



RQF LEVEL 5



FOPRT503

FOOD PROCESSING

Roots And Tubers Processing into Starch & Crisps

TRAINER'S MANUAL

October, 2024



ROOTS AND TUBERS PROCESSING INTO STARCH & CRISPS



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ACRONYMS

%: Percentage

°C: Degree Celsius

°F: Degree Fahrenheit

ADF: Acid Detergent Fiber

CA: Controlled atmosphere storage

CBT/A: Competency-Based Training and Assessment

CFU: Colony forming unit

CIP: Cleaning in Place

COP: Cleaning out of Place

E. coli: Escherichia coli

e.g: Example

EFSA: European Food Safety Authority

FDA: Food and Drug Administration

FFA: Free Fatty Acids

FIFO: First In, First Out

FOP: Food Processing

gr: Gram

IC: Indicative content

kHz: Kiloheiz

KOICA: Korea Cooperation International Cooperation Agency

MAP: Modified atmosphere packaging

Mm: Millimetre

MPN: Most Probable Number

MSG: Monosodium glutamate

NaCl: Sodium Chloride

NDF: Neutral Detergent Fiber

PE: Polyethylene

pH: Hydrogen potential

PP : Polypropylene

PPE: Personal protective equipment

PTS: Press-to-Seal

PVC: Polyvinyl chloride

RTB: Rwanda TVET Board

SDA: Sabouraud Dextrose Agar

TQUM Project: TVET Quality Management Project

TSS: Technical Secondary School

VFFS: Vertical Form-Fill-Seal

INTRODUCTION

This trainer's manual includes all the methodologies required to effectively deliver the module titled "**Roots and Tubers Processing into Starch & Crisps.**" Trainees enrolled in this module will engage in practical activities designed to develop and enhance their competencies.

The development of this training manual followed the Competency-Based Training and Assessment (CBT/A) approach, offering ample practical opportunities that mirror real-life situations.

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

As a trainer, you will begin by asking questions related to the activities to encourage critical thinking and guide trainees toward real-world applications in the labor market. The manual also outlines essential information such as learning hours, didactic materials, and suggested methodologies.

This manual outlines the procedures and methodologies for guiding trainees through various activities as detailed in their respective trainee manuals. The activities included in this training manual are designed to offer trainees opportunities for both individual and group work. Upon completing all activities, you will assist trainees in conducting a formative assessment known as the end learning outcome assessment. Ensure that trainees review the key reading and the points to remember section.

MODULE CODE AND TITLE: FOPRT503 ROOTS AND TUBERS

PROCESSING INTO STARCH &CRISPS

Learning Outcome 1: Receive Roots and Tubers

Learning Outcome 2: Prepare Roots and Tubers

Learning Outcome 3: Make Starch

Learning Outcome 4: Make Crisps

Learning Outcome 1: Receive Roots and Tubers



Indicative contents

- 1.1 Preparing Workplace**
- 1.2 Selecting Packaging Materials used in Processing of Starch and Crisps**
- 1.3 Selecting Seasoning Ingredients used in Crisps Making**
- 1.4 Analysing the Quality of Roots and Tubers**
- 1.5 Storing Raw Materials**

Key Competencies for Learning Outcome 1: Receive Roots and Tubers

Knowledge	Skills	Attitudes
● Description of tools and equipment used in processing roots and tubers into starch and crisps ● Description of cleaning agents ● Description of packaging materials of starch and crisps ● Description of seasoning ingredients used in crisps making ● Description of quality parameters of roots and tubers ● Description of the factors affecting deterioration of roots and tubers	● Selecting tool and equipment ● Adjusting tools and equipment ● Cleaning tools and equipment ● Checking the cleanliness of workplace ● Arranging workplace ● Selecting packaging materials used in processing of starch and crisps ● Selecting seasoning ingredients used in crisps making ● Checking the quality of raw materials ● Storing roots and tubers	● Being responsible while selecting tools and equipment ● Being diligent in cleaning workplace ● Having awareness of safety precautions when using cleaning agents. ● Being a critical thinker in evaluating the quality of raw materials. ● Being accurate in sorting raw materials based on size, quality, and other criteria. ● Being good observer to identify defects or abnormalities.

		• Being organizer in storage practices. • Being a Problem-solver to identify and address any issues that may arise during storage.
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Duration: 8 hrs

Learning outcome 1 objectives:



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

1. Describe correctly the tools and equipment used in processing roots and tubers into starch and crisps
2. Select appropriately the tool and equipment used in processing roots and tubers into starch and crisps according to the selection criteria
3. Adjust correctly tools and equipment used in processing roots and tubers into starch and crisps
4. Describe correctly cleaning agents used in processing roots and tubers into starch and crisps
5. Clean correctly the workplace, tools and equipment used in processing roots and tubers into starch and crisps
6. Check effectively cleanliness of workplace for processing roots and tubers into starch and crisps
7. Arrange properly the workplace for processing roots and tubers into starch and crisps
8. Describe correctly packaging materials used in processing roots and tubers into starch and crisps
9. Select properly packaging materials used for processing roots and tubers into starch and crisps
10. Describe correctly seasoning ingredients used in processing roots and tubers into crisps
11. Select properly seasoning ingredients used in processing roots and tubers into crisps
12. Describe correctly the quality parameters of roots and tubers for processing roots and tubers into starch and crisps
13. Check effectively the quality of raw materials for making starch and crisps
14. Describe correctly the factors affecting deterioration of roots and tubers for processing roots and tubers into starch and crisps
15. Store properly roots and tubers for processing roots and tubers into starch and crisps



Resources

Equipment	Tools	Materials
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● Washing machine ● Peeling machine ● Slicing machine ● Grater ● Blancher ● Flavouring machine ● Packaging machine ● Dewatering machine ● De-oiling machine ● Frying machine ● Sorting and grading machine ● Sedimentation tank ● Centrifuge ● Drying machine ● weighing scale ● PPE ● Working table ● Grinder ● High pressure water machine.	● Brushes ● Sieves ● Spoons ● Knives ● Basins ● Dustbins ● Squeegee ● Brooms ● Mop ● Buckets ● Moisture-meter ● Thermometer ● Timer	● Packaging materials ● Cleaning products ● Crisps Seasonings ● Roots and tubers (Cassava, Irish potatoes, sweet potato, Yams) ● Labels ● Cooking oil ● Towels
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Advance Preparation:

Before delivering this learning outcome, you are recommended to:

- Have classroom and workshop
- Avail fresh roots and tubers

- Avail tools and equipment which are in good working conditions for processing roots and tubers into starch & crisps
- Avail not expired cleaning agents
- Avail not expired seasoning ingredients for crisps
- Prepare teaching aids and didactic materials (manuals/guides, protocol, videos and photos) for receiving roots and tubers



Indicative content 1.1: Preparing Workplace



Duration: 3 hrs



Theoretical Activity 1.1.1: Description of tools and equipment used in processing roots and tubers into starch and crisps



Notes to the trainer:

- Trainer may use small groups to describe the tools and equipment used in processing roots and tubers into starch and crisps
- Trainer may avail photos as didactic materials to describe tools and equipment used in processing roots and tubers into starch and crisps



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to answer the following questions:
- i. What do you understand by terms starch and crisps?
 - ii. What could be the tools and equipment used in processing roots and tubers into starch and crisps?
 - iii. Based on the list of tools and equipment provided in question (ii) what could be the use of each tool and equipment?
 - iv. What could be the safety precautions to be followed when using tools and equipment for processing roots and tubers into starch and crisps?
- Step 2:** Ask trainees to write the findings on papers, flip chart.
- Step 3:** Facilitate trainees to present their findings.
- Step 4:** Provide the expert view and clarify ideas by using didactic materials.
- Step 5:** Address any questions or concerns.
- Step 6:** Ask trainees to read the key reading 1.1.1 in trainee manual



Points to Remember

- When describing tools and equipment used in processing roots and tubers into starch and crisps, consider:
 - ✓ Functions
 - ✓ Materials
 - ✓ Specific tasks it performs in the production process
 - ✓ Safety precautions or procedures associated with using the tool or equipment.



Practical Activity 1.1.2: Selecting and adjusting tools and equipment used in processing roots and tubers into starch and crisps



Notes to the trainer

- Trainer may use individualized work for demonstrating how to select and adjust tools and equipment used for processing roots and tubers into starch and crisps
- Avail photos and videos as didactic materials for selecting and adjusting tools and equipment
- Avail tools and equipment to be selected and adjusted that are used for processing roots and tubers into starch and crisps



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go to the roots and tubers processing workshop to select and adjust tools and equipment used in processing roots and tubers into starch and crisps.
- Step 2:** Explain the task and provide clear work instructions (PPE, Time allocated)
- Step 3:** Demonstrate how to select and adjust tools and equipment for starch and crisps making. While demonstrating, explain the selection criteria and adjustment procedure.

- Step 4:** Ask trainees to select and adjust tools and equipment for starch, crisps making.
- Step 5:** Verify whether tools and equipment for starch and crisps making are correctly selected and adjusted and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 1.1.2 in the trainee manual
- Step 7:** Ask trainees to perform the task provided in the application of Learning 1.1



Points to Remember

- While selecting tools and equipment used in processing roots and tubers into starch and crisps
 - ✓ Ensure the tool or equipment is designed and capable of handling the intended tasks efficiently.
 - ✓ Choose tools and equipment that are appropriate for the scale of production and the volume of materials being processed.
- While adjusting tools and equipment used in processing roots and tubers into starch and crisps
 - ✓ Refer to the user manual for specific instructions on adjusting the tool or equipment.
 - ✓ Prioritize safety during adjustments, following proper procedures and wearing appropriate protective gear.



Theoretical Activity 1.1.3: Description of cleaning for processing roots and tubers into starch and crisps



Notes to the trainer:

- Trainer may use small groups to describe cleaning in processing roots and tubers into starch and crisps
- Avail photos and videos as didactic materials for describing cleaning used in processing roots and tubers into starch and crisps



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to answer the following questions:

- i. What do you understand by cleaning agents?
- ii. What could be the selection criteria of cleaning agents used in processing roots and tubers into starch and crisps?
- iii. What could be the safety precautions that should be respected while using cleaning agents?
- iv. Which are the direction for using cleaning agent?
- v. What are the factors affecting effectiveness of cleaning?
- vi. Differentiate wet cleaning from dry cleaning as methods of cleaning
- vii. Differentiate Cleaning in Place from Cleaning out place as techniques of cleaning

Step 2: Ask trainees to write the findings on papers, flip chart.

Step 3: Facilitate trainees to present their findings

Step 4: Provide the expert view and clarify ideas by using didactic materials.

Step 5: Address any questions or concerns.

