RQF LEVEL 3

FOPNS303

FOOD PROCESSING

Nectar and Squash Production

TRAINEE'S MANUAL

October, 2024

NECTAR AND SQUASH PRODUCTION

KOICA Korea International Cooperation Agency

TQUM TVET Quality Management Project

2024

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TABLE OF CONTENT

ACRONYMS

ATP: Adenosine Triphosphate

$C_6H_{12}O_6$: Glucose

CA: Controlled atmosphere

CCPs: Critical control point

CO_2: Carbon dioxide

FIFO: First-in-first-out

FOP: Food processing

GAP: Good agricultural practices

GMP: Good manufacturing practices

KOH: Potassium hydroxide

LCD: Liquid crystal display

Ltd: Limited

NaOH: Sodium hydroxide

O_2: Oxygen

pH: Potential of hydrogen

PM: Production manager

PPE: Personal protective equipment

RH: Relative humidity

RTB: Rwanda TVET Board

TQUM: TVET quality management

TVET: Technical and vocation education and training

INTRODUCTION

This trainee's manual includes all the knowledge and skills required in food processing specifically for the module of **" Nectar and Squash Production ".** Trainees enrolled in this module will engage in practical activities designed to develop and enhance their competencies. The development of this training manual followed the Competency-Based Training and Assessment (CBT/A) approach, offering ample practical opportunities that mirror real-life situations.

The trainee's manual is organized into Learning Outcomes, which is broken down into indicative content that includes both theoretical and practical activities. It provides detailed information on the key competencies required for each learning outcome, along with the objectives to be achieved.

As a trainee, you will start by addressing questions related to the activities, which are designed to foster critical thinking and guide you towards practical applications in the labor market. The manual also provides essential information, including learning hours, required materials, and key tasks to complete throughout the learning process.

All activities included in this training manual are designed to facilitate both individual and group work. After completing the activities, you will conduct a formative assessment, referred to as the end learning outcome assessment. Ensure that you thoroughly review the key readings and the 'Points to Remember' section.

MODULE CODE AND TITLE: FOPNS303 NECTAR AND SQUASH PRODUCTION

Learning Outcome 1: Prepare workplace
Learning Outcome 2: Make nectar and squash
Learning Outcome 3: Store nectar and squash


SUKAR
SODIUM
LSWCIAR

Indicative contents

1.1 Selection of materials, tools and equipment used in nectar and squash

1.2 Cleaning of workplace

1.3 Arrangement of work area

1.4 Preparation of Ingredients

Key Competencies for Learning Outcome 1: Prepare workplace

Knowledge	Skills	Attitudes
• Description of tools and equipment used in nectar and squash production • Explanation of safety precautions of tools and equipment • Identification of cleaning agent • Explanation of safety and health precaution of cleaning product • Identification of materials used in nectar and squash • Description of the factors affecting postharvest storability of fresh fruits • Description cleaning methods, techniques and factors affecting cleaning effectiveness	• Selecting tools, equipment and materials • Adjusting tools and equipment • Checking the quality of ingredients • Storing fresh fruits • Cleaning of workplace • Arranging work area • Preparing of ingredients	• Being careful when using sharp and electric connected tools and equipment • Being attentive when adjusting tools and equipment • Being honest when handling fresh fruits • Being protected when cleaning workplace • Being accurate while preparing ingredients

Duration: 15 hrs

Learning outcome 1 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Describe properly tools and equipment used in nectar and squash production
2. Select properly materials, tools and equipment used in nectar and squash production
3. Adjust properly tools and equipment used in nectar and squash production
4. Identify properly cleaning agents according to the direction of uses
5. Prepare effectively ingredients used in nectar and squash production
6. Handle appropriately received fresh fruits used in nectar and squash production
7. Identify appropriately materials used in nectar and quash production
8. Describe correctly cleaning methods, techniques and factors affecting cleaning effectiveness
9. Clean properly workshop according to clean methods and techniques
10. Arrange correctly work area according to setting flow chart
11. Prepare properly ingredients used in nectar and squash production

 **Resources**

Equipment	Tools	Materials
● Pulping machine ● Pasteurizer ● Washing machine ● Slicing machine ● Peeling machine ● Cooling tank ● Filling machine ● Blender ● Working table ● PPE ● Juice extractor ● Fridge.	● Knives ● Spoons ● Refractometer ● Thermometer ● Jugs ● Electric balances ● Cutting boards ● Filters ● Sponges ● Brushes ● Broom ● Dustbin	● Fruits ● Sugar ● Water ● Preservatives ● Disinfectants ● Packaging materials ● Labels.

	● Mops ● Bucket ● Dustbin ● Sauce pan ● Stirrer ● Measuring cylinder ● Cups ● Calculator ● Napkins	

Indicative content 1.1: Selection of materials, tools and equipment used in nectar and squash

Duration: 5 hrs

Theoretical Activity 1.1.1: Description of tools and equipment used in nectar and squash

Tasks:

1. You are requested to answer the following questions related to description of tools, and equipment used in nectar and squash production

   i. According to you, what are the tools and equipment used in nectar and squash making?

   ii. What are the functions of tools and equipment you mentioned in question one?

2. Provide the answers to asked questions by writing them on papers, flip chart, Blackboard or white board.

3. Present the findings/answers to the whole class.

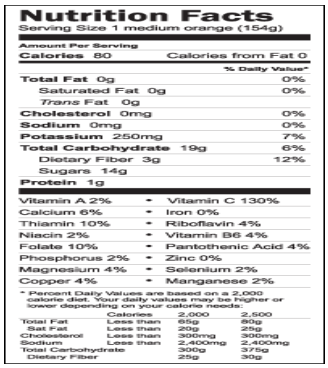
4. For more clarification, read the **key readings 1.1.1**

Key readings 1.1.1.: Description of tools and equipment used in nectar and squash

- **Functions of tools and equipment used in nectar and squash production:**

Tools	Picture	Use
Knives		A knife is used to cut into small pieces or peel the produce
Cutters		It is used to cut fruits in small parts
Thermometer		It is used to measure temperature of juice especially during heating and cooling
Refractometer		It is used to determine the sugar content in a liquid

Saucepan		It is used to heat and mixing juice
Sieves		It is to separate particles based on their size.
pH meter		A pH meter is an electronic device used for measuring the pH (acidity or alkalinity) of a liquid
Equipment	**Picture**	**Use**
Fruits washer machine		It is used for removing soil, microorganisms, and pesticide residues
Slicers Machine		It is used to cut fruits in small parts
Blender		It is used to cut and break down the produce. However, when fruit or vegetables are put into a blender the output contains everything that went into the blender, i.e., the fruit and vegetable fibres including skin, seeds, pith, flesh etc.
Electronic balance		It is used to weigh fruits and other ingredients
Mechanic balance		It is used to weigh fruits and other ingredients

Juicer		it is used to cut and breaks down the produce but There is a separation of the juice from the fibres, pulp, skin, seed
Mixer		It is used to mix juice to get homogenized product
Compressor		It is used to squeeze fruits in order to get juice
stainless steel fruit juice pasteurizer machine		A pasteurizer is a device which pasteurizes, treating a food product to kill disease-causing microorganisms such as bacteria.
labels machine		It is used to use labels on packaging materials
Labels		It is a piece of paper which shows characteristics of a product it represents. It contains information like name of the product, name of the company and its address, list of ingredients normally in descending order and some claims if any.

Practical Activity 1.1.2: Selecting tools and equipment used nectar and squash production.

Task:

Referring to the previous theoretical activities (1.1.1), you are requested to go to the food processing workshop for selecting tools and equipment used nectar and squash production.

1: Apply safety precautions

2: Select tools and equipment used in nectar and squash production
3: Present your work to the trainer and whole class. Ask clarification where necessary
4: Read key reading 1.1.2
5: Perform the task provided in application of learning 1.1.

Key readings 1.1.2: Selecting tools and equipment used nectar and squash production.

- **Selection criteria of tools and equipment**
  - ✓ Clean and hygienic: This stainless-steel Nectar and Squash production tools and equipment meet the international food hygiene standard
  - ✓ Convenient and fast: The machine uses saving time and effort
  - ✓ Multi-purpose machine for producing Nectar and Squash from various different fruits
  - ✓ They should have produced products that are of high quality (maintain the quality of product)
  - ✓ Take into account the dimension of the equipment
  - ✓ Safety of the equipment should be a priority (standard of tools and equipment)
  - ✓ Consider whether the equipment is for traditional or Modern operation
  - ✓ Scale of production
  - ✓ Production Process
  - ✓ Fruit type and volume
  - ✓ Material and build quality
  - ✓ Cost and budget
  - ✓ Safety and regulations
- **Procedures for Selecting Tools and Equipment in Nectar and Squash Production**

  The selection of appropriate tools and equipment is crucial for efficient, hygienic, and high-quality nectar and squash production. Here's a step-by-step approach:

1. Define Product Specifications and Production Capacity

- ✓ **Product type:** Determine the type of nectar or squash to be produced (fruit, vegetable, or combination).
- ✓ **Product consistency:** Define the desired consistency (thick, thin, pulpy, or clear).
- ✓ **Production volume:** Estimate the daily, weekly, or monthly production capacity.

2. Identify Production Processes

- ✓ **Raw material handling:** Consider processes like washing, peeling, cutting, and blending.
- ✓ **Processing:** Evaluate steps such as cooking, pasteurization, homogenization, and filling.

- ✓ **Packaging:** Determine packaging materials and equipment needed (bottles, cans, cartons, and sealing machines).

3. Conduct a Needs Assessment

- ✓ **Equipment availability:** Assess existing tools and equipment and their suitability.
- ✓ **Space limitations:** Consider the available production area and equipment dimensions.
- ✓ **Budget constraints:** Determine the financial resources available for equipment purchase or rental.
- ✓ **Labor availability:** Evaluate the number of workers and their skills to operate equipment.

4. Evaluate Tool and Equipment Options

- ✓ **Functionality:** Ensure equipment performs the required tasks efficiently and effectively.
- ✓ **Material compatibility:** Select materials that are safe for food contact and easy to clean.
- ✓ **Durability:** Choose equipment built to withstand heavy use and frequent cleaning.
- ✓ **Efficiency:** Consider equipment that minimizes labor and time requirements.
- ✓ **Safety:** Prioritize equipment with safety features to protect operators.
- ✓ **Maintenance:** Evaluate equipment that is easy to clean, maintain, and repair.
- ✓ **Cost-effectiveness:** Compare initial and operating costs of different options.

5. Consider Hygiene and Sanitation

- ✓ **Food-grade materials:** Select equipment made from stainless steel or other approved materials.
- ✓ **Easy cleaning:** Choose tools and equipment with smooth surfaces and minimal crevices.
- ✓ **Sanitization procedures:** Consider equipment that can be easily sanitized and disinfected.

6. Perform Equipment Testing

- ✓ **Trial runs:** Test equipment with small batches of product to assess performance.
- ✓ **Efficiency evaluation:** Measure production time, product quality, and energy consumption.
- ✓ **Operator feedback:** Gather input from operators on equipment usability and safety.

7. Make Informed Decisions

- ✓ **Compare options:** Weigh the pros and cons of different equipment choices.
- ✓ **Prioritize needs:** Focus on essential equipment first and consider optional additions later.
- ✓ **Seek expert advice:** Consult with equipment suppliers or industry professionals.
- ✓ **Consider long-term goals:** Choose equipment that can adapt to future production changes.

8. Implement and Monitor

- ✓ **Installation:** Ensure proper installation and setup of equipment.
- ✓ **Operator training:** Provide training on equipment operation, safety, and maintenance.
- ✓ **Regular inspection:** Conduct routine inspections to identify and address issues.
- ✓ **Maintenance schedule:** Establish a maintenance plan to prolong equipment life.
- ✓ **Performance evaluation:** Monitor equipment performance and make adjustments as needed.

Practical Activity 1.1.3: Adjusting and safety precautions of tools and equipment used nectar and squash production.

Task:

You are requested to go to the food processing workshop and adjust the tools and equipment to be used nectar and squash production.

1: Apply safety precautions.

2: Adjust tools and equipment used in nectar and squash production
3: Present your work to the trainer and whole class. Ask clarification where necessary
4: Read key reading 1.1.3
5: Perform the task provided in application of learning 1.1.

Key readings 1.1.3: Adjusting and safety precautions of tools and equipment used nectar and squash production.

- **Definition**

Adjustment: Adjusting refers to the process of making necessary changes or modifications to something in order to achieve a desired outcome or result.

Before adjustments are made, it is normal for equipment calibration to be carried out first.

Equipment **calibration** can be defined as the process of comparing values and measurements of an instrument to a specific standard in a controlled environment.

During equipment calibration, the accuracy of the required standard is known, which aids in determining if a piece of equipment will pass or fail each parameter. Parameters in calibration include, test conditions, operating conditions, industry specifications, tolerances, etc.

- **Adjustment steps**

To adjust equipment, the following steps can be taken:

- ✓ **Identify the problem:** Before adjusting any equipment, it is important to identify the problem. This can be done by observing the equipment and noting any unusual sounds or behaviours.
- ✓ **Consult the manual:** The equipment manual is a valuable resource that provides instructions on how to adjust the equipment. It is important to read the manual thoroughly before attempting any adjustments.
- ✓ **Gather necessary tools:** Depending on the type of equipment, specific tools may be required for adjustment. It is important to gather all necessary tools before beginning any adjustments.
- ✓ **Turn off the equipment:** Before making any adjustments, it is important to turn off the equipment and unplug it from its power source.
- ✓ **Make necessary adjustments:** Using the instructions provided in the manual, make the necessary adjustments to the equipment.
- ✓ **Test the equipment:** Once adjustments have been made, test the equipment to ensure that it is functioning properly.
- ✓ **Repeat if necessary:** If the equipment is still not functioning properly, repeat steps 1-6 until the problem is resolved.

1. **REFRACTOMETER**

Steps for Adjusting an Analog Refractometer

These steps are for a standard analog refractometer. Some models may have slight variations. Always refer to your specific refractometer's manual for detailed instructions.

Materials Needed:

- ✓ Distilled water
- ✓ Soft, lint-free cloth (e.g., lens cleaning cloth)
- ✓ Calibration tool (if provided)

Steps:

- ✓ **Clean the prism:** Open the prism cover. Gently clean the prism surface with a soft, lint-free cloth. Avoid using abrasive materials.
- ✓ **Apply distilled water:** Place a few drops of distilled water on the prism surface. Close the prism cover to spread the water evenly.
- ✓ **Read the scale:** Hold the refractometer up to a light source. Look through the eyepiece. You should see a boundary line between a light and dark field.

Read the value where the boundary line intersects the scale.

- ✓ **Adjust the zero point (if necessary):** If the reading is not zero, use the calibration tool (or a small screwdriver if provided) to adjust the zeroing screw. Turn the screw until the boundary line aligns with the zero mark on the scale.
- ✓ **Clean the prism again:** Open the prism cover and clean the prism surface with a soft, lint-free cloth.

Steps for Adjusting a Digital Refractometer

Materials Needed:

- ✓ Distilled water
- ✓ Soft, lint-free cloth (e.g., lens cleaning cloth)

Steps:

- ✓ **Clean the prism:** Open the prism cover. Gently clean the prism surface with a soft, lint-free cloth. Avoid using abrasive materials.
- ✓ **Apply distilled water:** Place a few drops of distilled water on the prism surface. Close the prism cover to spread the water evenly.
- ✓ **Calibrate the refractometer:** Turn on the refractometer. Most digital models have an automatic calibration function. Follow the on-screen prompts or refer to the manual for specific instructions. This usually involves pressing a designated button or following a sequence of steps.
- ✓ **Read the calibration result:** The refractometer should display a reading. If it's not zero (or the expected value for distilled water), refer to the manual for instructions on adjusting the calibration.
- ✓ **Clean the prism again:** Open the prism cover and clean the prism surface with a soft, lint-free cloth.

2. **PH-meter:**
    - ✓ Remove protective cap of pH-meter
    - ✓ First rinse the electrode with distilled water and suck it with filter paper.
    - ✓ Turn the meter on by pressing “ON/OFF” key.
    - ✓ Immerse the pH meter electrode in the solution to be tested (should not b e over the immersion line).
    - ✓ Stir gently and wait around 30 seconds till the reading stabilizes.

- ✓ After finishing, clear the electrode with pure water, turn the meter off by pressing “ON/OFF” key.
- ✓ Always replace the protective cap after use.

3. **Balance:**

Adjustment of Weighing Balance

Weighing balances are used to measure the weight of objects with a high degree of accuracy. However, over time, balances can become inaccurate due to wear and tear, environmental factors, or improper use. It is important to adjust your weighing balance regularly to ensure that it is providing accurate readings.

Steps to adjust a weighing balance:

- ✓ Make sure the balance is level. Use a spirit level to check the level of the balance platform. If the balance is not level, adjust the feet until it is level.
- ✓ Zero the balance. Place a tared weight on the balance platform and press the zero button. The balance should now read zero.
- ✓ Adjust the sensitivity. The sensitivity of the balance controls how much the balance needle moves in response to a change in weight. Adjust the sensitivity so that the needle moves smoothly and evenly.
- ✓ Calibrate the balance. Calibration is the process of comparing the readings of the balance to a known standard weight. To calibrate the balance, use a calibration weight that is certified by a recognized laboratory.

4. **Calibration procedure:**
   - ✓ Place the calibration weight on the balance platform.
   - ✓ Read the weight displayed on the balance.
   - ✓ Adjust the balance so that the displayed weight matches the known weight of the calibration weight.
   - ✓ Repeat steps 2 and 3 for each calibration weight that you are using.

- **Safety precautions of the tools and equipment (effect on the user and product)**
  - ✓ Before use equipment you should read the instruction for uses equipment and check cleanliness and functionality
  - ✓ Wear PPE when you use tools and equipment
  - ✓ Clean and sanitize food contact surfaces of tools and equipment routinely and

as frequently as practicable (clean equipment and tools before and after use)

- ✓ Identify sanitized utensils and equipment and store them properly
- ✓ Use approved equipment and utensils designed for food
- ✓ Prevent the risk of electric shock when employees come into contact with equipment in the damp and wet environment.
- ✓ Developing safety rules, training employees, safety inspections procedures and enforcing safety rules of equipment.
- ✓ Developing routine maintenance of tools and equipment
- ✓ Use an electrical system and equipment grounding that meet requirements of the National Electric Code
- ✓ Make sure fuse boxes, switches and electrical outlets in wet areas are moisture-proof.

Theoretical Activity 1.1.4: Identification of cleaning agents

Tasks:

1. You are requested to answer the following questions related to identification of cleaning agents used in processing fruits into nectar and squash

   i. According to your experience, what do you think could be the cleaning agents to use during cleaning of nectar and squash Production workplace?

   ii. What could be the direction of use and safety precautions of these cleaning agents?

