RWANDA POLYTECHNIC

TVET LEVEL II

AGRICULTURE

Fruits and Vegetables

TRAINER MANUAL

RWANDA POLYTECHNIC

Approved by: Workforce Development Authority

USAID FROM THE AMERICAN PEOPLE

EDC Education Development Center

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Acknowledgements

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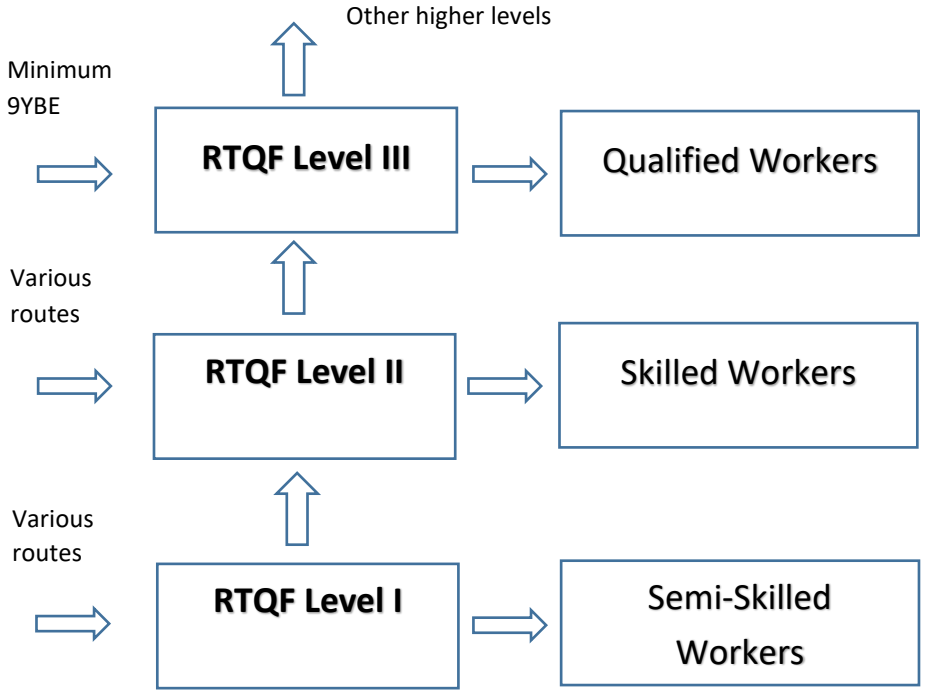
Introduction to RTQF Level II Training Modules

Background

Rwanda Polytechnic, with support of and in collaboration with USAID Huguka Dukore Akazi Kanoze, has developed RTQF TVET Level II programs that combine basic education, soft skills and vocational skills modules. Bridging the gap between Level I and Level III programmes, Level II aims to prepare learners who have a minimum education level of Primary 6 or equivalent to continue with their education or become skilled workers in the labour force.



Following the Workforce Development Authority (WDA) curriculum development process that involved experts from Rwanda Polytechnic, Rwanda Education Board, Ministry of Agriculture, technical vocational institutions, Education Development Center, Akazi Kanoze Access and other technical experts, training modules were developed in basic education, soft skills (work readiness) and, initially, agriculture. Additional vocational areas will be added over time. Trainees will be trained in all Basic Education and Soft Skills modules listed below, as well as in 6 - 8 modules that make up their chosen technical vocational programme.

Module Requirements:

Basic Education	Soft Skills	Vocational Skills
• English • Kinyarwanda • Mathematics	• Basic Entrepreneurship Skills • ICT Essentials • Communication Skills	• Vocational programmes will have a set of 6 – 8 required technical modules.

• Integrated Science (Physics, Chemistry, Biology)	• Safety, Health and Sustainable Environment • Personal Development and Career Guidance	E.g. Food Crop Production and Processing includes the following modules: 1. Food Crop Production 2. Small Scale Post-Harvest Operations 3. Growing Medium 4. Food Safety and Sanitation 5. Food Preservation and Storage 6. Flour Processing

Organization of the Training Manuals

For each module there is a Trainer Manual and a Trainee Manual. These manuals, based on the curricula for each subject, are divided into Learning Units, and each Learning Unit includes 3 – 5 Learning Outcomes. The learning outcomes make up the essential skills, knowledge and attitudes to be acquired by trainees. To make the Trainee Manual more user friendly, Unit and Topic are used respectively for Learning Unit and Learning Outcome. The number of hours per training module varies, ranging between 30 and 120 hours.

Teaching & Learning Methodology of RTQF Level II 2 TVET Materials

The teaching and learning methodology used in the materials is based in experiential and adult learning. Activities are designed to engage trainees, build upon what they know and learn and provide them with opportunities to build their skills in the classroom and in the workplace. More specifically, guiding principles in the development of the manuals include:

- Building on participants' knowledge, skills and experiences
- Facilitating a learning process through active engagement of participants rather than through lecturing
- Providing opportunities to practice – inquiry based and hands on practice, both in the classroom and workplace
- Using simple and clear language
- Connecting to the real world: use local resources and the environment for learning
- Promoting critical thinking through properly debriefing activities and asking questions that get learners to think, analyze, relate issues and topics to their own lives and come up with solutions

- Applying social inclusion principles: Finding ways to include all types of youth (and trainers) – males and females; different cultural/ethnic/religious backgrounds, people with disabilities (PWD); people with different types of health status …

- Encouraging risk taking – promote questioning and being free to explore

- Promoting habits of mind that support life-long learning: curiosity and wonder, open mindedness, creativity

These principles are reflected in the layout and flow of activities in the manuals:

1. **Key Competencies:** Table found at the beginning of each Learning Outcome that describes the main knowledge, skills and attitudes to be gained by the end of the activities.

2. **Self-Assessment:** Conducted at the beginning and end of each Learning Unit to get a sense of trainees' knowledge and skills going into it and what they have gained by the end of the Learning Unit (and steps they need to take to further their understanding and skills).

3.  **Getting Started Activity:** Typically, a quick activity or questions to 1) give the trainer a sense of trainees' existing knowledge and skills; 2) spark the interest of trainees in the topic; 3) introduce the objectives and key competencies of the topic.

4.  **Problem Solving Activity:** A challenging activity to get trainees engaged and to learn through discovery instead of memorization of facts. A variety of teaching and learning methodologies are used, including individual and group work such as reading real life work-based scenarios and answering accompanying questions to activities such as identifying proper tools and equipment from the school workshop to conduct a certain activity. Following the sharing of responses, the trainer guides trainees through the content and processes being introduced.

5.  **Guided Practice Activity:** Building on the concepts and skills gained in the Problem Solving Activity, the trainer guides trainees through practical examples.

6.  **Application Activity:** Consolidates trainees' knowledge and skills through a real-life application of the topic in the classroom, community or workplace. Trainees are given more independence in applying what they have learned.