Step 6: Ask trainees to read the key reading 1.1.3 in trainee manual



Points to Remember

- While using cleaning agents in cleaning:
 - ✓ Always prioritize safety
 - ✓ Choose cleaning agents that are effective for the specific contaminants and surfaces.
 - ✓ Follow the manufacturer's instructions for using cleaning agents



Practical Activity 1.1.4: Arranging the workplace for processing roots and tubers into starch and crisps



Notes to the trainer

- Trainer may avail a disorganized roots and tubers processing workshop.
- The trainer may request every trainee to arrange the roots and tubers processing workplace.
- Trainer may avail some video, pictures/drawing illustrating the process flow chart of starch and crisps processing



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in roots and tubers processing workshop to clean and arrange the workplace for processing roots and tubers into starch and crisps.
- Step 2:** Explain the task and provide clear work instructions (PPE, Time allocated)
- Step 3:** Demonstrate how to clean and arrange the workplace. While demonstrating, explain clearly the purpose of workplace arrangement and the safety to follow for arranging work area of starch and crisps
- Step 4:** Ask trainees to do the task individually.
- Step 5:** Providing more explanations where necessary.
- Step 6:** Verify whether the workplace is well clean and arranged, and provide feedback on each trainee's product
- Step 7:** Orient trainees to read key reading 1.1.4 in trainee manual
- Step 8:** Ask trainees to perform the task provided in application of learning 1.1



Points to Remember

- While cleaning and organizing workplace for processing roots and tubers into starch and crisps:
 - ✓ Always prioritize safety when working in a food-processing environment.
 - ✓ Maintain a clean and sanitized environment to prevent contamination.



Practical Activity 1.1.5: Checking the cleanliness of workplace in processing roots and tubers into starch and crisps



Notes to the trainer

- The trainer may use individualized method for demonstrating how to check cleanliness of workplace for processing roots and tubers into starch and crisps.
- The use of photos and videos as didactic materials is required.



Key steps:

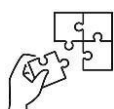
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in the roots and tubers processing workshop to check the cleanliness of workplace for processing roots and tubers into starch and crisps
- Step 2:** Explain the task and provide clear work instruction (PPE, Time allocated)
- Step 3:** Demonstrate how you can check the cleanliness of workplace for process roots and tubers into starch and crisps. While demonstrating, explain the procedures and methods.
- Step 4:** Ask trainees to check the cleanliness of workplace for process roots and tubers into starch and crisps and monitor the procedures.
- Step 5:** Verify whether the checking cleanliness of workplace for processing roots and tubers into starch and crisps is properly checked and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 1.1.5 in trainee manual
- Step 7:** Ask trainees to perform the task provided in application of learning 1.1



Points to Remember

- While checking cleanliness of workplace:
 - ✓ Conduct a thorough inspection of all areas of the workspace.
 - ✓ Pay attention to potential hiding spots for dirt and debris.
 - ✓ Record your findings for future reference.
 - ✓ Take prompt action to address any cleanliness issues identified



Application of learning 1.1.

Request trainees to go in the roots and tubers processing workshop to perform the following tasks:

Task1: Select and adjust tools and equipment for process roots and tubers into starch and crisps

Task 2: Clean workplace, tools and equipment for processing roots and tubers into starch and crisps

Task3: Check cleanliness of workplace for processing roots and tubers into starch and crisps

Task 4: Arrange the roots and tubers processing workshop

Checklist:

SN	Criteria	Indicators	Yes	No
1	Tools and equipment are appropriately selected according to the process of root and tubers into starch and crisps	1.1.Tools are selected		
		1.2.Equipment are selected		
2.	Tools and equipment are well adjusted according to the starch and crisps	2.1.Tools are adjusted		
		2.2.Equipment are adjusted		
3.	Workplace , tools and equipment are properly cleaned according to starch and crisps	3.1. workplace is cleaned		
		3.2. Tools are cleaned		

		3.3. Equipment are cleaned		
4.	Workplace are well arranged	4.1. Tools are arranged		
		4.2. Equipment are arranged		
5	Cleanliness of workplace are well checked	5.1. Visual inspection is done		
		5.2. Swab testing is done		
		5.3. Acidity test is done		



Indicative content 1.2: Selection of Packaging Materials used in Processing of Starch and Crisps



Duration: 1 hrs.



Theoretical Activity 1.2.1: Description of packaging materials of starch and



Notes to the trainer:

- Trainer may use small group for describing packaging materials for starch and crisps
- Trainer may avail photos and videos as didactic materials for describing packaging materials for starch and crisps



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to answer the following questions:
- i. What could be the packaging materials for starch and crisps
 - ii. What are the advantages and disadvantages of using plastic, paper, aluminium, glass, packaging for starch and crisps?
 - iii. What factors should be considered when selecting packaging materials for starch and crisps?
- Step 2:** Ask trainees to write the findings on papers, flip chart.
- Step 3:** Facilitate trainees to present their findings
- Step 4:** Provide the expert view and clarify ideas by using didactic materials.
- Step 5:** Address any questions or concerns.
- Step 6:** Ask trainees to read the key reading 1.2.1 in trainee manual



Points to Remember

- Select packaging materials that will effectively protect and promote starch and crisps products while meeting the needs of both consumers and regulatory requirements.



Practical Activity 1.2.2: Selecting packaging materials for starch and crisps



Notes to the trainer

- The trainer may demonstrate how to select packaging materials for starch and crisps
- The use of photos and videos as didactic materials is required



Key steps:

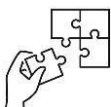
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go to the ice cream production workshop to select materials for processing roots and tubers into starch and crisps
- Step 2:** Explain the task and provide clear work instructions (PPE, Time allocated)
- Step 3:** Demonstrate how to select materials for processing roots and tubers into starch and crisps. While demonstrating, explain the selection criteria.
- Step 4:** Ask trainees to select materials for processing roots and tubers into starch and crisps and monitor the activity.
- Step 5:** Verify whether packaging materials for crisps and starch making are correctly selected and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 1.2.2 in the trainee manual
- Step 7:** Ask trainees to perform the task provided in the application of Learning 1.2



Points to Remember

- Select the packaging material that meets the needs of the product and the business objectives.



Application of learning 1.2.

Request trainees to go in roots and tubers processing workshop to select the packaging materials for processing roots and tubers into starch and crisps.

Checklist:

SN	Criteria	Indicators	Yes	No
1	Packaging materials are well selected	1.1.Safety precautions are taken into considerations		
		1.2.Starch packaging materials are selected		
		1.3.Crisps packaging materials are selected		



Indicative content 1.3: Selecting Seasoning Ingredients used in Crisps Making



Duration: 1 hrs



Theoretical Activity 1.3.1: Description of seasoning ingredients for crisps



Notes to the trainer:

- Trainer may use small group for describing seasoning ingredients for crisps
- Trainer may avail photos and videos as didactic materials for describing seasoning ingredients for crisps



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to answer the following questions:
(i)What could be the seasoning ingredients for crisps?
- Step 2:** Ask trainees to write the findings on papers, flip chart.
- Step 3:** Facilitate trainees to present their findings
- Step 4:** Provide the expert view and clarify ideas by using didactic materials.
- Step 5:** Address any questions or concerns.
- Step 6:** Ask trainees to read the key reading 1.3.1 in trainee manual



Points to Remember

- The seasoning ingredients can be used individually or in combination to create a wide variety of flavours and textures for crisps.



Practical Activity 1.3.2: Selecting seasoning ingredients for crisps making



Notes to the trainer

- The trainer may use individualized method for demonstrating how to select seasoning ingredient for crisps
- The use of photos and videos as didactic materials is required



Key steps:

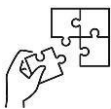
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in the roots and tubers workshop to select seasoning ingredients for crisps
- Step 2:** Explain the task and provide clear work instruction (PPE, Time allocated)
- Step 3:** Demonstrate how you can select seasoning ingredient for crisps. While demonstrating, explain the selection criteria.
- Step 4:** Ask trainees to select the seasoning ingredients for crisps and monitor the procedure.
- Step 5:** Verify whether the seasoning ingredients for crisps are properly selected and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 1.3.2 in trainee manual
- Step 7:** Ask trainees to perform the task provided in application of learning 1.3



Points to Remember

- While selecting seasoning ingredients for crisps:
 - ✓ Consider the desired taste profile, the type of crisp, and consumer preferences.
 - ✓ Avoid using too many different seasoning ingredients, as this can create a confusing or overpowering flavor.



Application of learning 1.3.

Request trainees to go in roots and tubers processing workshop to select seasoning ingredients for crisps making.

Checklist:

SN	Criteria	Indicators	Yes	No
1	Seasoning ingredients are well selected according to crisps making.	1.1.Dry ingredients are selected		
		1.2.Oils and fats are selected		
		1.3.Liquid ingredients are selected		
		1.4 Emulsions ingredients are selected		



Indicative content 1.4: Analysing the Quality of Roots and Tubers



Duration: 1 hrs.



Theoretical Activity 1.4.1: Description of quality parameters of roots and tubers.



Notes to the trainer:

- Trainer may use small group for describing quality parameters of roots and tubers
- Trainer may avail photos and videos as didactic materials for quality parameters of roots and tubers



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to answer the following questions:
(i) What could be the quality parameters of roots and tubers used in processing roots and tubers into starch and crisps?
- Step 2:** Ask trainees to write the findings on papers, flip chart.
- Step 3:** Facilitate trainees to present their findings
- Step 4:** Provide the expert view and clarify ideas by using didactic materials.
- Step 5:** Address any questions or concerns.
- Step 6:** Ask trainees to read the key reading 1.4.1 in trainee manual



Points to Remember

- While describing quality parameters of roots and tubers considering physical characteristics and chemical composition.



Practical Activity 1.4.2: Analysing quality parameters of roots and tubers



Notes to the trainer

- The trainer may use individualized method for demonstrating how to analyse quality parameters of roots and tubers
- The trainer may avail roots and tubers
- The use of photos and videos as didactic materials is required



Key steps:

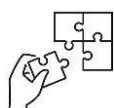
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in the roots and tubers processing workshop to analyse quality parameters of roots and tubers.
- Step 2:** Explain the task and provide clear work instruction (PPE, Time allocated)
- Step 3:** Analyse quality parameters of roots and tubers. While demonstrating, explain the procedures.
- Step 4:** Ask trainees to analyse quality parameters of roots and tubers and monitor the procedure.
- Step 5:** Verify whether the quality parameters of roots and tubers are properly analysed and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 1.4.2 in trainee manual
- Step 7:** Ask trainees to perform the task provided in application of learning 1.4



Points to Remember

- While analysing quality of roots and tubers:
 - ✓ Conduct a thorough analysis of all relevant quality parameters.
 - ✓ Use accurate and reliable methods for measurements and tests.
 - ✓ Record your findings clearly and comprehensively.
 - ✓ Follow safety guidelines when handling chemicals and equipment.