2. Provide the answers to asked questions by writing them on papers, flip chart, Blackboard or white board.

3. Present the findings/answers to the whole class.

4. Ask trainer for clarification where necessary

5. For more clarification, read the **key readings 1.1.4.**

Key readings 1.1.4: Identification of cleaning agents

- **Identification of cleaning agent**
  - ✓ **Cleaning agents** are substances (usually liquids, powders, sprays, or granules) used to remove dirt, including dust, stains, bad smells, and clutter on surfaces.), utensils and equipment.
  - ✓ **Cleaning**: simply defined as the removal of dirt, dust and other contaminants from surfaces.
  - ✓ **Sanitizing:** is the process of killing germs/bacteria in place such as food contact surface. This process kills 99.9% of germs and bacteria such as Escherichia coli…
  - ✓ **Disinfecting:** is defined as the process of killing all harmful germs, bacteria and viruses from surfaces. This process kills 100% of germs, bacteria and virus except spore forming bacteria.
  - ✓ **Sterilizing:** is the process of killing all microorganisms including spore forming bacteria from surfaces.
  - ✓ **Cleaning agent (product):** is simply defined as the substances or chemicals (all form: liquid, solid and powder) used to remove dirt, dust, odour and other contaminants.
- **Types of cleaning agent**
  - ✓ **Water**

    Water is referred as universal solvent, and this is the prime agent in cleaning process. However, though an excellent solvent, water alone is not an effective cleaner.
  - ✓ **Detergent**

    Detergent may be made from a base of either pure soap or organic chemicals. Detergents are of two types:
    - **soapy detergent**: Is made from animal or vegetable fat and may be used as solid block for washing materials and tools
    - **Synthetic detergent**: Is made from organic chemicals derived from petroleum. They are used for cleaning floors. They are in form of a powder, liquid, gel or crystal.
  - ✓ **Acid cleaners**

    Acids used as cleaning agents may vary from mild acid e.g., acetic acid or strong concentrated hydrochloric acid. Acids should be used in solutions followed by thorough rinsing. All, except under citric and acetic acid should be used under supervision with extreme caution and with the protection of rubber gloves. Strong acids are poisonous and corrosive.

    E.g., Citric acid and acetic acid used for metal cleaning

    Dilute hydrochloric acid used in removing lime scale from sanitary ware

Oxalic acid for removing water stains from hard floors and sanitary ware

- ✓ **Alkaline cleaners**
  Alkaline are particularly good for removing grease
  Example: -Sodium carbonate: is used to remove light grease
  Sodium hydroxide: is used to remove grease from grills and blocked drains
- ✓ **Sanitizers**
  Chemical's sanitizers; chlorine, iodophors, quaternary ammonium compounds used to destroy or inhibit the growth of microorganisms
- ✓ **Disinfectants**
  Those are chemicals that destroy pathogenic bacteria
  Examples: peroxyacetic acid and sodium hypochlorite

- **Direction of use and safety precautions of cleaning agents/products**

- ✓ Read product and equipment labels and usage instructions before starting to clean
- ✓ Wear recommend PPE
- ✓ Worker must know which cleaning chemicals must be diluted and how correctly dilution is,
- ✓ Thoroughly reviewing and training workers on the use, storage for cleaning chemicals
- ✓ Handling in a sanitary manner in order to protect its shelf-life
- ✓ Providing workers with a place to wash up after using cleaning chemicals
- ✓ Operating ventilation systems as needed to allow sufficient air flow and to prevent build-up of hazardous
- ✓ Warning workers not to mix cleaning products that contain bleach and ammonium

Theoretical Activity 1.1.5: Identification of materials used in nectar and squash production

Tasks:

1. You are requested to answer the following questions related to identification of materials used in processing fruits into nectar and squash

i. According to your experience, what are the ingredients used to make nectar and squash?
ii. What could be the uses of ingredients used to make nectar and squash?
iii. What could be the selection criteria of ingredients used to make nectar and squash?

2. Provide the answers to asked questions by writing them on papers, flip chart, Blackboard or white board.

4. Present the findings/answers to the whole class.

5. Ask trainer for clarification where necessary

6. For more clarification, read the **key readings 1.1.5.**

Key readings 1.1.5: Identification of materials used in nectar and squash production

- **Ingredients used in nectar and squash production**
  - ✓ **Fruits**
    - Citrus fruits: Oranges, grapefruits, lemons, limes and tangerines /mandarins
    - Grapefruit fruit
    - Tropical fruits : Mangoes, pineapples, guavas, passion fruits
    - Berries: Strawberries, raspberries, blueberries, blackberries
    - Stone fruits: Peaches, apricots, plums, nectarines
    - Other fruits: Apples, pears, grapes
  - ✓ **Sugar:** To sweeten the product and balance the tartness of some fruits.
  - ✓ **Preservatives:** to extend shelf life (citric acids, potassium sorbate, sodium benzoate, carbon dioxide, sulfur dioxide, ascorbic acids)
  - ✓ **Acidity regulators:** To adjust the pH level and improve shelf life. Citric acid is a common choice.
  - ✓ **Water** and other additives like flavouring agent and colouring agent.

- **Selection criteria of ingredients used in nectar and squash**

  Choosing the right ingredients for nectar and squash production involves various considerations.

  Here are key criteria to consider when selecting fruits and other ingredients:

  - ✓ **Appearance:** visual quality includes colour and colour uniformity, glossiness, and absence of defects in shape or skin finish and freedom from disease**.**
  - ✓ **Texture:** Degree of softening is required for optimal quality in fruit, over softening is undesirable and is a sign of senescence or internal decay.
  - ✓ **Flavour and aroma**: Flavour is a complex of taste and aromatic components.

  - Sweetness of some fruits may increase dramatically during ripening owing to starch to sugar conversions, for example in apples, bananas, mangoes and pears

- Sugar levels of fruits are often measured to determine whether produce has reached the required ripeness for marketing.
- Acid levels generally decrease during storage. If the acid/sugar ratio falls too low, the product can become bland and lose acceptable eating quality.

✓ **Maturity index**: fruits goes into three stages after harvesting; Maturation, ripening and senescence.

- Maturation: is indicative of the fruit being ready for harvest, at this point, the edible part of the fruit is fully developed in size, although it may not be ready for immediate consumption.
- Ripening is the process which follows maturation, rendering the produce edible, as indicated by taste.
- Senescence is the last stage, characterized by natural degradation of the fruit or vegetable, as in loss of texture, flavour, etc.

✓ **Freshness:** Choose fresh fruits free from blemishes, bruises, or signs of spoilage. Freshness ensures quality and reduces potential contamination.

✓ **Variety:** Select varieties suitable for juicing or pulping, considering characteristics like flesh firmness, juice yield, and flavor profile. Experiment with different varieties to find the perfect blend for your desired taste.

✓ **Source:** Consider sourcing fruits from reliable suppliers who practice sustainable and ethical farming methods.

✓ **Cost:** Balance cost with desired quality and fruit availability. Explore options like local growers or bulk purchases for cost-effectiveness.

✓ **Additional Ingredients:**

- **Sugar:** Use refined sugar or natural sweeteners like honey or agave nectar, considering sweetness level, cost, and potential allergens.
- **Acidity regulators:** Choose food-grade options like citric acid to optimize taste and shelf life without compromising flavor
- **Thickeners:** Opt for natural thickeners like pectin or agar-agar if desired consistency needs adjustment.
- **Preservatives**: Consider using natural preservatives like citric acid or rosemary extract if shelf life extension is necessary. Prioritize minimal processing and additives for a cleaner ingredient list.

Practical Activity 1.1.6: Checking the quality of ingredients

Task:

Referring to previous theoretical activities 1.1.5, you are requested to go to the food processing workshop check the quality of supplied ingredients that shall be used in nectar and squash production.

1. Apply safety precautions.
2. Check the quality of ingredients for nectar and squash production
3. Present your work to the trainer and whole class. Ask clarification where necessary
4. Read key reading 1.1.6
5. Perform the task provided in application of learning 1.1.

Key readings 1.1.6: Checking the quality of ingredients

- **Pre-purchase assessment:**
  - ✓ **Source selection**: Partner with reputable suppliers who adhere to good agricultural practices (GAP) and have proper quality control measures in place.
  - ✓ **Variety choice**: Select varieties known for their sweetness, flavor, and suitability for nectar or squash production based on your recipe.
  - ✓ **Contract specifications**: Clearly define quality expectations in your purchase agreements, covering ripeness, size, absence of defects, and any contaminant tolerances.

    Upon arrival:

    Visual inspection: Check if the fruit meet the following quality:
    - Well, ripen
    - Free from any deterioration and spoilage
    - Free from visible pest and diseases
    - Free from bruising and abrasion
    - Full mature with a good size, shape and colour
    - A fruit of good texture…
  - ✓ **Temperature check**: Ensure fruits arrive at the appropriate storage temperature to maintain freshness and prevent spoilage.
  - ✓ **Documentation:** Record inspection findings and temperatures for traceability and quality control purposes.

  Maintaining quality:
  - ✓ **Proper storage**: Implement appropriate storage conditions (temperature, humidity, ventilation) to prevent spoilage and maintain fruit quality until processing.

- ✓ **First-in-first-out (FIFO) principle**: Utilize fruits in the order they arrive to prevent older ones from deteriorating.
- ✓ **Sanitation**: Maintain a clean and hygienic processing environment to minimize contamination risks.
- ✓ **Regular monitoring**: Continuously monitor ingredient quality throughout storage and processing, taking corrective actions if necessary.
- ✓ **Checking other ingredients**
  - Sugar is sweetening agent which must selected basing on its high quality, it is better if you use white sugar as because it does not change the natural (original) colour of juice.
  - Water used in Nectar and squash must meet all portable water characteristics as potable water standard requirements.
  - Preservatives used in Nectar and squash making must be proved to be used in food processing, it is recommended to read label before use in order to check if those products are not expired and to respect the recommended guidelines for use.

Theoretical Activity 1.1.7: Description of factors affecting postharvest storability of fresh fruits

Tasks:

1. Answer the following questions related to description of factors affecting postharvest storability of fresh fruits

   According to your knowledge about fruits, what do you understand by the factors affecting postharvest storability of fresh fruits?

2. Provide the answers to asked questions by writing them on papers, flip chart, Blackboard or white board.

3. Present the findings/answers to the whole class.

4. For more clarification, read the key readings 1.1.7.

Key readings 1.1.7: Description of factors affecting postharvest storability of fresh fruits

- **Factors affecting postharvest storability of fresh fruits**

  Many factors can lead to loss of quality in fresh produce, hence the common description of these products as 'perishable'. Some of these factors are part of the

life cycle of living produce that is over-ripening of fruits. These many factors are **physiological factor, biological factor, Mechanical factor and Environmental factor.** As a consequence, normal factors such as transpiration and respiration lead ultimately to water loss and senescence of the product. The growth of pathogens or physical damage will cause direct loss of product quality through their visual impact but both also stimulate senescence.

✓ **Physiological factor**

Physiological disorders are adverse quality changes that occur in fresh produce because of metabolic disturbances. These disturbances can be caused by internal factors such as mineral imbalances or may be due to non-optimal environmental factors such as inappropriate storage temperatures or atmosphere composition.

Physiological disorders refer to the breakdown of tissue that is not caused by either invasion by pathogens (disease-causing organism) or by mechanical damage.

Respiration

Fruits respiration is process by which fruits cells obtain chemical energy by consumption of oxygen and release of carbon dioxide, respiration uses stored carbohydrate (starch or sugar) and will stop when reserves of these are exhausted; ageing follows and the produce dies and decays. Fresh produce cannot replace carbohydrates or water after harvest.

Formula of respiration

$C_6H_{12}O_6 + O_2 \rightarrow H_20 + CO_2 +$ Energy (ATP)

❖ Influencing respiration rate of fruits and vegetables

i. 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**.**

ii. Oxygen concentration: the reaction need oxygen, so if there is no oxygen, no respiration occurs. In general, less oxygen lead to a slower reaction rate**.**

iii. CO_2 Concentration: The influences of CO_2 concentration depend strongly on the fruits or vegetables. Some might increase in respiration, whereas with others more CO_2 might lead to slower reactions.

iv. Stress in fruits and vegetables

Fruits and Vegetables can be stressed, for instance if they are cut/ or damage

v. Ripening: some fruits and vegetables continue to ripe after they have been harvested. During ripening the respiration rate might increase or decrease, depending on the product, this can also be linked with ethylene concentration.

- **Transpiration or the loss of water**

  Fruits transpiration is process of fruits loss of water through pores its evaporation from aerial parts, the pores on the fruits surfaces can open or close with changing atmospheric conditions to give a controlled rate of loss of water. Most fresh fruits produce contains from 65 to 95 percent water when harvested. Fresh fruits produce continues to lose water after harvest, but unlike the growing plant it can no longer replace lost water from the soil and so must use up its water content remaining at harvest. This loss of water from fresh produce after harvest is a serious problem, causing shrinkage and loss of weight.

- **Ethylene ($C_2 H_4$) production**

  Ethylene is a plant hormone that plays a key role in the ripening and senescence of fruits and vegetables. Mature but unripe fruits are placed in well ventilated rooms and exposed to ethylene with acetylene. All plant cells produce low levels of ethylene; however, anything that causes stress to the plant tissues will stimulate ethylene synthesis. Stressors may include excessive water loss, physical damage or pathogenic attack.

  Climacteric fruits produce high levels of ethylene during initiation of ripening and the hormone is believed to stimulate and coordinate the physiological and biochemical changes which occur during ripening. Exposure to exogenous ethylene can lead to an acceleration of maturation and senescence while Carbon dioxide and temperature over 30^{o} C inhibit ethylene action.

- **Senescence**

  Senescence is the natural ageing of the plant tissues and is stimulated by the presence of ethylene and anything else that speeds up respiration rates. Senescence ultimately affects all aspects of quality, ending in the death of the product. Some senescence changes can specifically affect certain types of fresh produce processing, for example, changes to the chemical and physical structure of the cell wall.

✓ **Mechanical factor**

Mechanic damage (Physical injury) is careless handling of fresh produce (fruits) cause internal bruising which results in abnormal physiological damage. Injury also allows water loss which compromises the quality of the fresh produce. Furthermore, physical injury stimulates ethylene production in fruits tissues, which can lead to premature yellowing or ripening of commodities

✓ **Environmental factor**

Environmental factor is any factors abiotic or biotic that influence living organisms

Abiotic factors: it is factors which include physical condition and non- living resources that affect living organism in terms of growth, maintenance and reproduction.

Examples: temperature, light, humidity, atmosphere, water and soil.

Biotic factors: it is factors which can be described as any living component that affect another organism or ecosystem. **Examples: animals, bacteria, mould, ...**

- **Temperature**

  Temperature is physical quantity expressing hot and cold. The chemical reaction goes faster at a higher temperature until optimum temperature is reached, after which it deceases due to break down enzyme and respiration will stop. Since fruits, vegetables, and flowers are alive after harvest, all physiological processes continue after harvest such as respiration and transpiration (water loss), and supply of nutrient and water is not possible since produce is no more attached to the parent plant. Respiration results in produce deterioration, including loss of nutritional value, changes in texture and flavour, and loss of weight by transpiration.

  Lower temperatures slow respiration rates and the ripening and senescence processes, which prolongs the storage life of fruits and vegetables. Low temperatures also slow the growth of pathogenic fungi which cause spoilage of fruits and vegetables in storage.

- **Relative Humidity**

  The relative humidity of the air, expressed in percentage, is defined as the relationship between the weight of the water vapour contained in 1 kg of air and the weight of the water vapour contained in 1 kg of saturated air, at a given temperature:

$$RH\% = \frac{\text{Weight of water vapour in 1 kg of air}}{\text{Weight of water vapour in 1 kg of saturated air}} \times 100$$

  when: RH% = relative humidity of the air (in %).

  Transpiration rates (water loss from produce) are determined by the moisture content of the air, which is usually expressed as relative humidity. At high relative humidity, produce maintains weight, appearance, nutritional quality and flavour, while wilting, softening and juiciness are reduced. Low relative humidity increases transpiration rates.

- **Measures to control RH**
  - ✓ Operating a humidifier in the storage area.
  - ✓ Regulating air movement and ventilation in relation to storage room load.
  - ✓ Maintaining refrigeration temperature within 2°F of the storage room air temperature.
  - ✓ Wetting the storage room floor

Practical Activity 1.1.8: Handling of received fresh fruits to be processed

Task:

Referring to previous theoretical activities (1.1.7) you are requested to go to the food processing workshop and store/handle the received fruits that shall be used nectar and squash production.

1. Apply safety precautions.
2. Storing/handling the received fruits for nectar and squash production
3. Present your work to the trainer and whole class. Ask clarification where necessary
4. Read key reading 1.1.8
5. Perform the task provided in application of learning 1.1.

Key readings 1.1.8: Handling of received fresh fruits to be processed

- **Handling of received fresh fruits**

  It is estimated that in the tropics each year between 25 and 40% of stored agricultural products is lost because of inadequate farm- and village-level storage. The product may be spoiled by infection from fungi, yeasts or bacteria; In order to minimize the losses during storage it is important to know the optimum environmental conditions for storage of the product.

- **Storage techniques**

  a) Pre-cooling

  Precooling is done to remove field heat of harvested produce, which is detrimental to keeping quality of fruits and vegetables and it is done to retard the ripening and senescence processes.

  1. **Air –cooling or Room cooling**

  The use of refrigerator air as precooling medium is widely used for precooling packed fruits, but the system is not widely used for vegetables. Pre-cooling with air can be accomplished in a conventional cold storage room, a special pre-cooling is funnel cooler, or forced air cooler. Cooling with air requires a longer time than cooling with water or vacuum.

  - Air cooling is done by placing the fruits in the cold room. Fruits are placed in well ventilated containers in order to achieve some air exchange.

2. Hydro cooling

The hydro-cooling is an old and effective pre-cooling method for fruits. Fruits are dipped in cold water or spray the cold water on the fruits. Some chemicals are also mixed with water in hydro cooling to prevent the shade and disease.

Cooling with cold water is rapid and effective method of pre-cooling used for cooling a wide range of fruits and vegetables in bulk before packing. Water is better than air at transmitting heat. This method is commonly used for stem vegetables, many leafy vegetables and some fruits like tomatoes and melons. Some crops cannot be cooled in this way, for **example** strawberry, because free water on the surface greatly increases the risk of disease. Proper sanitation (usually by chlorination) of the water is required to prevent the build-up of bacteria in the water and subsequent contamination of the produce.

3. Icing

Crushed or liquid icing may be used on a variety of fresh produce; icing is particularly effective for perishable items that cannot be readily cooled by others methods. Top icing a truck loaded with already cooled produce is good way to provide additional assurance that the load will arrive properly cooled. However, icing in any form is not recommended for all types of fresh fruits and vegetables. Some items like straw berries, blues berries...cannot tolerate wetting, others items, such tomatoes, can be injured by chilling to near freezing, some produce items that can be successfully iced.

4. Vacuum cooling

Leafy vegetables are commonly cooled by reducing atmospheric pressure in artificial hermitically sealed chambers. Reducing atmosphere pressure also reduces the pressure or water vapour in the chamber and thus cooling is affected.