7. **Key Facts boxes:** Throughout the Trainee Manual, one will find Key Facts boxes. These contain the main information or content for a given Learning Outcome. They are there for the trainees' reference and are used throughout the different types of activities.

8.  **Points to Remember:** List of the top key learning points or "take-aways" from the topic.

9.  **Formative Assessment:** Questions and activities to assess trainees' level of understanding of the concepts introduced.

10.  **Summative Assessment:** Based on the integrated, real life situation approach used in other TVET levels, this is done at the end of every module for agricultural modules and, with some variations, at the end of each Learning Unit for Basic Education and Soft Skills modules.

11.  **Self-Reflection:** Trainees re-take the Self-Assessment given at the beginning of the Learning Unit and identify their strengths, challenges and actions to improve their level of competence.

The Trainer and Trainee Manuals are meant to be used in conjunction with each other and are well coordinated through the headings and labelling of activities. The trainer will always be able to refer trainees to specific activities by the coordinated numbering system. For instance, a specific exercise might be labelled Topic 1.2 Task 2. The Topic is the number of the Learning Outcome and the task is the specific exercise to be done. The Key Facts are also numbered for easy reference. These nor the Self-Assessment tables are in the Trainer's Manual so the trainer should have a copy of both manuals.

The Trainer's Manual includes answers (or guidelines to the trainer as appropriate) to Formative and Summative Assessments as well as to problems given throughout the activities. Summative Assessments are not included in the Trainee's Manual. These are meant to be used as a guide for those who will be developing a context-appropriative Summative Assessment at the end of the Module or Learning Unit. Basic Education and Soft Skills modules include Summative Assessments at the end of every Learning Unit while the technical modules include it only at the end of the module.

Lastly, there is a section in the Trainer's Manual for additional information to the trainer that includes either specific information or references to information that can help them deepen their understanding of the particular content.

FRUIT AND VEGETABLE PROCESSING

Learning Units	Learning Hours	Learning Outcomes
Learning Unit 1: Receive fruits and vegetables	30	**1.1** Prepare workplace and equipment
		1.2 Receive fruits and vegetables
		1.3 Prepare fruits and vegetables
Learning Unit 2: Assist processing in fruits and vegetables	70	**2.1** Perform measuring and mixing of ingredients
		2.2 Apply processing techniques
		2.3 Assess the quality of products

Learning Unit 1: Receive fruits and vegetables

Learning Outcomes

By the end of the Learning Unit, trainees will be able to:

1.1 Prepare workplace and equipment

1.2 Receive fruits and vegetables

1.3 Prepare fruits and vegetables

Learning Unit 1: Self-Assessment

1. Before teaching Unit 1, ask trainees to look at the illustration and explain what is being done with the fruits and vegetables in the different situations.

2. Use the illustration to point out the main topics to be covered in the unit: the preparation of the workplace and the reception and preparation of fruits and vegetables to be processed into different products such as juices, jams, sauces and pastes.

3. After the explanations given above, ask trainees to fill in the self-assessment table in their trainee manuals. Explain to the trainees that the self-assessment is not a test! It is used to know where to begin the lesson and which topics need to be better understood.

Learning Outcome 1.1: Prepare workplace and equipment

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

a. Identify sources of contaminants based on the design of the workplace and on the equipment to be used

b. Clean and sanitize the work area and equipment according to sanitation regulations

Time Required: 5 hours

Learning Methodology: Group discussion, brainstorming, discussion, observation, field visits

Materials Needed:

- **Substances**: For cleaning and sanitizing
- **Photos**: showing dirty and clean materials
- **Videos**: Cleaning and sanitizing: Bad effects of using wrong sanitizing substances on processing equipment
- **Standard training materials:** Flipchart, marker pens, pens
- **Reference materials**: internet, books, pamphlets

Preparation:

- ❑ Gather cleaning and sanitizing substances.
- ❑ Contact industries to organize visits that will allow observation of cleaning and sanitizing substances and techniques used in the workplace.

Cross Cutting Issues:

- ✓ **Environment and sustainability:** While preparing workplace and equipment, emphasize the need to prevent contamination from inside and from outside the preparation site.
- ✓ **Standardization culture:** While identifying the appropriate cleaning and sanitizing solutions consider standard procedures.
- ✓ **Inclusive education:** Consider inclusiveness while allocating roles for preparation of workplace.
- ✓ **Financial education:** Consider cost and durability while identifying PPE, cleaning materials, tools, and equipment.
- ✓ **Gender:** While forming small groups consider gender balance

Prerequisites:

- Basic sanitation knowledge: Understand the connection between dirt, uncleanliness, germs, and disease.

Key Competencies:

Knowledge	Skills	Attitudes
1. Identify source of contaminants	**1.** Prevent equipment and raw materials from contamination	**1.** Actively show care and 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 solid wastes and used cleaning and sanitizing substances	**3.** Treat solid wastes and water from a cleaned and sanitized workplace	**3.** Be devoted to protecting the environment

Steps:

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

1. Direct trainees to **Topic 1.1 Task 1** in their manuals and tell them to discuss the following with a partner:

a. What materials or tools are used in the kitchen when preparing fruits and vegetables at their home? Who washes these materials and how?

b. Where do the liquid and solid wastes from their kitchen get disposed?
Possible Answers: Locations within the home; outside the home; waste collection practices.

c. How might fruits and vegetables get contaminated?

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

2. Describe food contamination and how to control it to the trainees:

Food contamination can occur wherever bacteria comes in contact with food. This is why cleaning food preparation surfaces is not enough. Food preparation surfaces must also be sanitized.

3. Conclude by introducing the objectives, learning outcome, and the Key Competences.

Problem Solving Activity

1. Put trainees in small groups and ask each group to turn to **Topic 1.1 Task 2** in their manuals.

2. Ask trainees to refer to **1.1 and 1.2 Key Facts** and discuss the following in their groups:

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

b. Give examples of places to clean in a food processing plant or workplace to control contamination.
Answers:
- Food contact surfaces (tables, preparation areas, conveyors, bins)
- Equipment surfaces (inside and outside surfaces)
- Utensils
- Packaging materials
- Other aspects of the environment: (floors, drains, walls, light fixtures)

c. Describe how a workplace can get contaminated.
Answer: Use a graphic organizer to explain the chain of cross-contamination.

d. Suggest preventative measures that can be used to control contamination.

e. How frequently must you clean the following equipment?

Answers:

- Boiling pan/ pasteurizer: Daily after use with detergent and clean water
- Corers: Daily after use with detergent and clean water
- Cutting boards: Daily after use with detergent and clean water
- Dicers: Daily after use with detergent and clean water
- Energy saving charcoal stoves: Clean out ashes daily
- Bottle coolers: Weekly wipe with damp cloth
- Bottle washers: Weekly wipe with damp cloth
- Deep fat fryers: Periodic (monthly) removal of oil and cleaning

f. How can you dispose the solid wastes and water from a cleaned and sanitized workplace?

