of preserve.

Preserve:

Elaborate Procedure:

Mature fruits

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Washing

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Preparation for sugar treatment

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Keeping fruit and sugar in alternate layers (1 kg fruit: 1 kg sugar) or steeping fruit in syrup of 40% TSS for a day

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Removal of fruit

↓

Increasing consistency of syrup to 60% TSS by boiling

↓

Steeping of fruit (for a day)

↓

Repeating the process and raising the strength of syrup by 5% TSS to 70% TSS on alternate days

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Steeping in 70% TSS for a week

↓

Preserve

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Draining

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Filling in Jar or Container

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Covering fruit with freshly prepared sugar syrup of 68% TSS

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Sealing (airtight)

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Storage

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Problems in preparation of preserve

Floating of fruits in Jar:……

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Stickiness: ……..……

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Toughness of fruit skin or peel: …..……..

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Fermentation: ……..

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Q 1: Write the methods of preserve making?

Exercise: 9

Objective: Preparation of tomato sauce/ketchup.

Sauce/ketchup:……

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Recipe for tomato sauce/ketchup

Sl. No.	Ingredients	Quantity	Sl. No.	Ingredients	Quantity	Sl. No.	Ingredients	Quantity
1	Tomato pulp	1 kg	6	Garlic chopped	5 g	11	Aniseed	10 g
2	Sugar	0.75 g	7	Red chilli powder	5 g	12	Cumin powder	10 g
3	Salt	10 g	8	Cinnamon	10 g	13	Clove headless	5 No.
4	Onion chopped	50 g	9	Black pepper	10 g	14	Vinegar	25 ml.
5	Ginger chopped	10 g	10	Large cardamom	10 g	15	Sodium benzoate	0.25 g per kg of final product

Process:

Tomato (fully ripe, red)

↓

Washing

↓

Sorting and trimming

↓

Cutting and chopping

↓

Heating at 70-90^{O}C for 3-5 minutes (to soften)

↓

Pulping or extraction of juice/pulp (mechanically or by sieving)

↓

Straining tomato pulp/juice

↓

Cooking pulp with one third quantity of sugar

↓

Putting spice bag in pulp and pressing occasionally

↓

Cooking to one third of original volume of pulp/juice

↓

Removal of spice bag (after squeezing in pulp)

↓

Addition of remaining sugar and salt

↓

Cooking

↓

Judging of end point (tomato solids by hand Refractometer/volume by measuring stick, i.e., one third of its original volume

↓

Addition of vinegar/acetic acid and preservative

↓

Filling hot into bottles at about 88^{O}C

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Crown corking

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Pasteurization (at 85-90^{O}C for 30minutes)

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Cooling

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Storage at ambient temperature (in cool and dry place)

Elaborate procedure:……

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Precautions:…..……..……

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Q 1: Distinguish between sauce and ketchup.

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Q 2: What are the ingredients used for sauce making?

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Exercise: 10

Objective: Preparation of tomato puree and paste

Introduction:……

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Process:

Tomato juice

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Cooking to desired consistency (open cooker/vacuum pan)

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Judging of end point for puree or paste (tomato solids by hand Refractometer or volume by measuring stick)

⇓

Filling hot into bottles or cans (82-88^{O}C)

⇓

Sterilization in boiling water for 20 minutes

⇓

Cooling

⇓

Storage at ambient temperature (in cool and dry place)

Elaborate procedure:……

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Precautions:……

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Q 1: Distinguish between puree and paste.