It is one of the most rapid and a uniform method of cooling is vacuum cooling. This is most efficient with produce that has a large surface area to volume like leafy crops such as lettuce, spinach and cabbage

b) Surface coatings and wraps

Many fruits and vegetables benefit from a surface coating which can slow down the loss of water this is particularly true for crops which are washed, because hot water or the inclusion of detergents can remove natural waxes from the fruit surface. Coatings can also reduce the movement of O_2 and CO_2 in and out of the fruit, respectively. This internal atmosphere modification can slow down respiration; however, the layer must not be too thick or O_2 levels may fall too low and lead to fermentation problems.

Many of the coatings applied are derived from plant extracts, for example sugar cane waxes or polymers of sugar esters; however, petroleum-based products such as paraffin wax may be added to improve water loss control.

c) Control of humidity

Humidity: is the amount of water vapour present in the air. Water vapour is the gaseous states of water and invisible to the human eye. Humidity indicates the likelihood of precipitation, dew, or fog. Higher humidity reduces the effectiveness of fruits transpiration in cooling fruits by the reducing the rate of evaporation of moisture in fruits surface.

d) Controlled Atmosphere Storage

Controlled atmosphere (CA) storage involves altering and maintaining an atmospheric composition that is different from air composition (about 78% N_2, 21% O_2, and 0.03% CO_2); generally, O_2 below 8% and CO_2 above 1% are used.

Some Beneficial Effects of CA (optimum composition for the commodity):

I. Retardation of senescence (including ripening) and associated biochemical and physiological changes, i.e., slowing down rates of respiration, ethylene production, softening, and compositional changes.

ii. Reduction of sensitivity to ethylene action at O_2 levels < 8% and/or CO_2 levels > 1%.

iii. Alleviation of certain physiological disorders such as chilling injury of avocado and some storage disorders, including scald, of apples.

e) Control of ethylene

Ethylene is natural hormone in which plant emits its self to stimulate ripening process. The more the ethylene production the more the fruits ripe and continue to senescence and finally deterioration.

- The presence of ethylene can stimulate senescence and give rise to a number of disorders.
- Good store management is needed to ensure that ripening fruit is not stored together with unripe fruit or other produce which is sensitive to ethylene.
- Exhaust gases from vehicles contain ethylene and must be kept well apart from produce stores.
- For fruits and vegetables which only produce low levels of ethylene, adequate ventilation from a clean air source is usually sufficient to keep ethylene at safe levels.
- Where ventilation is not sufficient to manage ethylene levels, ethylene can be destroyed by oxidation. Store air can be passed over the oxidising compound, potassium permanganate held on an inert substrate. Alternatively, ultraviolet (UV) light is in use commercially to destroy ethylene.

- **Briefly Measures to control effects of Ethylene:**
  - ✓ Eliminate sources of ethylene

- ✓ Ventilation one air charge per hour
- ✓ Inhibiting ethylene effects by CAS-low oxygen or high carbon dioxide
- ✓ Chemical removal by activated charcoal, potassium permanganate, UV lamps, etc

- **Storage condition**

  Fruit storage condition depend on the type of fruits and are listed below:

  1. Storage temperature
  2. Humidity
  3. Relative humidity
  4. Duration and concentration of Ethylene
  5. Air concentration (percent of Oxygen and percent of Carbon dioxide)

❖ **Storage conditions of some fruits used in juice making**

Product	Optimum storage T°^{0}F	Optimum humidity	Ethylene production	Sensitive to ethylene	Storage time
Apples	30-40 ^{0}F	90-95	high	yes	1-12month
Banana green	62-70 ^{0}F	85-95	low	yes	-
Banana ripe	56-60^{0}F	85-95	Medium	no	1 week
Carrot immature	32^{0}F	98-100	-	-	4-6weeks
Carrot mature	32 ^{0}F	98-100			7-9 months
Grapes fruits	55-60 ^{0}F	90-95	Very low	no	-
Guava	45-50 ^{0}F	90-95	Medium	yes	2 weeks
Lemons	52-55 ^{0}F	90-95	Very low	no	1-4 months
Mangoes	50-55 ^{0}F	85-95	Medium	yes	-
Oranges	40-45 ^{0}F	90-95	Very low	no	6month
Papaya	50-55 ^{0}F	85-95	Medium	yes	1-2weeks
Pineapples	50-55 ^{0}F	85-95	Very low	no	3-4weeks
Straw berries	32 ^{0}F	90-95	Very low	no	3-7 days
watermelon	55-70 ^{0}F	-	-	-	-
Passion fruits	41.6-44.6 ^{0}F	-	-	-	4-5 weeks

Points to Remember

- These tools and equipment are essential for producing high-quality nectar and squash products, ensuring safety, and maintaining consistency in the final product.
- The specific tools and equipment used may vary depending on the scale of production, the type of nectar or squash being made, and the desired level of automation.
- Prioritize safety, and regulatory compliance when you select tools and equipment that contribute to the production of high-quality.
- Wear appropriate personal protective equipment (PPE) such as gloves, lab coats, and safety glasses when handling chemicals or sharp objects
- Always read the instructions for each tool or piece of equipment before use.
- The specific cleaning agents used in nectar and squash production may vary depending on the equipment, surfaces, and contaminants involved.
- It's essential to follow the manufacturer's instructions and safety guidelines when using any cleaning agent.
- It's essential to select high-quality, safe, and sustainable materials to ensure the quality and safety of the final product.
- Important ingredients used in nectar and squash production are fruits, water, sugar and preservatives.
- When selecting ingredients for nectar and squash production, it's crucial to assess their quality to ensure the final product meets high standards.
- Factors that affect postharvest and storability of fresh fruits are physiological, biological, mechanical and environmental factors.
- By understanding and managing these factors, it's possible to optimize the postharvest storage of fresh fruits and extend their shelf life.
- Proper handling of received fresh fruits is crucial to maintain their quality and prevent spoilage
- Ensure that the received fresh fruits are handled appropriately, preserving their quality and suitability for processing into nectar or squash.

Application of learning 1.1.

After learning the indicative content 1.1, you are requested to visit your school's workshop of nectar and squash production to select tools, equipment and materials and make proper handling of received fruits.

Indicative content 1.2: Cleaning of workplace

Duration: 3 hrs

Theoretical Activity 1.2.1: Description of the purpose of cleaning workplace and factors affecting cleaning effectiveness

Tasks:

1. You are requested to answer the following questions related to purpose of cleaning workplace

   i. Why do we clean the workplace during nectar and squash production?
   ii. During cleaning do you think that there are the factors affecting cleaning effectiveness? What are they?

2. Provide the answers to asked questions by writing them on papers, flip chart, Blackboard or white board.
3. Present the findings/answers to the whole class.
4. For more clarification, read the key readings 1.2.1.

Key readings 1.2.1.: Description of the purpose of cleaning workplace and factors affecting cleaning effectiveness

- **Cleaning of workplace**

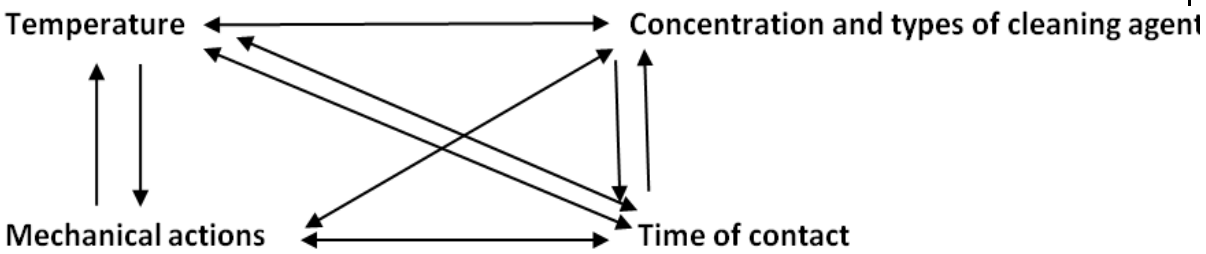
Cleaning removes dirt and organic matter from surfaces using soap or detergents.
Sanitizing kills bacteria on surfaces using chemicals. It is not intended to kill viruses.
Disinfecting kills viruses and bacteria on surfaces using chemicals

- **Purpose of cleaning workplace**
  - ✓ To reduce the risks from food hazards – food poisoning and foreign body contamination
  - ✓ To meet specific customer requirements
  - ✓ To meet the requirements of global food safety standards
  - ✓ To maintain positive audit and inspection outcomes
  - ✓ Improved Productivity
  - ✓ To present a hygienic visual image
  - ✓ To maintain product shelf-life
  - ✓ To avoid pest infestation
- **Factors affecting cleaning effectiveness**

To reach the optimum cleaning effectiveness, you have to produce with **TACT.** This refers on four factors that have direct influences on cleaning:

- ✓ Temperature of utilized product

- ✓ Mechanical Actions (brunching or turbulence)
- ✓ Concentration of a product
- ✓ Time of contact between product and surface for cleaning



Note: If one among these factors is notified, you must modify each among them to conserve the same affective

A. Temperature: The lower the temperature, the lower the viscosity, higher temperatures aid in chemical productivity. To put it simply, the cleaning process becomes faster and easier as temperature increases

You have to respect the temperature of a product during utilization as indicated by a manufacturer

- ✓ Same products will be effective at hot water other become effective with cold water
- ✓ The cold water will solidify fats while hot water denatures proteins which make their removal difficult.
- ✓ Risk warm water is required for Manuel cleaning less than 50 ^{o} c

B. Mechanical action: Desired results occur when optimal chemical reaction and mechanical action takes place. Agitation can help break up soils, increase wash efficiency and reduce wash time and a specific amount of pressure is required to affect the response rate. Brushing is an ancient cleaning model and in very effective if complies with required time.

- ✓ The use of wooden or metal brushes is forbidden.
- ✓ You can produce a mechanical action by agitating or make circulation of pressurized products.

C. Concentration level and Types of cleaning agent: The type of cleaning agents and concentration levels will dictate chemical actions. The type of chemical being applied will affect how the soil is removed from the surface and this will allow you to check for alkalinity, water hardness, pH levels, iron content, chlorine presence and sour levels. It imports to request to respect the recommendation or recommended concentration by a manufacture, to assure its effectiveness to protect the equipment from corrosion, chemical contamination on cleaned surface and to maintain health and security of employees

D. Time of contact: Time is the duration allotted to a cleaning task. The results in the cleaning process rely heavily on the amount of time spent. If you increase the amount of cleaning time, the chemistry behind the product has a better chance of breaking up soils and being more effective. You must respect the time of contact specified by a supplier in order to allow the product to complete its action. Short time will reduce the quality of cleanliness.

Additional factors:

- ✓ **Water quality**: Hard water can reduce the effectiveness of cleaning solutions. Consider using softened water or adjusting cleaning procedures accordingly.
- ✓ **Surface type:** Different surfaces require different cleaning approaches. Choose cleaning methods and solutions compatible with the specific surface material to avoid damage.
- ✓ **Organic matter**: The presence of food residues, grease, or other organic matter can hinder cleaning effectiveness. Pre-cleaning to remove these before applying the main cleaning solution is often necessary.
- ✓ **Employee training**: Properly trained employees understand the importance of cleaning and how to perform it effectively. Regular training on cleaning procedures and best practices is essential.
- ✓ **Equipment maintenance:** Cleaning equipment needs regular maintenance and replacement to function optimally. This includes ensuring brushes, cloths, and other tools are clean and in good condition.

Practical Activity 1.2.2: Applying cleaning methods and cleaning techniques

Task:

Referring to previous theoretical activities (1.2.1), you are requested to go to the food processing workshop and clean workplace for nectar and squash production using cleaning methods

1. Apply safety precautions.
2. Clean the workplace of nectar and squash production.
3. Read key reading 1.2.2.
4. Perform the task provided in the application of learning 1.2

Key readings 1.2.2: Applying cleaning methods and cleaning techniques

- **Cleaning methods**

  They are two methods of cleaning:

  1. **Wet cleaning**: It is method of cleaning use water-based solvents that are typically non-toxic and generally don't include chemicals. It is method of cleaning use water, detergents, soaps and bleaches, rather than chemical solvents.

     The steps of wet cleaning include
     - ✓ Pre-rinsing
     - ✓ Washing (with chemicals)
     - ✓ Rinsing
     - ✓ Sanitizing
     - ✓ Post rinsing.
  2. **Dry cleaning**: It is method of cleaning by removal of soil particles from surfaces by mechanical, manual or chemical methods rather than water. It can be done by using brushes, dry clothes, sweeper etc

- **Application of Cleaning techniques**

  ✓ **Cleaning in place (CIP)**

  Cleaning in Place (CIP) is system of cleaning the interior surface of pipelines, vessels, filters, process equipment and associated things without dismantling. Juice processing plants that require high level of hygiene rely on CIP. Cleaning-In-Place (CIP) involves the jetting or spraying of surfaces or circulation of

cleaning solutions through the plant under conditions of increased turbulence and flow velocity.

Applications:

- Cleaning tanks, pipes, valves, and other equipment in production lines.
- Removing product residues, microorganisms, and other contaminants.
- Maintaining product quality and consistency.
- Minimizing cleaning downtime and labor costs.

Benefits:

- Efficient and thorough cleaning.
- Reduces manual labor and risk of human error.
- Minimizes water and chemical usage.
- Improves product quality and safety.

✓ **Cleaning out of place (COP)**

Cleaning -out-of-place (COP): It is manual washing techniques used for cleaning equipment, tools, utensils and area of food processing plant. When using COP make sure all parts are completely submerged to ensure that adequate efficient cleaning.**Process:**

- Disassembly
- Pre-cleaning
- Cleaning
- Rinsing
- Sanitization
- Drying
- Reassembly

Applications:

- Cleaning complex or intricate equipment parts that cannot be effectively cleaned while in place.
- Removing stubborn stains, grease, or residues that require more intensive cleaning methods.
- Ensuring hygienic conditions for equipment in contact with food, pharmaceuticals, or other sensitive materials.
- Cleaning large or bulky equipment that cannot be accommodated in CIP systems.

Benefits:

- Provides thorough cleaning of all equipment surfaces.
- Allows for targeted cleaning of specific areas.
- Effective for removing difficult stains and residues.
- Suitable for complex or intricate equipment designs.

Disadvantages:

- Can be time-consuming and labor-intensive compared to CIP.

- Requires disassembly and reassembly of equipment, leading to potential downtime.
- May require additional space and resources for cleaning tanks and equipment.

Points to Remember

- Implementing effective cleaning practices, you can create a healthier, safer, and more productive work environment.
- Effective cleaning involves a combination of methods and techniques tailored to specific surfaces and contaminants.

Application of learning 1.2.

After learning the indicative content 1.2, you are requested to visit your school's workshop of nectar and squash production to clean the workshop by using cleaning methods and techniques.

Indicative content 1.3: Arrangement of work area

Duration: 3 hrs

Theoretical Activity 1.3.1: Description of purpose of arranging work area

Tasks:

1. You are requested to answer the following questions related to description of purpose of arranging work area:

   According to you, why do you arrange the work area before producing nectar and squash.

2. Provide the answers to asked questions by writing them on papers, flip chart, Blackboard or white board.
3. Present the findings/answers to the whole class.
4. For more clarification, read the key readings 1.3.1.

Key readings 1.3.1: Description of purpose of arranging work area

- **Purpose of arranging work area for nectar and squash production**

  Arranging your work area effectively for nectar and squash production serves several crucial purposes:

  1. **Efficiency and Productivity:**
     - ✓ **Minimizes unnecessary movement**: A well-organized workspace minimizes the need for employees to walk around unnecessarily, searching for tools or ingredients. This optimizes workflow and increases production efficiency.
     - ✓ **Improves accessibility**: Easy access to equipment, ingredients, and cleaning supplies reduces time spent searching and allows tasks to be completed faster.
     - ✓ **Reduces bottlenecks:** Proper layout prevents congestion and ensures smooth flow of materials and personnel, preventing bottlenecks that can hinder production.
  2. **Hygiene and Food Safety**

  ✓ **Prevents cross-contamination**: Separating raw materials from finished products and designating specific areas for cleaning and waste disposal helps maintain hygiene and prevent cross-contamination, ensuring food safety.

  ✓ **Facilitates cleaning:** A well-organized workspace is easier to clean and maintain, reducing the risk of harboring bacteria, mold, and other contaminants that can spoil your nectar and squash.

- ✓ **Promotes good practices**: A clean and organized environment encourages employees to follow proper hygiene practices, further enhancing food safety.

3. Quality Control and Consistency:

- ✓ **Standardized processes**: A clear layout facilitates the implementation of standardized processes for handling ingredients, equipment operation, and cleaning, ensuring consistent product quality.
- ✓ **Minimizes errors:** Clear organization helps prevent mistakes and ensures proper handling of materials, reducing the risk of errors that can affect product quality.
- ✓ **Easy monitoring:** A well-organized workspace allows for easier monitoring of production processes and identification of potential quality issues.

4. Safety and Ergonomics:

- ✓ **Reduces accidents:** A clear layout minimizes clutter and tripping hazards, promoting a safer work environment.
- ✓ **Improves ergonomics**: Proper placement of equipment and materials reduces strain and fatigue for employees, preventing injuries and promoting worker well-being.
- ✓ **Emergency access:** Clear walkways and designated exits ensure easy access for emergency personnel and evacuation in case of accidents.

5. **Additional benefits:**

- ✓ **Reduced stress:** A well-organized workspace can create a calmer and less stressful environment for employees, potentially leading to improved morale and job satisfaction.
- ✓ **Positive impression:** A clean and organized production area can impress customers and inspectors, boosting confidence in your production practices and product quality.

Practical Activity 1.3.2: Setting work area

Task:

Referring to previous theoretical activities (1.3.1.), you are requested to go to food processing workshop and set the work area.

1. Apply safety precautions.

2. Set the work area

3. Read key reading 1.3.2

4. Perform the task provided in application of learning 1.3.

Key readings 1.3.2: Setting work area

- **Purposes**
  - ✓ It helps to avoid any cross contamination and breakage.
  - ✓ We set work area in order to avoid an accident (good presentation)
- **Setting work area (Flow chart)**

Reception of fruits room

⇩

Sorting and grading area

⇩

Washing fruits area

⇩

Juice extraction area (crushing, pressing, centrifugation, diffusion) area

⇩

Filtration area

⇩

Pasteurization area

⇩

Mixing area

⇩

Cooling area

⇩

Filling/packaging area

⇩

Storage room area

Points to Remember

- By carefully arranging your work area, you can create a space that supports your work goals and enhances your overall productivity.
- Arranging a work area is essential for creating a productive and efficient workspace.
- By following the guidelines of setting work area, you can create a work area that is both functional and comfortable, promoting productivity and efficiency.

Application of learning 1.3.

After learning the indicative content 1.3, you are requested to visit your school's workshop of nectar and squash production to set the work area using processing flow chart.