Answers: All waste should be stored in secure areas until collected. The following wastes should be put in different bins:

- Material (Glass and metal; plastic and paper)
- Biological (leftover food products, ingredients…)
- Chemical (Used detergents, sanitizers, preservatives…)

g. What is the 4-step process that removes waste and other contaminants?

Answers:

- Step 1: Preparation
- Step 2: Cleaning
- Step 3: Sanitising
- Step 4: Air drying

3. Give trainees enough time to respond to the questions in their groups.

4. After the discussions, have each group share their work/answers with the rest of the class. As groups present their work, encourage other trainees to ask questions and add anything they have.

5. After all groups have presented, review **1.1 and 1.2 Key Facts** in their training manuals for clarification.

Guided Practice Activity

1. Tell trainees to remain in their groups and refer to **Topic 1.1 Task 3** in their manuals.

2. Ask trainees in their respective groups to:

a. For review, draw the cross-contamination cycle on the blackboard as a pathway for a workplace to get contaminated.
Answer: See **1.2 Key Facts**.

b. Identify different contaminants in your classroom.
Possible Answers: Biological (ex: insects, pests); Chemical (ex: some painting on windows and doors); Physical (ex: dust, animal droppings, hair, glass, metal, dirt and fake nails)

c. Identify sanitizing types at your disposal and propose techniques you can use to sanitize the workplace.
Possible Answers:

- General types of sanitization include:
  - **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. Choose a detergent to remove soils and a sanitizer to kill microbes.
    - Techniques:
      - Sanitizing spray
      - Paper towels
      - Cloth on the mop

- Mechanical Cleaning is often referred to as Clean- in-Place (CIP). It requires no disassembly or only partial disassembly of recipients used to process fruits and vegetables.
- Clean-out-of-Place (COP)- recipients used to process fruits and/or vegetables can be partially disassembled and cleaned in specialized COP pressure tanks.
- Manual Cleaning requires total disassembly for cleaning and inspection.

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

- Locations must be determined on a community-by-community basis
- During site visits to processing plants, ask trainees to observe locations used

3. Observe groups as they discuss details, and provide assistance where needed.

4. After all groups have finished their discussions, ask them to share findings. Supplement their responses with information from **1.1 and 1.2 Key Facts**.

Application Activity

1. Refer trainees to **Topic 1.1 Task 4** in their manuals and read the story out loud together:

   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.

2. Tell trainees to discuss the following questions with a partner:
   a. Was there any contamination?
   b. If yes, how did the contamination start and spread?

3. Give trainees a few minutes to discuss the different biological, chemical and physical contaminants on the walls, windows, doors, cutting table, knives, pots, basins, crates, sacks and water, as well as on pineapples, tomatoes, and amaranths.

4. Take trainees for a visit to a fruit and vegetable processing workplace. Ask them to write a short report on the different cleaning and sanitizing techniques observed there (manual, foam, machine washing, spray, fogging, cleaning in place) and on the cleaning substances used (detergent, sanitizer and disinfectant) at this workplace.

Points to Remember

- An area must be cleaned before it can be sanitized. You cannot sanitize dirt. Only clean surfaces can be sanitized!
- Check the expiry 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.
Answer: False

b. Using hot water is a sanitizing method.
Answer: True

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

a. Water is …….
Answer: a cleaning agent

b. A soap is …….
Answer: a detergent

c. Hot water is……
Answer: a sanitizer

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.
Answer: Cleaning is removing dirt using physical or chemical means and sanitizing is reducing microbes on a workplace surface by killing germs and microorganisms that detergent cannot remove. Clean first, then sanitize. Pre-rinse to remove soil, wash with detergent and water, wash off detergent and sanitize. Use a sanitizing solution to completely scrub down all surfaces used to prepare fruits and vegetables.

b. Write down where detergent and sanitizer have been used.
Answer: Wash basins, sinks, worktables, and storage shelves.

c. List commonly used detergents and sanitizers.
Answer: Three types of sanitizers are: chlorine (bleach), ammonia, and iodine. Dosage should not exceed recommendations.

ⓘ Further Information for the Trainer

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Learning Outcome 1.2: Receive fruits and vegetables

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

a. Check the physical quality of fruits and vegetables
b. Test the chemical quality of fruits and vegetables
c. Sort and grade fruits and vegetables
d. Reject/refuse fruits and vegetables based on the standards and factory requirements

Time Required: 15 hours

Learning Methodology: Observation, demonstration, visits to industries, practical exercises

Materials Needed:

- **Materials for mature fruits and vegetables**: Maturity scale sheets, colour chart sheets, charts for maturity indices, and ripeness rating scales
- **Audio/visual materials**: Images of damaged fruits and vegetables, videos showing decay, insect damage, and signs of disease
- **Measurement tools:** Refractometer, pH meter, thermometers
- **Standard training materials:** Flipchart, marker pens, pens
- **Samples**: Fruits and vegetables with quality defects
- **Other materials**: Protective jacket, labels, tables, wooden spoons, sharp knives and a forks, jugs, cups, spoons, cutters, basins, and slicers

Preparation:

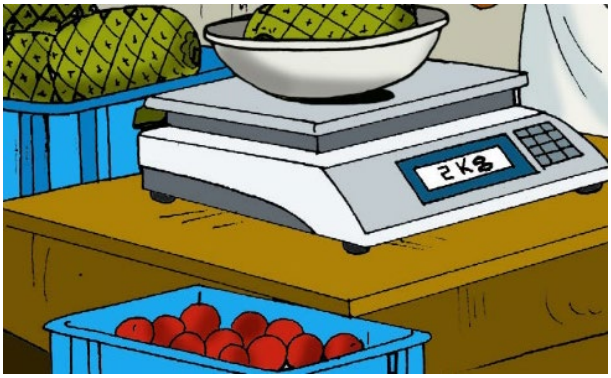
- ❑ Search for a market where mature, immature, damaged fruits, and vegetables are available.
- ❑ Print out maturity scale sheets for fruits and vegetables.
- ❑ Print out colour chart sheets for maturity fruits and vegetables.

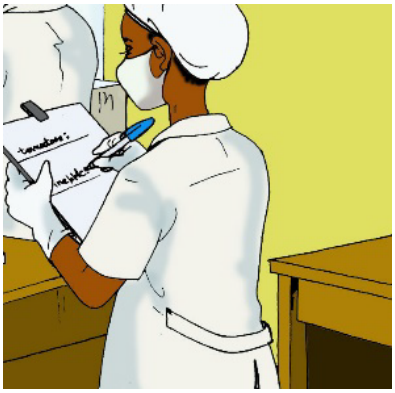
Cross Cutting Issues:

- ✓ **Standardization culture:** Maintain standard practices and procedures while weighing received produce.
- ✓ **Financial education:** Consider cost while paying for received produce.
- ✓ **Inclusiveness:** Be inclusive to people will all abilities while allocating roles for the reception of fruits and vegetables.
- ✓ **Environment and sustainability:** While throwing away produce, emphasize the need to protect the environment through proper disposing of waste materials as they represent hazards for employees and the environment.

