RWANDA POLYTECHNIC

TVET LEVEL II

AGRICULTURE

Fruits and Vegetables

TRAINEE MANUAL

RWANDA POLYTECHNIC

Approved by: Workforce Development Authority

USAID FROM THE AMERICAN PEOPLE

EDC Education Development Center

2020

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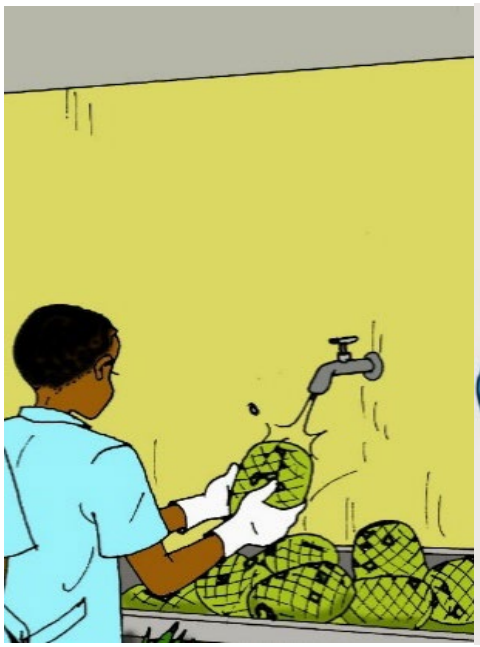
FRUIT AND VEGETABLE PROCESSING

Unit 1: Receiving fruits and vegetables

Unit 2: Processing fruits and vegetables

Unit 1: Receiving fruits and vegetables



Topics

1.1 Preparation of workplace and equipment

1.2 Reception of fruits and vegetables

1.3 Preparation of fruits and vegetables

Unit Summary

This unit will provide learners with the proper practices for cleaning and sanitizing the workplace and for preparing fruits and vegetables for processing in a safe environment.

Self-Assessment: Unit 1

1. Look at the unit illustration. What do you see? What do you think this unit will be about? What topics might be covered?

2. Fill in the self-assessment below.

There is no right or wrong way to answer this assessment. It is for your own use during this course. The trainer will read a skill that is listed in the left column. Think about yourself: Do you think you can do this? How well? Read the statements across the top. Put a check in column that best represents your situation. At the end of this unit, we'll take this survey again.

My experience Knowledge, skills, and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Identify sources of contaminants in fruit and vegetable processing					
List cleaning and sanitizing substances and techniques for fruits and vegetables					
Describe how to dispose of solid wastes and used cleaning and sanitizing substances					
Prevent equipment and raw materials from contamination					
Treat solid wastes and water from cleaned and sanitized workplace					
Evaluate the physical and chemical quality of fruits and vegetables for processing					

My experience Knowledge, skills, and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Sort and grade fruits and vegetables for processing					
List detergents and sanitizers for fruits and vegetables					
Store fruits and vegetables					

Topic 1.1: Preparation of workplace and equipment

Key Competencies:

Knowledge	Skills	Attitudes
1. Identify source of contaminants	**1.** Prevent equipment and raw materials from contamination	**1.** Show active concern for the health of others
2. List cleaning and sanitizing substances and techniques	**2.** Use detergents and sanitizers	**2.** Use equipment safely and responsibly
3. Describe how to dispose of used cleaning and sanitizing substances	**3.** Treat water from cleaned and sanitized workplace	**3.** Be devoted to protecting the environment

Getting Started: What do we know and where are we going?

Topic 1.1 Task 1:

1. Reflect on and discuss the following questions with a partner:

a. What materials or tools are used in your kitchen at home? Who washes these materials and how?

b. Where do you or your family dispose of liquids and solid waste from the kitchen?

c. How might fruits and vegetables get contaminated?

d. Have any of you ever experienced food poisoning (vomiting, diarrhoea from eating contaminated food)? If so, how do you think what you ate may have become contaminated?

Problem Solving Activity

Topic 1.1 Task 2:

1. Complete the task and discuss the questions in your group. Use the information in **1.1 and 1.2 Key Facts** to guide you.

a. Sketch out (draw) a simple layout for a food processing factory.

b. Give examples of places to clean in a food processing plant.

c. Describe how a workplace can get contaminated.

d. Suggest preventative measures to control contamination.

e. How frequently should you clean the following equipment?
- Boiling pans/ pasteurizers
- Bottle coolers
- Bottle washers
- Bottle brushes
- Corers
- Cutting boards
- Deep fat fryers
- Dicers
- Energy saving charcoal stoves

f. How can you dispose of the solid wastes and water from cleaned and sanitized workplaces?

g. What is the four step process that removes waste and other contaminants?

2. After the discussions, share your group's responses with the rest of the class. Be sure to ask questions to other groups and add any addition information you have.

3. Review **1.1 and 1.2 Key Facts** together for clarification.

1.1 Key Facts

- Common sources of microorganism contamination:
  Soil, dust, animal feed, plant surfaces, sewage, and food utensils.

- Simple layout for a food processing factory:
  - Storage room for fresh produce
  - Processing room
  - Storage room for processed produce and equipment
  - Quality testing room
  - Reception area
  - Waste treatment area
  - Office

- Frequency of cleaning and use of detergents and sanitizers:
  - DAILY: For boiling pans, pasteurizers, corers, cutting boards, dicers, charcoal stove ashes
  - WEEKLY: For bottle coolers and bottle washers
  - MONTHLY: For deep fat fryers

- Materials in contact with foods must be sanitized after use with detergent and clean water. [1]
  - Sanitizers all work best at the correct dilution. If they are too weak, they do not work effectively.
  - Sanitizing solution can be made up as needed and put into labelled spray bottles for use on bench tops, fridges, door handles and other surfaces. Ethanol 70% can be used. For effective use of a sanitizer, follow the manufacturer's instructions provided on the label.

- The 4-step process that removes food waste, dirt, grease and destroys food-borne diseases causing contamination:[2]
  - **Step 1** – **Preparation**
    - Remove loose dirt and food particles. Rinse with warm, potable water.
  - **Step 2** – **Cleaning**
    - Wash with hot water (60 °C) and detergent. Rinse with clean potable water.
  - **Step 3** – **Sanitizing (bacteria killing stage)**
    - Treat with very hot, clean, potable water (75 °C) for at least 2 minutes.
    - Apply sanitizer as directed on the label.
  - **Step 4** – **Air drying**
    - Leave benches, counters and equipment to air dry. The most hygienic way to dry equipment is in a draining rack.

[1] Department of Health. (2020, July 14). *Cleaning and sanitising food premises and food equipment*. WA Health, Government of Western Australia. https://ww2.health.wa.gov.au/Articles/A_E/Cleaning-and-sanitising-food-premises-and-food-equipment

[2] Department of Health. (2020, July 14). *Cleaning and sanitising food premises and food equipment*. WA Health, Government of Western Australia. https://ww2.health.wa.gov.au/Articles/A_E/Cleaning-and-sanitising-food-premises-and-food-equipment

Guided Practice Activity

Topic 1.1 Task 3:

1. In your groups from the previous activity, work together to complete the following tasks:

a. On the board or a piece of paper, draw a pathway showing a contaminated workplace.

b. Identify different contaminants in your classroom.

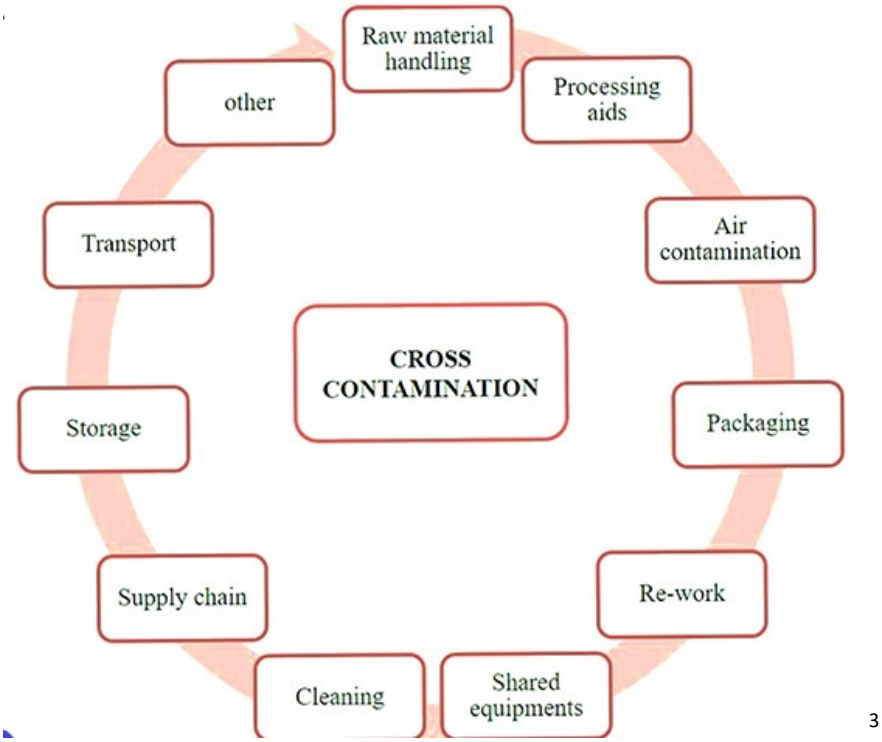
c. Identify detergents and sanitizers at your disposal and propose techniques you can use to clean and sanitize the workplace.

d. Identify locations where you can dispose of solid wastes and water from a cleaned and sanitized workplace.

2. After discussing, share and compare your ideas with the rest of the class. Supplement your responses with the information from **1.1 and 1.2 Key Facts**.