Indicative content 1.4: Preparation of Ingredients

Duration: 4 hrs

Theoretical Activity 1.4.1: Description of sorting and grading criteria of fresh fruits for nectar and squash production fruits for nectar and squash production

Tasks:

1. Answer the following questions related to description of criteria to consider while sorting and grading fresh fruits for nectar and squash production

   i. According to your knowledge, differentiate sorting and grading.

   ii. As a food processor, what criteria do you follow during sorting and grading of fruits in nectar and squash production.

2. Provide the answers to asked questions by writing them on papers, flip chart, Blackboard or white board.

3. Present the findings/answers to the whole class.

4. For more clarification, read the **key readings 1.4.1.**

Key readings 1.4.1: Description of sorting and grading criteria of fresh fruits for nectar and squash production fruits for nectar and squash production

- **Fruits sorting and grading criteria**

  Fruits are typically sorted and graded according to:

  - ✓ Weight
  - ✓ Size
  - ✓ Colour
  - ✓ Form
  - ✓ Specific gravity
  - ✓ Lack of illness

Sorting criteria	Description
By size	Rollers (cherries), diverging belts, reels with holes
By weight	Fruits sorters are used to differentiate fruits grades based on individual fruits weight

By texture	To measure firmness or hardness of fruits system
By colour	colour sorter or chat are used to measure green to yellow ratio (depending on ripening colour of fruits)

- **Sorting and grading of fruits**
  - ✓ **Sorting**

    Sorting is the removal of rotten, damaged, or diseased fruits from the healthy and clean ones. The damaged or diseased fruits can produce ethylene in substantial or in large amounts which can affect the adjacent fruits.

    Fruit sorting covers two main separate processing operations:

    (1) Removal of damaged fruit and any foreign substance; and

    (2) Qualitative sorting based on organoleptic criteria and maturity stage.

    - **Methods:**
      - **Manual sorting:** Trained personnel visually inspect fruits for blemishes, disease, spoilage, and foreign objects.
      - **Mechanical sorting:** Utilize sorting machines based on size, color, or shape to automate the process.
  - ✓ **Grading**

    Grading is also the process of categorizing fruits and vegetables on the basis of colour, size, shape, stage of maturity, and or degree of ripening.

    - **Methods:**
      - **Static grading**

        It is grading system where the product is placed on an inspection table where sorters remove units which do not meet the requirements for the grade or quality category
      - **Dynamic grading**

        It is grading system where product moves along a belt in front of the sorters who remove units with defects. Main flow is the highest quality grade. Often second and third grade quality units are removed and placed onto other belts. It is much more efficient in terms of volume sorted per unit of time.

Theoretical Activity 1.4.2: Description of purpose of washing fresh fruits for nectar and squash production

Tasks:

1. Answer the following questions related to description of purpose of washing fresh fruits for nectar and squash production:

   According to your knowledge, why do you wash fruits before nectar and squash production.

2. Provide the answers to asked questions by writing them on papers, flip chart, Blackboard or white board.
3. Present the findings/answers to the whole class.
4. For more clarification, read the key readings 1.4.2.

Key readings 1.4.2: Description of purpose of washing fresh fruits for nectar and squash production

- **Purpose of washing fruits**
  - ✓ Removing dirt, debris, and contaminants
  - ✓ To remove pesticide residues
  - ✓ Reducing microbial contamination
  - ✓ Improving flavor and color
  - ✓ Extending the product shelf life
  - ✓ Regulatory compliance

NOTE: Overall, washing fruits is a fundamental step in ensuring the quality, hygiene, and safety of your nectar and squash production. By implementing proper washing practices, you can contribute to a delicious, safe, and shelf-stable product that meets consumer expectations and regulatory requirements.

Benefits:

- ✓ **Enhanced microbial control:** Washing disinfectants can significantly reduce bacteria, viruses, and other microorganisms on fruit surfaces compared to plain water washing alone.
- ✓ **Reduced risk of foodborne illness**: By minimizing harmful pathogens, disinfectants can contribute to safer nectar and squash products, reducing the risk of foodborne illness outbreaks.
- ✓ **Extended shelf life:** By lowering microbial counts, disinfectants can potentially extend the shelf life of your product by delaying spoilage.

Drawbacks:

- ✓ **Regulatory restrictions**: Many countries and regions have strict regulations

regarding the use of disinfectants in food production, specifying approved substances and maximum allowable concentrations. Ensure you comply with all relevant regulations.

- ✓ **Potential residue concerns**: Some disinfectants can leave residues on fruits, raising concerns about consumer safety and taste. Choose disinfectants approved for food contact and ensure thorough rinsing to minimize residues.
- ✓ **Impact on flavor and quality**: Certain disinfectants might affect the taste or aroma of fruits, impacting the final product quality. Conduct trials to assess potential flavor changes before implementing widespread use.
- ✓ **Environmental impact**: Some disinfectants can be harmful to the environment if not disposed of properly. Choose eco-friendly options and follow proper disposal guidelines.

Identification of dosages of disinfectants used during washing

Dosages of washing disinfectants

Dosages of washing disinfectants can vary depending on the specific product and its intended use. It's important to carefully follow the manufacturer's instructions on the product label or packaging. Disinfectants come in various forms, including liquids, sprays, wipes, and powders, and each may have different application methods.

Here are some general guidelines:

1. **Read the Label:** Always read and follow the instructions provided by the manufacturer on the product label. The label will provide information on proper usage, dilution ratios, contact time, and any safety precautions.
2. **Dilution Ratios:** Many disinfectants need to be diluted with water before use. The label should specify the recommended dilution ratio. Using the correct dilution is crucial for the disinfectant to be effective without causing harm.
3. **Surface Type:** Different surfaces may require different concentrations or contact times. For example, some disinfectants may be suitable for hard, non-porous surfaces, while others are formulated for use on soft surfaces.
4. **Contact Time:** The contact time is the duration that the disinfectant must remain wet on the surface to effectively kill or inactivate pathogens. The label will specify the recommended contact time.
5. **Application Method:** Some disinfectants may be applied using a cloth, sponge, or spray. Ensure that you apply the disinfectant as directed to achieve the best results.
6. **Ventilation:** Pay attention to any ventilation recommendations. Some disinfectants may require adequate ventilation during and after use to ensure safe application.

7. **Personal Protective Equipment (PPE):** Depending on the disinfectant, the label may recommend using personal protective equipment, such as gloves or eye protection, during application. Follow these recommendations to protect yourself.
8. **Residual Activity:** Some disinfectants may leave a residual layer on surfaces to provide ongoing protection. If this is the case, follow guidelines on reapplication intervals.

Practical Activity 1.4.3: Applying disinfectants during washing fresh fruits for nectar and squash production

Task:

Referring to previous theoretical activities (1.4.2), you are requested to go to the food processing workshop and wash fresh fruits for nectar and squash production using disinfectants

1. Apply safety precautions.
2. Wash fresh fruits for nectar and squash production using disinfectants
3. Read key reading 1.4.3
4. Perform task provided in the application of learning 1.4

Key readings 1.4.3: Applying disinfectants during washing fresh fruits for nectar and squash production

When applying washing disinfectants to fruits, it's essential to follow proper procedures to ensure the effective removal of contaminants while maintaining food safety. Here is a general procedure for the application of disinfectants in fruit washing:

- ✓ **Select a Suitable Disinfectant:**
  - ✓ Choose a disinfectant that is safe for use on fruits and vegetables. Look for products labeled as fruit and vegetable washes or sanitizers.
- ✓ **Read the Product Instructions:**
  - ✓ Carefully read and follow the manufacturer's instructions on the product label. Pay attention to recommended concentrations, contact times, and any specific guidelines for use on fruits.
- ✓ **Wash Hands:**
  - ✓ Wash your hands thoroughly with soap and water before handling the disinfectant and the fruits.
- ✓ **Prepare the Disinfectant Solution:**

- ✓ If the disinfectant requires dilution, prepare the solution according to the recommended concentration. Use clean, potable water for dilution.

✓ **Inspect the Fruits:**
- ✓ Inspect the fruits for visible dirt, debris, or contaminants. Remove any damaged or spoiled fruits.

✓ **Pre-Rinse the Fruits:**
- ✓ Rinse the fruits under cold, running water to remove loose dirt and debris. Use a brush for fruits with thicker skins, such as melons or potatoes.

✓ **Apply the Disinfectant:**
- ✓ Immerse or spray the fruits with the prepared disinfectant solution, ensuring thorough coverage. Follow the recommended contact time specified on the product label.

✓ **Agitate Gently:**
- ✓ If the disinfectant label allows, gently agitate the fruits in the solution to enhance the effectiveness of the disinfection process.

✓ **Rinse Thoroughly:**
- ✓ After the recommended contact time has elapsed, thoroughly rinse the fruits under running water to remove any residual disinfectant. Make sure all surfaces of the fruits are rinsed.

✓ **Air Dry or Pat Dry:**
- ✓ Allow the fruits to air dry or pat them dry with a clean cloth or paper towel. This step helps remove any remaining contaminants and disinfectant.

✓ **Storage:**
- ✓ Store the cleaned and disinfected fruits in a clean and sanitary environment.

✓ **Clean and Sanitize Equipment:**
- ✓ Clean and sanitize any equipment, brushes, or surfaces used during the washing process according to food safety guidelines.

- **Application of washing procedures of fruits**

  General outline of the washing procedures typically applied in nectar and squash production:
  - ✓ Wetting
  - ✓ Apply disinfectant
  - ✓ Gently rub
  - ✓ Scrub
  - ✓ Rinse
  - ✓ Drying
- **Application disinfectants in washing**

- ✓ Addition of detergents or 1.5%-HCl solution in washing water to remove traces of insecticides and fungicides;
- ✓ Use of warm water (about 50^0C) to kill psychrophile and mesophilic microorganisms
- ✓ Chlorine to kill spoilage and pathogenic microorganisms
- ✓ Sodium Hypochlorite to kill spoilage and pathogenic microorganisms

Note: Washing must be done before the fruit is cut in order to avoid losing high-nutritive value soluble substances (vitamins, minerals, sugars, etc.).

The application of washing disinfectants in fruit washing for nectar and squash production requires careful consideration due to potential benefits and drawbacks.

Theoretical Activity 1.4.4: Description of purpose of peeling and cutting fresh fruits for nectar and squash production

Tasks:

1. Answer the following questions related to description of purpose of peeling and cutting fresh fruits for nectar and squash production:
   i. According to you, why do you peel and cut fruits before production of nectar and squash.
   ii. What are the methods could you use during peeling of fruits?
2. Provide the answers to asked questions by writing them on papers, flip chart, Blackboard or white board.
3. Present the findings/answers to the whole class.
4. For more clarification, read the key readings 1.4.4.

Key readings 1.4.4: Description of purpose of peeling and cutting fresh fruits for nectar and squash production

- **Purpose of Peeling and cutting the fruit**

✓ **Peeling and cutting**

After cleaning your fruits, preparation of them is next important step in the following ways:

The fruits peeling consists of skin removal: Although manual peeling is still used for certain large vegetables, the method is very expensive. When required, fruits are usually peeled by removing skin. In general, loss increases with surface to volume ratio and decreases with fruit size. Mechanical methods are the worst, with up to 30% loss, while chemical (caustic) methods reduce loss to 10%.

- **Purpose of Peeling and cutting the fruit**

  In nectar and squash production, peeling and cutting fruits play specific roles to achieve desired qualities and characteristics in the final product.

  Here are some purposes:

✓ **Extracting Juice:**
  - **Peeling:** Removing the skin helps in extracting the juice more efficiently. In nectar and squash production, the goal is often to capture the essence of the fruit, and peeling facilitates this process.

✓ **Texture and Consistency:**
  - **Cutting:** Slicing or dicing fruits ensures a uniform size and consistency, which is crucial for creating a smooth and even texture in nectars and squash. This consistency enhances the overall mouthfeel of the product.

✓ **Flavor Concentration:**
  - **Peeling:** Some fruit peels can have a bitter or astringent taste, and removing them concentrates the desirable flavors in the juice, contributing to a more flavorful end product.

✓ **Aesthetics:**
  - **Peeling and Cutting:** The visual appeal of nectars and squash is important for consumer perception. Well-peeled and cut fruits contribute to a visually appealing product, which can influence consumer preference.

✓ **Ease of Processing:**
  - **Cutting:** Smaller, uniform pieces of fruit are easier to process in industrial equipment. Cutting fruits into consistent sizes helps in efficient juicing and extraction processes.

✓ **Removal of Undesirable Components:**
  - **Peeling:** Removing peels can eliminate any undesirable compounds, such as pesticides or waxes, which may be present on the skin of the fruits.

✓ **Consistency in Flavor Profiles:**
  - **Cutting:** Uniformly cut fruits contribute to a consistent flavor profile in the final product. This is crucial for maintaining a standard taste across batches.

✓ **Oxidation Control:**
  - **Peeling:** Peeling helps reduce the surface area exposed to air, minimizing oxidation. This is important in maintaining the color and freshness of the fruit juice, especially in products like clear nectars.

✓ **Hygiene and Safety:**
  - **Peeling and Cutting:** Thoroughly washing, peeling, and cutting fruits contribute to the safety and hygiene of the production process. It helps eliminate potential contaminants that may be present on the surface of the fruits.

- **Peeling methods**

Method	Description
✓ Mechanical peeling	**By abrasion:** It is used in batch with rotating abrasive base and water wash. This method is inefficient, with excessive losses. **Abrasive roll peelers:** This is a continuous method that combines rolls and brushes. **Blade type:** The fruit rotates and mechanized knives separate the peel. **Live knife:** Incorporates hydraulic control of the knife pressure. Good for apples and pears.
✓ Steam peeling	Pressure steam peeling make the peel blow off with pressure drop coming out of peeling chamber. May be combined with dry caustic peeling system
✓ Chemical peeling	Caustic peeling is extremely common. The simplest type involves immersion on a pocketed paddle wheel, with hot NaOH (20%), followed by scrubbing and washing. Tomatoes, peaches, and apples are peeled by this method. KOH is preferred because or its tissue penetration and disposal properties
✓ Hot gas peeling	When hot gas contacts a vegetable on the belt or roller conveyor, the skin is blown off by the steam formed. It is generally not used in fruits
✓ Freeze–thaw peeling	Fruit is frozen in a low temperature medium (40^0C) for few seconds and then warmed in water (40^0C). As a result of freezing the immediate subpeel cells are disrupted, releasing pectinases, which free the peel. Peeling loss is reduced to a minimum

Practical Activity 1.4.5: Peeling and cutting the fruit

Task:

Referring to previous theoretical activities (1.4.4.), you are requested to go to the food processing workshop and peel and cut fresh fruits for nectar and squash production

1. Apply safety precautions.
2. Peel and cut fresh fruits for nectar and squash production
3. Read **key reading 1.4.5**
4. Perform the task provided in **application of learning 1.4**

Key readings 1.4.5: Peeling and cutting the fruit

- **Procedure of Peeling and cutting the fruits**

  In the context of nectar and squash production, peeling and cutting fruits is a crucial step to extract juice for further processing. Here's a step-by-step procedure tailored to this specific application:

  Procedure:

  ✓ **Select Ripe Fruits:** Choose ripe and fresh fruits for optimal flavor and juice extraction.

  ✓ **Wash Fruits:** Thoroughly wash the fruits to remove any dirt, pesticides, or contaminants.

  ✓ **Peeling:**
  - Use a fruit peeler or knife to remove the skin from the fruits.
  - For fruits like citrus (oranges, lemons), remove the outer peel, leaving the white pith behind, as it can be bitter.

  ✓ **Removing Seeds or Pits:**
  - Cut the fruits in half and remove any seeds, pits, or hard cores.
  - For small seeds, like those in berries, you may not need to remove them.

  ✓ **Cutting:**
  - Cut the peeled and deseeded fruits into smaller pieces. The size depends on the type of fruit and the equipment you're using for extraction.
  - For squash production, you may want to cut the fruits into smaller chunks to facilitate cooking.

Points to Remember

- By carefully sorting and grading fruits, producers can ensure that only the highest-quality fruits are used in nectar and squash production, leading to a superior final product.
- By thoroughly washing fresh fruits before processing, producers can ensure the safety and quality of their nectar and squash products.
- Always consult with local food safety regulations and guidelines to determine the appropriate use of disinfectants.
- By peeling and cutting fruits appropriately, producers can ensure that the final nectar or squash product is of high quality, appealing to consumers, and easy to consume
- By following the procedures, you can effectively peel and cut fruits for nectar and squash production, ensuring a high-quality and visually appealing final product.

Application of learning 1.4.

After learning the indicative content 1.4, you are requested to visit your school's workshop of nectar and squash production to sort and grade fruits and make proper peeling and cutting of fruits.

Learning outcome 1 end assessment

Theoretical assessment

Q1. Read carefully the statement below and answer **True** if the statement is correct or **False** if the statement is wrong

A. Refrigerator is used in lowering the reproduction rate of bacteria, so the refrigerator reduces the rate of spoilage

B. Bottles are used for packaging juice

C. Pasteurizer machine is a device which is used in cutting the fruits

D. Adjustment of tools and equipment is considered as the ability of equipment to perform desired task properly

Q2. By using the following words (maturation, ripening, senescence, evaporation, peeling) fill the missing term in the blank spaces:

Maturity index of fruits goes into three stages after harvesting……**1**……, ……**2**……..and……**3**…….by which ……**4**……. is indicative of the fruit being ready for harvest, at this point, the edible part of the fruit is fully developed in size. Although it may not be ready for immediate consumption. ……**5**……. is the process which follows maturation, rendering the produce edible, as indicated by taste. ……**6**……. is the last stage, characterized by natural degradation of the fruit or vegetable, as in loss of texture, flavor?

Q3. Among the following chemical products used in Food processing, choose the correct cleaning agents by encircling the corresponding letter.

a) Bleachb) Sodium hydroxide

c) Hot water

d) Ethanol

Q4. In a table below, the Column B contains the definitions of the terms stated in Colum C. Match the columns B and C and write the letter in (Column A).

Column A	**Column B**	**Column C**
1 =……	Is the process of killing all microorganisms including spore forming bacteria from surfaces?	**A.** Disinfecting **B.** Cleaning
2 =……	Is defined as the process of killing all harmful	

	germs, bacteria and viruses from surfaces. This process kills 100% of germs, bacteria and virus except spore forming bacteria.	**C.** Sterilizing **D.** Sanitizing **E.** Degreasing
3 =……	Is the process of killing germs/bacteria in place such as food contact surface? This process kills 99.9% of germs and bacteria such as Escherichia coli.	

Q5. Among the elements listed below, choose the purposes of work area arrangement during nectar and squash production:

1. Productivity
2. Personal protective equipment
3. Collaboration
4. Ripening
5. Safety

Q6. By using the table, categorize the elements listed below into tools, equipment and materials used in nectar and squash production:

Knives, pasteurizer, working table, Juicer, water, refractometer, packaging material, sieve.