Prerequisites:

- None





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

Steps:

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

1. Ask trainees to talk about the following questions with a partner from **Topic 1.2 Task 1** in their manuals:
   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. Conclude by introducing the objectives, Learning Outcome, and the Key Competences.

Problem Solving Activity

1. Put trainees in small groups and have them turn to **Topic 1.2 Task 2** in their manuals.

2. Ask each group to discuss and answer the following questions:
   a. What qualities should a factory producing jam, juice, sauce and paste consider when receiving fruits and vegetables?"
      Possible Answers:
      - Physical qualities: Maturity; Ripeness; Size; Weight; Density
      - Chemical qualities: Sugar content; Acidity

   b. Brainstorm how the sugar content can be determined.
      Possible Answers: Using sense of taste; by checking the sample using a sugar content measuring instrument (known as a refractometer; see **1.4 Key Facts**).

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

3. Give trainees some time to respond to the questions in their groups.

4. After the group discussions, have each group share their work/answers with the rest of the class. As groups present their work, encourage other trainees to ask questions and add any comments they might have.

5. After all groups have presented, recommend that participants closely read **1.4 Key Facts**: in their trainee manuals and review the information together.

Guided Practice Activity

1. Tell trainees to remain in their groups and turn to **Topic 1.2 Task 3**.

2. Explain why it is important to check the sugar content of fruits and vegetables and how a refractometer helps to do that. Show a refractometer, or if not available, a picture of one.

 [1]

3. Explain what the "Brix" is and why knowing it is important.
   Answer:
   - Brix is a measure of sugar content in juices, jams, sauces, and pastes.
   - It is important because an imbalance in sugar content can affect product quality in a way that may not be desirable.

4. After trainees have finished discussing, explain how to find the Brix:

   A refractometer is an instrument that 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.

5. Demonstrate how to use a refractometer. Refer trainees to **1.4 Key Facts** on written instructions for using a refractometer. **Note**: To calculate sugar content: One degree Brix is equal to 1 gram of sucrose in 100 grams of solution.

[1] *Portable Refractometer* [Photograph]. (n.d.). Wikimedia. https://upload.wikimedia.org/wikipedia/commons/7/7d/Portable-Refractometer-16.jpg

6. Provide scales, refractometers, distilled water, and clean cloths. Ask trainees in their respective groups to:
   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 and size.

   Possible Answers/Tips:
   - Size can be graded as small, medium, large, and extra-large.
   - On the basis of colour/maturity/ripeness, the fruits are graded as immature, properly mature, and over mature.
   - Sorting is done to make sure you discard the very worst fruits and vegetables. Those that are damaged, too small, diseased, too green or over-ripe, and so on, are not going to be bought and processed.
   - The higher the Brix level (sugars, vitamins, minerals, proteins and other solids), the higher the nutritional value of the fruit or vegetable.
   - For grading, the better quality is separated from the lower quality and a price can be reached between buyer and seller. Grade 1 (Class 1) sells for a better price than Grade 2 and Grade 3 so on.

7. Observe groups as they carry out the tasks for provision of assistance where needed.

8. After all groups have finished the task, invite group representatives to share experiences they have gained throughout the session.

Application Activity

1. Refer trainees to **Topic 1.2 Task 4** to do a series of practical activities.

2. Take trainees for a visit into a fruit and vegetable processing factory, and ask them to write a report on what they saw in the factory, specifically:
   a. Sorting techniques
   b. Grading techniques

3. Give the groups refractometers, distilled water, and clean cloths to each trainee to compare the sugar content/brix of:
   a. Immature pineapples and mature pineapples
   b. Red tomatoes and pink tomatoes
   c. Immature tree tomatoes with mature and over mature tree tomatoes

4. Distribute pineapples, guava, tomatoes, and carrots to trainees and ask them to accept or reject these commodities 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 a combination of the two.
Answer: True

b. Microorganisms speed produce deterioration through decay.
Answer: True

3. Tell trainees to imagine the following:

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?

Possible Answers: Ripeness, damage, weight, and/or decay

4. Form groups of trainees and distribute tomatoes to each group. Ask group members to categorize the tomatoes according to ripeness, damage, weight, decay, sunburn and cracks.

5. Next, distribute a refractometer, distilled water, and clean cloth to each group. Give them pineapples, tomatoes and passion fruit. Ask the trainees to compare sugar content/brix of the produce given. Ask each group to draw conclusions from the analysis of the produce and write a statement about it.

6. Ask the groups to share their results from Questions 4 and 5. Compare and discuss their results.

ⓘ Further Information for the Trainer

1. Sharon. P. S. and Martha. C. S (2010). Post-harvest technology of horticultural crops. Oxford Book Company, New Delhi.
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Learning Outcome 1.3: Prepare fruits and vegetables

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

a. Wash and sanitize fruits and vegetables according to standards

b. Store sanitized fruits and vegetables according to facility conditions

Time Required: 10 hours

Learning Methodology: Brainstorming, visits to industries, practical exercises

Materials Needed:

- **Measurement tool:** Electronic and mechanical balances
- **Standard training materials:** Flipchart, marker pens, pens
- **Reference materials:** Internet, reference books
- **Preparation materials:** Samples of sanitizing products, containers, washing tanks, washing machine
- **Audio/visual materials:** Video showing sanitizing of fruits and vegetables

Preparation:

- ❑ Search for shops to buy detergents and sanitizers for fruits and vegetables.
- ❑ Download video showing cleaning and sanitizing of fruits and vegetables.
- ❑ Clean storage places.

Cross Cutting Issues:

- ✓ **Standardisation culture:** Consider standard procedures when cleaning, sanitizing, and storing fruits and vegetables.
- ✓ **Environment and sustainability:** Consider the environment by avoiding overuse of water during cleaning.
- ✓ **Gender:** Consider gender balance when forming small groups.
- ✓ **Inclusiveness:** Consider inclusivity while allocating roles for the preparation of fruits and vegetables.

Prerequisites:

- None

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

Steps:

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

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

2. Conclude by introducing the objectives of learning outcome.

3. Review the Key Competencies table together.

Problem Solving Activity

1. Put trainees in small groups and have them turn to **Topic 1.3 Task 2**.

2. Ask each group to:
   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 the fruits and vegetables are to be kept for later processing.

3. Give trainees some time to respond to the questions.

4. After the discussions, have each group share their work/answers with the rest of the class. As groups present their work, encourage other trainees to ask questions and add anything they have. Suggest the possible answers below, if they are not mentioned by the trainees.

   Possible Answers for questions a and b:
   - Fruits and vegetables are often washed with detergent, water and agitation, with the visible dirt and detergent then rinsed and removed with clean water.
   - Fruits and vegetables are often sanitized using heat and water, or chemicals, or a combination of both methods, i.e. treated with very hot, clean, potable water (75 °C) for at least 2 minutes or more and then applying sanitizer as directed on the product label.
   - Fruits and vegetables are also often left to air dry. The most hygienic way to dry produce is on a draining rack.