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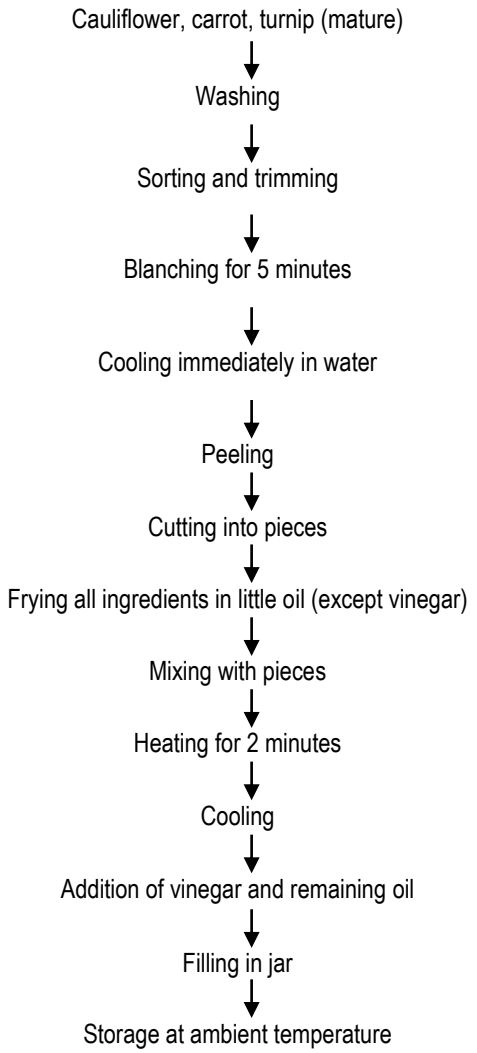
Exercise: 11

Objective: Preparation of mixed vegetable pickle.

Recipe for mixed vegetable pickle

Sl. No.	Ingredients	Quantity	Sl. No.	Ingredients	Quantity
1	Cauliflower pieces	1.0 Kg	11	Turmeric	10 g
2	Diced carrot	1.0 Kg	12	Large cardamom	10 g
3	Turnip slices	1.0 Kg	13	Aniseed	10 g
4	Peas	1.0 Kg	14	Cumin	10 g
5	Salt	100 g	15	Fenugreek powdered	10 g
6	Ginger chopped	20 g	16	Cloves	5 No.
7	Onion chopped	50 g	17	Mustard ground	50 g
8	Garlic chopped	10 g	18	Vinegar	200 ml
9	Red chilli	10 g	19	Mustard oil	450 ml
10	Black pepper	10 g			

Process:



Elaborate procedure:……

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Precautions: ……

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Q 1: How many types of pickles are available in Indian market?

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Exercise: 12

Objective: Determination of maturity on the basis of Total Soluble Solids (TSS) content.

Principle:……..……...……..

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Materials required:……..……..……

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Procedure:…..……..……

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Observation:

Crops	Upper position	Middle position	Lower position	Average

Draw a picture of Hand Refractometer:

Conclusion:……..……..……...

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Temperature correlation for standard model of sugar Refractometer calibrated at 20 ^{0}C

Temp. (^{o}C)	Percentage of dry substance													
	5	10	15	20	25	30	35	40	45	50	55	60	65	70
Subtract of dry substance														
15	0.29	0.31	0.33	0.34	0.34	0.35	0.36	0.37	0.37	0.38	0.39	0.39	0.40	0.40
16	0.24	0.25	0.26	0.27	0.28	0.28	0.29	0.30	0.30	0.30	0.31	0.31	0.32	0.32
17	0.18	0.19	0.20	0.21	0.21	0.21	0.22	0.22	0.23	0.23	0.23	0.23	0.24	0.24
18	0.13	0.13	0.14	0.14	0.14	0.14	0.15	0.15	0.15	0.15	0.16	0.16	0.16	0.16
19	0.06	0.06	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Add to the reading														
21	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
22	0.13	0.14	0.14	0.15	0.15	0.15	0.15	0.14	0.16	0.16	0.16	0.16	0.16	0.16
23	0.20	0.21	0.22	0.22	0.23	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24
24	0.27	0.28	0.29	0.30	0.30	0.31	0.31	0.31	0.31	0.31	0.32	0.32	0.32	0.32
25	0.35	0.36	0.37	0.38	0.38	0.39	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
26	0.42	0.43.	0.44	0.45	0.46	0.47	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48
27	0.50	0.52	0.53	0.54	0.55	0.55	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
28	0.57	0.60	0.61	0.62	0.63	0.63	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
29	0.66	0.68	0.69	0.71	0.72	0.72	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73
30	0.74	0.77	0.78	0.79	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81

Source: Proceeding of the ninth session of the International Commission for Uniform Methods of sugar analysis, London, 1936.