Tools	**Equipment**	**Materials**

Q7. Give three (3) factors affecting postharvest storability of fresh fruits used to produce nectar and squash

Q8. Differentiate dry cleaning from wet cleaning as both are methods of cleaning workplace of nectar and squash production.

Practical assessment

Buryohe ltd is an industry which produce nectar and squash from fruits and is located in western province of Rwanda. You are requested to select, adjust tools/equipment and to receive materials used in nectar and squash production within 4 hours. All tools, equipment and materials are available in the workshop.

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Indicative contents

2.1 Extraction of fruits juice

2.2 Adjustment of brix in juice

2.3 Pasteurization of juice

2.4 Addition of nectar and squash preservatives

Key Competencies for Learning Outcome 2: Make nectar and squash

Knowledge	Skills	Attitudes
• Description of juice extraction methods depending on the types of fruits • Description of calculating the ratio of juice/water/sugar • Description of method of juice pasteurization • Description of calculating the preservatives ratio	• Extracting juice from fruits • Filtrating and clarifying the juice • Measuring and adjusting brix of juice • Mixing of ingredient • Pasteurizing the juice • Adding the preservatives in nectar and squash	• Being careful when extracting juice • Being honest when filtrating and clarifying juice • Being accurate when measuring and adjusting brix of juice • Being attentive when mixing and pasteurize juice • Paying attention to addition of preservative in nectar and squash

Duration: 35 hrs

Learning outcome 2 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Describe properly juice extraction methods used in nectar and squash production
2. Extract properly juice from fruits according to the types of fruits used

3. Perform correctly filtration and clarification of juice used in nectar and squash production
4. Calculate accurately ratio of all ingredients used in nectar and squash production
5. Measure and adjust properly brix of juice used in nectar and squash production
6. Mix effectively ingredients used in nectar and squash production
7. Describe properly methods of juice pasteurization used in nectar and squash production
8. Pasteurize effectively juice used in nectar and squash production
9. Describe properly calculation of preservatives ratio used in nectar and squash
10. Add properly preservations in juice for producing nectar and squash

Resources

Equipment	Tools	Materials
● Pulping machine, ● Slicing machine, ● Pressing /squeezing machine, ● Storage tank, ● Pasteurizers, ● Juice mixer, ● Blender, ● Crushing machine, ● Juicer, ● PPE, ● Cooker ●	● Basins, ● Bucket, ● Refractometer, ● Jugs, ● Analytical balance, ● Filter cloths, ● Sponges, ● Cutting boards, ● Thermometer, ● Clocks, ● Brushes, ● Brooms, ● Boiling pans, ● Dust bin, ● pH-meter	● Fruits ● Sugars ● Preservatives (Citric acid, potassium sorbate) ● Water, ● Flavoring agent ● Cleaning agents ●

Indicative content 2.1: Extraction of fruits juice

Duration: 20 hrs

Practical Activity 2.1.1: Extracting juice

Task:

You are requested to go to the food processing workshop to crush, scoop the fruits and extract juice for nectar and squash production

1: Apply safety precautions.

2: Extract Juice

3: Present your work to the trainer and whole class. Ask clarification where necessary

4: Read key reading 2.1.1

5: Perform the task provided in application of learning 2.1

Key readings 2.1.1: Extracting juice

- **Applying juice extraction**

  Juice extraction: Juice extraction is the process of obtaining liquid juice from fruits, vegetables, or other plant materials. It typically involves separating the juice from the solid components, such as pulp, seeds, and skins, to create a liquid product that is primarily composed of the natural juices and flavours of the original source material.

  ✓ **Difference between crushing and scooping**

  Crushing: is referred to as the process of applying mechanical force which reduces the size of fruits in order to obtain mash (mixture of juice and solid matter). This process is achieved by blending (by blender machine), fruit crusher machine.

  Examples: **pineapples, apple, strawberry and grapes**

  Scooping: it is the process of opening some type of fruits and removing the internal edible and inedible part of fruits which in turn used in juice extraction process. E.g. **passion fruits, tree tomato.**

  ✓ **Methods of juice extraction**

There are several methods of juice extraction, and the choice of method depends on

the type of fruit being processed and the desired quality of the juice. Here are some common methods of juice extraction:

1. Mechanical Pressing: This method involves applying pressure to the fruit or vegetable to squeeze out the juice. It is commonly used for citrus fruits like **oranges and lemons**. Types of mechanical presses include hydraulic presses, screw presses, and basket presses.

2. Grinding and Pulping: Fruits are first crushed or ground into a pulp, and then the juice is separated from the pulp. This method is often used for soft fruits like **berries, grapes**

3. Centrifugal Extraction: In this method, the fruit is chopped or grated, and then the resulting pulp is placed in a centrifuge. The centrifuge rapidly spins, separating the juice from the pulp due to the centrifugal force.

4. Steam Extraction: This method is used for extracting juice from some fruits with tougher skins, such as **grapes for winemaking.** Steam is applied to the fruit, softening the skins and making it easier to extract the juice.

5. Cold Pressing (Hydraulic Cold Press): This method is commonly used for extracting juice from fruits while minimizing heat generation, which can preserve the juice's flavour and nutritional quality. It involves pressing the material under high hydraulic pressure.

6. Enzyme-Assisted Extraction: Enzymes are used to break down the cell walls of the fruit or vegetable, making it easier to extract juice. This method is often used for delicate fruits like pineapple.

- ✓ **Application of crushing, Scooping of the fruits and Extraction of the juice**

Crushing and scooping procedures are commonly used in food preparation to extract the juice or pulp from fruits. These methods are particularly useful for fruits with relatively soft or easily scoopable flesh, such as bananas and some berries.

Here are the general **steps for the crushing and scooping procedures for fruits**:

- ✓ **Crushing Procedure:**

1. Prepare the fruit: Start by selecting ripe fruits with the desired level of ripeness. Wash the fruits to remove any dirt or contaminants.

2. Cut or slice the fruit: Depending on the fruit's size and the intended use, you may need to cut the fruit into smaller pieces. For some fruits like berries, you may not need to cut them.

3. Use a utensil or tool: There are various tools and utensils that can be used to crush fruits, including:

- ✓ Fork: Use a fork to mash and crush softer fruits like bananas. Simply press down and mash the fruit until it reaches the desired consistency.
- ✓ Potato masher: A potato masher is a tool with a flat bottom and a handle that can be used to crush and mash fruits. It's useful for larger quantities.
- ✓ Mortar and pestle: A mortar and pestle are often used for grinding and mashing small quantities of fruits or herbs.

4. Mash or crush the fruit: With the selected equipment, mash or crush the fruit until it reaches the desired consistency. The level of crushing will depend on your recipe or personal preference.

- ✓ **Scooping Procedure:**

  1. Prepare the fruit: Choose ripe fruits and wash them to ensure they are clean.

  2. Cut the fruit: Cut the fruit in half, and in the case of fruits with large seeds or pits, like avocados or mangoes, cut around the pit. This will create two halves.

  3. Use a spoon: To scoop the flesh or pulp out of the fruit, use a spoon. A regular tablespoon or a dedicated fruit spoon can work well for this purpose.

  4. Scoop out the flesh: Place the spoon between the fruit flesh and the skin, and gently scoop the flesh from the skin. Be careful not to damage the skin or leave behind any unwanted parts.

The choice of method will depend on the fruit type, recipe, and desired texture of the final product.

Theoretical Activity 2.1.2: Description of filtration and clarification of juice

Tasks:

1: Answer the following questions related to Juice filtration and clarification for nectar and squash production:

As a food processor what do you understand by juice filtration? State the methods of juice filtration.

2: Provide the answers to asked questions by writing them on papers, flip chart, blackboard or white board.

3: Present the findings/answers to the whole class.

4: For more clarification, read the key readings 2.1.2.

Key readings 2.1.2: Description of filtration and clarification of juice

- **Juice filtration method and clarification techniques**

  Filtration is a process designed for clarification by removing insoluble solids from a high-value liquid food, by the passage of most of the fluid through a porous barrier, which retains most of the solid particulates contained in the food. Filtration is performed using a filter medium, which can be a **screen, cloth, paper, or bed of solids**. Filter acts as a barrier that lets the liquid pass while most of the solids are retained. The liquid that passes through the filter medium is called the filtrate and the separated solids are the filter cake

  ✓ **Filtration method and techniques**

1. **Membrane filtration**: is mode of filtration by use of cartridge composed of such material as nylon, polypropylene, celluloses esters or grass fibres.

2. **Pad filtration**: this a filtration method by which juice pass through filtering pad(cloth) composed of cotton, cellulose or manmade fibres like polyethene. This filtration method makes use of absorption, screening, sedimentation, turbulence to complete the juice filtration process. In this method juice are often filtered through sequentially pad depth.

3. **Depth filtration**: is a process in which juice moves in perpendicular flow to words the filter, allowing clear juice to pass through after particles get captured with in.

4. **Vacuum filtration**: is a procedure in which a pressure differential is maintained across the filter medium by evacuating the air below the filter paper. The vacuum creates a driving force that pulls a liquid through the filter while the solids cake on the outside of the filter.

✓ **Types of Pressure Filters**

Pressure filters usually found in the food industry are:

a. Filter press,

Two commonly used pressure filters are the batch plate-and-frame filter press and the shell-and-leaf pressure filter.

- In the plate-and-frame design, cloth or paper filters are supported on vertical plates. Feed liquor is pumped into the press and liquid passes through the filter cloths and flows down the grooved surfaces of the plates to drain through an outlet channel in the base of each plate. A layer of cake builds up on the cloths until the space between the plates is filled
- The shell-and-leaf pressure filter is used to overcome the problems of

high labour costs and lack of convenience of plate-and-frame presses. It consists of mesh 'leaves', which are coated in filter medium and supported on a hollow frame which forms the outlet channel for the filtrate. When filtration is completed, the cake is blown or washed from the leaves

b. Vacuum Filters

Vacuum filters are simple and reliable machines widely used in the fruit industry. Among the different types of vacuum filter (drum, disk, horizontal belt, tilting pan, and table filters) drum filters are most commonly utilized in the food industry.

The advantages and disadvantages of vacuum filtration compared to other separation methods are:

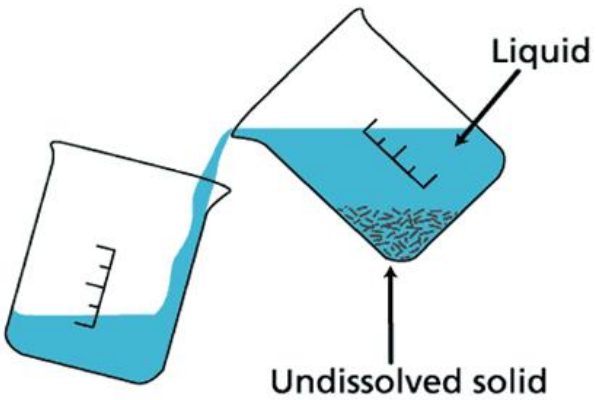
- Advantages: Continuous operation, very effective polishing (finishing) of solutions (on a precoat filter), and easy control of operating parameters such as cake thickness.
- Disadvantages: Higher residual moisture in the cake and difficulty in cleaning (as required mainly for food-grade applications)

Clarification: is the process of making juice clear.

✓ **Techniques of juice clarification**

1. **Centrifugation** is a process which involves the use of the centrifugal force for the sedimentation of heterogeneous mixtures with a centrifuge, used in industry and in laboratory settings. This process is used to separate two immiscible liquids

2. **Decantation** is a process for the separation of mixtures, by removing a layer of liquid, generally one from which a precipitate has settled. The purpose may be either to produce a clean decant, or to remove undesired liquid from the precipitate (or other layers).



3. Application of Enzyme

Examples: Pectin Esterase, Polygalacturonase, Cellulase and Hemicellulose

Pectic enzymes: it is used for break down the cellular structure of fruits. Homogenous distribution of cloud particles or fruit pulp throughout the bottled volume without sedimentation during the required shelf-life is expected by the consumer, whilst especially products with a clear phase above sediment at the bottom are rejected. Hydrocolloid addition besides homogenization treatments have been suggested for various cloudy juice products. In contrast to juices from all other fruit species, the addition of pectin (E 440) at least 3 g/l juice resulting in cloud stabilization.

- **Factors Affecting Filtration and Clarification**
  - ✓ **Type of juice:** Different juices contain varying levels of solids and impurities.
  - ✓ **Desired product quality:** The desired clarity and stability of the final product influence the choice of methods.
  - ✓ **Economic factors:** The cost of equipment and processing affects the selection of techniques.
  - ✓ **Juice temperature:** Temperature can affect the viscosity of the juice and the efficiency of filtration and clarification.
  - ✓ **pH:** The pH of the juice can influence the stability of suspended particles and the effectiveness of enzymes.

Practical Activity 2.1.3: Filtrating and clarifying juice

Task:

1: Referring to previous theoretical activities (2.1.2.), you are requested to go to the food processing workshop to filtrate and clarify juice for nectar and squash production

2: Apply safety precautions.

3: Filtrate and clarify juice for nectar and squash production

4: Present your work to the trainer and whole class. Ask clarification where necessary

5: Read key reading 2.1.3

6: Perform the task provided in application of learning 2.1

Key readings 2.1.3: Filtrating and clarifying juice

- **Perform juice filtration method and clarification techniques**
  - ✓ **Filtration method**
    - **Membrane filtration**

1. Pad filtration,
2. Depth filtration: is a process in which juice moves in perpendicular flow to words the filter, allowing clear juice to pass through after particles get captured with in.
3. Vacuum filtration: is a procedure in which a pressure differential is maintained across the filter medium by evacuating the air below the filter paper. The vacuum creates a driving force that pulls a liquid through the filter while the solids cake on the outside of the filter.

Clarification: is the process of making juice clear.

- ✓ **Techniques of juice clarification**

1. Centrifugation is a process which involves the use of the centrifugal force for the sedimentation of heterogeneous mixtures with a centrifuge, used in industry and in laboratory settings. This process is used to separate two immiscible liquids

2. Decantation is a process for the separation of mixtures, by removing a layer of liquid, generally one from which a precipitate has settled. The purpose may be either to produce a clean decant, or to remove undesired liquid from the precipitate (or other layers).

3. Application of Enzyme

Examples: Pectin Esterase, Polygalacturonase, Cellulase and Hemicellulase

Pectic enzymes: it is used for break down the cellular structure of fruits. Homogenous distribution of cloud particles or fruit pulp throughout the bottled volume without sedimentation during the required shelf-life is expected by the consumer, whilst especially products with a clear phase above sediment at the bottom are rejected. Hydrocolloid addition besides homogenization treatments have been suggested for various cloudy juice products. In contrast to juices from all other fruit species, the addition of pectin (E 440) at least 3 g/l juice resulting in cloud stabilization.

- **Procedures of Filtration and Clarification of Juice**

✓ **Filtration Procedures**

Coarse Filtration:

1. **Preparation:** The juice is pumped or transferred to the filtration system.
2. **Sieving or Screening:** The juice is passed through sieves or screens with appropriate mesh sizes to remove large particles like pulp, seeds, and skin fragments.
3. **Centrifugal Separation:** The juice is subjected to high centrifugal force to separate solid particles from the liquid phase.

Fine Filtration:

1. **Depth Filtration:**
   - **Preparation of filter aid:** Diatomaceous earth or other filter aids are mixed with water to form a slurry.
   - **Filter bed formation:** The slurry is pumped into a filter press or leaf filter to form a filter bed.
   - **Juice filtration:** The juice is passed through the filter bed, where particles are trapped within the bed.
2. **Membrane Filtration:**
   - **Preparation:** The juice is pre-filtered to remove large particles.
   - **Filtration:** The juice is pumped through a membrane with specific pore sizes to retain desired components while allowing the clarified juice to pass through.
3. **Centrifugal Clarification:**
   - **Separation:** The juice is subjected to high centrifugal force to separate fine particles from the liquid phase.

✓ **Clarification Procedures**

Centrifugation:

1. **Separation:** The juice is pumped into a centrifuge, where centrifugal force separates suspended solids from the liquid phase.
2. **Clarified juice collection:** The clarified juice is collected, while the solids are discharged.

Enzymatic Clarification:

1. **Enzyme addition:** The appropriate enzyme (e.g., pectinase) is added to the juice.
2. **Incubation:** The juice is incubated under controlled conditions to allow the enzyme to break down pectin and other substances.
3. **Clarification:** The clarified juice is separated from the resulting precipitate.

Flotation:

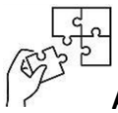
1. **Air injection:** Air is introduced into the juice to create bubbles.
2. **Particle attachment:** Suspended particles attach to the air bubbles.
3. **Separation:** The bubble-particle complex rises to the surface, forming a foam layer.
4. **Clarified juice collection:** The clarified juice is collected below the foam layer.

Membrane Filtration:

(Same as fine filtration procedures)

Points to Remember

- By following these steps and considering the factors that affect juice extraction, you can produce high-quality nectar and squash products.
- The choice of method depends on the type of fruit, the desired consistency of the juice, and the available equipment.
- By combining filtration and clarification techniques, producers can create nectar and squash products with a clear and appealing appearance, while also ensuring the removal of impurities.
- When you follow the procedures, you can effectively filter and clarify juice to improve its appearance and remove impurities.



Application of learning 2.1.

After learning the indicative content 2.1, you are requested to visit your school's workshop of nectar and squash production to extract juice and make proper filtration and clarification of juice.

Indicative content 2.2: Adjustment of brix in juice

Duration: 5hrs

Practical Activity 2.2.1: Determining ratio, mixing of ingredients and measuring of crude juice brix

Task:

You are requested to go to the food processing workshop to determine the ratio, mix and measure the crude juice brix for nectar and squash production

1: Apply safety precautions.

3: Determine the ratio, mix ingredients and measure the crude juice brix used in nectar and squash production

4: Present your work to the trainer and whole class. Ask clarification where necessary

5: Read key reading 2.2.1

6: Perform the task provided in application of learning 2.2

Key readings 2.2.1: Determining ratio, mixing of ingredients and measuring of crude juice brix

- **Adjustment of brix in juice.**
  - ✓ **Brix or degree Brix**: is the percentage of total dissolved solids expressed on weight basis as determined by a refractometer calibrated at 20^0C or by a calibrated hydrometer. It expresses the percentage concentration, by mass, of juice solution at 20^0C
  - ✓ **Brix (total soluble solids):** The soluble solids are primarily sugars; sucrose, fructose, and glucose. Brix is reported as "degrees Brix" and is equivalent to percentage. For example, a juice which has 12 degrees Brix has 12% total soluble solids. Instrument used for measuring sugar content is called Refractometer.

N.B. if the brix of the juice did not reach the desired level, sugar is added until the brix reaches the required amount of sugar. When brix is too high then dilution is done in order
to reduce sugar content.

- **Determination of Percent Juice Content**

Percent Juice Content: Juice content is an important measure of internal quality. Under or over-ripe fruit tend to be less juicy, which directly affects eating quality. The juice content is determined by weighing components of the whole fruit and the juice.