1.2 Key Facts

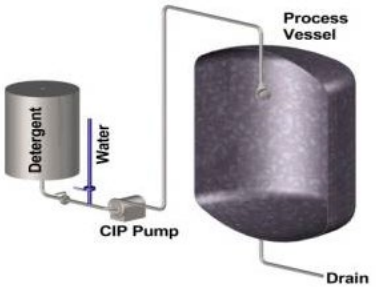
- General knowledge of cross contamination includes:



[3]

- Know the source of biological, chemical and physical contaminants:
  - Biological (ex: insects, pests)
  - Chemical (ex: some chemicals)
  - Physical (ex: dust, animal droppings, hair, glass, metal, dirt, and dead nails)

- Know how to perform mechanical and manual cleaning, cleaning in/out of place, thermal and chemical sanitization:
  - Mechanical Cleaning, often referred to as “Clean- in-Place” (CIP), requires no disassembly or only partial disassembly.
    - Example of a CIP system:

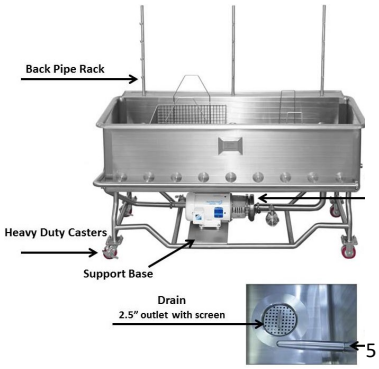


[4]

[3] ResearchGate. (n.d.). *The sources of chemical contaminants in food and their health implications* [Scientific figure]. https://www.researchgate.net/figure/Food-contamination-A-Contamination-in-the-food-production-and-processing-B_fig1_321141037

[4] Lenntech. (n.d.). *Single pass Cleaning-in-Place system* [Graphic]. https://www.lenntech.com/images/disinf2.jpg

- "Clean-out-of-Place" (COP): Can be partially disassembled and cleaned in specialized COP pressure tanks.
    - Example of a COP system:



[5]

- Manual Cleaning requires total disassembly for cleaning and inspection.
- Thermal Sanitization involves the use of hot water or steam for a specified temperature and contact time.
- Chemical Sanitization involves the use of an approved chemical sanitizer at a specified concentration and contact time.

Application Activity

Topic 1.1 Task 4:

1. Read the following story as a class:

A trainee who fumigated on his farm the previous day came in wearing the dirty pullover he had on that day. The pullover had some pesticide residue on it. He left his pullover on the table in the classroom and went to greet his classmates. One of his classmates deposited his apple on the same table and later took it to eat. Was there any contamination? If yes, how did the contamination start and spread?

2. Discuss the following questions with a partner:
- **a.** Was there any contamination?
- **b.** If yes, how did the contamination start and spread?

[5] Anco Equipment. (n.d.). *Clean in Place Tank* [Graphic]. Pulaski Industrial Coatings. http://www.pulaskiindustrialcoatings.com/uploads/3/4/6/6/34662113/7175432.jpg?362

3. Consider the different biological, chemical and physical contaminants on walls, windows, doors, cutting tables, knives, pots, basins, crates, sacks and water, pineapples, tomatoes, and amaranths.

4. Visit a fruit and vegetable processing workplace. Write a simple report on different cleaning and sanitizing techniques (manual, foam, machine washing, spray, fogging, cleaning in place) and substances (detergent, sanitizer and disinfectant) you have seen in the fruit and vegetable processing company you have visited.

1.3 Key Facts

Sources of Contamination and Tips for Decontamination:[6]

- Cleaning agents: Proper storing of cleaning chemicals is essential. Never keep food stored in the same place as your cleaning chemicals, and always use cleaning products designed especially for food use.
- Unwashed fruits and vegetables: The pesticides and fungicides often used on fruits and vegetables to help them grow free from diseases are harmful if consumed. This is why it is vital to properly wash all fruits and vegetables before eating them.
- Food containers made from non-safe plastics: Single-use items - such as plastic containers - are not designed to be reused again and again. Always store food in containers that are specially designed to safely be reused.
- Pest control products: Items like fly spray and rat poison are extremely hazardous if consumed. Always store these products away from food items.
- Chemicals used in equipment maintenance: Some machines and equipment with moving parts - such as slicers and mixers - may need regular oiling. Always use food-safe oil to help make sure this does not contaminate the food you use them to prepare.
- Hair: Always wear hair neatly tied back and use a hair net if possible.
- Glass or metal: This can occur when items are not maintained. Cracked or broken crockery and utensils should be thrown away, as well as any food that might have come into contact with it.
- Jewellery: Keep jewellery to a minimum when preparing and handling food
- Dirt: Because dirt is so small, it is easy not to notice that it is contaminating your food. It usually gets into the food from unwashed food and vegetables.
- Fingernails: Always keep nails short and clean to prevent contamination. Also, avoid wearing fake nails as these can fall off and may contaminate food.

[6] Australian Institute of Food Safety. (n.d.). *Food safety and the different types of food contamination*. https://www.foodsafety.com.au/blog/food-safety-and-the-different-types-of-food-contamination

- Clothing: Dirty clothes can transport bacteria from one place to another. If possible, clothing should be replaced when moving from one work area to another. You should also thoroughly wash your face and hands. This is especially important when working with allergens or high-risk foods.
- Utensils: Separate utensils should always be used to prepare different types of foods. For example, never use the same chopping board or knife to prepare raw meat and ready-to-eat foods.
- Personal hygiene: Coughing, sneezing or even touching your face and hair before handling food can also result in cross-contamination. Washing hands regularly when handling food is essential.
- Pests: Flies, cockroaches, mice and rats carry harmful bacteria, which they can transport from one place to another. Pest control is vitally important in the workplace when it comes to preventing cross-contamination.
- Raw food storage: One of the most common types of cross-contamination is when raw food comes into contact with cooked or ready-to-eat food. If this happens, it's a good idea to assume the raw food has been contaminated. Raw food should always be covered and stored below cooked foods to prevent this type of contamination.
- Waste control: Garbage should be stored and sealed correctly to prevent cross-contamination. It should always be stored away from other items in the workplace to ensure it never comes into contact with food preparation. Regular cleaning and sanitizing of waste bins should also be carried out to prevent the risk of pest infestation.

Points to Remember

- An area must be cleaned before it can be sanitized. You can't sanitize dirt. Only clean surfaces can be sanitized!
- Check the expiration date of the detergent, sanitizer and disinfectant.
- Detergent, sanitizer and disinfectant must not come in contact with, or be stored in, the same place as food.
- Wear Protective Person Equipment (PPE) when handling detergent, sanitizer and disinfectant.
- Workplace must be left clean before and after each activity.

Formative Assessment

1. Ask trainees to determine if the following statements are true or false:

a. Cleaning is done after sanitizing.

b. Using hot water is a sanitizing method.

2. Complete the following sentences by correctly using one of the following terms: a cleaning agent; a sanitizer; a detergent.

a. Water is …….

b. A soap is …….

c. Hot water is……

3. Take trainees into a fruit and vegetable processing workplace where there are wooden and stainless steel shelves, tables, wooden crates, scales, water, detergents. and sanitizers.

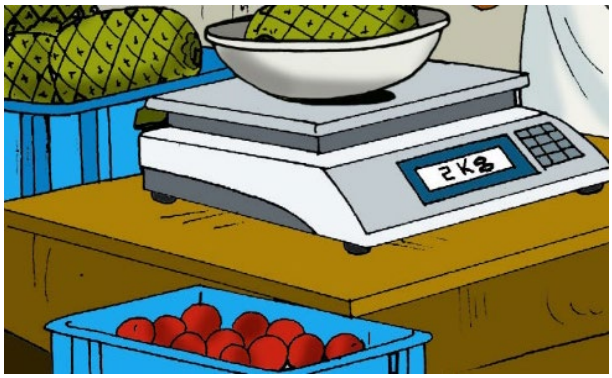
Ask them to:

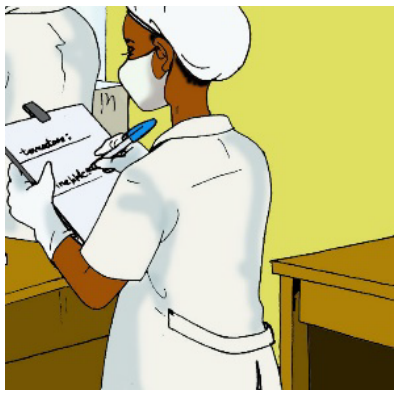
a. Describe how to use detergent and sanitize the workplace.

b. Write down where detergent and sanitizer have been used.

c. List commonly used detergents and sanitizers.

Topic 1.2: Reception of fruits and vegetables





Key Competencies:

Knowledge	Skills	Attitudes
1. List the physical and chemical qualities of fruits and vegetables	**1.** Evaluate the physical and chemical quality of fruits and vegetables	**1.** Detail-oriented
2. Describe the conditions leading to fruits and vegetables being refused for processing	**2.** Select fruits and vegetables without defects	**2.** Precise
3. Describe the levels of grading of fruits and vegetables	**3.** Sort and grade fruits and vegetables for processing	**3.** Responsible

Getting Started: What do we know and where are we going?

Topic 1.2 Task 1:

1. Discuss the following questions with a partner:
   a. How many times did you buy fruits and vegetables last month?

   b. Did you eat all fruits and vegetables bought at once, or did you keep some of them at home for another day?