Exercise: 13

Objective: To understand the method of total sugar estimation by Alcohol method

Principle:……..……..……..……..

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Reagents:……..……..……..……

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Chemical preparation:…..……

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Procedure: ……..……..……

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Observation:

Sl. No.	Sample	Titrate value/Reading (ml.)	Total sugar (%)

Calculation

$$\textbf{Total sugars as invert sugars (\%)} = \frac{\text{Factor} \times \text{Dilution}}{\text{Titre} \times \text{Weight of sample taken}} \times 100$$

% Sucrose = (% total invert sugars - % reducing sugars) x 0.95
% Total sugars = (% reducing sugars + % sucrose)

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Precaution:……

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Q 1: What is total sugar and significance in food?

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Q 2: What are different methods of total sugar estimation?

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Q 3: What is the principle of total sugar estimation by Alcohol method?

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Exercise: 14

Objective: To understand the method of reducing sugar estimation.

Principle:……….………………………..…………………………………………………………………………..

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Reagents:…………..………………………………………………………………………………………..……

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Chemical preparation:…...……………………………………………………………………………………

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Observations:

Sl. No.	Sample	Titrate value/Reading (ml.)	Reducing sugar (%)

Calculation:

$$\textbf{Reducing sugars (\%)} = \frac{\text{Factor} \times \text{Dilution}}{\text{Titre value} \times \text{Weight of sample taken}} \times 100$$

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Precaution: ……

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Q 1: What is reducing sugar and significance in food?

Q 2: What are different methods of reducing sugar estimation?

Q 3: What is the principle of reducing sugar estimation by Lane and Eynon?

Exercise: 15

Objective: To understand the method of titrable acidity estimation by AOAC method.

Principle:………………………………………………………………………………………………..

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Reagents:……………………………………………………………………………………………….

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Chemical preparation:………………………………………………………………………………

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Procedure: ……………………………………………………………………………………………

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Observation:

Sample No.	Micro-burette reading			Acidity (%)
	Initial	Final	Average	

Calculation:

$$\text{Titrable Acidity (\%)} = \frac{\text{d X 0.064 (if NaOH solution is 0.1 } N\text{) X C}}{\text{a X b}} \text{ X } \frac{100}{10}$$

Where,

a= weight of sample.
b= volume of aliquot taken for examination.
c= volume made with distilled water.
d= average burette reading for sample.

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Precautions:……

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Q 1. Why titratable acidity is determined?

Q 2. What are the methods of acidity estimation?

Q 3. What is the principle of Titrable acidity estimation by AOAC?

Exercise: 16

Objective: To understand the method of ascorbic acid estimation by titration method.

Principle:……..……...……..

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Reagents:……..……..……..……

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Chemical preparation:…...……

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Procedure:…..……..……..…….

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Observation:

Sample No.	DFV	Titrate value (ml)	Ascorbic acid content (mg/100g)

Calculation: D.F.V. (Dye Factor Value) = 0.5/ Titrate Reading (ml)

$$\textbf{Ascorbic Acid (mg/100g)} = \frac{\text{D.F.V.} \times \text{Titrate Value} \times \text{Volume make up}}{\text{Aliquot taken} \times \text{Weight of the sample}} \text{X } 100$$

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Precautions:……

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Q 1: What is ascorbic acid and significance in food?

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Q 2: What is the method of ascorbic acid estimation?

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Q 3: What is the principle of ascorbic acid estimation by AOAC?

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Exercise: 17

Objective: Drying and dehydration of fruits and vegetables

Drying:……

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Dehydration:……

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Draw a neat sketch of dryer:

Exercise: 18

Objective: Visit to processing unit.

Exercise: Write a brief report on the visit to the processing unit with full details of the unit.

Student's Notes