The test to determine the '**Percent Juice Content'** is important to determine the quality of the fruit. If to fruit is under or over-ripe there can be less juice, which affects eating quality and the amount of money a farmer will receive for their crop.
The following procedure can be used to determine the Percent Juice Content.

Equipment:

- Scales
- Fruit juices, juice only - no rind
- Fine plastic strainer
- 100 mL conical flask
- 1 to 2 L jug
- Graduated cylinder
- Test tube

Procedure

a) Collection of fruit sample: A minimum of three fruits, representative of the variety to be harvested, must be collected. This does not mean selecting the biggest and best fruit to test. Select fruit that are of similar size and colour to as those that you would pick for market.
b) Weigh the three representative fruit and record the combined weight in grams.
c) Weigh the empty jug and record the weight in grams.
d) Cut the fruit in halves and extract the juice from the three-sample fruit using a juicer (this will ensure you collect as much juice as possible from the fruit).
e) Strain the juice into the weighed jug.
f) Weigh the juice and record the weight in grams.
g) Calculate the percentage of juice.

Example Calculation

Gross fruit weight = 600 g
Gross juice weight = 450 g
Jug weight = 150 g
600
Net juice weight: Gloss juice Weight-Jug weight
Net juice weight: 450 g - 150 g = 300 g
% juice: Juice weight net x 100
Fruit weight
% juice: 300 x 100 = 50%

- **Determination of ratio of juice/water/sugar**
  - ✓ **Measuring of crude juice brix**

Refractometer is instrument used to measure total soluble solids (TSS) as °Brix in 0.1% graduations. There **are hand-held refractometers** as well as **digital battery/mains-**

operated models available. All models apply similar principles. However, the manufacturers' instructions must always be followed.

Some refractometers automatically compensate for changes in temperature, whereas others may be calibrated to read accurately at a fixed temperature (usually 20°C). To obtain accurate readings at temperatures other than 20°C it is necessary to refer to the International Temperature Correction factor.

- ✓ Use of the refractometer
  - Depending on the purpose of the analysis, several drops of distilled water, sucrose solution or juice are placed on the prism surface.
  - The liquid on the prism plate should be free from bubbles or floating particles of pulp or other matter.
  - Hand-held model: The prism lid is closed. To get proper readings, the instrument is turned towards the light. If necessary, the eye piece is focused until a clear image appears. The position at which the demarcation line between the light and dark blue regions crosses the vertical scale gives the percentage soluble solids reading.

  - For liquid crystal display (LCD) Digital model: Push the button to get the soluble solids reading in percent.

This is a summary of how to use refractometer:

1. Collect a refractometer and should be handled carefully
2. Ensure the refractometer prism surface is clean and dry.
3. Place a small amount of fresh juice (a couple of drops is sufficient) onto the prism of the refractometer.
4. Look through the eyepiece while pointing the prism in the direction of good light (not directly at the sun).
5. Focus and take the reading of where the base of the blue colour sits on the scale and record the % percentage sugar (°Brix).

6. Clean the refractometer immediately with a damp tissue, and dry thoroughly

Brix or degree Brix

Definition 1

It is the percentage of total dissolved solids expressed on weight basis as determined by a refractometer calibrated at 20 ^{0}C or by a calibrated hydrometer. It expresses the percentage concentration, by mass, of juice solution at 20 ^{0}C

Definition 2

It is the percentage of total dissolved solids in solution; it expresses the percentage mean 1brix equal 1% of dissolved sugar

1^{0}brix= 1% of dissolved sugar = 1g/100g=10g/kg

Amount of sugar in juice= Y Brix x Weight of juice

- **Calculation of sugar and water added**

Once you have measured the brix of juice sample using a refractometer, you can assess and modify the juice to your desired mixture or brix. This can be done by:

a) Diluting the juice with water
b) Further concentrating the juice with juice with sugar

1. **Diluting juice with water:**

If your juice is highly concentrated, you can dilute it by adding more water to reduce the sugar concentration and brix this process is called dilution.

Dilution: is the process of decreasing the concentration of solute in a solution by adding more solvent.

Dilution ratio: is ratio of solute to solvent (juice to water).

Dilution factor: factor by which the solution is diluted. The dilution factor can also be expressed as the ratio of the volume initial concentrated solution to the volume of final diluted solution.

- **Calculating dilution quantity**

Use the formulas below to determine how much water needs to be added to dilute a concentrated solution to lower target brix when given: **starting volume, starting brix and target brix**

1) Volume of diluted juice(L2) = volume of undiluted juice(L1) X Original Brix(OB)/Desired brix after dilution(DB).

(L2=L1 X OB/DB)

2) Volume of water needed to dilute juice to desired Brix(y)

Y=L2-L1

- **Dilution ratio (ratio of juice to water)**

Determined using volume of undiluted juice(L1) and volume of water needed(Y). ratio values should equal final volume of the solution when added. Simply ratios to lower terms by dividing both terms by their greatest common factor.

Determine amount of sugar in juice

- **Brix or degree Brix**

It is the percentage of total dissolved solids in solution; it expresses the percentage mean 1brix equal 1% of dissolved sugar

1^0brix= 1% of dissolved sugar = 1g/100ml=10g/kg

Amount of sugar in juice= Brix x weight of juice

The weight of diluted juice: weight of juice x dilution factor

The brix of diluted juice=$\frac{\text{initial brix}}{\text{dilution factor}}$

Summative assessment

Question 1

Karekezi produce 100kg of squash with 60 brix and dilute with water for 1:3 ratio

a) How much of Potable water added

b) What is total weight of diluted juice after dilution?

c) What is brix of final diluted juice?

ANSWER

Given data: -Volume of squash: 100kg with 16 brix

Dilution ratio: 1:3

Dilution factor= 1+3=4

Brix of squash: 60 brix

Asked: a) how much of potable water added

b) What is total weight of diluted juice after dilution?

c) What is brix of final diluted juice?

Calculation

a) weight of water added: 100kgx 3 = 300kg

b) **Formula:** The weight of juice after dilution: volume of crude juice+ weight of potable water added

The weight of juice after dilution: 100kg+300kg=400kg

The brix of diluted juice=$\frac{\text{initial brix}}{dilution\ factor}$

c) The Brix of Nectar after dilution=$4 = 15\ \text{brix}$

Question 2:

Kirezi want to produce squash of 65^0 brix from 100kg of crude juice with 15 brix. Determine amount of sugar she is added in order to adjust standard 65^0brix?

Answer

Given data: -weight of crude juice: 100kg with 15 brix

Final brix squash want to produce: 65 brix

Asked: Determine amount of sugar added in order to set standard squash brix

Calculations

Difference Brix = 65 brix-15 brix= 50brix

1^0brix=1g/100g=10g/kg

The amount of sugar added in order to adjust standard brix= 100kgx50x10g/kg=**50000g**=**50kg**

2.Further concentrating the juice with sugar:

- Calculating needed sugar to increase concentration:

Use the following formula to determine how much sugar needs to be added to juice to achieve a target brix when given the following information: **starting volume of juice, starting brix and target brix.**

Amount of sugar to be added= **starting volume of juice x (target brix-starting brix)**

Example: Karekezi wants to produce squash with 65 brix from 100l of crude juice with 15 brix. How much solids sugar in Kg will Karekezi needs to add**?**

Answer: sugar in kg=100l x (65-15)

= 100l x 50

= 5000g which is equal to **5kg**

To produce a 65 brix squash, Karekezi will need to add 5kg of sugar to the crude juice.

- Use Pearson square to calculate the amount of sugar and water

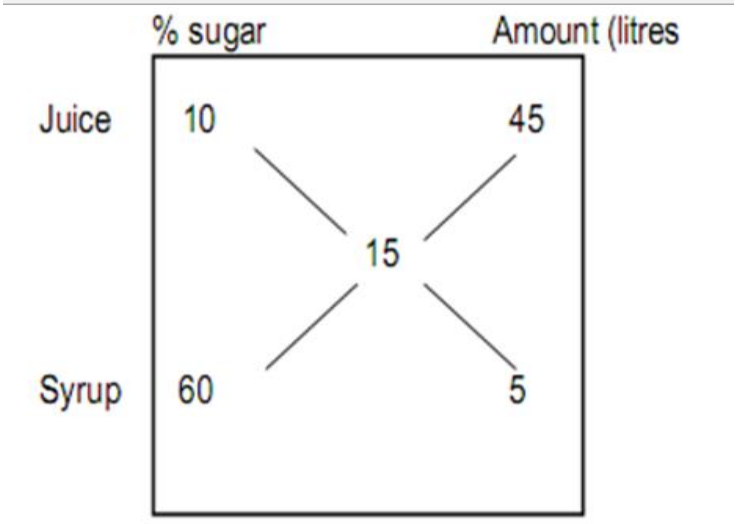
Use Pearson square for calculation of quantities to mix:

- ✓ % sugar in juice and syrup on left side
- ✓ % sugar of the final product in middle
- ✓ Substrate the smaller from the larger amount diagonally to find the amounts (liters)

to mix for getting to the defined concentration of sugar in the final product.

Example:

If the brix of juice is 10°brix and 15°brix is required, in this case to adjust the brix to the required one it needs to add syrup with high sugar concentration.



- ✓ 45l of juice will be mixed with 5l of juice to make 50L of Nectar juice. Which will have 15^0brix

- **Mixing ingredients**

  After calculating the additives, the next step is to mix them with juice, in order to avoid any contamination sugar is added during pasteurization. Preservatives are added during or after moment of pasteurization in order to ensure their efficiency and also to avoid any further contamination.

  - ✓ **Mixing ingredient for Fruit nectar**

    Unfermented pulpy product, intended for direct consumption, obtained by blending the total edible part of sound and ripe fruit(s), concentrated or un concentrated, with water and sugars, and preserved exclusively by physical means. It is juice obtained by mixing crude juice, water, preservatives and with or without sugar accordance to product standard. Its sugar content is around 14% but not less than 12%.

  - ✓ **Mixing ingredient for Fruit squash**

    Squash is a concentrated form of fruit drink obtained by adding sugar to crude juice in an amount sufficient to standard the Brix level. They can be served as a beverage by just adding water because their sugar content is too much which makes it not safe for your health to drink without dilution by adding three times of water.

  - ✓ **Mixing ingredient for concentrated fruit juice**

    It is fruit juice where water has been physically removed in an amount sufficient to increase the Brix level to a value at least 50% greater than the Brix value established for reconstituted juice from the same fruit. It is also served by adding water in order to adjust its sugar content

Points to Remember

- The ratio of ingredients in nectar and squash production depends on the desired flavor, sweetness, and consistency.
- By accurately determining the ratio of ingredients, mixing them thoroughly, and measuring the crude juice Brix, you can ensure the production of high-quality nectar and squash products with the desired flavor, sweetness, and consistency.

Application of learning 2.2.

After learning the indicative content 2.2, you are requested to visit your school's workshop of nectar and squash production to determine the ratio and mix the ingredients and make measuring of brix of crude juice.

Indicative content 2.3: Pasteurization of juice

Duration: 5hrs

Practical Activity 2.3.1. Pasteurizing of juice

Task:

You are requested to go to the food processing workshop to perform pasteurization methods for nectar and squash production.

1: Apply safety precautions.

2: Pasteurize the juice

3: Present your work to the trainer and whole class. Ask clarification where necessary

4: Read key reading 2.3.1

5: Perform the task provided in application of learning 2.3

Key readings 2.3.2: Pasteurizing of juice

- **Pasteurization methods of juice**

  Pasteurization is defined as the process of heating juice to a specific *temperature* for a specified period of *time* in order to kill pathogenic microorganisms. This is a relatively mild heat treatment, in which food is heated to below 100ºC to kill only pathogenic microorganisms but not spore forming bacteria. It is achieved under the following methods:

  - ✓ **Low temperature long time (LTLT)**

    Fruit juice has been traditionally pasteurized by batch heating at 63-65°C for relatively long time 30 minutes. This method has been replaced by high temperature short time treatment due to the undesirable quality changes during this process
  - ✓ **High temperature Short time (HTST)**

    HTST treatment could minimize those undesirable quality changes made by batch heating due to the much less duration of heat treatment. Currently, HTST pasteurization is the most commonly used method for heat treatment of fruit juice. For example, orange juice is processed by HTST at 90 to 95°C for 15 to 30 seconds. And apple juice is treated by HTST at 77 to 88°C for 25 to 30 seconds
- **Factors Affecting Pasteurization**
  - ✓ **Type of juice:** Different juices have varying microbial loads and acidity, which influence pasteurization conditions.

- ✓ **Desired shelf life:** The longer the desired shelf life, the higher the pasteurization temperature or holding time.
- ✓ **Equipment:** The pasteurization equipment should be designed to ensure accurate temperature control and rapid cooling.

- **Application of pasteurization of Juice for Nectar and Squash Production**
  - ✓ **Pasteurization Process Steps**

    Regardless of the method, the general pasteurization process involves the following steps:

1. **Preparation:**
   - The juice is prepared by filtering and removing any solid particles.
   - The juice is heated to a specific temperature to ensure it is homogeneous.
2. **Holding:**
   - The juice is held at the pasteurization temperature for the required time to kill microorganisms.
3. **Cooling**: The juice is rapidly cooled to required temperature for adding preservatives.

Points to Remember

- By properly pasteurizing juice, producers can ensure the safety and quality of their products while extending their shelf life.

Application of learning 2.3.

After learning the indicative content 2.3, you are requested to visit your school's workshop of nectar and squash production to pasteurize the juice.

Indicative content 2.4: Addition of nectar and squash preservatives

Duration: 5hrs

Practical Activity 2.4.1: Determining preservatives ratio

Task:

You are requested to go to the food processing workshop to determine and add the ratio of preservatives in juice.

1: Apply safety precautions.

2: Determine and add the preservatives in juice

3: Present your work to the trainer and whole class. Ask clarification where necessary

4: Read **key reading 2.4.1**

5: Perform the task provided in **application of learning 2.4**

Key readings 2.4.1: Determining preservatives ratio

- **Determination of preservatives ratio**

  Preservatives: are additives which added in processed food (juice) to retard or inhibit the growth of microorganisms and increasing shelf life of juice. They two types of preservatives used in Juice as explained below:

  i) Acidifying agents:

  Edible acids are added to increase acidity of juice; addition of lemon juice, citric acid, for the Purposes of:

  ➢ Product fortification, essential nutrients (e.g. vitamins, minerals) may be added to juice.

  ➢ Acidity regulation: Citric acid is used to increase acidity by preventing microorganisms to grown in food.

  ii) Antimicrobial growth

  Sodium benzoate and potassium sorbate are used to inhibit growth of microorganisms in food and increasing shelf life of the juice.

Determination of preservatives ratio

<u>The ratio is calculated basing on the following table:</u>

Ingredient	Use	Maximum Level
Sulphur Dioxide	Retards microbial and enzymatic activity	350mg/l
Sodium Benzoates	Antimicrobial pH <4.5	250 mg/kg
Potassium Sorbates	Antimicrobial pH <6.5	1000 mg/kg
Carbon Dioxide	pH reduction, anaerobic atmosphere	Limited by GMP
Citric acid	Acidity regulation	Adjust pH between 2.8-4.2
Ascorbic Acid	Retards enzymatic browning	Limited by GMP

Preservation conditions

- Preservatives are added during or after moment of pasteurization in order to ensure their efficiency and also to avoid any farther contamination.
- Preservatives used are those which are food grade in order to avoid complication after eating.

Points to Remember

- By carefully selecting and using preservatives, producers can ensure the safety and longevity of their nectar and squash products while maintaining their quality and flavor.

Application of learning 2.4.

After learning the indicative content 2.4, you are requested to visit your school's workshop of nectar and squash production to determine and add preservatives in juice.

Learning outcome 2 end assessment

Theoretical assessment

Q1. Read carefully the statement below and answer **True** if the statement is correct or **False** if the statement is wrong

a) Juice extractor is equipment used in nectar and squash production.
b) Cheese cloth should be used as tool in nectar and squash production.
c) Citric acid is preservative used in nectar and squash production.
d) Pasteurization is one of many techniques used in fermentation of juice.
e) Mixing of crude juice should be used in procedures of brix measurement.
f) Sieving is a method used in coarse filtration to remove large particles.
g) Centrifugation is primarily used to remove large particles from the juice.
h) Membrane filtration relies on the size of pores to separate particles.
i) Membrane filtration is identical to the fine filtration process.
j) Enzymatic clarification does not require any incubation time.

Q2. Choose the letter corresponding to the appropriate description of sorting criteria:

a. Size
i. Fruits sorters are used to differentiate fruits grades based on individual fruits weight
ii. Rollers (cherries), diverging belts, reels with holes
iii. To measure firmness or hardness of fruits system
iv. Color sorter or chat are used to measure green to yellow ratio (depending on ripening colour of fruits).

b. Weight
i. Fruits sorters are used to differentiate fruits grades based on individual fruits weight
ii. Rollers (cherries), diverging belts, reels with holes
iii. To measure firmness or hardness of fruits system
iv. Color sorter or chat are used to measure green to yellow ratio (depending on ripening colour of fruits)

c. Texture
i. Fruits sorters are used to differentiate fruits grades based on individual fruits weight
ii. Rollers (cherries), diverging belts, reels with holes
iii. To measure firmness or hardness of fruits system
iv. Color sorter or chat are used to measure green to yellow ratio (depending on ripening colour of fruits)

d. Color
i. Fruits sorters are used to differentiate fruits grades based on individual fruits weight
ii. Rollers (cherries), diverging belts, reels with holes
iii. To measure firmness or hardness of fruits system

iv. Color sorter or chat are used to measure green to yellow ratio (depending on ripening colour of fruits)

Q3. Juice maker need to adjust the brix while he/she is producing nectar and squash? Why?

Q4. Explain CCPs needed in nectar and squash making

Q5. Complete the following table relating to the pasteurization of nectar and squash.

Nectar and squash pasteurization type	**Temperature**	**Time**	**Purpose**
HTST	……	……..	…….
LTLT	……	……	……
UHT	……	……..	……

Q6. Choose correct answer to describe product with its corresponding ingredients and process.

a. Fruit nectar

i. Concentrated form of fruit drink with high sugar content, requiring dilution.

ii. Unfermented pulpy product, usually containing water, sugar, and preservatives.

iii. Fruit juice with reduced water content, requiring dilution.

b. Fruit squash

i. Concentrated form of fruit drink with high sugar content, requiring dilution.

ii. Unfermented pulpy product, usually containing water, sugar, and preservatives.

iii. Fruit juice with reduced water content, requiring dilution.

c. Concentrated fruit juice

i. Concentrated form of fruit drink with high sugar content, requiring dilution.

ii. Unfermented pulpy product, usually containing water, sugar, and preservatives

iii. Fruit juice with reduced water content, requiring dilution.