2. After discussing, review the Key Competencies table together.

Problem Solving Activity

Topic 1.2 Task 2:

1. In small groups, discuss and note your answers to the following:
   a. What qualities should a factory producing jam, juice, sauce and paste consider when receiving fruits and vegetables?

   b. Brainstorm how the sugar content can be determined.

   c. Describe the conditions that can lead to the low payment, high payment, or refusal of fruits and vegetables for processing.

2. After discussing, share your group's responses with the rest of the class. As other groups present their work, be sure to ask questions and add any comments you might have.

3. After all groups have presented, closely read **1.4 Key Facts** and review the information as a class.

1.4 Key Facts

- Identifying the physical and chemical quality of fruits:
  - Physical quality: maturity, ripeness, size, weight, density
  - Chemical quality: sugar content, acidity

- **Manually**

- With small fruits or vegetables, use the whole fruit, cut a representative wedge from the stem end to the blossom end and to the centre of the fruit.
- Crush using a blender, mortar and pestle, or squeeze through cheesecloth.
- Remove pulp or seeds by filtering through a small piece of cheesecloth or filter paper.[7]

- **Refractometer**: an instrument used to measure sugar content

 [8]

- **When using a refractometer to measure sugar content, follow these steps**:[9]
  1. Open the plastic cover and make sure the glass prism is clean and not scratched.
  2. If not clean, put a few drops of distilled water on the glass, shake the water off, and touch the edge of the glass with a soft, clean cloth to wipe the remaining water off.
  3. Place a few drops of sample on the glass measuring surface using a plastic pipette or spoon.
  4. Replace cover. If trapped air exists, gently press down on the cover.
  5. Look through the eyepiece while holding the refractometer up to a natural light or incandescent light source. Adjust the focus by twisting the eyepiece.
  6. There is a scale inside showing the percentage of sugar.
  7. Read where the shadow boundary or contrast line (difference between blue and white areas) crosses the scale and record the % SSC or Brix value.
  8. Clean between each reading with distilled water, which should be 0% SSC at 20°C.

[7] UC Davis Postharvest Technology. (n.d.). *Fact sheet - How to use a refractometer*. Fruit & Vegetable Preservation Resources. https://www.fruitandvegetable.ucdavis.edu/files/237293.pdf
[8] *Portable Refractometer* [Photograph]. (n.d.). Wikimedia. https://upload.wikimedia.org/wikipedia/commons/7/7d/Portable-Refractometer-16.jpg
[9] UC Davis Postharvest Technology. (n.d.). *Fact sheet - How to use a refractometer*. Fruit & Vegetable Preservation Resources. https://www.fruitandvegetable.ucdavis.edu/files/237293.pdf

- **Calibration**:[10]
  - Calibrate to 0% SSC using distilled water at the beginning of use, and depending on how many samples are measured, periodically throughout the measurements.
  - Contrast line should cross the scale at zero. If not, the scale needs adjustment.
  - Refer to specific manufacturer instructions, but there is usually a calibration screw to adjust.

- **Checking maturity scale and defects of fruits and vegetables**:[11]
  - **Maturity**:
    - **Fruit colour**: fruit skin or flesh colour changes as the fruit matures or ripens. Use colour meters and colour charts where possible.
    - **Firmness**: Some fruits may change in texture during maturation. Textural changes are detected subjectively by touch or gentle squeezing. Objective measurement can be achieved using pressure testers.
    - **Soluble solids (sugar) content**: The sugar content is measured in terms of total soluble solids content using a brix hydrometer or refractometer.
    - **Number of days from fruit set**: In some fruits, the time taken between fruit set until the fruit starts showing signs of maturity has been recorded and this can be used to determine maturity.
    - **Specific gravity**: The specific gravity of fruit can be considered as an index for maturity grading.

  - **Defects**:
    - **Can be checked visually**: Abnormal colouring; broken specimens; bruises; crown damage; decay; disease; growth cracks; injury from mechanical mishandling or other sources: insect injury; seed stems; sunburn; sunken discoloured areas; trimming; water blisters; watery areas; translucent areas

Guided Practice Activity

Topic 1.2 Task 3:

1. In your same groups from the previous activity, discuss and note your answers to the following:

[10] UC Davis Postharvest Technology. (n.d.). *Fact sheet - How to use a refractometer*. Fruit & Vegetable Preservation Resources. https://www.fruitandvegetable.ucdavis.edu/files/237293.pdf

[11] Musa. (208, June 20). *Maturity, maturity indices, types and determination of maturity*. Agriculturalist Musa. https://agriculturistmusa.com/maturity-indices-types-and-determination/

a. Explain why it is important to check the sugar content of fruits and vegetables and how a refractometer helps to do that.

b. Explain what the "Brix" is and why knowing it is important.

2. After discussing, listen as the trainer explains how to find the Brix.

3. Observe the trainer as he/she demonstrates how to use a refractometer. Then, refer to **1.4 Key Facts** for written instructions for using a refractometer.

4. Using the materials provided by the trainer, perform the following tasks with your group:

a. Weigh the raw materials before sorting.

b. Check defects of pineapples, guava, tomatoes, and carrots.

c. Check sugar content/brix of pineapples, tomatoes, passion fruit and carrots.

d. Sort and grade pineapples and tomatoes according to colour, size and maturity.

5. Ask for assistance form the trainer as needed.

6. After all groups have finished, select a group representative to share your group's experiences with the rest of the class.

1.5 Key Facts

- Grading fruits and vegetables:
  - On the basis of colour/ripeness, the fruits are graded as too green or over-ripe.
  - Sizes can be graded as a small, medium, large, and extra-large, and immature, properly mature and over mature.

- Sorting produce:
  - Discard the very worst fruits and vegetables – those that are damaged, too small, and diseased.

- Using refractometer (see **Topic 1.2** and **1.4 Key Facts**).

- Finding Brix: A refractometer can measure the concentration of a liquid. "Light refracts," or bends, when it passes through solids like sugars or salts that are in liquids.

- The Brix scale assigns a value to the concentrations. Pure water has a Brix value of zero because there are no solids in it. Water with sugar bends, or refracts, light and the Brix scale shows it at a higher value.

- Finding sugar content: One-degree Brix is equal to 1 gram of sucrose in 100 grams of solution.[12]

Application Activity

Topic 1.2 Task 4:

1. Write a report on what you have seen in the factory focusing on:
   a. Sorting techniques
   b. Grading techniques

2. Using the materials provided by the trainer, work with your group to compare the sugar content/brix of:
   a. Immature pineapples with mature ones
   b. Red tomatoes with pink tomatoes
   c. Immature tree tomatoes with mature and over mature tree tomatoes

[12] Robinson, A. (n.d.). *How to calibrate a refractometer*. Sciencing. https://sciencing.com/calibrate-refractometer-5233419.html

4. Accept or reject pineapples, guava, tomatoes, and carrots according to their defects.

Points to Remember

- Weigh the raw materials before sorting.
- A refractometer will indicate the sugar content in fruits and vegetables.
- The maturity of fruits and vegetables is based primarily on their size, colour, firmness, and sugar content.
- Discard fruit and vegetables that are damaged, too small, or diseased.

Formative Assessment

1. Select the correct answer for each statement.

a. Fruits and vegetables are kept:

i) Wet
ii) Dry
iii) Wet and dry

b. A refractometer is used to determine:

i) Moisture content
ii) Vitamin C
iii) Concentration of solids

2. Determine whether the following statements are true or false:

a. The quality of fresh fruits and vegetables is generally based on the chemical composition or physical characteristics or combination of the two

b. Microorganisms speed produce deterioration through decay.

3. Imagine you work in a company located in Gakenke district, and your job is to receive pineapples for processing. Famers come in the early morning hours bringing their pineapples to the company. The company pays the farmers based on the quality of their pineapples.

What categories do you use to receive the pineapples and evaluate their quality?

4. The trainer will give your group tomatoes. Group the tomatoes according to ripeness, damage, weight, decay, sunburn, and cracks.

5. After you are given refractometer, distilled water, and clean cloth, compare the sugar content/brix of the following produce: pineapple, tomato, and passion fruit. Draw conclusions from the analysis of the produce and write a statement about it.

6. Share and compare your group's results from Questions 4 and 5 with the rest of the class.

Topic 1.3: Preparation of fruits and vegetables

Key Competencies:

Knowledge	Skills	Attitudes
1. List detergents and sanitizers for fruits and vegetables	**1.** Use detergents and sanitizers to wash and sanitize fruits and vegetables	**1.** Safety-oriented
2. Describe washing and sanitizing techniques for fruits and vegetables	**2.** Show washing and sanitizing techniques for fruits and vegetables	**2.** Methodical
3. Describe storage conditions for fruits and vegetables	**3.** Store fruits and vegetables	**3.** Responsible

Getting Started: What do we know and where are we going?

Topic 1.3 Task 1:

1. Discuss as a class: What can a person do when he/she has more fruits and vegetables than what he/she wants to eat in one week?

2. Review the Key Competencies table together.

Problem Solving Activity

Topic 1.3 Task 2:

1. In small groups, complete the following tasks:
   a. List detergents and sanitizers for fruits and vegetables.

   b. Discuss how fruits and vegetables are washed and sanitized before they are stored.

   c. Describe the place fruits and vegetables are to be kept for later processing.

2. After discussing, share your group's responses with the rest of the class. Ask questions and provide comments to other groups. Listen to the trainer's suggestions as well.