   Possible Answers for question c: See **1.6 Key Facts**, point number 2.

5. After all groups have presented, refer participants to **1.6 Key Facts** in their training manuals and review it together.

Guided Practice Activity

1. Tell trainees to remain in their groups and turn to **Topic 1.3 Task 3** in their manuals.

2. Provide each group with tomatoes and pineapples, detergents, sanitizers, and water. Also provide each group with a table and wooden crates.

3. Ask trainees in the respective groups to:
   a. Choose appropriate agents to wash and sanitize the tomatoes and pineapples.
   b. Wash and sanitise the tomatoes and pineapples.
   c. Then store sanitized tomatoes and pineapples.

4. Proceed to open a storage room at school equipped with wooden and stainless steel shelves, tables, wooden crates.

5. Observe groups as they carry out the tasks. Provide assistance where needed.

6. After all groups have finished their tasks, ask them to share their findings.

7. Invite group representatives to share the experience they have gained throughout the session.

Application Activity

1. Organise a visit to a plant for processing fruits and vegetables. Get the necessary permissions and reserve a date.

2. Have trainees turn to **Topic 1.3 Task 4** in their manuals and explain to them that you are going to visit a fruit/vegetable processing plant.

3. Guide trainees in creating a checklist for items they need to observe during the visit. Have them consider the following when drafting the list:
   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 are stored.

4. Ask trainees to formulate questions they would like to ask during their visit.

5. Discuss protocol for visits to the processing plant: safety measures, preparation, and follow-up.

6. Guide the plant visit.

7. Ask trainees to write what they have seen after their visit to the processing plant.

8. Make sure trainees have covered all the points on their checklist and add in any questions they may have asked or heard answered during the visit.

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.

Ask trainees to:

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. Ask trainees to re-take the self-assessment at the beginning of the unit. They should then fill in the table in the Trainee's Manual to identify their areas of strength, areas for improvement and actions to take to improve.

2. Discuss trainees' results with them. Identify any areas that are giving many trainees difficulties and plan to give additional support as needed (ex. use class time before you begin the next learning outcome to go through commonly identified difficult concepts).

Further Information for the Trainer

1. Bakka, R 1995. Making the Right Choice-Cleaners. Ecolab, Inc/Food & Beverage Div., St. Paul, MN.
2. Boufford, T. 1996. Making the Right Choice-Sanitizers. Ecolab, Inc/Food & Beverage Div., St. Paul, MN.
3. Barnard, S. Extension. Handout. Penn. State Univ.
4. Cords, B.R. and G.R. Dychdala. 1993. Sanitizers: Halogens, Surface-Active Agents, and Peroxides. Pp. 36-52. In: P M. Davidson and A. L. Branen, (eds.). Antimicrobials in Foods. Marcel Dekker, Inc., New York, NY
5. Food Code 1995. U.S. Public Health Service, Food and Drug Admin., Washington, DC.
6. Grade A Pasteurized Milk Ordinance, 1995. Revision. U.S. Public Health Service, FDA, Washington, DC.
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Learning Unit 2: Assist in processing fruits and vegetables

Learning Outcomes

By the end of the Learning Unit, trainees will be able to:

2.1 Perform measuring and mixing of ingredients

2.2 Apply processing techniques

2.3 Assess quality of products

Learning Unit 2: Self-Assessment

1. Before teaching Unit 2, ask trainees to observe and discuss what the pictures of fruits and vegetables in different situations represent. Be sure all trainees notice the main topics of the unit in the pictures, including mixing ingredients, checking quality of and processing fruits and vegetables in different products such juices, jams, sauces and pastes and their packaging.

2. After the explanations given above, ask trainees to fill in the self-assessment table in their trainee's manual. Remind trainees that the self-assessment is not a test!

Learning Outcome 2.1: Perform measuring and mixing of ingredients

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

a. Measure concentration of sugars and acidity in fruits and vegetables

b. Formulate recipes for juice, sauce, and paste making

Time Required: 10 hours

Learning Methodology: Individual and group work, practical exercises

Materials Needed:

- **Consumables**: Additives, preservatives, muslin bag
- **Equipment:** Mixing tank
- **Measurement tools**: Weighing scales, refractometer, pH meter

Preparation:

- ❑ Arrange working refractometer, pH meter, calibrated weighing scales into place.
- ❑ Arrange graduated cups in place.
- ❑ Purchase record notebook.

Cross Cutting Issues:

- ✓ **Standardisation culture:** While measuring and mixing, use proper, standard amounts and techniques.
- ✓ **Environment and sustainability:** While throwing away produce, emphasize the need to protect the environment through proper disposing of waste materials as they represent hazards for employees and the environment.
- ✓ **Gender:** While forming small groups, consider gender balance.

Prerequisites:

- Basic Math: Addition, subtraction, multiplication, quantities (kg, grams), volumes (litres, millilitres)

Key Competencies:

Knowledge	Skills	Attitudes
1. State ingredients for juice, jam, sauce, and paste	**1.** Choose ingredients for juice, jam, sauce and paste making	**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

Steps:

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

1. Ask trainees to turn to **Topic 2.1 Task 1** in their manuals and do the following with a partner:
   a. Discuss what you know about making jams or juices.
   b. Can you outline some steps in the process?

2. Ask for a few volunteers to share their responses.

3. Conclude by introducing the objectives of learning outcome and the Key Competencies.

Problem Solving Activity

1. Put trainees in small groups.

2. Ask each group to answer the following questions found in **Topic 2.1 Task 2**:
   a. Why are some juices sweeter than others?
      Possible Answers:
      - Type of fruit and its natural sweetness
      - Growing conditions and the climate
      - Quantity of added sugar or water
      - Quantity of remaining water after heating

   b. What can you do to prolong the shelf life of juices, jam, sauces, and pastes?
      Possible Answers:
      - Heat and/or add preservatives
      - Package

   c. Which materials are used to measure water and weigh sugar?
      Possible Answers:
      - Water is measured in litres (centilitres, millilitres) in graduated measuring cups, jars, buckets or other graduated containers
      - Sugar is weighed in grams (centigrams, milligrams) on a scale

3. Give trainees some time to respond to the questions.

4. After the discussions, have each group share their work/answers with the rest of the class. As groups present their work, encourage other trainees to ask questions and add anything they have.

5. After all groups have presented, refer participants to their training manuals**, 2.1 Key Facts** and review it together.