Q7. Use the following terms to complete these questions related to nectar and squash production:

(Preservatives, microorganisms, shelf life, acidifying agents, citric acid, sodium benzoate, potassium sorbate)

a) _____ are substances added to juice to prevent the growth of _____ and extend the _____ of the product.

b) _____, such as _____, can be added to juice to increase acidity and inhibit microbial growth.

c) _____ and _____ are examples of preservatives that directly target and inhibit the growth of microorganisms.

d) The addition of _____ can help to regulate the acidity of juice, creating an environment unfavorable for the growth of _____.

e) By increasing the _____ of juice through the use of _____, the potential for spoilage caused by _____ is reduced.

Practical assessment

ISANGE Ltd which is located in Rulindo district is a company process nectar and squashes daily, they received an order from G.S Makoko for supplying to their learner's nectar and squashes. This company faces a sudden problem of their employees who are in charge of extracted, adjust brix, pasteurize and presser juice during processing of nectar and squashes. The company asks you to support it on that task within 3 hours. All necessary tools and equipment are available in the workshop.

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Indicative contents

3.1 Cooling of Nectar and Squash

3.2 Checking the quality of Nectar and Squash

3.3 Selection of packaging materials

3.4 Packaging of nectar and squash

Key Competencies for Learning Outcome 3: Store nectar and squash

Knowledge	Skills	Attitudes
• Description of organoleptic and chemical quality parameters of nectar and squash • Description of packaging material types for nectar and squash • Description of labelling requirements for nectar and squash • Description of packaging of nectar and squash	• Cooling of nectar and squash • Checking organoleptic and chemical quality parameters of nectar and squash • Packaging of nectar and squash • Labelling of nectar and squash • Storing of nectar and squash	• Be attentive when checking the quality of nectar and squash • Being protective when packaging and labelling of nectar and squash • Taking care when using packaging machine • Having good communication when storing nectar and squash

Duration: 10 hrs

Learning outcome 3 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Cool properly nectar and squash according to the packing temperatures
2. Describe properly of organoleptic and chemical quality parameters of nectar and squash

3. Check properly the quality of nectar and squash according to quality specification
4. Describe appropriately packaging material used for nectar and squash
5. Package appropriately nectar and squash according to packaging requirement
6. Description properly labelling requirements for nectar and squash
7. Label properly nectar and squash according to label requirement
8. Store appropriately the nectar and squash final products according to storage conditions

Resources

Equipment	Tools	Materials
● Packaging machine ● Washing machine ● Cooling tank ● Packing tables ● Sealing machine ● Fire extinguisher ● Compressor ● Generator	● Basin ● Bucket ● Jugs ● Analytical balance ● Sponges ● Projector ● Boards ● Computer ● Pallets ● Dustbin ● Glue	● Juices ● Water ● Cleaning detergents ● Chalks ● Pens ● Packaging materials ● Labels ● Cartons

Indicative content 3.1: Cooling of Nectar and Squash

Duration: 3 hrs

Practical Activity 3.1.1: Cool nectar and squash

Task:

You are requested to go to the food processing workshop to cool nectar and squash production to the temperature of packing.

1: Apply safety precautions.

2: Cooling nectar and squash

3: Present your work to the trainer and whole class. Ask clarification where necessary

4: Read key reading 3.1.1.

5: Perform the task provided in application of learning 3.1

Key readings 3.2.1.: Cool nectar and squash

- Procedures for Cooling Nectar and Squash Before Packaging

  Cooling nectar and squash before packaging is a critical step to ensure product quality, safety, and shelf life. Here's a general procedure:

  - ✓ **Pre-Cooling**
    - ✓ Purpose: To reduce the initial temperature of the product before entering the main cooling system.
    - ✓ Methods:
      - Spray cooling: The product is sprayed with cold water to rapidly reduce temperature.
      - Immersion cooling: The product is placed in a cold water bath for a short period.
  - ✓ **Main Cooling**
    - ✓ Purpose: To achieve the desired product temperature.
    - ✓ Methods:
      - Plate heat exchanger: The product flows through channels, exchanging heat with a cold fluid on the other side of the plates.
      - Tube-in-shell heat exchanger: The product flows through tubes surrounded by a cooling medium.
      - Indirect cooling systems: The product is cooled without direct contact with the cooling medium.
  - ✓ **Temperature Monitoring**

- ✓ Purpose: To ensure the product reaches and maintains the desired temperature.
- ✓ Methods:
  - Use temperature sensors at various points in the cooling process.
  - Continuously monitor and record temperature data.

✓ **Holding**

- ✓ Purpose: To allow the product to stabilize at the target temperature before packaging.
- ✓ Methods:

Hold the product in insulated tanks or holding areas.

✓ **Packaging**

- ✓ Purpose: To transfer the cooled product into packaging containers.
- ✓ Methods:
  - Aseptic filling: The product is filled into sterilized containers in a sterile environment.
  - Hot fill: The product is filled at high temperatures and then cooled rapidly.

Points to Remember

- By effectively cooling nectar and squash, producers can ensure the safety, quality, and freshness of their products.

Application of learning 3.1.

After learning the indicative content 3.1, you are requested to visit your school's workshop of nectar and squash production to cool nectar and squash to the temperature of packing.

Indicative content 3.2: Checking the quality of Nectar and Squash

Duration: 3 hrs

Practical Activity 3.2.1: Testing of quality parameter of nectar and squash

Task:

You are requested to go to the food processing workshop to test organoleptic and chemical parameters for nectar and squash production.

1: Apply safety precautions.

2: Test the organoleptic and chemical quality parameter for nectar and squash production

3: Present your work to the trainer and whole class. Ask clarification where necessary

4: Read **key reading 3.2.1.**

5: Perform the task provided in **application of learning 3.2**

Key readings 3.2.1: Testing of quality parameter of nectar and squash

- **Identification of quality parameters of nectar and squash**
  - ✓ **Testing of organoleptic parameters**

    An organoleptic test is a sensory evaluation conducted to assess the qualities of a product using human senses, particularly taste, smell, appearance, texture, and sometimes sound. These tests are subjective and rely on the perceptions and preferences of individuals. Organoleptic testing is commonly used in the food and beverage industry to evaluate the sensory characteristics of products. Here are the key aspects of organoleptic testing:

    1. **Taste:**
       - **Flavor:** Evaluators assess the overall taste profile of the product, including sweetness, saltiness, bitterness, sourness, and umami.
       - **Aftertaste:** The lingering taste or aftertaste is considered, including any undesirable flavors.
    2. **Smell (Aroma or Olfactory Perception):**

- **Intensity:** The strength of the aroma is evaluated.
- **Quality:** Descriptors are used to identify specific scents and aromas present in the product.

3. **Appearance:**

- **Color:** Evaluators consider the color of the product, looking for consistency with expectations.
- **Clarity:** For liquids, clarity or cloudiness may be assessed.
- **Texture:** Visual assessment of the product's texture, whether it is smooth, chunky, etc.

4. **Texture:**

- **Mouthfeel:** Evaluators assess how the product feels in the mouth, including factors like creaminess, grittiness, or thickness.
- **Consistency:** The overall texture and uniformity of the product are considered.

5. **Overall Acceptability:**

- **Preference:** Testers may express their overall preference for the product.
- **Likelihood to Purchase:** In a commercial context, evaluators might indicate whether they would buy the product.

✓ **Testing of chemical parameters**

Chemical parameters are crucial in determining the quality, safety, and nutritional value of nectar and squash.

Testing chemical parameter

- Total soluble solids content (Brix): The soluble solids are primarily sugars; sucrose, fructose, and glucose. Most Nectar juice has a brix level range from 10% to 12% in rarely 14% And for concentrated juice has a brix level more than 55%. Mostly it ranges from 55.3-58.9%.

Determination of sugar/acid ratio

It is **the sugar/acid ratio** which contributes towards giving many fruits their characteristic flavor and so is an indicator of commercial and organoleptic ripeness. At the beginning of the ripening process the sugar/acid ratio is low, because of low sugar content and high fruit acid content, this makes the fruit taste sour. During the ripening process the fruit acids are degraded, the sugar content increases and the sugar/acid ratio achieves a higher value. Overripe fruits have very low levels of fruit acid and therefore lack characteristic flavor.

Titration is a chemical process used in ascertaining the amount of constituent substance in a sample, e.g. acids, by using a standard counter-active reagent, e.g. an alkali (NaOH). Once the acid level in a sample has been determined it can be used to find the ratio of sugar to acid.

There are two methods specified for the determination of the titratable acidity of fruits:

- Method using a colored indicator;
- Potentiometric method, using a pH meter, which should be used for very coloured juices.

The °Brix value of the fruit concerned must also be obtained before calculation of the sugar/acid ratio is possible. The calculations for determining the sugar/acid ratios of all produce are the same, but as some products contain different acids the appropriate multiplication factor must be applied to each calculation. Some products may contain more than one type of acid; it is the primary acid that is tested.

The sugar acid ratio = $\frac{^0\text{Brix value}}{\%\ \text{acid}}$

- To determine the sugar / acid ratio you need to divide the sugar concentration (°Brix) by the citric acid concentration.

  Examples Calculation

  Sugar concentration = 15.2°Brix

  Citric Acid concentration = 1.55 g per 100mL

  $\frac{\text{Sugar concentration (°Brix)}}{\text{Citric acid concentration}}$ = X: 1 sugar/acid ratio

  Sugar/acid ratio = $\frac{15.2}{1.55}$

  Sugar/acid ratio = 9.8:1

- Acidity (pH): pH is a measure of the acidity or basicity of juices.

  in general, PH of different types of juices range from (+-2) 3.0 – 4.0 due to tartaric acids, malic acids and small amount of citric acids. These acids appear to inhibit the growth of many undesirable bacteria.

- **Procedures for Testing Organoleptic and Chemical Parameters of Nectar and Squash**

  ✓ **Organoleptic Evaluation**

  Organoleptic evaluation assesses the sensory properties of a product using human senses. For nectar and squash, it primarily involves taste, aroma, appearance, and texture.

  Procedures:

  1. **Sensory Panel Selection:** Recruit a trained sensory panel or consumers for evaluation.
  2. **Sample Preparation:** Prepare samples under standardized conditions, ensuring consistency in temperature, volume, and presentation.
  3. **Evaluation Environment:** Create a controlled environment free from distractions.

4. **Sensory Attributes:** Develop a sensory evaluation form to assess specific attributes like sweetness, acidity, flavor intensity, aroma, color, clarity, viscosity, and overall acceptability.
5. **Rating Scales:** Use appropriate rating scales (hedonic, descriptive, or category scales) to record panelists' responses.
6. **Statistical Analysis:** Analyze the sensory data to identify significant differences between samples and determine consumer preferences.

✓ **Chemical Analysis**

Chemical analysis involves laboratory techniques to determine the composition of nectar and squash.

Procedures:

1. **Sample Preparation:** Prepare samples for analysis by filtering, homogenizing, or diluting as required.
2. **Total Soluble Solids (TSS):** Use a refractometer to measure the refractive index, which correlates to TSS.
3. **Acidity (Titratable Acidity):** Titrate a sample with a standard alkali solution to determine acid content.
4. **pH:** Use a pH meter to measure the hydrogen ion concentration.
5. **Preservatives:** Employ chromatographic or spectrophotometric methods to quantify preservatives.

- **Procedure of measuring pH**

Juice is normally acidic food which means that its pH should be below 4.6 and this delays the deteriorative effect by microorganism.

pH is the measure of H+ activity, it measures active acid. PH may be determined by measuring electrode potential between glass and reference electrode; pH meter is standardized using pH buffer.

Acidity

Citric acid, and small amounts of malic and tartaric acid, give citrus its tartness and unique taste. The levels of acid are at the highest concentrations early in the season and they decrease as the fruit mature.

The amount of acid present in the juice is reported as percent citric acid. To calculate this value, we use a titration with sodium hydroxide.

Materials

- 50 mL burette
- Burette stand and clamp
- 10 mL pipette and pump
- 1 L volumetric flask
- 0.1 M sodium hydroxide (NaOH)
- 1% Phenolphthalein indicator

- 100 mL conical flask
- Pipette
- Distilled water
- Fresh Juice
- Gloves, safety glasses and lab coat (ensure all students are wearing)

Procedure of Titration

1. Pipette 10 mL of juice into a clean conical flask

2. Clean pipette immediately

3. Pipette 10 mL of distilled water into the conical flask containing the juice

4. Add six drops of phenolphthalein indicator to flask

5. Carefully swish mixture

6. Fill the burette with 0.1 M sodium hydroxide solution.

7. Open burette tap and allow a trickle of sodium hydroxide NaOH to run into a beaker. This is to ensure no air is in the burette prior to titration

8. Refill the burette, making sure that it reads zero at the top of the scale.

9. Hold the conical flask containing the juice mix under the burette and while swirling, slowly add the sodium hydroxide to the juice.

10. Keep adding sodium hydroxide to the flask while swirling until the solution just starts to change color to pink/purple.

This is the end point and you should now record how much sodium hydroxide you have added to the flask.

11. Calculate % of TTA according to the formulas:

Note: the end point of the titration may be very difficult to tell at the start until you get used to the procedure. If you look closely, you will see the juice mix slowly lighten in colour and then change to a green colour. This is the point just before the end of the titration and a few extra drops will see the solution change colour to pink. If you go past this point, and the solution becomes a deep purple/orange, you have gone too far

$$\%\mathbf{TTA}\ \left(\frac{\mathbf{g}}{\mathbf{l}}\right) = \frac{\mathbf{volume of\ NaOH}\ \times \mathbf{0.1N\ of\ NaOH} \times \mathbf{F} \times \mathbf{1000}}{\mathbf{sample\ volume(ml)}}$$

F: Multiplication factor

Multiplication Factors of principal's acid

Principal acid	Factor	Food sample
Citric acid	0.0064	Citrus fruit, Straw berries, Pineapples Passion fruits, Melon
Malic acid	0.0067	Apples, unripe fruits, apricot
Tartaric acid	0.0075	Grapes

Points to Remember

- Testing quality parameters is crucial to ensure the safety, purity, and overall quality of nectar and squash products.
- By conducting the tests, producers can ensure that their nectar and squash products meet the highest quality standards and are safe for consumption.

Application of learning 3.2.

After learning the indicative content 3.2, you are requested to visit your school's workshop of nectar and squash production to check organoleptic and chemical test of nectar and squash.

Indicative content 3.3: Selection of packaging materials

Duration: 2 hrs

Theoretical Activity 3.3.1: Description of packaging material types for nectar and squash

Tasks:

1: Answer the following questions related to the type of packaging materials used in nectar and squash production

Why do you use the packaging material for nectar and squash? Describe the packaging materials.

2: Provide the answers to asked questions by writing them on papers, flip chart, Blackboard or white board.

3: Present the findings/answers to the whole class.

4: For more clarification, read the **key readings 3.3.1**

Key readings 3.3.1.: Description of packaging material types for nectar and squash

- Packaging **materials**
  Are those materials which are used to keep product after processing in order to protect it from any damage, contamination, spoilage, pest attacks and tempering during transport, storage and retail sale.
- Types of packaging materials for nectar and squash
  - ✓ **Glass Bottles**
    Glass bottles provide excellent protection to perfect gas and aroma barriers. Insufficient tightness around the metal closure is a potential source of oxygen ingress, but can be minimized by various liner solutions. Shelf life is usually 12 months, or more, for fruit beverages in glass. They are commonly hot-filled, nevertheless a number of installations for cold aseptic filling. Oxygen should be minimized to limit oxidation at the high filling temperatures.
  - ✓ **Aseptic Carton**
    Aseptic cartons deliver juice in a shelf-stable form that requires no refrigeration. They are multilayer containers made of an inner layer of LDPE, an aluminium layer, paperboard and an outer layer of LDPE.
    The laminated cardboard carton, like the “drink-box”, is currently the most common package for fruit beverages.

Although features like openings and package shape matter extremely to consumers, differences in filling system and packaging material have a greater influence on product quality. Most shelf stable fruit beverages in cartons are filled aseptically at ambient temperature. Cartons typically permit shelf life of 12 months for juice beverages.

✓ **PET (Poly ethylene terephtharet) Bottles.**

To consumers, PET bottles offer several advantages compared to glass: they have lower

weight, unbreakable, and have an attractive, glossy appearance.

For producers of juices and drinks the picture is more complex. PET (polyethylene

terephthalate) provides a good aroma barrier and a relatively high oxygen barrier.

Nevertheless, it is not sufficient to protect quality of oxygen sensitive beverages, both in

terms of maintaining sensorial properties and nutritional content, during extended storage.

Furthermore, visual changes, such as browning or fading colours, become more apparent in

thin wall PET bottles than in glass bottles. To improve gas barriers for PET containers. Continued developments aim to refine the existing systems and to find more cost-effective solutions by applying burrier material with PET either ***mono_layer***when it is one or ***Multilayer*** when it is more than one. they are two types of barrier:

i) Active barrier:

These are oxygen scavengers that react with oxygen migration through the bottle wall.

ii) Passive barrier materials

These reduce oxygen permeation rate through bottle wall during the entire shelf life.

✓ **Others Plastics Bottles**

There are several alternative polymer materials to PET for bottles, such as bio-plastics, clarified polypropylene and polycarbonates. Their attractiveness depends on many factors, including consumer preferences and economics.

✓ **General Characteristics of a good packaging material for nectar and squash**

- It should protect the commodity from physical damage and hazard handling and
- Transportation
- It should protect the commodity from the microbiological damage and chemical
- Change

- It should be light weight, attractive, water resistant, temperature tolerant printable
- It should be nontoxic and non-reactive with the product
- It should retain the quality and quantity of the produce
- It should be transparent, low cost and temper proof
- It should be environment friendly and biodegradable
- It should not carry any unethical value
- It should have desired barrier properties (impermeability for individual gases and gas mixture)
- Closure of packaging should be heat sealable

Theoretical Activity 3.3.2: Description of labelling requirements for nectar and squash

Tasks:

1: Answer the following questions related to labelling requirements for nectar and squash production.

According to your experience, why do you use information on label? Describe that information.

2: Provide the answers to asked questions by writing them on papers, flip chart, Blackboard or white board.

3: Present the findings/answers to the whole class.

4: For more clarification, read the key readings 3.3.2

Key readings 3.3.2.: Description of labelling requirements for nectar and squash

- Labelling **key definitions**

  Labelling is defined as the process of attaching a descriptive word or phrase to product on its container, packaging, or the product itself.

  They are two types of labelling:

  - ✓ **Applied labelling:** it is type of labelling at which all information is pointed on the paper which is applied on the bottle
  - ✓ **Direct labelling:** it is type of labelling at which all information is printed on the package.