Application of learning 1.4.

Request trainees to go in roots and tubers processing workshop to analyse quality parameters of roots and tubers.

Checklist:

SN	Criteria	Indicators	Yes	No
1	Quality parameters of roots and tubers are well analysed	1.1. Color, shape, size, and surface texture are assessed		
		1.2. Signs of damage, defects, or foreign matter is checked		
		1.3. Moisture Content is analyzed		
		1.4 Dry matter is analyzed		
		1.5 Specific gravity is analyzed		
		1.6 Starch content is analyzed		
		1.7 Sugar content is analyzed		



Indicative content 1.5: Storing Raw Materials



Duration: 2hrs



Theoretical Activity 1.5.1: Description of the factors affecting deterioration of roots and tubers



Notes to the trainer:

- Trainer may use small group for describing the factors affecting deterioration of roots and tubers
- Trainer may avail photos and videos as didactic materials for the factors affecting deterioration of roots and tubers



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to answer the following question:
What could be the factors affecting deterioration of roots and tubers?
- Step 2:** Ask trainees to write the findings on papers, flip chart.
- Step 3:** Asks trainees to present their findings.
- Step 4:** Provide the expert view and clarify ideas by using didactic materials.
- Step 5:** Address any questions or concerns.
- Step 6:** Ask trainees to read the key reading 1.5.1 in trainee manual



Points to Remember

- ✓ Taking appropriate measures to prevent deterioration and maintain the quality of stored roots and tubers.



Practical Activity 1.5.2: Storing of roots and tubers



Notes to the trainer

- The trainer may use individualized method for demonstrating how to store roots and tubers
- The trainer may avail tools, materials and equipment to be used in storing roots and tubers
- The use of photos and videos as didactic materials is required



Key steps:

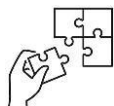
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in the food-processing workshop to store roots and tubers
- Step 2:** Explain the task and provide clear work instruction (PPE, Time allocated)
- Step 3:** Demonstrate how you can store roots and tubers and explain the procedures and techniques.
- Step 4:** Ask trainees to store roots and tubers and monitor the procedures.
- Step 5:** Verify whether the storing roots and tubers are properly stored and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 1.5.2 in trainee manual
- Step 7:** Ask trainees to perform the task provided in application of learning 1.5



Points to Remember

- Maintaining optimal temperature, humidity, and ventilation is crucial for preserving quality of roots and tubers.



Application of learning 1.5.

Request trainees to go in roots and tubers processing workshop to store roots and tubers for starch and crisps making.

Checklist

SN	Criteria	Indicators	Yes	No
1	Roots and tubers are well stored	1.1.Storage containers are selected		
		1.2.Storage conditions are respected		
		1.3. Storage techniques are applied		
		1.4. Record keeping is done		



Learning outcome 1 end assessment

Written assessment

I. Read the statements below related to receiving roots and tubers and encircling the letter corresponding to the correct response

1. When selecting equipment for processing roots and tubers, which of the following factors should be considered?

- A. Scale of production
- B. Desired product quality
- C. Safety
- D. All of the above
- E. None of the above

2. Which of the following is not a factor to consider when selecting equipment?

- A. Cost
- B. Efficiency
- C. Product type
- D. Color

3. Detergents are used to:

- A. Remove dirt and debris
- B. Sanitize surfaces
- C. Remove mineral deposits
- D. All of the above
- E. None of the above

4. Which of the following is a dry seasoning for crisps?

- A. Salt
- B. Oil
- C. Vinegar
- D. Mayonnaise

5. Emulsions are mixtures of:

- A. Dry powders and liquids.
- B. Oils and fats.
- C. Oils and water.
- D. Acids and bases.

6. Potatoes are a type of:

- A. Root
- B. Tuber

C. Fruit

7. Which of the following is not a physical characteristic of roots and tubers?

- A. Color
- B. Texture
- C. Moisture content
- D. Size

8. Which of the following is a chemical characteristic of roots and tubers?

- A. Shape
- B. Starch content
- C. Surface texture
- D. Germination**

9. Which of the following is a biodegradable packaging material?

- A. Plastic
- B. Aluminium
- C. Paper
- D. Glass

10. Which of the following factors can affect the deterioration of roots and tubers?

- A. Temperature
- B. Humidity
- C. Mechanical damage
- D. All of the above
- E. None of the above

11. Roots and tubers should be stored in a:

- A. Warm and humid environment.
- B. Cool and dry environment.
- C. Cold and wet environment.
- D. all of the above
- E. None of the above

12. Cold storage is suitable for:

- A. Storing roots and tubers at high temperatures.
- B. Preventing mold growth.
- C. Increasing respiration.
- D. None of the above
- E. All of the above**

13. Modified atmosphere packaging (MAP) is used to:

- A. Control the levels of oxygen, carbon dioxide, and nitrogen.
- B. Increase humidity.
- C. Reduce temperature.
- D. All of the above
- E. None of the above

14. Visual inspections are used to:

- A. Assess the cleanliness of surfaces.
- B. Check for equipment malfunctions.
- C. Monitor temperature and humidity.
- D. All of the above
- E. None of the above

Answer

- 1. **D. All of the above**
- 2. **D. Color**
- 3. **D. All of the above**
- 4. **A. Salt**
- 5. **C. Oils and water**
- 6. **A. Root**
- 7. **C. Moisture content**
- 8. **B. Starch content**
- 9. **C. Paper**
- 10. **D. All of the above**
- 11. **B. Cool and dry environment**
- 12. **B. Preventing mold growth**
- 13. **A. Control the levels of oxygen, carbon dioxide, and nitrogen.**
- 14. **D. All of the above**

II. Read carefully the statements below related to receiving roots, tubers, and answer by true if the statement is correct or answer by False if the statement is wrong

- 1. The size and shape of the root or tuber are factors to consider when selecting equipment.
- 2. The desired quality of the final product is not relevant to equipment selection.
- 3. The scale of production should be considered when choosing equipment.
- 4. Safety is not a crucial factor in equipment selection.
- 5. Alkaline cleaners are suitable for removing grease and organic matter
- 6. Oils and fats are used to add flavor and moisture to crisps
- 7. Sweet potatoes are a type of tubers

8. Starch content is not a relevant quality parameter for root and tuber products
9. Paper is not suitable for packaging crisps due to its moisture absorption
10. Mechanical damage can accelerate deterioration

Answer:

1. True
2. False
3. True
4. False
5. True
6. True
7. True
8. False
9. True
10. True

Practical assessment

The Production unit operating in your school wants to start a business of processing roots and tubers into starch and crisps for the purpose of exportation but it has low skills in receiving roots and tubers. You are requested to demonstrate how to receive roots and tubers for processing into starch and crisps by performing the following tasks within 4 hours:

Task1: Prepare workplace

Task 2: Select packaging materials for starch and crisps

Task 3: select seasoning ingredients for crisps

Task4: Analyse the quality of roots and tubers

Task5: Store raw materials

Checklist

SN	Criteria	Indicators	Yes	No
1	Workplace is well prepared	1.1 Tools and equipment are selected and adjusted		
		1.2 Tools and equipment are cleaned		
		1.3 Workplace is cleaned		
		1.4.workplace cleanliness is checked		
		1.5Workplace is arranged		
2	Packaging materials are well selected	2.1.Safety precautions are taken into considerations		
		2.2.Starch packaging materials are selected		
		2.3.Crisps packaging materials are selected		
3.	Crisps seasoning ingredients are well selected	3.1.Dry ingredients are selected		
		3.2.Oils and fats are selected		

		3.3.Liquid ingredients are selected		
4	Quality of roots and tubers is well analyzed	4.1 Physical qualities are analyzed		
		4.2 Chemical composition is analyzed		
5	Roots and tubers are properly stored	5.1.Storage containers are selected		
		5.2.Storage conditions are respected		
		5.3. Storage techniques are applied		
		5.4. Record keeping is done		

END



Further information to the trainer

Martinez, J. P. (2019). *A comprehensive guide to starch and crisp making equipment* (pp. 200-215). Advanced Food Tech Publications

Taylor, H. L. (2017). *Potato crisps: A guide to production and flavoring techniques* (pp. 150-165). Snack Master Press.

White, D. F. (2021). *Starch and snack production: Tools and machinery* (pp. 90-105). Snack Tech Publishing.

Learning Outcome 2: Prepare Roots and Tubers



Indicative contents

- 2.1 Sorting of Raw Materials**
- 2.2 Washing Roots and Tubers**
- 2.3 Peeling Roots and Tubers**
- 2.4 Grinding Roots and Tubers for Starch**
- 2.5 Slicing Roots and Tubers for Crisps**

Key Competencies for Learning Outcome 2: Prepare Roots and Tubers

Knowledge	Skills	Attitudes
● Identification of roots and tubers sorting parameters ● Identification of factors to consider in choosing washing methods ● Identification of factors to consider in choosing peeling methods ● Identification of factors to consider in choosing grinding methods of roots and tubers ● Description of popular shapes of sliced root and tubers	● Sorting roots and tubers ● Washing roots and tubers ● Peeling roots and tubers ● Grinding roots and tubers ● Slicing roots and tubers	● Being accurate while sorting roots and tubers ● Being carefully while washing, peeling and grinding roots and tubers ● Being precise while slicing roots and tubers



Duration: 10 hrs.

Learning outcome 2 objectives:



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

1. Identify correctly the roots and tubers sorting parameters.
2. Sort properly roots and tubers according to sorting parameters of roots and tubers
3. Identify correctly the factors to consider in choosing washing methods of roots and tubers
4. Wash properly roots and tubers used in processing roots and tubers into starch and crisps
5. Identify the factors to consider in choosing peeling methods of roots and tubers
6. Peel correctly roots and tubers used in processing roots and tubers into starch and crisps
7. Identify the factors to consider in choosing grinding methods of roots and tubers
8. Grind effectively roots and tubers used in processing roots and tubers into starch
9. Describe correctly the popular shapes of sliced root and tubers used for processing roots and tubers into crisps
10. Slice correctly roots and tubers used in processing roots and tubers into crisps



Resources

Equipment	Tools	Materials
● Washing machine ● Peeling machine ● Belt conveyors ● Slicing machine ● Grater ● Sorting and grading machine ● Sedimentation tank ● Centrifuge ● weighing scale	● Brushes ● Sieves ● Spoons ● Knives ● Basins ● Dustbins ● Towels ● Squeegee ● Brooms ● Mop	● Cleaning products ● Roots and tubers such as yam, sweet potatoes, Irish potatoes and cassava ● Labels

● PPE ● working table ● Grinder ● Hydro-cyclones ● High pressure water machine ● Decanter	● Buckets ● Timers	
 Advance Preparation: Before delivering this learning outcome, you are recommended to: ● Have classroom and workshop ● Avail fresh roots and tubers ● Avail tools and equipment which are in good conditions for process roots and tubers into starch & crisps ● Prepare teaching aids and didactic materials (manuals/guides, protocol, videos and photos for preparing roots and tubers)		



Indicative Content 2.1: Sorting of raw materials



Duration: 2 hrs.