3. Then, refer to **1.6 Key Facts** and review it together.

1.6 Key Facts

1. Using detergents and sanitizers in food processing industry:
   - Effective cleaning must occur before sanitizing, as sanitizers may not work as well if the food contact surface has not had all visible contamination removed.
   - Cleaning is often achieved with detergent, water and agitation, with the visible dirt and detergent then rinsed and removed with clean water.
   - Sanitizing is usually achieved using heat and water, or chemicals, or a combination of both methods. An effective alternative to chemical sanitizers is hot water used at (75°C or hotter) to soak items for 2 minutes or more.[13]

[13] Department of Health. (2020, July 14). *Cleaning and sanitising food premises and food equipment*. WA Health, Government of Western Australia. https://ww2.health.wa.gov.au/Articles/A_E/Cleaning-and-sanitising-food-premises-and-food-equipment

2. Storing fruits and vegetables:[14]

- Harvest fruits and vegetables at peak maturity or as near to it as possible.
- Only use produce that is free from all visible evidence of disease.
- Do not store any fruit or vegetable that has severe insect damage.
- Handle food carefully after harvest so that it is not cut or bruised.
- Leave an inch or more of stem on most vegetables to reduce water loss and prevent infection.
- Use late-maturing varieties better suited to storage.
- Store produce under the proper conditions immediately after harvest.
- Use plastic bags, lined boxes, crocks, metal cans with liners, or plastic garbage cans because all of these items can retain moisture.
- Perforated plastic bags or liners at regular intervals to allow air circulation and prevent condensation. Vegetables requiring moist storage should never be left directly exposed to air.
- Wash produce from soil and place into plastic bags with 5-11.5 cm holes for ventilation.
- Use a refrigerator, indoor storage, outdoor shed, and basement storage room. The room should have an outside window for ventilation. Humidity can be kept high by pouring water on the floor or by keeping wet burlap sacks or some similar material in the room.
- Use respective recommended storage temperatures and relative humidity tables for each fruit and vegetable.
- All fruits and vegetables must be kept in a dark, aerated environment. Most vegetables like moist conditions, standing water must be avoided, as it will quickly lead to rot.
- Fruits and vegetables should always be stored separately.[15]

Guided Practice Activity

Topic 1.3 Task 3:

1. Your trainer will provide you with tomatoes, pineapples, and cleaning materials.

[14] Cornell Cooperative Extension of Chemung County. (2004). *Storage guidelines for fruits & vegetables*. https://chemung.cce.cornell.edu/resources/storage-guidelines-for-fruits-vegetables

[15] Shiksha, K. (2013, September 30). *Lesson 44. Storage conditions for various fruits & vegetables*. E-Courses Online. https://ecoursesonline.iasri.res.in/mod/page/view.php?id=930

2. With your group, perform the following tasks:
   a. Choose appropriate agents to wash and sanitize tomatoes and pineapples.

   b. Wash and sanitise the tomatoes and pineapples.

   c. Store the sanitised tomatoes and pineapples.

3. After completing the tasks, share and compare your group's experience with the rest of the class.

Application Activity

Topic 1.3 Task 4:

1. Participate in preparations for a field visit to a processing plant:
   a. Prepare an observation checklist.
   b. Formulate questions.
   c. Discuss upon agreed protocols for observation, safety, and information gathering.

2. When creating your checklist, consider the following:
   a. Different cleaning techniques and sanitizing agents (use of detergents, warm water, high water pressure spray).

   b. Use of conveyor shakers to remove water through a mesh.

   c. Air drying on conveyors with forced air to blow excess water off the surface of the wet produce. Dry produce with a clean cloth or paper towel to further reduce bacteria that may be present.

   d. Storage facility requirements.

   e. Storage conditions (temperature, air circulation) and how produce is stored.

3. Follow the trainer's instructions and protocols during the visit, including safety measures, preparation, and follow-up.

4. Write what you have seen after the visit to plant regarding fruits and vegetables. Describe the different cleaning and sanitizing agents and techniques such as:

- Use of detergents, warm water, high water pressure spray.
- Use of conveyor shakers to remove water through a mesh.
- Use of forced air to blow excess water off the surface of the wet produce.
- Use of dry clean cloth or paper towel to further reduce bacteria that may be present on produce.
- Storage facility requirements and storage conditions (temperature, air circulation).

5. Verify your checklist with the trainer and ask questions for clarification.

Points to Remember

- Wash fruit before it is cut in order to avoid losing high-nutritive value soluble substances (vitamins, minerals, sugars, etc.).
- Do not store damaged fruits and vegetables together with good ones.
- Before using sanitizer or disinfectant, read its intended use to know if it can be in contact with foods.

Formative Assessment

Ask trainees to choose a correct answer.

1. Sanitizers are used to:
   a. Kill microorganisms
   b. Remove soil
   c. Remove soil and kill microorganisms

2. Detergents are used to:
   a. Kill microorganisms
   b. Remove soil
   c. Remove soil and kill microorganisms

3. Set up a processing room at school where there are wooden and stainless steel shelves, table, wooden crates, water, detergents, sanitizers, thermometer, and disinfectants. Provide amaranths and pineapples.

Do the following:

a. Choose appropriate agents to clean and sanitize amaranths and pineapples.

b. Store sanitized amaranths and pineapples.

c. Record temperature in degrees Celsius in the place where amaranths and pineapples are stored.

Self-Reflection

1. You have come to the end of the unit. You are going to do the survey you did at the beginning of the unit again to help you do self-assessment of your knowledge, skills and attitudes.

Again, there are no right or wrong answers to this survey. It is for your own use to gauge your knowledge, skills and attitudes after the unit. Read the Knowledge, Skill or Attitude in the left column. Think about yourself: do you think you can do this? How well? Read the statements across the top. Put a check in column that best represents your situation.

My experience **Knowledge, skills, and attitudes**	**I don't have any experience doing this.**	**I know a little about this.**	**I have some experience doing this.**	**I have a lot of experience with this.**	**I am confident in my ability to do this.**
Identify source of contaminants in fruit and vegetable processing					
List cleaning and sanitizing substances and techniques					
Describe how to dispose solid wastes and used cleaning and sanitizing substances					
Prevent equipment and raw materials from contamination					

My experience Knowledge, skills, and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Treat solid wastes and water from cleaned and sanitized workplace					
Evaluate the physical and chemical quality of fruits and vegetables for processing					
Sort and grade fruits and vegetables for processing					
List detergents and sanitizers for fruits and vegetables					
Use detergents and sanitizers to wash and sanitize fruits and vegetables					
Store fruits and vegetables					

2. Complete the table below by identifying areas from the unit where you show strength and where you need improvement with the actions/strategies you will use to help you improve when receiving and interpreting information at the workplace.

Areas of strength	Areas for improvement	Actions to be taken to improve
1. **2.**	**1.** **2.**	**1.** **2.**

Unit 2: Assist in processing fruits and vegetables

Topics

2.1 Measurement and mixing of ingredients

2.2 Application of processing techniques

2.3 Assessment of quality of product

Unit Summary

This unit will offer training in the proper processing of different fruits and vegetables in order to promote good quality food products for healthy eating.

Self-Assessment: Unit 2

1. Look at the unit illustration. What do you see? What do you think this unit will be about? What topics might be covered?

2. Fill in the self-assessment below.

There is no right or wrong ways to answer this assessment. It is for your own use during this course. The trainer will read a skill that is listed in the left column. Think about yourself: Do you think you can do this? How well? Read the statements across the top. Put a check in column that best represents your situation. At the end of this unit, we'll take this survey again.

My experience **Knowledge, skills, and attitudes**	**I don't have any experience doing this.**	**I know a little about this.**	**I have some experience doing this.**	**I have a lot of experience with this.**	**I am confident in my ability to do this.**
State ingredients for juices, jams, sauces and pastes					
List steps to make juices, jams, sauces and pastes					
Measure and mix ingredients (weighing solids, measuring liquids)					
Determine brix and pH of juices, jams, sauces and pastes					
Extract juice and pulp					
Choose preservatives for juices, jams, sauces, pastes					
Use pasteurizer to heat juice and pulp					
Assess quality of products					
List packaging materials for juices, jams, sauces and pastes					

My experience Knowledge, skills, and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Package juices, jams, sauces and pastes					
List information on the label					
Evaluate information on label for juices, jams, sauces and pastes					

Topic 2.1: Measurement and mixing of ingredients

Key Competencies:

Knowledge	Skills	Attitudes
1. State ingredients for juice, jam, sauce, and paste	**1.** Choose ingredients for juice, jam, sauce and paste	**1.** Precise
2. List preservatives for juice, jam, sauces, paste	**2.** Choose preservatives for juice, jam, sauces, paste	**2.** Safety-oriented
3. List steps for weighing	**3.** Weigh ingredients and raw materials for processing	**3.** Methodical

Getting Started: What do we know and where are we going?

Topic 2.1. Task 1:

1. With a partner:
   a. Discuss what you know about making jams or juices.

   b. Can you outline some steps in the process?

2. Volunteer to share your responses with the rest of the class.

3. Review the Key Competencies together.

Problem Solving Activity

Topic 2.1 Task 2:

1. Discuss the following with your group:
   a. Why are some juices sweeter than others?

   b. What can you do to prolong the shelf life of juices of juices, jam, sauces, and pastes?

   c. Which materials are used to weigh water and sugar?