Guided Practice Activity

1. Tell trainees to remain in their groups. Explain that together with your help, they 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. Remind trainees 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. Ask trainees to turn to **Topic 2.1 Task 3** and use the information in **2.1 and 2.2 Key Facts** as needed to perform the following tasks in their respective groups. (You should have gathered the materials and ingredients beforehand.)

a. Choose some fruits and vegetables among the ones the trainer has provided for making juice, jam, paste, and sauces (tomatoes, pineapples).

b. Choose preservatives for juice, jam, sauces, paste among the ones trainer has provided: Sodium benzoate, Sodium sorbate, citric acid, sugar, salt, water, and pectin. **Note:** Trainer should explain that pectin helps set the jams and jellies. It can be made naturally or purchased in liquid or powder form.

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. Explain how to use a Pearson Square to determine mixtures and then 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.

Answers:

Use a Pearson Square to find

Orange juice: 77% which is 41/53 parts

Sugar syrup: 23% which is 12/53 parts

5. After all groups have finished their task, ask them to share findings.

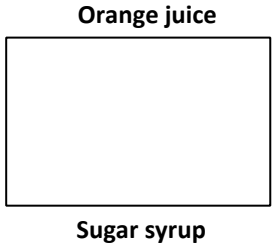
6. Invite group representatives to share the experience they have gained throughout the session.

Application Activity

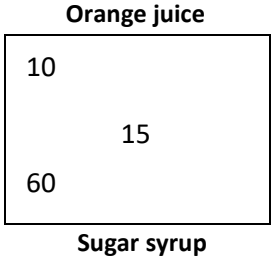
1. Give trainees time to talk about the chemical preservatives for the juices, jams, and pastes that they have observed in shops.

2. Provide trainees in a processing room at school with a refractometer, distilled water, clean cloth, orange fruit (that contains 10% sugar), and a 60% sugar syrup to prepare a fruit drink with a final sugar concentration of 15%.

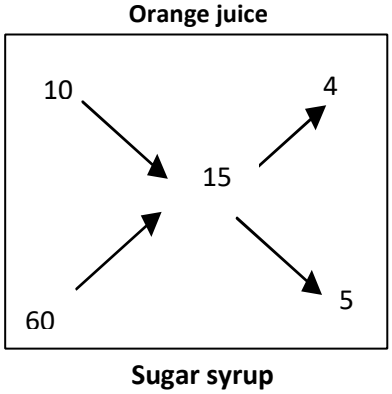
Answer:
Draw a rectangle and label the two horizontal lines with the names of the two products to be blended (fruit juice and sugar syrup).



Enter the sugar composition of each product in the rectangle as shown below and put the desired final concentration of sugar (the Brix) in the centre of the box:



Mix the two components by crossing diagonally through the centre of the rectangle.



Following the arrows, subtract the smaller number from the larger one to give two new numbers (45 and 5) in the opposite corners of the rectangle. These numbers (10% orange juice and 60% sugar syrup) are the amounts that need to be mixed (45 parts of orange juice and 5 parts of sugar syrup) to give a fruit drink with a final sugar concentration of 15%.

3. Give more examples to trainees to solve if there is time. Work out the responses beforehand so you can easily assist them.

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 amounts (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

Tell the trainees to complete the following:

1. List the main ingredients added in:

a. Juice
Answer: Sugar, preservatives

b. Jam
Answer: Sugar, preservatives

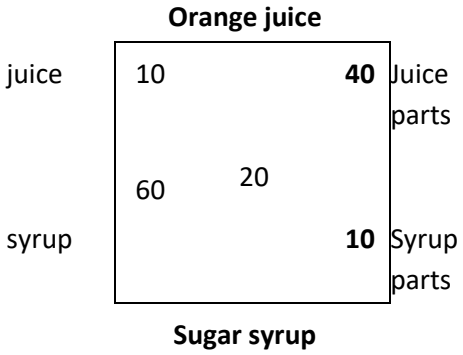
c. Sauces
Answer: Salt, preservatives

d. Pastes
Answer: Salt, preservatives

2. Explain why it is necessary to measure ingredients in a recipe.
   Answer: To optimize quality and quantity of a food acceptable by standards.

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.
   Answers:
   Fruits: Pineapple, guava, passion fruit, tree tomato, bananas
   Vegetables: Tomatoes, onions, green leafy vegetables, carrots, eggplant

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.
   Answer:
   Sugar syrup: 10 parts = 10/50 = **20%**
   Orange juice: 40 parts = 40/50 = **80%**



Further Information for the Trainer

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3. Jorge E. L (2006). Fruit manufacturing. Scientific Basis, Engineering Properties, and Deteriorative Reactions of Technological Importance. Springer Science and Business Media, LLC, U.S.
4. Sharon. P. S. and Martha. C. S (2010). Post-harvest technology of horticultural crops. Oxford Book Company, New Delhi.
5. Small-scale processing of ready to drink pineapple juice. Food Chain No 27 Principles and practices of small and medium-scale fruit juice processing. FAO Agricultural Services Bulletin 146, Food and Agriculture Organization of the United Nations (FAO), Rome (2001).

Learning Outcome 2.2: Apply processing techniques

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

a. Extract juice

b. Use preservatives in juice, jam, sauce and paste making

c. Use heating equipment for juice, jam, sauce and paste making

Time Required: 50 hours

Learning Methodology: Practical exercises, group work, brainstorming, discussion, demonstration, field visit

Materials Needed:

- **Consumables**: Additives, preservatives, muslin bag
- **Equipment:** Mixing tank
- **Measurement tools**: Weighing scales, refractometer, and pH meter

Preparation:

- ❑ Put the working blender and processing unit in place.
- ❑ Print out the labels.
- ❑ Buy and arrange the packaging materials and preservatives.
- ❑ Contact industries to organize a visit to observe processing techniques of juices, jam, sauces, and pastes.

Cross Cutting Issues:

- ✓ **Environment and sustainability:** While processing, emphasize the need to protect the environment through proper disposing of used water, wastes of peels and seeds from produce as they represent hazards for employees and the environment.
- ✓ **Standardisation:** While packaging, consider standardised procedures.
- ✓ **Financial education:** Consider financial education while identifying the cost and value of processing equipment.
- ✓ **Gender:** While forming small groups, consider gender and inclusivity.

Prerequisites:

- Basic Math: addition, subtraction, multiplication, quantities (Kg, grams), volume (litres, millilitres)




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

Steps:

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

1. Ask trainees to turn to **Topic 2.2 Task 1** in their manuals and discuss the following in small groups:
   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. Ask groups to share their responses and discuss as a class.

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

Problem Solving Activity

1. Present the flow charts in **2.3 Key Facts** for making juice and paste found under **Topic 2.2 Task 2**.

2. Put trainees in groups of 12 trainees each, if possible.

3. Ask trainees to follow these steps as a group:
   a. Start with juice making. Each trainee in their group writes on a sheet of paper ONE of the key manufacturing stages of juice. Make sure there are no repetitions.
   b. Instruct the trainees to mix the pieces of paper up.
   c. Then they should 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.

4. Discuss any questions trainees may have regarding the steps in the process of making juice, paste, jam, and sauce.

5. Explain to trainees that now they are going to practise using the flow charts to find information. Ask trainees to:
   a. Look at the flow chart for juice making. Ask them to describe how to pasteurize pineapple juice.
      Answer: Heat up the juice to 78° Celsius for 15 seconds before filling and storage.