Practical Activity 2.1.1: Sorting of roots and tubers



Notes to the trainer

- The trainer may use individualized method for demonstrating how to sort roots and tubers
- The trainer may avail roots and tubers for sorting
- The use of videos as didactic materials is required



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in the roots and tubers processing workshop to sort roots and tubers used in processing roots and tubers into starch and crisps.
- Step 2:** Explain the task and provide clear work instruction (PPE, Time allocated)
- Step 3:** Demonstrate how you can sort roots and tubers while demonstrating, explain the procedures and methods.
- Step 4:** Ask trainees to sort roots and tubers and monitor the procedures.
- Step 5:** Verify whether roots and tubers are properly sorted and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 2.1.1 in trainee manual
- Step 7:** Ask trainees to perform the task provided in application of learning 2.1



Points to Remember

- When sorting roots and tubers for starch and crisps making:
 - ✓ Assess the overall appearance of the roots and tubers, looking for any signs of damage, discoloration, or defects.
 - ✓ Keep accurate records of the sorting process, including the date, quantity, and any quality issues identified. This documentation can be used for traceability and quality control purposes.



Application of learning 2.1.

Suppose that you want to produce starch and crisps from Irish potatoes, ask trainees to go in roots and tubers processing workshop to sort Irish potatoes.

Checklist:

SN	Criteria	Indicators	Yes	No
1	Irish potatoes are properly sorted according to sorting parameters	1.1. Sorting machine is adjusted		
		1. 2 Damaged or diseased irish potatoes are discarded		
		1.3. Irish potatoes are sorted		



Indicative Content 2.2: Washing Roots and Tubers



Duration: 2 hrs.



Practical Activity 2.2.1: Washing roots and tubers



Notes to the trainer

- The trainer may use individualized method for demonstrating how wash roots and tubers
- The trainer may avail roots and tubers
- The use of photos and videos as didactic materials is required



Key steps:

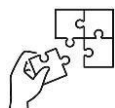
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in the roots and tubers workshop to wash roots and tubers used in processing roots and tubers into starch and crisps
- Step 2:** Explain the task and provide clear work instruction (PPE, Time allocated)
- Step 3:** Demonstrate how you can wash roots and tubers while demonstrating, explain the procedures and techniques.
- Step 4:** Ask trainees to wash roots and tubers and monitor the procedures.
- Step 5:** Verify whether the roots and tubers are properly washed and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 2.2.1 in trainee manual
- Step 7:** Ask trainees to perform the task provided in application of learning 2.2



Points to Remember

- when washing roots and tubers for starch and crisps production:
 - ✓ Ensure that all dirt, soil, and debris are removed from the surface of the roots and tubers.
 - ✓ Use clean water, follow proper sanitation practices, and maintain a clean work environment.



Application of learning 2.2.

Suppose that you want to produce starch and crisps from Irish potatoes, ask trainees to go in roots and tubers processing workshop to wash Irish potatoes.

Checklist:

SN	Criteria	Indicators	Yes	No
1	Irish potatoes are properly washed according to washing methods	1. 1 Irish potatoes are washed		
		1.2 Clean water is used		
		1.3 Dirt and Debris are removed		
		1.4 Pesticides and Chemicals are removed		
		1.5 Washing method is applied		



Indicative Content 2.3: Peeling Roots and Tubers



Duration: 2 hrs.



Practical Activity 2.3.1: Peeling roots and tubers



Notes to the trainer

- The trainer may use individualized method for demonstrating how to peel roots and tubers
- The trainer may avail roots and tubers
- The use of photos and videos as didactic materials is required



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in the roots and tubers processing workshop to peel roots and tubers
- Step 2:** Explain the task and provide clear work instruction (PPE, Time allocated)
- Step 3:** Demonstrate how you can peel roots and tubers while demonstrating, explain the procedures and techniques.
- Step 4:** Ask trainees to peel roots and tubers and monitor the procedures.
- Step 5:** Verify whether the roots and tubers are properly peeled and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 2.3.1 in trainee manual
- Step 7:** Ask trainees to perform the task provided in application of learning 2.3



Points to Remember

- When peeling roots and tubers for starch and crisps production, consider the following key points:
 - ✓ Consider the yield of the product after peeling. Peeling may reduce the overall yield.
 - ✓ Wear appropriate protective gear, such as gloves and safety glasses, to prevent injuries.
 - ✓ Use appropriate peeling equipment that is suitable for the specific root or tuber being processed.



Application of learning 2.3.

Request trainees to go in roots and tubers processing workshop to peel cassava and irish potatoes for processing them into starch and crisps respectively.

Checklist:

SN	Criteria	Indicators	Yes	No
1	Irish potatoes are properly peeled according to peeling methods	1. 1 Peeler is adjusted		
		1.2 .irish potatoes are peeled		
		1.3 cassava are peeled		
		1.4. wastage is minimized		
		1.5. PPE is used		
		1.6.Skin is removed		



Indicative Content 2.4: Grinding Roots and Tubers for Starch



Duration: 2 hrs.



Practical Activity 2.4.1: Grinding roots and tubers for starch



Notes to the trainer

- The trainer may use individualized method for demonstrating how to grind roots and tubers for starch
- The trainer may avail roots and tubers
- The use of photos and videos as didactic materials is required



Key steps:

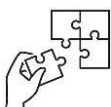
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in the roots and tubers processing workshop to grind roots and tubers for starch
- Step 2:** Explain the task and provide clear work instruction (PPE, Time allocated)
- Step 3:** Demonstrate how you can grind roots and tubers while demonstrating, explain the procedures and techniques.
- Step 4:** Ask trainees to grind roots and tubers and monitor the procedures.
- Step 5:** Verify whether the roots and tubers are properly ground and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 2.4.1 in trainee manual
- Step 7:** Ask trainees to perform the task provided in application of learning 2.4



Points to Remember

- When grinding roots and tubers for starch production, consider the following key points:
 - ✓ Select the appropriate type of grinder based on the desired particle size and capacity.
 - ✓ Monitor the temperature during grinding to prevent overheating, which can damage the starch.



Application of learning 2.4.

Suppose you want to produce starch from cassava, ask trainees to go in roots and tubers processing workshop to grind cassava for processing them into starch.

Checklist:

SN	Criteria	Indicators	Yes	No
1	Cassava are well ground according to grinding parameters	1. 1 Grinder is adjusted		
		1.2 Chosen grinding method is suitable to the desired particle ,size and consistency		
		1.3. cassava are ground		
		1.4 Grinding Temperature is monitored		



Indicative Content 2.5: Slicing Roots and Tubers for Crisps



Duration: 2 hrs



Theoretical Activity 2.5.1: Description of popular shapes of sliced root and tubers



Notes to the trainer:

- Trainer may use small groups to describe popular shapes of sliced root and tubers
- Trainer may avail photos and videos as didactic materials for description of popular shapes of sliced root and tubers



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to answer the following questions:
(i) What could be the popular shapes of sliced root and tubers used in processing roots and tubers into crisps?
- Step 2:** Ask trainees to write the findings on papers, flip chart.
- Step 3:** Facilitate trainees to present their findings
- Step 4:** Provide the expert view and clarify ideas by using didactic materials.
- Step 5:** Address any questions or concerns.
- Step 6:** Ask trainees to read the key reading 2.5.1 in trainee manual



Points to Remember

- Each shape has its specific uses and can be selected based on the desired outcomes.



Practical Activity 2.5.2: Slicing roots and tubers for crisps



Notes to the trainer

- The trainer may use individualized method for demonstrating how to slice roots and tubers for crisps
- The trainer may avail roots and tubers
- The use of photos and videos as didactic materials is required



Key steps:

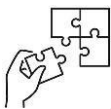
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in the roots and tubers processing workshop to slice roots and tubers
- Step 2:** Explain the task and provide clear work instruction (PPE, Time allocated)
- Step 3:** Demonstrate how you can slice roots and tubers and explain the procedures
- Step 4:** Ask trainees to slice roots and tubers and monitor the procedures.
- Step 5:** Verify whether the roots and tubers are properly sliced and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 2.5.2 in trainee manual
- Step 7:** Ask trainees to perform the task provided in application of learning 2.5



Points to Remember

- When slicing roots and tubers for crisps making:
 - ✓ Select the desired shape based on the type of crisp you want to create.
 - ✓ Consider the desired cooking time when selecting the thickness. Thinner slices will cook faster than thicker slices.
 - ✓ Use a suitable slicer that is designed for cutting thin, even slices of roots and tubers.
 - ✓ Handle sharp blades with care to avoid injuries.
 - ✓ Wear appropriate protective gear, such as gloves and safety glasses, when using slicing equipment.



Application of learning 2.5.

Suppose you want to make crisps from Irish potatoes, ask trainees to go in roots and tubers processing workshop to slice Irish potatoes for processing them into crisps.

Checklist:

SN	Criteria	Indicators	Yes	No
1	Irish potatoes are well sliced according to products specification	1. 1 Desired slice thickness and uniformity is achieved		
		1.2 slices consistent in size and shape, meeting product specifications		
		1.3.Slicer is adjusted		



Learning outcome 2 end assessment

Written assessment

I. Read carefully the statements below related to prepare roots and tubers and answer by encircling the letter corresponding to the right answer.