2. Share your group's work with the rest of the class. Be sure to ask questions and add comments to other groups.

3. Refer to **2.1 Key Facts** and review it together.

2.1 Key Facts

1. **Diluting juice**:
   - Start with full strength juice and add potable (drinking) water to it.
   - Add as much water as you like, depending on your requirements.
   - You can add twice as much water to the concentrate as recommended, even up to 4 times as much.[16]

2. **Pasteurizing juice and using preservatives**:
   - Heat the juice to about 70°C, stirring frequently.
   - Keep it at 70°C for at least 1 minute. Maintain the container of juice at room temperature or put it in cold water.
   - Preservatives are commonly used at the level of 0.03-0.2% of the juice.[17]

3. **Weighing scales and equipment**:
   - Analytical balance for very precise measurements
   - 100 kg scale
   - Cups, tablespoon, buckets
   - Graduated measuring cups

4. **Types of preservatives**:
   - **Natural**: Sugar, lemon or lime juice, fermentation, salt, and vinegar
   - **Chemical**:
     - Common salt: brined vegetables
     - Sugars: sucrose, glucose, fructose, and syrups
     - Foods preserved by high sugar concentrations: jellies, preserves, syrups, juice concentrates; interaction of sugar with other ingredients or processes such as drying and heating.
     - Acids: lactic (fermentation); acetic (vinegar); citric (lemons and limes); ascorbic (Vitamin C), benzoic acid (sodium salt), sorbic acid
     - Sorbates

[16] Walacavage, K. (2018, November 29). *How to make diluted orange juice*. Quora. Retrieved 2019, from https://www.quora.com/How-do-you-make-diluted-orange-juice

[17] BC Centre for Disease Control. (2013, September). *Food safety notes*. https://www.bccdc.ca/resource-gallery/Documents/Educational%20Materials/EH/FPS/Fruit%20and%20Veg/DontDrinkItRaw_HowToPasteurizeJuiceAndCiderSafely.pdf

- Sulphur dioxide: a preservative and antiseptic for bacteria, yeasts, and moulds

- **Common food products with chemical preservatives**:
  - Citric acid: fruit juices, jams, other sugar preserves
  - Acetic acid: vegetable pickles, other vegetable products
  - Sodium benzoate: vegetable pickles, preserves, jams, jellies, semi-processed products
  - Sodium propionate: fruits, vegetables
  - Potassium sorbate: fruits, vegetables, pickled products, jams, jellies
  - Methyl paraben: fruit products, pickles, preserves
  - Sulphur dioxide: fruit juices, dried/dehydrated fruits and vegetables, semi-processed products[18]

Guided Practice Activity

Topic 2.1 Task 3:

1. In this activity, with the trainer's help, you are going to practice choosing ingredients and preservatives, measuring and weighing them as well as find the right amount of mixtures to make juices, jams, pastes, and sauces.

2. Remember that, as discussed in **Unit 1**, illness from food is most often caused by one or more types of cross-contamination so we all need to be attentive to cleaning and sanitizing the workplace. Active steps must be taken to prevent contamination at every point in the production process.

Some of these steps are:
- Personal hygiene
- Sanitized equipment and tools
- Pest control
- Temperature control: heating and cooling properly
- Following a cleaning schedule

3. Using **2.1** and **2.2 Key Facts**, perform the following tasks:
a. Choose some fruits and vegetables among the ones the trainer has provided for making juice, jam, paste, and sauces (tomatoes, pineapple).

[18] Pederson. (n.d.). *General procedures for fruit and vegetable preservation*. Food and Agriculture Organization of the United Nations. https://www.fao.org/3/V5030E/V5030E0d.htm

b. Choose preservatives for juice, jam, sauces, and pastes among the ones the trainer has provided: Sodium benzoate, sodium sorbate, and citric acid; sugar, salt, water, pectin.

c. Practice weighing 5 kg of sugar, 2 kg of salt, 0.3 g of sodium sorbate, 500 ml of water, 20 kg of pineapples, and 20 kg of tomatoes.

4. The trainer will help you to calculate the percentage of orange juice and sugar syrup to be mixed to make a fruit drink with a final sugar concentration of 24%. The orange juice should contain 12% sugar, while the sugar syrup should have a concertation of 65% sugar.

The process is illustrated in **2.2 Key Facts** for your reference and to use as a guide in solving the problems in the Application Activity which follows.

5. Ask for assistance from the trainer as needed.

6. After all groups have finished, share your answers.

7. With the class, discuss the experience you've gained, including the challenges and main learning points.

2.2 Key Facts

1. Preservatives are added to juices, jams, sauces and pastes to prolong their shelf life.
- There are natural and chemical preservatives and processes.
- The dosage is very important when using chemical preservatives. With some of the acids (lactic, citric and acetic) there is no limit to the daily intake.
- With sodium benzoate and sodium sorbate there are limits.
- Check with local agricultural agents for proper dosing.

2. Sugar is also a preservative. Adding sugar prevents or slows down bacteria growth.

3. To calculate the amount of sugar to be added in the juice, use **the Pearson Square** method to find the degree Brix. The Pearson Square is a rectangular box with a circle drawn in the middle. On the left side of the box, two quantities of ingredients are displayed. In the middle is the % of the desired mixture. On the right side of the box are the answers to the calculations for parts needed to arrive at the desired mixture.[19]

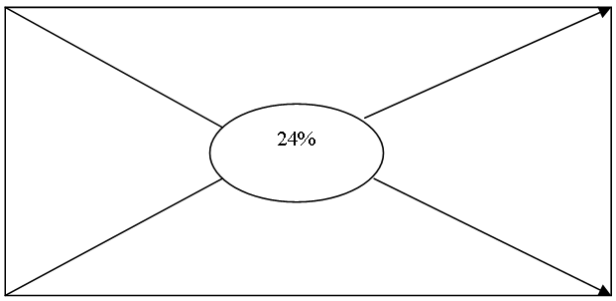
[19] Wagner, J., & Stanton, T. L. (2012, June). *Formulating rations with the Pearson Square*. Colorado State University. https://extension.colostate.edu/topic-areas/agriculture/formulating-rations-with-the-pearson-square-1-618/

Pearson Square

Syrup

12 parts of

Syrup of



41 parts of

Juice of

53 total

Calculations:

65 -24 = 41 parts of juice

12 – 24 = - 12 but ignore negative sign so 12 parts of syrup

Total parts of juice and syrup = 56

% juice = 41/56 = 77%

% syrup = 12/56 = 23%

4. In order to make the square work consistently, there are three very important considerations:[20]

- The value in the middle of the square must fall between the two values that are used on the left side of the square. For example, the 24°Brix requirement has to come between the weak concentrated juice that has 12°Brix and the syrup of 65°Brix. If the syrup has 35°Brix and the concentrated juice has 26°Brix, the square calculation method will not work because the 24°Brix requirement of the strong jam is outside the range of the values on the left side of the square.

- Disregard any negative numbers that are generated on the right side of the square. Be concerned only with the numerical differences between the nutrient requirement in the middle of the square and the ingredient nutrient values on the left.

- Subtract the nutrient value and the nutritional requirement on the diagonal and arrive at a numerical value entitled parts of syrup and the number of parts of juice. By summing those parts and dividing by the total, you can determine the percent of the

[20] Wagner, J., & Stanton, T. L. (2012, June). *Formulating rations with the Pearson Square*. Colorado State University. https://extension.colostate.edu/topic-areas/agriculture/formulating-rations-with-the-pearson-square-1-618/

ration that each ingredient should represent in order to provide a specific nutrient level. Always subtract on the diagonal within the square in order to determine parts (subtract the smaller amount from the larger amount).

5. The desired mixture is the TSS (Total Soluble Solids), or more simply put, the sugar content. Sugar content is measured in percent Brix with a refractometer (see **1.5 Key Facts**). The amount of sugar content or TSS varies in juices, jams, sauces, and pastes.

6. Chemical preservatives include:

Type of preservative	Found in or used for
Lactic acid	Fermentation
Citric acid	Lemons and limes
Ascorbic acid	Vitamin C
Sulphur dioxide	Preservative and antiseptic for yeasts, moulds and bacteria
Pectin (can be chemical or natural)	Jellies, jams, marmalades

Application Activity

Topic 2.1 Task 3:

1. With a partner, discuss the chemical preservatives for juices, jams, and pastes that you have observed in shops.

2. Prepare a fruit drink with a final sugar concentration of 15% made from orange juice with 10% sugar and sugar syrup at 60%.

3. Practice using the Pearson Square with more examples, if there is time. Be sure to ask the trainer for assistance.

Points to Remember

- One can prolong the shelf life of juices, jam, sauces, and pastes by heating, adding preservatives, and packaging.

- The Pearson Square can be used to calculate the amount (number of parts) of sugar/syrup and juice that should be combined to end up with the correct mixture in the final product.

- When using the Pearson Square:
  1. Put the blends brix at A and D and target brix in C.
  2. Then, write the value of (A-C) at E.
  3. Then, write the value of (D-C) at B. The negative value must be positive.
  4. Then blend A and D in the ratio of values put at B and E.

Formative Assessment

Complete the following:

1. List the main ingredients added in:
   a. Juice
   b. Jam
   c. Sauces
   d. Pastes

2. Explain why it is necessary to measure ingredients in a recipe.

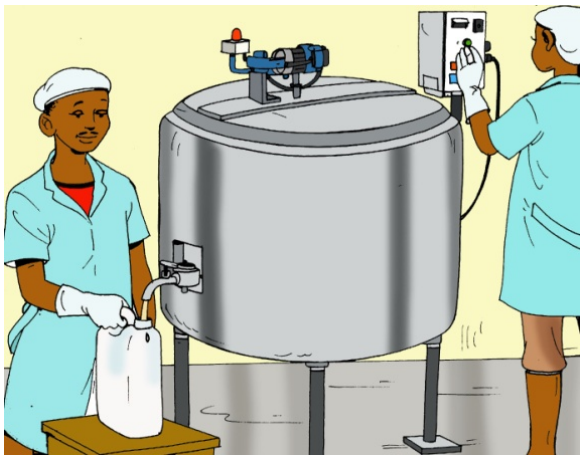
3. List at least five fruit and five vegetable crops grown abundantly in your region that can be processed into juice, jam, sauce, and/or paste.