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.
Answer: The equipment needed includes a pasteurizer, jars, packaging materials, spoon, thermometer, cooling machine, crusher, filters, graduated bucket, weighing balance, blender, refractometer, pH meter, knife, slicer, fillers, sealers, and stirrer.

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.
Answer: See **2.3 Key Facts** for paste and sauce making.

6. Have each group share their work/answers to questions in steps a – c above with the rest of the class. As groups present their work, encourage other trainees to ask questions and add any comments they have.

Guided Practice Activity

Before class, prepare the food processing area to make pineapple juice and jam and tomato sauce and paste. This includes gathering the ingredients and the equipment. Set up areas in the room to be able to prepare the different products.

1. Tell trainees to remain in their groups from the previous activity and turn to **Topic 2.2 Task 3** in their manuals.

2. Demonstrate or show videos in the classroom on making pineapple juice, jam, tomato sauce and paste. **Note:** You might have these videos at the training centre or search online for videos appropriate to your context.

3. Explain to trainees that they are going to now practice making the different products. There are different stations around the room – one area for making pineapple juice and jam and another for making tomato paste and sauce.

4. Divide the class amongst the two main areas. After finishing the products at the assigned station, they will switch and make products at the other station.

5. Ask trainees in their respective groups to:
   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.

6. Observe groups as they carry out the tasks. Provide assistance where needed.

7. After all groups have finished their tasks, ask them to share their final products.

8. Invite each group representatives to share the experience they have gained throughout the session.

Application Activity

1. Organise a visit to a local food processing factory or small scale operation centre.

2. Ask trainees to turn to **Topic 2.2 Task 4** and explain to them that during the visit they will be expected to make observations on the following points:
   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. Back in the classroom, form groups and assign each group one of the five areas above to report back on. Other groups can supplement their responses according to their own observations.

4. Answer any questions trainees may have about processing fruits and vegetables based on what they observed in the food processing factory or centre.

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**.**
   Answer: False

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

3. Explain the key manufacturing stages of a fruit juice.
Answer: Look at flow chart in **2.3 Key Facts.**

Further Information for the Trainer

1. Ansari, I.A. and Datta, A.K (2003). An overview of sterilization methods for packaging materials used in aseptic packaging systems. Institution of Chemical Engineers, Vol 81, Part C.
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3. Jorge E. L (2006). Fruit manufacturing. Scientific Basis, Engineering Properties, and Deteriorative Reactions of Technological Importance. Springer Science and Business Media, LLC, U.S.

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5. Sharon. P. S. and Martha. C. S (2010). Post-harvest technology of horticultural crops. Oxford Book Company, New Delhi.
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Learning Outcome 2.3: Assess quality of product

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

a. Check the sensory properties (colour, flavour, smell, texture) of juices, jam, sauces, and pastes

b. Measure concentration of sugar and acidity in juices, jam, sauces and pastes

c. Package juices, jam, sauces, and pastes

Time Required: 10

Learning Methodology: Brainstorming, problem solving in groups, practical exercises, field visit

Materials Needed:

- **Measurement tools:** pH meter, refractometer
- **Sample products**: Juice, jam, sauce and pastes
- **Standard training materials:** Flipchart, markers, pens, internet

Preparation:

- ❑ Make sensory evaluation tables available.
- ❑ Put clean water and garbage in place.

Cross Cutting Issues:

- ✓ **Standardisation culture:** When assessing the sensory quality of food products and while packaging, consider the benefits of standardised products.
- ✓ **Environment and sustainability:** While processing, emphasize the need to protect the environment through proper disposing of used water and wastes of peels and seeds from produce as they represent hazards for employees and the environment.
- ✓ **Financial education:** Consider financial education while calculating the cost of products and sales.
- ✓ **Gender:** Consider gender and inclusivity when forming small groups.

Prerequisites:

- Basic Math: addition, subtraction, multiplication, quantities (kg, grams), volume (litres, millilitres)

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

Steps:

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

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

2. Ask a few volunteers to share their responses and discuss.

3. Conclude by introducing the objectives of the learning outcomes and the Key Competencies table.

Problem Solving Activity

1. Ask trainees to form several small groups.

2. Ask each group to answer the following questions found in **Topic 2.3 Task 2**:
   a. What sensory factors should be considered when manufacturing juice, jam, sauce, and paste? In other words, juice, jam, sauce and paste should appeal positively to which of your senses?
      Answers: Colour, aroma, thickness, fluidity, appearance, general acceptability, etc.

   b. How are diluted juices differentiated from concentrated juices?
      Answers: Diluted juice has less Brix than concentrated ones.

   c. Describe how to determine Brix and pH of fruit and vegetable products.
      Answers: Use a refractometer to determine Brix. Use pH strips to determine pH values.

   d. What is the necessary information needed on the label of pineapple juice, jam, tomato sauce and paste?
      Answers:
      - Name and address of food factory
      - List ingredients in descending order of predominance by weight
      - The total percentage of food must be included (e.g. prepared with x grams fruit per 100 grams).

3. Give trainees some time to respond to the questions.

4. After the discussions, have each group share their work/answers with the rest of the class. As groups present their work, encourage other trainees to ask questions and add comments they have.

5. After all groups have presented, refer participants to **2.5 Key Facts** in their training manuals and review it together.

Guided Practice Activity

1. Tell trainees to remain in their groups and while providing the following items for each group:
   - score sheets for sensory evaluation
   - refractometer, pH meter
   - distilled water
   - clean cloth
   - packed pineapple juices and jams
   - tomato sauces and pastes

2. Ask trainees in their respective groups to turn to **Topic 2.3 Task 3**. Also refer them to **2.5 Key Facts** to complete the following:
   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.

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

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

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

3. Observe groups as they carry out the tasks for the provision of assistance where needed.

4. After all groups have finished the task, ask them to share their findings.

5. Invite group representatives to share the experience they have gained throughout the session.

Application Activity

1. Divide trainees into two main groups. One group will make pineapple juices and jams; the other one will make tomato sauces and pastes.

2. The group who made pineapple juices and jam is invited to evaluate the sensory quality of the tomato sauces and pastes. Allow the group that made sauces and pastes to evaluate the sensory quality of the juices.

3. Ask trainees to identify packaging materials they could use for the juice, jam, sauce and paste. How have they seen these types of products packaged in the shops and market? What would be best for the environment?

   Possible Answers: Recycled glass containers that have been sterilized. The best packaging for the environment is biodegradable or made from recycled materials. Light weight plastic containers can out preform glass one in cost, weight and emissions required to transport them. However, adequate recycling facilities must available to minimize environmental impact otherwise such plastic containers negatively affect the environment more than glass.