1. Which one of the following is a key parameter for sorting roots and tubers?

- A) Shape
- B) Color
- C) Size
- D) All of the above
- E) None of the choice

Answer: D) All of the above

2. When choosing a washing method for roots and tubers, what is a critical factor to consider?

- A) Desired level of cleaning
- B) Thickness of the skins
- C) Color of the produce
- D) Type of packaging used

Answer: A) Desired level of cleaning

3. What is an important consideration when selecting a peeling method for roots and tubers?

- A) Available equipment
- B) Season of the year
- C) Origin of the produce
- D) Type of cooking method

Answer: A) Available equipment

4. Which grinding method is most suitable for high-volume production of roots and tubers?

- A) Manual grinding
- B) Hammer mill
- C) Mortar and pestle
- D) Traditional hand grinder

Answer: B) Hammer mill

5. Which shape of sliced root or tuber is commonly used for creating a unique texture in dishes?

- a) Round
- b) Wavy/Crinkle
- c) Star-shaped
- d) Oval

Answer: B) Wavy/Crinkle

6. When choosing a washing method for roots and tubers, what is a critical factor to consider?

- A) Desired level of cleaning
- B) Thickness of the skins
- C) Color of the produce
- D) Type of packaging used

Answer: A) Desired level of cleaning

7. What is a primary reason for washing roots and tubers before processing?

- A) To enhance flavor
- B) To remove soil and contaminants
- C) To improve texture

D) To change color

Answer: B) To remove soil and contaminants

8. Which method is often used to peel roots and tubers on a small scale?

A) Drum peeler

B) Knife

C) Brush peeler

D) Ultrasonic cleaner

Answer: B) Knife

9. What is a critical factor in selecting a grinding method for roots and tubers?

A) Desired starch quality

B) Season of the year

C) Color of the produce

D) Type of packaging used

Answer: A) Desired starch quality

10. Which peeling method uses rotating blades to remove skin from roots and tubers?

A) Manual peeling

B) Drum peeler

C) Knife peeling

D) Ultrasonic peeling

Answer: B) Drum peeler

11. For high consistency and volume, which slicing method is commonly used?

A) Mandoline slicer

B) Manual knife

C) Mortar and pestle

D) Crinkle cutter

Answer: A) Mandoline slicer

II. Read carefully the statements below related to prepare roots and tubers and answer by **True (T)** if the statement is correct and **False (F)** if the statement is wrong.

1. Sorting roots and tubers based on their size, shape, and color is crucial for ensuring uniform quality.

Answer: True

2. Ultrasonic cleaning is the most common method used for washing roots and tubers in small-scale operations.

Answer: False

3. Mechanical peeling methods are generally more labor-intensive than manual methods.

Answer: False

4. The shape of sliced roots and tubers, such as star-shaped or spiral-cut, primarily affects their cooking time.

Answer: False

5. The primary purpose of grinding roots and tubers is to prepare them for immediate consumption as a whole.

Answer: False

Practical assessment

UBURYOHE Company has given your school instructions to provide 20 kg of ground cassava for starch extraction and 10 kg of sliced Irish potatoes for crisps, ask trainees to go in the production unit of your school to do the following tasks within 4 hours. All materials, tools and equipment are available in production unit of school.

Task 1: Sort cassava and irish potatoes

Task 2: Wash cassava and irish potatoes

Task 3: Peel cassava and irish potatoes

Task 4: Grind cassava for starch

Task 5: Slice irish potatoes for crisps

Checklist:

SN	Criteria	Indicators	Yes	No
1	Cassava and irish potatoes are properly sorted according to sorting parameters	1. 1 Damaged or diseased cassava and irish potatoes are discarded		
		1.2. cassava and irish are sorted		
2	Cassava and irish potatoes are properly washed according to washing methods	2. 1 Cassava are washed		
		2.2 Irish potatoes are washed		
		2.3. Impurities are removed		
3	Cassava and irish potatoes are properly peeled according to peeling methods	3. 1 Peeler is adjusted		
		3.2 .cassava are peeled		
		3.3. Irish potatoes are peeled		
4	Cassava are well ground according to grinding parameters	4. 1 Grinder is adjusted		
		4.2 Chosen grinding method is suitable to the desired particle size and consistency		
		4.3. Cassava is ground		
5	Irish potatoes are well sliced according to products specification	5. 1 Desired slice thickness and uniformity is achieved		
		5.2 slices consistent in size and shape, meeting product specifications		
		5.3. Slicer is adjusted		

END



Further information to the trainer

Foster, R. D. (2017). *Advanced methods in root and tuber processing: Techniques for peeling and slicing* (pp. 120-135). Agricultural Science Publishing.

Jackson, P. W. (2018). *Root crop handling and processing: A guide to peeling, washing, and grading* (pp. 75-92). Crop Science Publications.

Roberts, C. T. (2015). *Processing techniques for roots and tubers: Peeling, washing, slicing, and grading* (pp. 45-60). Food Processing Technology Press.

Learning Outcome 3: Make Starch



Indicative contents

- 3.1 Purifying the Wet Starch**
- 3.2 Drying of Wet Starch**
- 3.3 Grinding Starch**
- 3.4 Sifting Starch**
- 3.5 Modifying of Native Starch**
- 3.6 Analysing Quality of Starch**
- 3.7 Storing of Starch**

Key Competencies for Learning Outcome 3: Make Starch

Knowledge	Skills	Attitudes
● Description of purification methods ● Description of drying methods ● Description of grinding methods ● Description of sifting methods ● Description of modification methods ● Description of starch quality characteristics ● Description of labelling requirements of starch ● Identification of storage conditions of starch	● Purifying the wet starch ● Drying the wet starch ● Grinding starch ● Sifting starch ● Modifying native starch ● Checking the quality of starch ● Packaging the starch ● Labelling the starch ● Storing starch	● Being careful during purification and drying starch ● Being attentive during sifting ● Being cleanliness in grinding and packaging ● Being methodical in labelling ● Being Environmental awareness on packaging material ● Being awareness on storing conditions ● Being Responsible to ensure if the products are stored



Duration: 16 hrs

Learning outcome 3 objectives:



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

1. Describe correctly purification methods of wet starch
2. Purify properly wet starch according to purification methods
3. Describe correctly the drying methods for wet starch
4. Dry effectively the wet starch according to drying methods
5. Describe correctly the grinding methods of starch
6. Grind properly the starch according to grinding methods
7. Describe correctly sifting methods of starch
8. Sift effectively the starch according to sifting methods
9. Describe correctly modification methods of starch
10. Modify properly the native starch according to modification methods
11. Describe correctly the starch quality characteristics
12. Analyse correctly quality characteristics of starch
13. Pack appropriately the starch according to filling methods
14. Describe correctly the labelling requirements of starch
15. Label properly the packaged starch according to labelling requirements
16. Identify correctly the storage conditions of starch
17. Store properly the starch according to storage conditions



Resources

Equipment	Tools	Materials
● Sedimentation tank ● Centrifuge ● Drying machine ● Weighing scale ● PPE ● Working table	● Brushes ● Sieves/ strainers ● Spoon ● Knives ● Basins ● Dustbins ● Towels	● Packaging materials ● Cleaning products ● Roots and tubers such as Potatoes, sweet potatoes, yam, cassava ● Labels

• High pressure water machine	• Squeegee • Brooms • Mop • Buckets • Moisture-mete • Timers	
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Advance Preparation:

Before delivering this learning outcome, you are recommended to:

- Have classroom and workshop
- Avail fresh roots and tubers
- Avail tools and equipment which are in good conditions for process roots and tubers into starch
- Prepare teaching aids and didactic materials (manuals/guides, protocol, videos and photos for making starch)



Indicative content 3.1: Purifying the Wet Starch



Duration: 2 hrs.



Theoretical Activity 3.1.1: Description of purification methods of wet starch



Notes to the trainer:

- Trainer may use small groups to describe purification methods of wet starch
- Trainer may avail photos and videos as didactic materials for description of purification methods of wet starch



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to answer the following questions:
- i. What do you understand by term purification in starch making?
 - ii. What could be the purpose of purifying wet starch?
 - iii. What could be the methods of purification?
 - iv. Based on the methods of purification provided in question (iii) what could be the factors affecting purification methods?
 - v. What could be the Selection criteria for starch purification method?
- Step 2:** Ask trainees to write the findings on papers, flip chart.
- Step 3:** Facilitate trainees to present their findings
- Step 4:** Provide the expert view and clarify ideas by using didactic materials.
- Step 5:** Address any questions or concerns.
- Step 6:** Ask trainees to read the key reading 3.1.1 in trainee manual



Points to Remember

- When describing purification methods of wet starch:
 - ✓ Specify selection criteria of purification methods
 - ✓ Specify factors affecting purification methods
 - ✓ Specify the type of purification method, such as sedimentation, filtration, centrifugation, or solvent extraction.
 - ✓ Highlight the advantages and disadvantages of purification method



Practical Activity 3.1.2: Purifying a wet starch



Notes to the trainer

- The trainer may use individualized method for demonstrating how to purify wet starch
- The trainer may avail tools, materials and equipment to be used in purifying wet starch
- The use of photos and videos as didactic materials is required



Key steps:

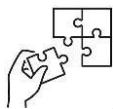
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in the roots and tubers processing workshop to purify wet starch
- Step 2:** Explain the task and provide clear work instruction (PPE, Time allocated)
- Step 3:** Demonstrate how you can purify wet starch while demonstrating, explain the procedures and methods.
- Step 4:** Ask trainees to purify wet starch and monitor the procedures.
- Step 5:** Verify whether the wet starch is properly purified and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 3.1.2 in trainee manual
- Step 7:** Ask trainees to perform the task provided in application of learning 3.1



Points to Remember

- Each purification methods is selected based on the specific requirements of the purification process, including the type of impurities, desired purity of the starch, and the intended application of the final product.



Application of learning 3.1

Suppose you want to purify wet starch, Ask trainees to go in roots and tubers processing workshop to purify the wet starch of cassava.

Checklist

SN	Criteria	Indicators	Yes	No
1	Cassava Wet starch is properly purified according to purification process	1.1. Purification process is respected		
		1.2 Impurities are removed		
		1.3 Wet starch is obtained		



Indicative content 3.2: Drying of Wet Starch



Duration: 4 hrs.



Theoretical Activity 3.2.1: Description drying methods of wet starch



Notes to the trainer:

- Trainer may use small groups to describe drying methods of wet starch.
- Trainer may avail photos and videos as didactic materials for description of drying methods of wet starch.



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to answer the following questions:
- i. What could be the purpose of drying wet starch?
 - ii. What could be the methods of drying wet starch?
- Step 2:** Ask trainees to write the findings on papers, flip chart.
- Step 3:** Facilitate trainees to present their findings
- Step 4:** Provide the expert view and clarify ideas by using didactic materials.
- Step 5:** Address any questions or concerns.
- Step 6:** Ask trainees to read the key reading 3.2.1 in trainee manual



Points to Remember

- Drying method must maintain or improve the desired properties of the starch, such as viscosity, solubility, and appearance.