	Fruits	Vegetables
1		
2		
3		
4		
5		

4. Prepare fruit juice with a final sugar content of 20%. Use orange juice that contains 10% sugar, mixed with a sugar syrup that contains 60% sugar.

Topic 2.2: Application of processing techniques






Key Competencies:

Knowledge	Skills	Attitudes
1. List steps to make juice, jam, sauce and paste	**1.** Extract juice and pulp	**1.** Productive
2. Describe how to pasteurize juice and pulp	**2.** Use pasteurizer to heat juice and pulp	**2.** Cautious
3. Describe packaging materials for juice, jam, sauces and paste	**3.** Package juice, jam, sauce, and paste	**3.** Responsible

Getting Started: What do we know and where are we going?

Topic 2.2 Task 1:

1. In small groups, discuss the following:
   a. Tell others which fruit or vegetable product(s) you have tried to prepare for consumption.
   b. Describe what makes consumers confident about using juice, jam, sauce, and paste products.
   c. Discuss the link between making and packaging these products and consumer health.

2. Share your responses with the rest of the class.

3. Review the learning outcomes and Key Competencies table together.

Problem Solving Activity

Topic 2.2 Task 2:

1. As a class, review and discuss the flow chart on juice, paste, jam, and sauce making presented in **2.3 Key Facts**.

2. Get into groups of 12 people. Follow these steps with your group:
   a. Start with juice making. Each person in your group should write on a sheet of paper ONE of the key manufacturing stages of juice. Make sure there are no repetitions.

   b. Mix the pieces of paper up.

   c. Put the pieces of paper in order to show the steps of how to make juice.

   d. Repeat the process for paste, jam, and sauce making.

3. Ask the trainer any questions you have regarding the steps for making juice, paste, jam, and sauce.

4. Practise reading the flow charts to find information:
   a. Look at the flow chart for making juice. Use the information to describe how to pasteurize pineapple juice.

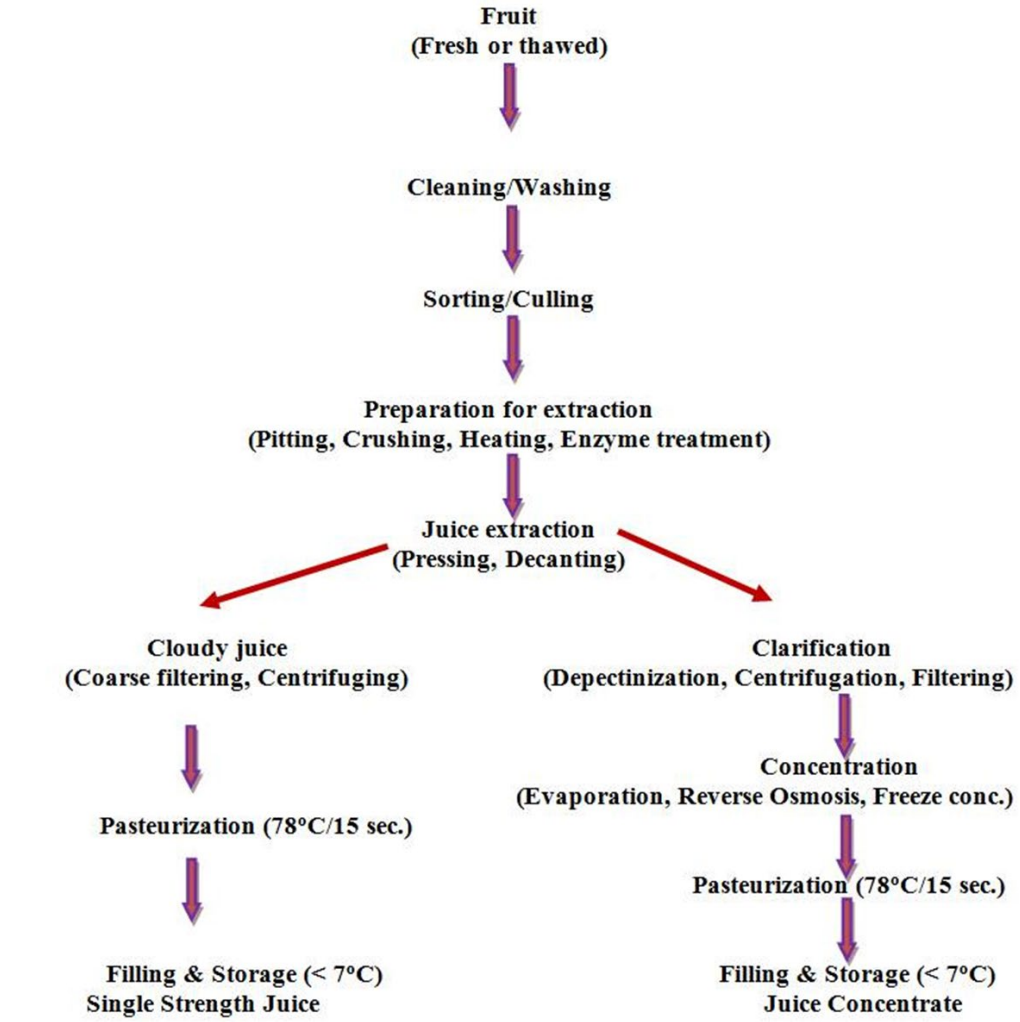
b. Use the information in the flow charts to list the necessary equipment needed to start to run a business processing passion fruit juice and making jam.

c. Describe the processing steps and equipment needed if a business is located in a place where there is extremely high loss of postharvest of tomatoes and the owner wants to contribute to the reduction of this loss by processing tomatoes into sauce and paste.

5. Share your group's responses with the rest of the class. As other groups present their work, ask questions and add any comments you have

2.3 Key Facts

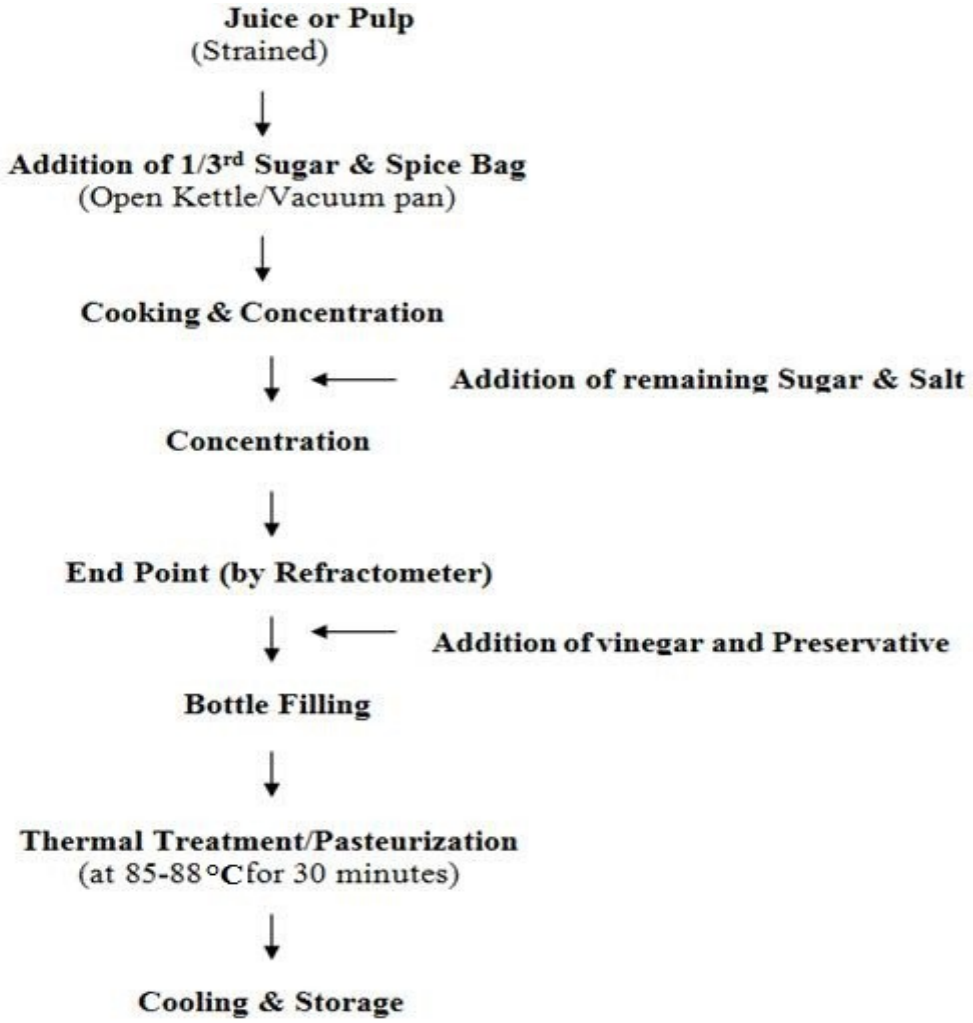
1. Flow chart for making juice:



21

[21] E-Krishi Shiksha. (n.d.). *Figure 12.1* [Flow chart]. E-Courses Online. http://ecoursesonline.iasri.res.in/mod/resource/view.php?id=147597