4. Ask volunteers to share the results of the sensory quality evaluations and discuss.

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 ……..
Answers: Flavour, colour, appearance

2. Determine if the following statements are true or false:
- **a.** Brix is determined only in juices.
  Answer: False

- **b.** Sauce and paste are made only from tomato.
  Answer: False

- **c.** Concentrated juice is sweeter than diluted juice.
  Answer: True

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.
Answers: Off-flavour, leaking, discolouration, bad packaging

6. List 10 pieces of information that should be shown on the label of a food product
Possible Answers: Name of food factory, location of food factory, telephone number of the factory, website of the factory, email of the factory, list of ingredients, total percentage of food, serving size, preparation before consumption, nutrients contained in the food, manufacturing and expiration dates, allergies, restriction to consumers

7. Identify the key parameters to evaluate the quality of juices, jams, pastes, sauces.
Answers: Colour, aroma, thickness, fluidity, appearance, general acceptability, packaging materials

Self-Reflection

1. After teaching Unit 2, ask trainees to fill in the self-reflection table found in their trainee manuals noting their areas of strength, areas for improvement and actions to take to improve. Remember that the self-reflection is not a test!!!

2. After going through what trainees have written in the self-reflection table above in (1), reorganize learning activities such as group discussions, demonstrations, watching videos, practical exercises, and visits to industries based on feedback from many trainees. Make improvements based on the difficulties that trainees report.

Summative Assessment

Integrated situation	Resources
Ms. Kantengwa is a production manager at Rwamagana fruits and vegetable factory located in Rwamagana district. There was an urgent order placed for juices, jams, sauces, and pastes over the weekend. Ms. Uwimana, a person who is involved in processing, was not informed in time about the order, and she arrived late. Thus, Ms. Kantengwa decided to hire someone to perform the required activities for processing juices, jams, sauces, and pastes. The trainee must demonstrate that they are a skilled fruit and vegetables processing worker by performing the following: • Sanitize the entire workplace • Receive and prepare produce • Process produce for 50 litres of diluted juices, 50 litres of concentrated juices, and 20 kg of jam. The diluted and concentrated juices, and jams should have 7, 20 and 50 Brix respectively. • Receive and sort a load of tomatoes • Process tomatoes into 20kg of pastes and 20kg of sauces	✓ Mango fruits ✓ Tomatoes ✓ Maturity rating charts ✓ Sugar ✓ Water ✓ Sodium Benzoate ✓ Potassium sorbate ✓ PPE ✓ Brushes ✓ Containers ✓ Washing tanks ✓ Washing machine, ✓ Chlorine based detergents ✓ Detergents ✓ Towels ✓ Sponges ✓ Quaternary ammonium based detergents ✓ Stainless steel fruit juice pasteurizer machine ✓ Bottles ✓ Saucepan ✓ Wooden spoon for stirring ✓ Sieves ✓ Tables

- All this should be done within 3 hours.

- ✓ Sharp knives
- ✓ Forks
- ✓ Jugs
- ✓ Cups
- ✓ Spoons
- ✓ Mixer
- ✓ Compressors
- ✓ Blender
- ✓ Cutters
- ✓ Basins
- ✓ Beakers
- ✓ Pans
- ✓ Utility trays
- ✓ Juice blender
- ✓ Refractometer
- ✓ pH meter
- ✓ Utensils
- ✓ Slicers
- ✓ Electronic balance
- ✓ Mechanic balance
- ✓ labels machine
- ✓ Measuring cylinder

Assessment Criterion 1: Quality of process

Checklist	Score	
	Yes	No
Indicator 1: Sources of contaminants is properly identified based on the design of workplace and equipment		
Biological		
Physical		
Chemical		
Indicator 2: Cleaning and sanitizing of the work area and equipment are properly according to sanitation regulations		
Detergents/sanitizers		
Sanitized workplace		
Sanitized equipment		
Sanitizing tools		
Indicator 3: Quality of fruits and vegetables are properly selected according to characteristics of an intended derivative product		
Ripe mangoes		
Ripe tomatoes		
Indicator 4: Physical quality of fruits and vegetables are properly checked according to characteristics of an intended derivative product		
Density		
Ripeness rating charts		
Indicator 5: Chemical quality of fruits and vegetables is accurately tested based on protocol		
Sugar content		
Acidity		
Refractometer		
pH meter		
Indicator 6: Fruits and vegetables are properly sorted and graded according to standards		
Size		
Ripeness		
Uses rating charts		
Indicator 7: Fruits and vegetables are appropriately rejected/refused based on the standards and factory requirements		
Rejected produce		
Bins		
Indicator 8: Fruits and vegetables are properly washed and sanitized in line with regulations		
Washed and sanitized mangoes		
Washed and Sanitized tomatoes		

Washing tanks		
Sanitizing tanks		
Detergents/Sanitizers		
Indicator 9: Sanitized fruits and vegetables are properly stored according to facility conditions		
Storage room		
Thermometer		
Mangoes in storage room		
Tomatoes in storage room		
Record of temperature in storage room		
Indicator 10: Ingredients are accurately measured and mixed according to recipe specification		
Ingredients available		
Recipe is followed		
Preservatives are added if needed		
Mixtures are correct		
Weighing scale is used correctly		
Measuring instruments are used correctly		
Indicator 11: Processing techniques are properly applied according to product specification and requirements		
Pasteurizers		
Heaters		
Extraction and clarifying enzymes		
Juices		
Squashes		
Jams		
Sauces		
Pastes		
Indictor 12: Quality of products are adequately assessed according to specifications and standards		
Refractometer		
pH meter		
Sensory evaluation sheets		
Grade of flavour		
Grade of texture		
Grade of aroma		
Grade of appearance		
Indicator 13: Packaging materials are properly selected according to product specification and standards		
Packaging materials are appropriate for product		

Package is labelled		
Indicator 14: Product are properly packaged and labelled according to specification and standards		
Product is packaged correctly		
Labels contain all relevant information		
Indicator 15: Finished products are properly stored in accordance with storage parameters and specification		
Thermometer is used to determine temperature		
Record of temperatures		
Storeroom is correct temperature		
Observation		

Assessment Criterion 2: Quality of product

Checklist	Score	
	Yes	No
Indicator 1: Juices, jams, sauces, and pastes are properly packaged		
Light container		
Much information on the label		
Easy opening		
Indicator 2: Juices, jams, sauces, and pastes are available for sale		
Attractive appearance		
Enough quantity		
Observation		

Assessment Criterion 3: Relevance

Checklist	Score	
	Yes	No
Indicator 1: Time is effectively managed		
Duration: 3 hours		
Indicator 2: Quality of juices, jams, sauces, and pastes is accurately respected		
13 brix for diluted juices		
23 brix for squashes		
55 brix for jams		
Indicator 3: Number of juices, jams, sauces and pastes is completely available		
22 litres of mango diluted juices		
22 litres of mango squashes		
10 kg of mango jams		
10 kg of tomato sauces		
10 kg of tomato pastes		
Observation		

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