Practical Activity 3.2.2: Drying wet starch



Notes to the trainer

- The trainer may use individualized method for demonstrating how to dry wet starch
- The trainer may avail tools, materials and equipment to be used in drying wet starch

- The use of photos and videos as didactic materials is required



Key steps:

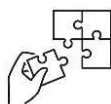
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in the roots and tubers processing workshop to dry wet starch
- Step 2:** Explain the task and provide clear work instruction (PPE, Time allocated)
- Step 3:** Demonstrate how you can dry starch while demonstrating, explain the procedures and methods.
- Step 4:** Ask trainees to dry wet starch and monitor the procedures.
- Step 5:** Verify whether the wet starch is properly dried and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 3.2.2 in trainee manual
- Step 7:** Ask trainees to perform the task provided in application of learning 3.2



Points to Remember

- Each drying method has its specific applications and benefits depending on the scale of production and the properties of the starch being dried.



Application of learning 3.2.

Suppose you want to dry cassava starch, ask trainees to go in roots and tubers processing workshop to dry cassava starch.

Checklist

SN	Criteria	Indicators	Yes	No
1	Cassava Wet starch is properly dried according to drying process	1.1. Drying process is respected		
		1.2 Moisture is reduced		
		1.3 Dried cassava starch is obtained		



Indicative Content 3.3: Grinding Starch



Duration: 2 hrs.



Theoretical Activity 3.3.1: Description of grinding methods of starch



Notes to the trainer:

- Trainer may use small groups to describe grinding methods of dried starch
- Trainer may avail photos and videos as didactic materials for description of grinding methods of dried starch



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to answer the following questions:
- What could be the purpose of grinding starch?
 - Differentiate grinding methods of starch?
 - Identify the factors to consider in grinding of starch?
- Step 2:** Ask trainees to write the findings on papers, flip chart.
- Step 3:** Facilitate trainees to present their findings
- Step 4:** Provide the expert view and clarify ideas by using didactic materials.
- Step 5:** Address any questions or concerns.
- Step 6:** Ask trainees to read the key reading 3.3.1 in trainee manual



Points to Remember

- Select the most appropriate grinding method and equipment by carefully considering the factors in grinding starch, to achieve the desired particle size and quality of the starch for the specific application.



Practical Activity 3.3.2: Grinding starch



Notes to the trainer

- The trainer may use individualized method for demonstrating how to grind starch
- The trainer may avail tools, materials and equipment to be used in grinding starch
- The use of photos and videos as didactic materials is required



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in the roots and tubers processing workshop to grind the dried starch
- Step 2:** Explain the task and provide clear work instruction (PPE, Time allocated)
- Step 3:** Demonstrate how you can grind starch while demonstrating, explain the procedures and methods.
- Step 4:** Ask trainees to grind starch and monitor the procedures.
- Step 5:** Verify whether the dried starch is properly ground and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 3.3.2 in trainee manual
- Step 7:** Ask trainees to perform the task provided in application of learning 3.3



Points to Remember

- While grinding starch:
 - ✓ Wear PPE
 - ✓ Select the best grinding methods
 - ✓ Respect the grinding procedures



Application of learning 3.3.

Suppose you want to grind cassava dried cassava starch, ask trainees to go in roots and tubers processing workshop to grind the dried cassava starch.

Checklist

SN	Criteria	Indicators	Yes	No
1	Dried starch is properly Ground according to Grinding process	1.1. Grinding process is respected		
		1.2 Size is reduced		
		1.3 Ground starch is obtained		



Indicative Content 3.4: Sifting Starch



Duration: 2 hrs.



Theoretical Activity 3.4.1: Description of sifting methods of starch



Notes to the trainer:

- Trainer may use small groups to describe sifting methods of ground starch
- Trainer may avail photos and videos as didactic materials for description of sifting methods of ground starch.



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to answer the following questions:
- i. What could be the purpose of sifting starch?
 - ii. What could be the methods of sifting starch?
 - iii. What could be the factors to consider in choosing sifting methods of starch?
- Step 2:** Ask trainees to write the findings on papers, flip chart.
- Step 3:** Facilitate trainees to present their findings
- Step 4:** Provide the expert view and clarify ideas by using didactic materials.
- Step 5:** Address any questions or concerns.
- Step 6:** Ask trainees to read the key reading 3.4.1 in trainee manual



Points to Remember

- By considering the factors in choosing sifting methods, you can select the most appropriate sifting method for your starch processing needs, ensuring that the final product meets the desired specifications and quality standards.



Practical Activity 3.4.2: Sifting starch



Notes to the trainer

- The trainer may use individualized method for demonstrating how to sift starch
- The trainer may avail tools, materials and equipment to be used in sifting starch
- The use of photos and videos as didactic materials is required



Key steps:

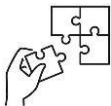
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in the roots and tubers processing workshop to sift the starch of root and tubers
- Step 2:** Explain the task and provide clear work instruction (PPE, Time allocated)
- Step 3:** Demonstrate how you can sift starch while demonstrating, explain the procedures and methods.
- Step 4:** Ask trainees to sift wet starch and monitor the procedures.
- Step 5:** Verify whether the ground starch is properly sifted and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 3.4.2 in trainee manual
- Step 7:** Ask trainees to perform the task provided in application of learning 3.4



Points to Remember

- By following the sifting methods and procedures, you can ensure that the starch is sifted effectively, resulting in a smoother and more consistent product.



Application of learning 3.4.

Suppose that you want to sift ground cassava starch, ask trainees to go in roots and tubers processing workshop to sift ground cassava starch.

Checklist:

SN	Criteria	Indicators	Yes	No
1	Cassava starch is properly sifted according to sifting process	1.1.Sifting machine is adjusted		
		1.2. Sifting process is respected		
		1.3. Sifted cassava starch is obtained		



Indicative Content 3.5: Modifying of Native Starch



Duration: 2 hrs.



Theoretical Activity 3.5.1: Description of modifying methods of native starch



Notes to the trainer:

- Trainer may use small groups to describe modifying methods of native starch
- Trainer may avail photos and videos as didactic materials for description of modifying methods



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to answer the following questions:
- i. What could be the purpose of modifying native starch?
 - ii. Describe the methods used to modify native starch?
 - iii. Discuss on the changes that could occur during modification of native starch?
- Step 2:** Ask trainees to write the findings on papers, flip chart.
- Step 3:** Facilitate trainees to present their findings
- Step 4:** Provide the expert view and clarify ideas by using didactic materials.
- Step 5:** Address any questions or concerns.
- Step 6:** Ask trainees to read the key reading 3.5.1 in trainee manual



Points to Remember

- Understanding the changes occur during modifications helps in selecting the right modification method to achieve the desired characteristics for various applications



Practical Activity 3.5.2: Modifying of native starch



Notes to the trainer

- The trainer may use individualized method for demonstrating how to modify the native starch
- The trainer may avail tools, materials and equipment to be used in modifying the starch
- The use of photos and videos as didactic materials is required



Key steps:

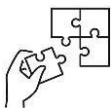
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in the roots and tubers processing workshop to modify native starch
- Step 2:** Explain the task and provide clear work instruction (PPE, Time allocated)
- Step 3:** Demonstrate how you can modify native starch while demonstrating, explain the procedures and methods.
- Step 4:** Ask trainees to modify native starch and monitor the procedures.
- Step 5:** Verify whether the native starch is properly modified and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 3.5.2 in trainee manual
- Step 7:** Ask trainees to perform the task provided in application of learning 3.5



Points to Remember

- Modified starch, also called starch derivatives, is prepared by physically, enzymatically, or chemically treating native starch to change its properties.



Application of learning

Suppose that you want to produce modified cassava starch, ask trainees to go in roots and tubers processing workshop to modify the cassava native starch.

Checklist

SN	Criteria	Indicators	Yes	No
1	Native cassava starch is properly modified according to modifying process	1.1. Correct modifying method is used		
		1.2. Modifying process is respected		
		1.3. Modified cassava starch is obtained		



Indicative Content 3.6: Analysing Quality of Starch



Duration: 2hrs



Theoretical Activity 3.6.1: Description of starch quality characteristics



Notes to the trainer:

- Trainer may use small groups to describe starch quality characteristics
- Trainer may avail photos and videos as didactic materials for starch quality characteristics



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Step 1: Introduce the activity and ask trainees to answer the following questions:
- i. Identify the sensory characteristics of starch
 - ii. How would you describe the texture and solubility as physical properties of starch?
 - iii. What could be the Chemical properties of starch
 - iv. What could be the essential compositional requirements and limits for starch in terms of moisture content, protein levels, ash content, and other relevant parameters?
 - v. Discuss on Microbiological requirements and Limits of starch
- Step 2:** Ask trainees to write the findings on papers, flip chart.
- Step 3:** Facilitate trainees to present their findings
- Step 4:** Provide the expert view and clarify ideas by using didactic materials.
- Step 5:** Address any questions or concerns.
- Step 6:** Ask trainees to read the key reading 3.6.1 in trainee manual



Points to Remember

- By adhering to the sensory, physical, chemical, compositional, and microbiological requirements, starch can be produced and used effectively in various applications while ensuring safety and quality.



Practical Activity 3.6.2: Analysing starch quality characteristics



Notes to the trainer

- The trainer may use individualized method for demonstrating how to analyse the quality characteristics of starch
- The trainer may avail tools, materials and equipment to be used in analysis of starch
- The use of photos and videos as didactic materials is required



Key steps:

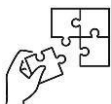
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in the roots and tubers processing workshop to analyse starch quality characteristics
- Step 2:** Explain the task and provide clear work instruction (PPE, Time allocated)
- Step 3:** Demonstrate how you can analyse starch quality characteristics while demonstrating, explain the procedures and methods.
- Step 4:** Ask trainees to analyse starch quality characteristics and monitor the procedures.
- Step 5:** Verify whether the starch quality characteristics are properly analysed and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 3.6.2 in trainee manual
- Step 7:** Ask trainees to perform the task provided in application of learning 3.6



Points to Remember

- The methods and procedures used for starch quality analysis helping to ensure that starch meets the required quality standards for its intended applications, ensuring safety, functionality, and consistency.



Application of learning 3.6.

Suppose you want to analyse quality characteristics of cassava starch, ask trainees to go in roots and tubers processing workshop to analyse cassava starch quality characteristics.

Checklist:

SN	Criteria	Indicators	Yes	No
1	Cassava Starch is properly analysed according to analysis process	1.1. Analysis process is respected		
		1.2 Quality characteristics are analysed		
		1.3 Compositional quality requirements and limits are analysed		
		1.4. Microbiological requirements and limits are analysed		
		1.5. Quality of cassava starch is found		



Indicative Content 3.7: Storing of Starch



Duration: 2 hrs.