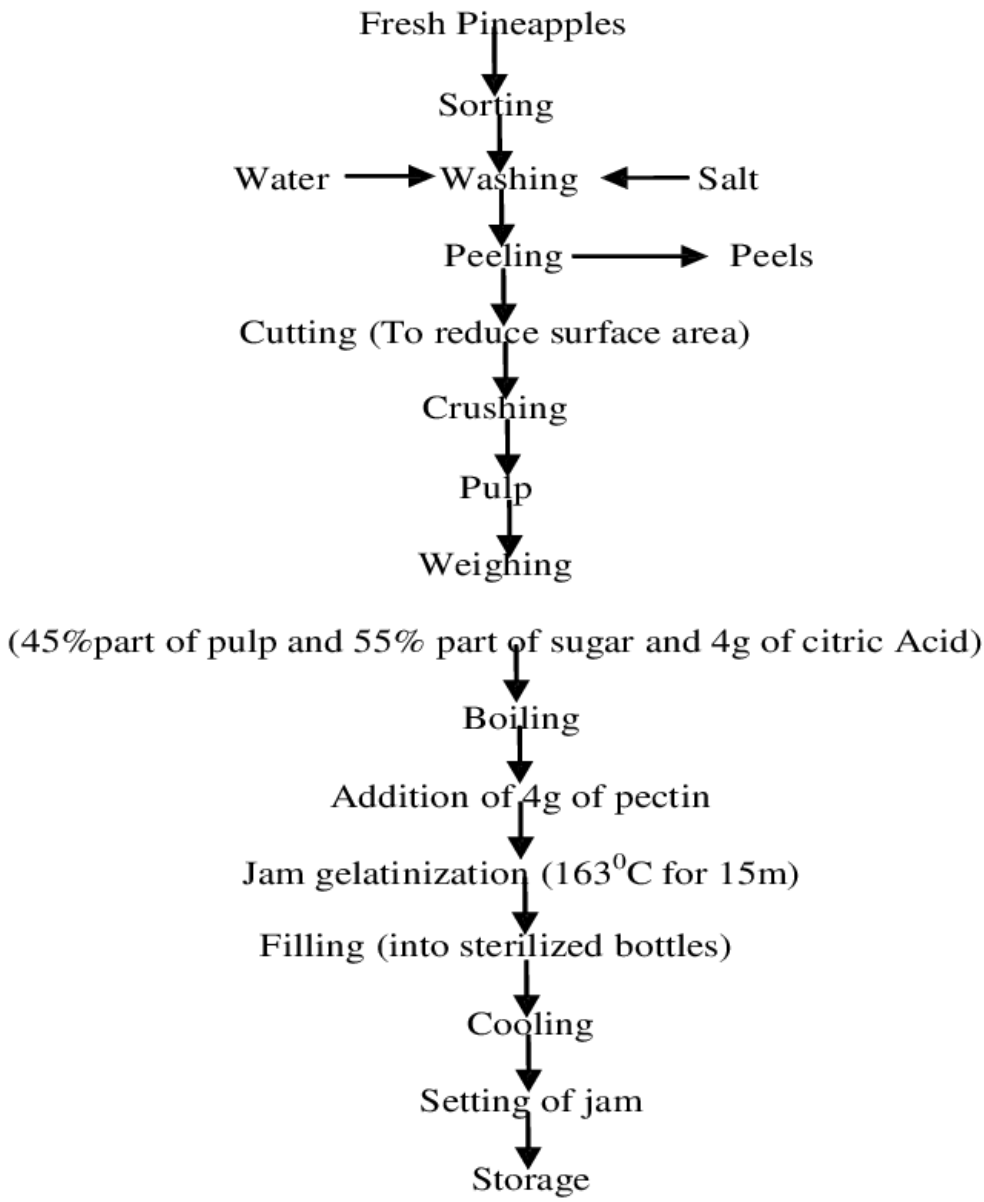
2. Flow chart for making paste:



22

[22] E-Krishi Shiksha. (n.d.). *Figure 22.1* [Flow chart]. E-Courses Online. http://ecoursesonline.iasri.res.in/mod/resource/view.php?id=147617

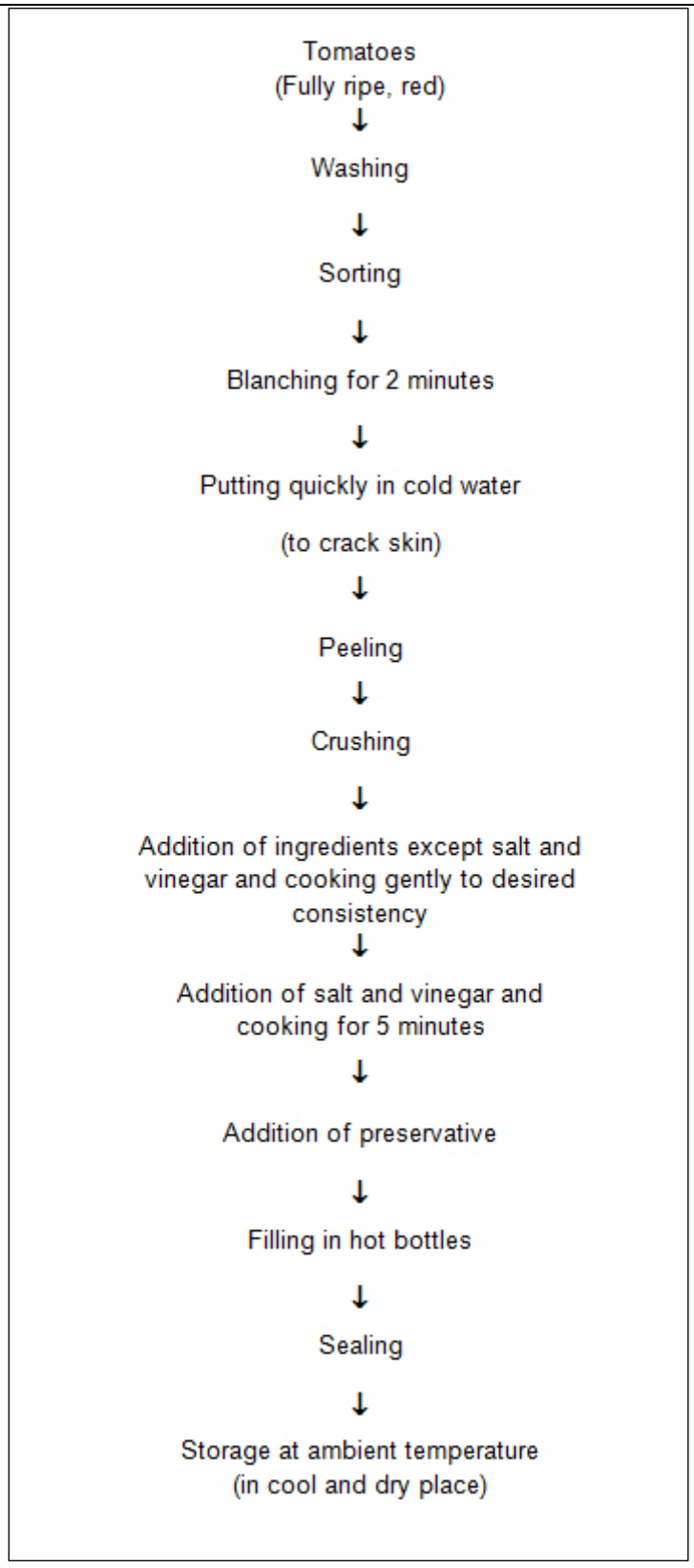
3. Flow chart for making pineapple jam:



[23]

[23] Ogueke, C. (n.d.). *Flow chart for production of pineapple jam* [Flow chart]. Research Gate. https://www.researchgate.net/profile/Chika_Ogueke/publication/265726469/figure/fig1/AS:416682821603328@1476356334139/Flow-chart-for-production-of-pineapple-jam.png

4. Flow chart for making tomato paste and sauce:



[24]

Guided Practice Activity

[24] Tamil Nadu Agricultural University. (n.d.). *Flow chart for tomato sauce/ketchup* [Flow chart]. TNAU Agritech Portal. http://agritech.tnau.ac.in/postharvest/pht_tomato.html

Topic 2.2 Task 3:

1. Watch the videos or demonstration provided by the trainer on making pineapple juice, jam, tomato sauce and paste.

2. Practise making pineapple juice and jam as well as tomato paste and sauce. There are different stations around the room – one area for making pineapple juice and jam and another for making tomato paste and sauce.

3. After finishing the products at one station, you should switch and make products at the other station.

4. In your groups, perform the following tasks:
   a. Follow the steps included in the flow charts and video or demonstration to make juice/jam and tomato paste/sauce. This will begin with cleaning the pineapples or tomatoes and the processing area in general.

   b. Choose the equipment and tools for the different stages of making the product and get them ready.

   c. Move on to extracting the juice from the pineapples or the pulp from tomatoes.

   d. Pasteurize pineapple juice, jam, tomato sauce and paste.

   e. Package pineapple juice, jam, tomato sauce and paste.

   f. Discuss the information that you would include on labelling the package and create a label for your product. Verify your label with the information provided in **2.4 Key Facts** and adjust as needed.

5. Be ready to show your final products to your classmates!

2.4 Key Facts

1. The necessary equipment needed to start to run a business processing fruit juice and making jam includes:

- pasteurizers
- jars
- packaging materials
- crusher
- graduated buckets
- Blender
- pH meter
- fillers
- stirrer
- spoons
- thermometers
- cooling machine
- filters
- weighing balance
- refractometer
- knife/slicer
- sealers

2. Labelling a package or container should include the following essential information:[25]

- Name and address of food factory location
- List ingredients in descending order of predominance by weight
- The total percentage of food (e.g. prepared with x grams fruit per 100 grams)
- Manufacturing and expiration dates

3. Additional relevant information for to include on the label:

- Serving size
- Preparation before consumption
- Nutrients contained in the food
- Manufacturing and expiration dates
- Allergies
- Restriction to consumers

Application Activity

Topic 2.2 Task 4:

1. You will visit a local food processing factory or small scale operation.

2. During the visit, observe the following and write them into the chart provided:

a. Cleanliness of the food processing environment.