- Information presented on label are:

  - ✓ **Product name:** the product should be named for its identification
  - ✓ **Quantity of product / Net quantity:** the quantity of product to the label is very crucial as its even justifies its price

- ✓ **List of ingredients in descending order**
- ✓ **Company location/ producer location:** food processing company should be located such that anyone can know it. Its name should be in well-known to everybody
- ✓ **Shelf-life information:** including production date, expiration date or best before date
- ✓ **Company/ produce address:** company address plays a critical function as it is helpful in knowing company and getting different information about is that will attract many customers
- ✓ **Batch number:** it is a number given to food product by food processing company
  which helps in product traceability
- ✓ **Allergen's content (if any):** the food manufacturer has to clearly identify and explain the allergens content if they are present for helping clients to whom they are allergic.
- ✓ **Nutritional information:** this includes vitamin, minerals, carbohydrates, ….
- ✓ **Instruction of use:** instruction about the product utilization or usage is very important to achieve its effectiveness
- ✓ **Storage conditions:** identification of product storage conditions is very important
  to contribute to product quality and safety
- ✓ **Others**
  - Lot number or batch number, Bar code
  - Universal product card/barcode
  - Advertising: sealed for freshness, aroma etc
  - Direction for use
  - Nutritional information
  - Serving quantity

Points to Remember

- By carefully selecting packaging materials, producers can ensure the safety, quality, and appeal of their nectar and squash products.
- By ensuring that your nectar and squash products meet all labelling requirements, you can provide consumers with the necessary information and comply with food safety regulations.

Application of learning 3.3.

After learning the indicative content 3.3, you are requested to visit your school's workshop of nectar and squash production to label the packaging material of nectar and squash.

Indicative content 3.4: Packaging of nectar and squash

Duration: 2 hrs

Theoretical Activity 3.4.1: Description of packaging of nectar and squash

Tasks:

1: Answer the following questions related to packaging for nectar and squash production.

Why do you package nectar and squash? Describe the packaging of nectar and squash

2: Provide the answers to asked questions by writing them on papers, flip chart, Blackboard or white board.

3: Present the findings/answers to the whole class.

4: For more clarification, read the key readings 3.4.1

Key readings 3.4.1.: Description of packaging of nectar and squash

- **Purpose of packaging**

  Juice Packaging: is the enclosing of juice in packaging material to protect it from any damage, contamination, spoilage, pest attacks and tempering during transport, storage and retail sale. The package is often labelled with information such as net content, ingredients, Nutritional content, cooking or serving instruction if relevant and shelf life.

The following are several purpose of packaging processed products:

- ✓ **Physical protection:** the objects enclosed in the package may require protection from, among other things, mechanical shock, vibration, electrostatic discharge, compression, temperature, …
- ✓ **Information transmission:** Packages and labels communicate how to use, transport, recycle, or dispose of the package or product.
- ✓ **Marketing:** Packaging and labels can be used by marketers to encourage potential buyers to purchase a product.
- ✓ **Convenience:** Packages can have features that add convenience in distribution, handling, stacking, display, sale, opening, reclosing, using, dispensing, reusing, recycling, and ease of disposal.
- ✓ **Barrier protection:** A barrier to oxygen, water vapor, dust, etc, is often required.
- ✓ **Security:** Packaging can play an important role in reducing the security risks during shipment.

- **Characteristics of good packaging material for nectar and squash:**
  - ✓ **Barrier Properties:**
    - **Oxygen barrier:** Prevents oxidation, which can alter flavor and color.
    - **Moisture barrier:** Maintains product consistency and prevents spoilage.
    - **Light barrier:** Protects against UV light, which can degrade product quality.
  - ✓ **Chemical Inertness:**
    - Material should not react with the product, causing contamination or flavor changes.
    - No migration of chemicals from packaging to product.
  - ✓ **Sealability:**
    - Effective sealing to prevent leaks and contamination.
    - Good heat resistance for thermal sealing.
  - ✓ **Clarity:**
    - Transparent or translucent packaging to showcase the product.
    - Enhances visual appeal for consumers.
  - ✓ **Strength and Durability:**
    - Able to withstand handling and transportation without damage.
    - Protects the product from physical impacts.
  - ✓ **Flexibility:**
    - Easy to fill and seal.
    - Adaptable to different packaging shapes and sizes.
  - ✓ **Cost-Effective:**
    - Reasonable pricing to ensure profitability.
    - Balance between cost and performance.
  - ✓ **Sustainability:**
    - Environmentally friendly materials or recyclable options.
    - Aligns with consumer preferences and regulatory requirement

- **Types of packaging**

  Technics/types of packaging:

✓ **Primary technique** consists of packaging food product in primary or sales packaging material i.e. packaging conceived so as to constitute a sales unit to the final user. The packaging material is therefore, in direct contact with the product. It provides the initial and usually the major protective barrier. Examples of primary packages include metal cans, glass bottles and plastic pouches. It is frequently the only primary package which the consumer sees and purchases at retail outlets and use.

- ✓ **Secondary technique** consists of packaging food product in grouped packaging or secondary packaging, i.e. packaging conceived so as to constitute at the point of purchase a grouping of a certain number of sales units for instance a corrugated fibre, board case or shipping container, contains a number of primary packages. It is the physical distribution carrier and is sometimes so designed as it can be used in retail outlets for the display of primary packages.
- ✓ **Tertiary technique** involves the usage of transport packaging or tertiary packaging i.e. packaging conceived so as to facilitate handling and transport of a number of sales units. A tertiary package is made up of a number of secondary packages, the common example being a stretch-wrapped pallet of corrugated cases

Theoretical Activity 3.4.2: Description of Storage conditions for nectar and squash

Tasks:

1: In small groups, you are requested to answer the following questions related to storage conditions of nectar and squash.

What are the storage conditions of nectar and squash?

2: Provide the answers to asked questions by writing them on papers, flip chart, Blackboard or white board.

3: Present the findings/answers to the whole class.

4: For more clarification, read the key readings 3.4.2

Key readings 3.4.2.: Description of Storage conditions for nectar and squash

- **Storage conditions for nectar and squash**

  The storage conditions for nectar and squash depend on whether they are homemade or commercially produced, as well as their specific ingredients. Here are general guidelines for storing both homemade and commercially produced nectar and squash:

  Homemade nectar and squash

  1. Refrigeration:
     - Once prepared, store homemade nectar and squash in the refrigerator.
     - Use a clean, airtight container to prevent contamination.
  2. Shelf Life:

- Consume homemade nectar and squash within a few days to a week for optimal freshness.
- Check for any signs of spoilage, such as an off smell or mould.

Commercially Produced Nectar and Squash:

1. Follow Label Instructions:
   - Always follow the storage instructions provided on the product's label.
   - Some commercially produced nectar and squash may require refrigeration after opening.
2. Refrigeration After Opening:
   - If the label instructs refrigeration after opening, store the product in the refrigerator.
   - Use a sealed container if the original packaging is not resealable.
3. Room Temperature Storage (Unopened):
   - Some commercially produced nectar and squash may be stored at room temperature before opening.
   - Keep them in a cool, dry place away from direct sunlight.
4. Check Expiry Date:
   - Pay attention to the expiration or "best by" date on the packaging.
   - Consume the product before the indicated date for optimal quality.
5. Avoid Contamination:
   - Use clean utensils to scoop out the nectar or squash to prevent contamination.
   - Reseal the packaging tightly to maintain freshness.
6. Shelf Stability:
   - Some commercial products are designed for shelf stability even after opening. Follow the manufacturer's guidelines.
7. Temperature Considerations:
   - Avoid exposing nectar and squash to extreme temperatures, as this can affect their quality.

Always refer to the specific storage instructions provided by the manufacturer for the particular brand and type of nectar or squash you have. These guidelines can vary based on the ingredients and preservatives used in the product. Additionally, if you notice any changes in colour, odour, or texture, it's advisable to discard the product to ensure food safety.

Practical Activity 3.4.3: Storage nectar and squash

Task:

Referring to previous theoretical activities (3.4.2.), you are requested to go to the food processing workshop to monitor storage conditions for nectar and squash production.

1: Apply safety precautions.
2: Store nectar and squash
3: Present your work to the trainer and whole class. Ask clarification where necessary
4: Read key reading 3.4.3.
5: Perform the task provided in application of learning 3.4

Key readings 3.4.3.: Storage nectar and squash

- **Monitoring storage conditions for nectar and squash**

  Monitoring the storage conditions for nectar and squash is essential to ensure their quality, safety, and compliance with any specific storage instructions provided by the manufacturer. Here are some general guidelines for monitoring storage conditions:

  ✓ **Temperature:**

  1. **Refrigeration**: If the nectar or squash requires refrigeration, use a refrigerator thermometer to ensure the temperature stays within the recommended range (usually 32-40°F or 0-4°C).

  2. **Room Temperature**: For products stored at room temperature, keep them in a cool, dry place away from heat sources and direct sunlight. Use a thermometer to monitor the ambient temperature.

  ✓ **Storage Containers:**

  1. **Airtight Containers:** Ensure that homemade nectar and squash are stored in clean, airtight containers to prevent contamination and maintain freshness.

  2. Resealable Packaging: If using commercially produced nectar or squash, make sure to reseal the packaging tightly after each use.

  ✓ **Expiry Dates:**

  1. **Check Expiry Dates:** Regularly inspect the expiration or "best by" date on the packaging. Discard any product that has passed its recommended shelf life.

  ✓ **Visual Inspection:**

  1. Appearance: Check for any changes in colour, consistency, or separation in the product. Unusual changes may indicate spoilage.

2. Mould or Unpleasant Odours: Inspect for the presence of mould or any off-putting odours. If detected, discard the product immediately.

- ✓ **Hygiene:**

1. Clean Utensils: Use clean utensils when handling nectar and squash to prevent introducing contaminants.

- ✓ **Follow Manufacturer Instructions:**

1. Read Labels: Follow any storage instructions provided on the product's label. Manufacturers often provide specific guidelines to maintain product quality.

2. Refrigeration After Opening: If the product requires refrigeration after opening, adhere to those instructions.

3. **Shelf Stability:** Understand whether the product is designed for shelf stability even after opening. Some products may remain stable at room temperature for a certain period.

- ✓ **Record Keeping:**

1. Date Labelling: If preparing homemade nectar or squash, label containers with the date of preparation to help track freshness.

By actively monitoring these factors, you can ensure that nectar and squash remain safe for consumption and retain their intended quality. Always prioritize food safety, and when in doubt, it's better to err on the side of caution and discard products that show signs of spoilage or have exceeded their recommended storage period.

Theoretical Activity 3.4.4. Description of food storage guidelines

Tasks:

1: You are requested to answer the following questions related to the storage guideline of food for nectar and squash.

What are the food storage guidelines of nectar and squash?

2: Provide the answers to asked questions by writing them on papers, flip chart, Blackboard or white board.

3: Present the findings/answers to the whole class.

4: For more clarification, read the key readings 3.4.4

Key readings 3.4.4.: Description of food storage guidelines

- **Food storage guidelines**

  Storing nectar and squash properly is essential to maintain their quality, flavor, and safety. Here are some general guidelines for storing nectar and squash:

  ✓ **Nectar Storage**

  1. Refrigeration: Once opened, it's advisable to store nectar in the refrigerator. Check the label for specific instructions, but generally, refrigerate opened nectar to prevent spoilage.

  2. Sealing: Ensure the container is tightly sealed to prevent air and contaminants from affecting the nectar's quality. Transfer any leftover nectar from a can or bottle into a sealable container.

  3. **Use-by Date:** Always check the expiration or "use-by" date on the nectar packaging. Consume it before the date to ensure freshness and quality.

  4. Avoid Sunlight: Keep nectar away from direct sunlight, as exposure to light can degrade the quality of the product over time.

  ✓ **Squash Storage:**

  1. Cool and Dark Place: Store squash in a cool, dark place, such as a pantry or cupboard. Avoid exposure to direct sunlight, as this can cause the squash to deteriorate.

  2. Dry Environment: Squash should be stored in a dry environment to prevent mold growth. Moisture can lead to decay and spoilage.

  3.Ventilation: Ensure good ventilation around the squash. Avoid placing them in airtight containers, as they need some airflow to prevent moisture buildup.

  4. Check for Damage: Inspect the squash regularly for any signs of damage or rot. Remove any damaged pieces promptly to prevent the spread of spoilage.

  5. Separation: Store squash away from fruits and vegetables that produce ethylene gas, as this can accelerate the ripening and deterioration of squash.

  Remember that specific storage instructions may vary depending on the type of nectar or squash and whether they are fresh or prepared. Always refer to the product's label for any specific storage recommendations provided by the manufacturer. Additionally, once opened, it's generally best to consume both nectar and squash within a specified timeframe to ensure optimal quality.

Practical Activity 3.4.5. Application of food storage guidelines

Task:

Referring to previous theoretical activities (3.4.4.), you are requested to go to the food processing workshop to apply the guideline for nectar and squash production.

1: Apply safety precautions.

3: Package and store nectar and squash

5: Present your work to the trainer and whole class. Ask clarification where necessary

6: Read **key reading 3.4.5.**

7: Perform the task provided in **application of learning 3.4**

Key readings 3.4.5.: Application of food storage guidelines

Food storage guidelines are crucial for maintaining the quality, safety, and shelf life of various food items. Proper application of these guidelines helps prevent spoilage, preserve nutritional content, and reduce the risk of foodborne illnesses. Here are some key applications of food storage guidelines:

1. Preventing Food Spoilage: Following temperature recommendations for refrigeration and freezing helps slow down the growth of bacteria and other microorganisms, extending the shelf life of perishable foods.

2. Ensuring Food Safety: Proper storage helps prevent the growth of pathogens that can cause foodborne illnesses. Storing food at recommended temperatures and avoiding cross-contamination are essential for food safety.

3. Maintaining Nutritional Value: Appropriate storage conditions, such as avoiding exposure to light and air, help preserve the nutritional content of foods. This is particularly important for items like fruits, vegetables, and certain vitamins that can degrade with exposure to oxygen and light.

4. Minimizing Food Waste: By storing food properly, you can reduce the likelihood of spoilage and extend the usability of various items. This helps minimize food waste, saving money and resources.

5. **Preserving Flavour and Texture:** Proper storage helps maintain the flavour, texture, and overall quality of food. For example, storing dry goods in airtight containers prevents them from becoming stale or absorbing odours from other items.

6. Adhering to Use-By Dates: Following use-by or expiration dates provided by

manufacturers ensures that you consume products within their recommended timeframe, reducing the risk of consuming spoiled or unsafe food.

7. Organizing Food Storage Spaces: Proper organization of storage spaces, such as refrigerators, freezers, and pantry shelves, facilitates efficient use of ingredients. It also makes it easier to see what items are available and helps prevent food from getting lost or overlooked.

8. Minimizing Cross-Contamination: Storing raw meats separately from ready-to-eat foods and using designated containers for different food types helps prevent cross-contamination, reducing the risk of foodborne pathogens spreading

9. Following Specific Product Instructions: Different foods may have specific storage requirements based on their nature and packaging. Following the instructions on the product labels helps ensure optimal storage conditions.

10. Rotating Stock: Practicing the first-in, first-out (FIFO) method ensures that older food items are used first, reducing the likelihood of items expiring before they are consumed.

By understanding and applying food storage guidelines, individuals can promote food safety, minimize waste, and enjoy food at its best quality throughout its shelf life.

Points to Remember

- By carefully selecting packaging materials and designing effective packaging, producers can enhance the appeal, safety, and shelf life of their nectar and squash products.
- By following the storage guidelines, you can help maintain the quality and safety of nectar and squash products.
- Proper food storage is essential to maintain food safety, quality, and freshness.
- By following food storage guidelines, you can help to prevent foodborne illnesses and ensure that your food remains safe and enjoyable.

Application of learning 3.4.

After learning the indicative content 3.4, you are requested to visit your school's workshop of nectar and squash production to package and store nectar and squash.

Learning outcome 3 end assessment

Theoretical assessment

Q1. Read carefully the statement below and answer **True** if the statement is correct or **False** if the statement is wrong.

a. Storage conditions of juice are direct to sun light, room temperature and Dry Place.
b. The shelf life of a juice represents the period in which the product remains in good sensory and microbiological for consumption, without harming the taste or health.
c. During juice storage, acidity decrease as well as an increase in sugars in juice.
d. The organic acids undergo degradation during storage which might be due to conversion of acids into sugar and salt.
e. Glass bottles are the only packaging material that provides perfect gas and aroma barriers.
f. Aseptic cartons are primarily made of plastic.
g. PET bottles offer excellent protection against oxygen for all types of beverages.
h. Active barriers react with oxygen to prevent its penetration into the packaging.
i. Bio-plastics are a sustainable alternative to traditional plastic packaging.
j. Packaging materials should be heavy to protect the product effectively.
k. It is essential for packaging materials to be compatible with the product to prevent chemical reactions.
l. All packaging materials are biodegradable.
m. The closure of a package should not affect its overall performance.
n. Packaging materials should be visually appealing to consumers.

Q2. Choose correct answer for the cooling stages with their primary purposes.

a. Pre-Cooling
    i. To transfer the cooled product into packaging containers.
    ii. To reduce the initial temperature of the product
    iii. To ensure the product reaches and maintains the desired temperature.
    iv. To allow the product to stabilize at the target temperature.
b. Main Cooling
    i. To transfer the cooled product into packaging containers.
    ii. To reduce the initial temperature of the product.
    iii. To ensure the product reaches and maintains the desired temperature.
    iv. To allow the product to stabilize at the target temperature.
c. Temperature Monitoring
    i. To transfer the cooled product into packaging containers.
    ii. To reduce the initial temperature of the product.
    iii. To ensure the product reaches and maintains the desired temperature.
    iv. -To allow the product to stabilize at the target temperature.

d. Holding
    i. To transfer the cooled product into packaging containers.
    ii. To reduce the initial temperature of the product.
    iii. To ensure the product reaches and maintains the desired temperature.
    iv. To allow the product to stabilize at the target temperature.
e. Packaging
    i. To transfer the cooled product into packaging containers.
    ii. To reduce the initial temperature of the product.
    iii. To ensure the product reaches and maintains the desired temperature.
    iv. To allow the product to stabilize at the target temperature.

Q3. Give any two purposes of cooling the nectar and Squash?

Q4. Choose the quality parameters of nectar and squash in the following statement:

(a) Low fruit moisture content,
(b) A thicker texture
(c) A sweeter taste
(d) Presence of fruit seeds

Q5. Use the following terms to fill in the following statements:

(Organoleptic, sensory, appearance, aroma, taste, texture, chemical, total soluble solids, acidity, pH, preservatives, titration, sodium hydroxide, phenolphthalein, citric acid, malic acid, tartaric acid)

a) _____ evaluation assesses the _____ properties of a product using human senses, including _____ , _____ , _____ , and _____ .
b) _____ analysis involves laboratory techniques to determine the _____ composition of a product.
c) _____ is a measure of the _____ ion concentration in a solution.
d) _____ is a common method used to determine the _____ of a juice sample.
e) The primary acids found in citrus fruits are _____ , _____ , and _____ .
f) _____ is used as an indicator in the _____ of a juice sample to determine its acidity.
g) _____ is the main reagent used in the titration of juice to determine acidity.

Practical assessment

BINGO ltd is company producing nectar and squash, located in GASABO district. It has technical issue which is related to low skills of cooling, testing and packaging nectar and squash in good condition. The above issues cause losses in the plant. You are requested to solve above problems as food processing assistant technician within 2 hours. All necessary tools, equipment and materials are available in the workshop.

END

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