[25] U.S. Food and Drug Administration. (2013, January). *Food labeling guide*. https://www.fda.gov/media/81606/download

b. Types of equipment used to product juices, jams, sauces, and paste.

c. Ingredients used to make the food products – fruits, vegetables, preservatives, etc.

d. Processes used in making the food products.

e. Packaging and labelling of the products.

Food Processing Requirements	Observations
a. Cleanliness of the food processing environment	
b. Types of **equipment** used to product juices, jams, sauces and paste	
c. Ingredients used to make the food products – fruits, vegetables, preservatives, etc.	
d. Processes used in making the food products	
e. Packaging and labelling of the products.	

3. Report back with your group on one of the areas assigned by the trainer and supplement other groups' responses with your observations.

4. Ask the trainer questions about processing fruits and vegetables based on your experience.

Points to Remember

- Before starting the processing, check if the equipment is functioning properly.
- Follow the steps of processing juice, jams, sauce, and paste carefully to avoid missing any critical steps.
- Put necessary information concerning the ingredients of the food products and contact information of the producer on the label.

Formative Assessment

Ask trainees to answer the following questions:

1. Circle the correct answer.
Juice is pasteurized mainly to:
   a. Kill microorganisms
   b. Add flavour
   c. Increase sugar content
   d. All answers are true

2. Determine if the following statements are true or false:
   a. Sugar is added right before putting jams in the bottles**.**

   b. Processing of fruits and vegetables can be done with simple and cheap local equipment.

3. Explain the key manufacturing stages of a fruit juice.

Topic 2.3: Assessment of quality of product

Key Competencies:

Knowledge	Skills	Attitudes
1. State sensory attributes for juice, jam, sauces, and paste	**1.** Evaluate sensory attributes of juice, jam, sauces, and paste	**1.** Respectful
2. Describe how to determine Brix and pH of juice, jam, sauces, and paste	**2.** Determine the Brix and pH of juice, jam, sauces, and paste	**2.** Persistent
3. List information on the label	**3.** Evaluate information on label for juice, jam, sauces, and paste	**3.** Attentive

Getting Started: What do we know and where are we going?

Topic 2.3 Task 1:

1. Share with others what juices you drink and why you like these particular juices. What features do you think are important to consider when deciding if a juice is good or not?

2. Volunteer to share your responses. Discuss as a class.

3. Review the learning objectives and the Key Competencies table.

Problem Solving Activity

Topic 2.3 Task 2:

1. Discuss the following questions in small groups:
   a. What sensory factors should be considered when manufacturing of juice, jam, sauce, and paste? In other words, juice, jam, sauce and paste should appeal positively to which of your senses?

   b. How do we differentiate diluted from concentrated juices?

   c. Describe how to determine Brix and pH of fruit and vegetable products.

d. What information is needed on the labels of pineapple juice, jam, tomato sauce and paste?

2. After discussing, share your group's ideas with the rest of the class. As other groups present their work, ask questions and add comments you have.

3. Read and discuss **2.5 Key Facts** together.

2.5 Key Facts

Sensory evaluation of fruit and vegetable products

- The following characteristics are based on the five senses of sight, smell, hearing, taste, and touch:
  - Sight: colour, shape, size
  - Smell: aroma
  - Hearing: chewing sounds
  - Taste: sweetness, spiciness, freshness
  - Touch: texture – smoothness, thickness, harness, crispness

- Sensory Evaluation Scoring Sheet:

	Low				Mid					High
	1	2	3	4	5	6	7	8	9	10
Colour										
Size										
Flavour										
Aroma										
Texture										

- Use a refractometer for the determination of sugar content:
  See **1.4 Key Facts** in Unit 1.

Brix determination: See **1.4 Key Facts** in Unit 1.

pH determination:

- pH determines whether a solution is basic or acidic.
- A pH value of 7 is neutral and values below 7 are acidic. Values above 7 are basic, or alkaline.
  - First, calibrate the pH meter with standard buffers: 4,7, and 10. (See **1.4 Key Facts.**)

- Between measurements, rinse electrodes with distilled water and then with the next sample to be measured.
- Pour sample in beaker and immerse electrode.
- Add a magnet and turn on the stir plate.
- Record pH and temperature when meter says ready/hold. Ensure electrode is placed in storage solution.
- When finished, rinse in a small beaker filled with 40ml of buffer solution.
- Each individual meter has its own set of step-by-step calibration instructions. Therefore, read instructions carefully before use.
- Discard after calibration, never pour used buffer back into original bottle. [26]

Use biodegradable packaging

- These are products that can be easily broken down by microbes and other biological processes which are natural. Biodegradable goods include those made of paper, food waste, fabric and wood.
  - Remember to label packaging with:
    - Name and address of food factory location
    - List of ingredients in descending order of predominance by weight
    - The total percentage of food (e.g. prepared with x grams fruit per 100 grams)
    - Manufacturing and expiration dates[27]

Guided Practice Activity

Topic 2.3 Task 3:

1. In your groups, assess the quality of some pineapple juices and jams, and tomato sauces and pastes. The trainer will provide you with score sheets for sensory evaluation, a refractometer, a pH meter, distilled water, clean cloth, and packed pineapple juices and jams, tomato sauces and pastes.

2. Perform the following tasks:

a. On a scale of 1 to 10, score the colour, size, flavour, aroma and texture of the pineapple juices/jams, and tomato sauces/pastes. Add any other qualities such as thickness to evaluate if applicable.

[26] Mountain Empire Community College. (n.d.). *PH*. Water/Wastewater Distance Learning. https://water.mecc.edu/exam_prep/ph.html

[27] Kandelin Koons, E. S. (2019, April 5). *What is biodegradable packaging*. Desjardin. https://www.desjardin.fr/en/blog/what-is-biodegradable-packaging#:~:text=The%20most%20commonly%20used%20material%20for%20packaging%20is%20plastic.&text=Biodegradable%20packaging%20is%20produced%20using,waste%20plant%20products%20%5B4%5D

b. Determine sugar content and pH of pineapple juices/jams and tomato sauces/pastes.

c. Evaluate the information found on the labels of packed pineapple juices, jams, tomato sauces and pastes.

d. Evaluate the packaging materials for pineapple juices/jams and tomato sauces/pastes.

3. Ask for assistance from the trainer as needed.

4. Share your findings with the rest of the class.

Application Activity

Topic 2.3 Task 4:

1. Working in one of two large groups, you will either make pineapple juices and jam, or tomato sauces and paste.

2. The group who made pineapple juices and jam will evaluate the sensory quality of the tomato sauces and pastes. The group who made sauces and pastes will evaluate the sensory quality of the juices.

3. Identify packaging materials that could be used for the juice, jam, sauce and paste. How have you seen these types of products packaged in the shops and market? What would be best for the environment?

4. Share and discuss you experiences with the class.

Points to Remember

- Sensory evaluation of fruit and vegetable products assess characteristics based on our senses. One can assess colour, size, texture, flavour, aroma, and more.
- Put company's relevant contact information on the label of the food product, such as telephone number and location address.

Formative Assessment

1. Complete the following sentence:
The sensory quality of food products include odour, texture, ……., ……. and ……..

2. Determine if the following statements are true or false:

a. Brix is determined only in juices.

b. Sauce and paste are made only from tomato.

c. Concentrated juice is sweeter than diluted juice.

Circle the correct answer for Questions 3 & 4:

3. Refractometer measures:

a. Brix
b. Texture
c. both are true

4. Labels show:

a. The ingredients and contacts
b. Photos of the persons who made the food products
c. Both are true

5. List the quality defects that can lead consumers to doubt the quality of food products such as juice, jam, sauce and paste.

6. List 10 pieces of information that should be shown on the label of a food product

1		**6**	
2		**7**	
3		**8**	
4		**9**	
5		**10**	

7. Identify the key parameters to evaluate the quality of juices, jams, pastes, sauces.

Self-Reflection

1. You have come to the end of the unit. You are going to do the survey you did at the beginning of the unit again to help you do self-assessment of your knowledge, skills and attitudes.

Again, there are no right or wrong answers to this survey. It is for your own use to gauge your knowledge, skills and attitudes after the unit. Read the Knowledge, Skill or Attitude in the left column. Think about yourself: do you think you can do this? How well? Read the statements across the top. Put a check in column that best represents your situation.

My experience **Knowledge, skills, and attitudes**	**I don't have any experience doing this.**	**I know a little about this.**	**I have some experience doing this.**	**I have a lot of experience with this.**	**I am confident in my ability to do this.**
State ingredients for juices, jams, sauces, and pastes					
List steps to make juices, jams, sauces, and pastes					
Measure and mix ingredients (weighing solids, measuring liquids)					
Determine brix and pH of juices, jams, sauces and pastes					
Extract juice and pulp					
Choose preservatives for juices, jams, sauces, pastes					
Use pasteurizer to heat juice and pulp					
Assess quality of products					

My experience Knowledge, skills, and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
List packaging materials for juices, jams, sauces and pastes					
Package juices, jams, sauces and pastes					
List information on the label					
Evaluate information on label for juices, jams, sauces and pastes					

2. Complete the table below by identifying areas from the unit where you show strength and where you need improvement with the actions/strategies you will use to help you improve when receiving and interpreting information at the workplace.

Areas of strength	Areas for improvement	Actions to be taken to improve
1. **2.**	**1.** **2.**	**1.** **2.**

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