Practical Activity 3.7.1: Packaging of starch



Notes to the trainer

- The trainer may use individualized method for demonstrating how to package starch
- The trainer may avail tools, materials and equipment to be used in packaging of starch
- The use of photos and videos as didactic materials is required



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in the roots and tubers processing workshop to package starch
- Step 2:** Explain the task and provide clear work instruction (PPE, Time allocated)
- Step 3:** Demonstrate how you can package starch while demonstrating, explain the procedures and methods.
- Step 4:** Ask trainees to package starch and monitor the procedures.
- Step 5:** Verify whether the starch is properly packaged and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 3.7.1 in trainee manual
- Step 7:** Ask trainees to perform the task provided in application of learning 3.7



Points to Remember

- Always wear the PPE while you are packaging the starch to avoid contamination



Theoretical Activity 3.7.2: Description of labelling requirements of starch



Notes to the trainer:

- Trainer may use small groups to describe labelling requirements of starch
- Trainer may avail photos and videos as didactic materials for labelling of starch



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to answer the following questions:
What could be the labelling requirements of starch ?
- Step 2:** Ask trainees to write the findings on papers, flip chart.
- Step 3:** Facilitate trainees to present their findings
- Step 4:** Provide the expert view and clarify ideas by using didactic materials.
- Step 5:** Address any questions or concerns.
- Step 6:** Ask trainees to read the key reading 3.7.2 in trainee manual



Points to Remember

- Remember to follow the labelling guidelines, in order to ensure that the starch labels are accurate, informative, and compliant with relevant regulations.



Practical Activity 3.7.3: Storing starch



Notes to the trainer

- The trainer may use individualized method for demonstrating how to store starch
- The trainer may avail tools, materials and equipment to be used in storing of starch
- The use of photos and videos as didactic materials is required



Key steps:

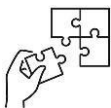
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in the roots and tubers processing workshop to store the starch
- Step 2:** Explain the task and provide clear work instruction (PPE, Time allocated)
- Step 3:** Demonstrate how you can store wet starch while demonstrating, explain the procedures and methods.
- Step 4:** Ask trainees to store starch and monitor the procedures.
- Step 5:** Verify whether the starch is properly stored and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 3.7.3 in trainee manual
- Step 7:** Ask trainees to perform the task provided in application of learning 3.7



Points to Remember

- Follow the storage guidelines in order to store effectively roots and tubers starch and ensure its quality and safety for future use.



Application of learning 3.7.

Ask trainees to go in roots and tubers processing workshop to store cassava starch

Checklist:

SN	Criteria	Indicators	Yes	No
1	Cassava Starch is properly stored according to storage conditions	1. 1 The cassava starch is packaged in Packaging material for starch		
		1.2. Cassava starch is labelled		
		1.3. The cassava starch is stored in a cool and dry place		
		1.4. Cassava starch storage conditions are monitored		



Learning outcome 3 end assessment

Written assessment

I. Ready carefully the statements below related to starch making and answer by encircling the letter corresponding to the correct answer.

1. What does the purification process in starch making aim to achieve?

- a. Increase the starch yield
- b. Remove impurities and non-starch components
- c. Enhance the color of the raw starch
- d. Add flavor to the starch

Answer: B) Remove impurities and non-starch components

1. Which method of starch purification involves using gravity to separate heavier particles from the starch suspension?

- a. Centrifugation
- b. Sedimentation
- c. Sieving
- d. Filtration

Answer: B) Sedimentation

2. What is the primary purpose of alkaline extraction in starch purification?

- a. Remove proteins and some contaminants
- b. Increase starch viscosity
- c. Break down starch into glucose
- d. Enhance the color of the starch

Answer: A) Remove proteins and some contaminants

3. Why might enzymatic treatments be used in starch purification?

- a. To break down starch molecules into simpler sugars
- b. To remove colorants from the starch
- c. To enhance the texture of the starch
- d. To separate starch based on particle size

Answer: A) To break down starch molecules into simpler sugars

4. What factor is NOT typically considered when selecting a starch purification method?

- a. Type of impurities
- b. Cost and efficiency
- c. Environmental impact
- d. Packaging design of the final starch product

Answer: D) Packaging design of the final starch product

6. What is one of the primary purposes of drying wet starch?

- a. To increase its moisture content for better consistency
- b. To convert it into a liquid form for easier application
- c. To reduce moisture content to prevent microbial growth and spoilage
- d. To enhance its color for better visual appeal

Answer: c) To reduce moisture content to prevent microbial growth and spoilage

7. Which method of drying wet starch involves spreading it in thin layers and exposing it to ambient air?

- a. Spray Drying
- b. Fluidized Bed Drying
- c. Freeze Drying
- d. Air Drying

Answer: d) Air Drying

8. Which grinding method involves using high-speed hammers to crush starch into smaller particles?

- a. Roller Milling
- b. Cryogenic Grinding
- c. Ball Milling
- d. Hammer Milling

Answer: d) Hammer Milling

9. What factor should be considered when grinding starch to avoid affecting its functional properties?

- a. Particle size only
- b. Temperature sensitivity to prevent gelatinization or degradation
- c. The color of the starch
- d. The brand of grinding equipment

Answer: b) Temperature sensitivity to prevent gelatinization or degradation

II. Read the statements below related to starch making and answer by True (T) if the statement is correct and False (F) if the statement is wrong

1. Modified starches always have the same solubility as native starches.

Answer: False

2. The presence of E. coli in starch is a major concern for food safety.

Answer: True

3. High humidity is ideal for storing starch

Answer: False

4. The net weight is not necessary for food products.

Answer: False

5. Cross-contamination should be avoided in starch storage.

Answer: True

5. Pest control measures are unnecessary for starch storage

Answer: False

6. Sifting helps in maintaining consistency in product quality by removing oversized particles.

Answer: True

7. Starch should typically be white or off-white. Any discoloration may indicate contamination or degradation.

Answer: True

8. A high moisture content in starch is desirable for long-term storage.

Answer: False

Practical assessment

Two weeks ago, your school has received a gift of tools and equipment used in processing cassava into starch. But the school does not have a qualified technician in roots and tubers processing which will use those tools and equipment to make cassava starch. To overcome above issue, the school manager decided to hire you as qualified technician in roots and tubers processing to do the following task as demonstration how to make cassava starch.

Task 1: Purify wet cassava starch

Task 2: Dry wet cassava starch

Task 3: Grind dried cassava starch

Task 4: Sift cassava starch

Task 5: Modify cassava native starch

Task 6: Analyse quality of cassava starch

Task 7: Store cassava starch

Note:

The tasks should be performed within six (6) hours

All materials, tools and equipment are available in production area of your school.

Checklist:

SN	Criteria	Indicators	Yes	No
1	Cassava Wet starch is properly purified according to purification process	1.1. Purification process is respected		
		1.2 Impurities are removed		
		1.3 Wet starch is obtained		
2	Cassava Wet starch is properly dried according to drying process	2.1. Drying process is respected		
		2.2 Moisture is reduced		
		2.3 Dried cassava starch is obtained		
3	Dried cassava starch is properly Ground according to Grinding process	3.1. Grinding process is respected		
		3.2 Size is reduced		
		3.3 Ground starch is obtained		
4	Cassava starch is properly sifted according to sifting process	4.1. Sifting process is respected		
		4.2. sifted cassava starch is obtained		

5	Native cassava starch is properly modified according to modifying process	5.1. Modifying process is respected		
		5.2.Modified cassava starch is obtained		
6	Cassava Starch is properly analysed according to analysis process	6.1. Analysis process is respected		
		6.2.Quality characteristics are analysed		
		6.3.Compositional quality requirements and limits are analysed		
		6.4.Microbiological requirements and limits are analysed		
		6.5.Quality of cassava starch is found		
7	Cassava starch is properly stored according to storage conditions	7.1. The cassava starch is packaged in Packaging material for starch		
		7.2.The cassava starch is stored in a cool and dry place		
		7.3. cassava starch storage conditions are monitored		
		7.4. Cassava starch are labelled		

END



Further information to the trainer

Masamba, W. R. (2003).). Development and evaluation of maize and cassava starch-based cold-setting adhesives for case sealing. *Malawi Journal of Agricultural Science*, 65–76.

Matsui, K. N. (2004). *Cassava bagasse-Kraft paper composites: Analysis of the influence of impregnation with starch acetate on tensile strength and water absorption properties. Carbohydrate Polymers.*

Maziya-Dixon, B. A. (2005). *Effect of variety and drying methods on physico-chemical properties of high-quality cassava starch from yellow cassava root. African Crop Science Conference Proceedings*, 7, 835–841.

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Learning Outcome 4: Make Crisps



Indicative contents

- 4.1 Blanching Sliced Roots and Tubers**
- 4.2 De-Watering Sliced Roots and Tubers**
- 4.3 Frying Sliced Roots and Tubers**
- 4.4. De-Oiling Crisps**
- 4.5. Seasoning of Crisps**
- 4.6. Cooling of Crisps**
- 4.7 Analysing the Quality of Crisps**
- 4.8. Storing of Crisps**

Key Competencies for Learning Outcome 4: Make Crisps

Knowledge	Skills	Attitudes
● Description of blanching methods of sliced roots and tubers ● Description of dewatering methods of sliced roots and tubers ● Description of frying methods of sliced roots and tubers ● Description of Changes occur during frying ● Description of de-oiling methods ● Description of seasoning methods	● Blanching sliced roots and tubers ● De-watering sliced roots and tubers ● Frying sliced roots and tubers ● De-oiling crisps ● Seasoning of crisps ● Cooling of crisps ● Analysing the quality of crisps	● Being attentiveness to maintaining precise blanching times and temperatures to ensure quality and safety. ● Being diligence in ensuring thorough dewatering to prevent soggy and achieve optimal crispiness ● Being vigilance in monitoring the frying process to avoid overcooking and ensure uniformity ● Being awareness of the implications of changes occur during frying on the quality and safety of the final product ● Being commitment to maintaining product quality by effectively removing excess oil ● Being precise in seasoning to balance flavor while avoiding over- or under-seasoning ● Being carefully in cooling crisps to ensure they remain crisp and of high quality

• Description of cooling methods • Description of crisps quality requirements and testing methods • Description of sealing methods • Description of labelling requirements and regulations	• Packaging the crisps • Sealing the crisps • Monitoring storage conditions of crisps	• Being attentive to quality control to ensure product standards • Being compliance with regulations and attention to accuracy in labelling. • Being vigilance in maintaining storage conditions to prevent spoilage
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Duration: 16hrs

Learning outcome 3 objectives:



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

1. Describe correctly blanching methods of sliced roots and tubers for crisps
2. Blanche effectively sliced roots and tubers according to choosing factors of blanching methods
3. Describe correctly de-watering methods of sliced roots and tubers for crisps
4. De-water effectively sliced roots and tubers according to choosing factors of dewatering methods
5. Describe correctly frying methods of sliced roots and tubers for crisps
6. Fry effectively roots and tubers according to frying conditions
7. Describe correctly the Changes occur during frying of roots and tubers for crisps
8. Describe correctly de-oiling methods for crisps
9. De-oil effectively crisps according to choosing factors of de-oiling methods
10. Describe correctly seasoning methods for crisps
11. Season effectively crisps according to choosing factors of seasoning methods
12. Describe correctly cooling methods for crisps

13. Cool effectively crisps according to choosing factors of cooling methods
14. Describe correctly crisps quality requirements and testing methods for crisps
15. Analyse properly crisps physical quality parameters according to product specification
16. Describe correctly sealing methods and their advantages and disadvantages for crisps
17. Package properly the crisps according to the packaging methods
18. Seal effectively crisps according to the sealing methods
19. Describe correctly the labelling requirements of crisps according to product specification
20. Monitor effectively storage conditions of crisps according to storage procedures



Resources

Equipment	Tools	Materials
● Blancher ● Flavouring machine ● Dewatering machine ● De-oiling machine ● Frying machine ● Sorting machine ● Cooling system ● Weighing scale ● PPE ● Working table ● High pressure water machine ● Labelling machine ● Oil tank ● Vacuum nitrogen packaging machine	● Brushes ● Sieves ● Spoons, ● Knives ● Basins ● Dustbins ● Towels ● Squeegee ● Brooms ● Mop ● Buckets ● Moisture-meter ● Thermometer ● Pallet ● Mixing bowls ● Spoons ● Shakers	● Packaging materials ● Cleaning products ● Seasonings ● Roots and tubers ● Labels ● Cooking oil

	• Timers • Colanders and draining rack	
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Advance Preparation:

Before delivering this learning outcome, you are recommended to:

- Have classroom and workshop
- Avail fresh sliced roots and tubers for crisps
- Avail tools and equipment which are in good conditions for process roots and tubers into crisps
- Prepare teaching aids and didactic materials (manuals/guides, protocol, videos and photos for making crisps)



Indicative Content 4.1: Blanching Sliced Roots and Tubers



Duration: 2 hrs.



Theoretical Activity 4.1.1: Description of blanching methods of sliced roots for crisps



Notes to the trainer:

- Trainer may use small group for describing blanching methods of sliced roots and tubers
- Trainer may avail photos and videos as didactic materials for describing blanching methods of sliced roots and tubers



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to answer the following question:
(i)What do you understand by blanching methods of sliced roots and tubers for crisps?
- Step 2:** Ask trainees to write the findings on papers, flip chart.
- Step 3:** Asks trainees to present their findings and choose the correct ones.
- Step 4:** Provide the expert view and clarify ideas by using didactic materials.
- Step 5:** Address any questions or concerns.
- Step 6:** Ask trainees to read the key reading 4.1.1 in trainee manual



Points to Remember

- Choosing the right blanching method depends on the type of root or tuber, slice thickness, desired texture, and the final cooking method.



Practical Activity 4.1.2: Blanching sliced roots and tubers for crisps



Notes to the trainer

- The trainer may use individualized method for demonstrating how to blanch sliced roots and tubers for crisps
- The trainer may avail sliced roots and tubers
- The use of photos and videos as didactic materials is required



Key steps:

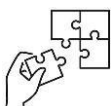
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in the roots and tubers processing workshop to Blanch sliced roots and tubers
- Step 2:** Explain the task and provide clear work instruction (PPE, Time allocated)
- Step 3:** Demonstrate how you can Blanch sliced roots and tubers While demonstrating, explain the methods and procedures.
- Step 4:** Ask trainees to Blanch sliced roots and tubers and monitor the procedures.
- Step 5:** Verify whether the sliced roots and tubers are properly blanched and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 4.1.2 in trainee manual



Points to Remember

- For effective blanching:
 - ✓ Use fresh, high-quality ingredients.
 - ✓ Control blanching time and temperature
 - ✓ Ensure proper cooling
 - ✓ Consider equipment



Application of learning 4.1.

Ask trainees to go to roots and tubers processing workshop to blanch sliced irish potatoes

Checklist:

SN	Criteria	Indicators	Yes	No
1	Sliced irish potatoes are properly blanched according to blanching conditions	1. 1 Sliced irish potatoes are blanched		
		1.2. Blanching time is respected		
		1.3. Blanching temperature is respected		



Indicative Content 4.2: De-Watering of Sliced Roots and Tubers



Duration: 2 hrs.



Theoretical Activity 4.2.1: Description of dewatering methods of sliced roots and tubers



Notes to the trainer:

- Trainer may use small group for describing dewatering methods of sliced roots and tubers
- Trainer may avail photos and videos as didactic materials for describing dewatering methods of sliced roots and tubers



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to answer the following question:
(i)What do you understand by dewatering methods of sliced roots and tubers for crisp?
- Step 2:** Ask trainees to write the findings on papers, flip chart.
- Step 3:** Asks trainees to present their findings and choose the correct ones.
- Step 4:** Provide the expert view and clarify ideas by using didactic materials.
- Step 5:** Address any questions or concerns.
- Step 6:** Ask trainees to read the key reading 4.2.1 in trainee manual



Points to Remember

- A number of factors, such as the temperature, humidity, and airflow, can affect the dewatering process.



Practical Activity 4.2.2: De-watering sliced roots and tubers



Notes to the trainer

- The trainer may use individualized method for demonstrating how to de-water sliced roots and tubers for crisps
- The trainer may avail sliced roots and tubers
- The use of photos and videos as didactic materials is required



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in the roots and tubers processing workshop to de-water sliced roots and tubers
- Step 2:** Explain the task and provide clear work instruction (PPE, Time allocated)
- Step 3:** Demonstrate how you can de-water sliced roots and tubers While demonstrating, explain the methods and procedures.
- Step 4:** Ask trainees to de-water sliced roots and tubers and monitor the procedures.
- Step 5:** Verify whether the sliced roots and tubers are properly de-watered and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 4.2.2 in trainee manual



Points to Remember

- Ensure adequate airflow to facilitate moisture removal and prevent product sticking.
- Adjust dewatering time based on moisture content, slice thickness, and desired final product.
- Regularly clean and maintain dewatering equipment to prevent contamination and ensure optimal performance.



Application of learning 4.2.

You want to produce de-watered blanched sliced irish potatoes, ask trainees to go to roots and tubers processing workshop to de-water blanched irish potatoes.

Checklist:

SN	Criteria	Indicators	Yes	No
1	Blanched irish potatoes are properly de-watered according to de-watering methods	1. 1 Blanched irish potatoes are de-watered		
		1.2. Water is removed		
		1.3 De-water machine is used		



Indicative Content 4.3: Frying Sliced Roots and Tubers



Duration: 2 hrs



Theoretical Activity 4.3.1: Description of frying method of sliced roots and tubers



Notes to the trainer:

- Trainer may use small group for describing frying methods of sliced roots and tubers
- Trainer may avail photos and videos as didactic materials for describing frying methods of sliced roots and tubers



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to answer the following question:
(i) What do you understand by frying methods of sliced roots and tubers for crisp?
- Step 2:** Ask trainees to write the findings on papers, flip chart.
- Step 3:** Asks trainees to present their findings and choose the correct ones.
- Step 4:** Provide the expert view and clarify ideas by using didactic materials.
- Step 5:** Address any questions or concerns.
- Step 6:** Ask trainees to read the key reading 4.3.1 in trainee manual



Points to Remember

- The choice of frying method for sliced roots and tubers depends on several factors including desired oil content, crisp characteristics, production volume, cost, and efficiency.



Theoretical Activity 4.3.2: Description of Changes occur during frying of sliced roots and tubers



Notes to the trainer:

- Trainer may use small group for describing changes occur during frying of sliced roots and tubers
- Trainer may avail photos and videos as didactic materials for describing changes occur during frying sliced roots and tubers



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to answer the following question:
(i)What could be the changes occur during frying of sliced roots and tubers?
- Step 2:** Ask trainees to write the findings on papers, flip chart.
- Step 3:** Asks trainees to present their findings and choose the correct ones.
- Step 4:** Provide the expert view and clarify ideas by using didactic materials.
- Step 5:** Address any questions or concerns.
- Step 6:** Ask trainees to read the key reading 4.3.1 in trainee manual



Points to Remember

- Frying is a complex process that involves a combination of physical and chemical changes, resulting in the production of crispy, flavorful chips.



Practical Activity 4.3.3: Frying sliced roots and tubers



Notes to the trainer

- The trainer may use individualized method for demonstrating how to fry sliced roots and tubers for crisps
- The trainer may avail sliced roots and tubers
- The use of photos and videos as didactic materials is required



Key steps:

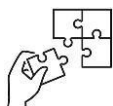
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in the roots and tubers processing workshop to fry sliced roots and tubers
- Step 2:** Explain the task and provide clear work instruction (PPE, Time allocated)
- Step 3:** Demonstrate how you can fry roots and tubers While demonstrating, explain the methods and procedures.
- Step 4:** Ask trainees to fry sliced roots and tubers and monitor the procedures.
- Step 5:** Verify whether the sliced roots and tubers are properly fried and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 4.3.2 in trainee manual



Points to Remember

- The oil should be heated to a high temperature, typically around 350-375°F (175-190°C), to ensure the slices cook quickly and evenly
- The frying time varies depending on the thickness of the slices and the desired level of crispiness.
- Avoid overcrowding the fryer, as this can lower the oil temperature and result in soggy crisps.



Application of learning 4.3.

Suppose you want to produce fried irish potatoes crisps, ask trainees to go to root and tubers processing workshop to fry sliced irish potatoes .

Checklist:

SN	Criteria	Indicators	Yes	No
1	Sliced irish potatoes are properly fried according to frying conditions	1. 1 Sliced irish potatoes are fried		
		1.2.Frying time is respected		
		1.3.Frying temperature is respected		
		1.4Oil is heated		



Indicative content 4.4: De-oiling Crisps



Duration: 2 hrs.



Theoretical Activity 4.4.1: Description of de-oiling methods of crisps



Notes to the trainer:

- Trainer may use small group for describing de-oiling methods of crisps
- Trainer may avail photos and videos as didactic materials for describing de-oiling methods of crisps



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to answer the following question:
- (i) What do you understand by de-oiling methods of crisp?
- Step 2:** Ask trainees to write the findings on papers, flip chart.
- Step 3:** Asks trainees to present their findings and choose the correct ones.
- Step 4:** Provide the expert view and clarify ideas by using didactic materials.
- Step 5:** Address any questions or concerns.
- Step 6:** Ask trainees to read the key reading 4.4.1 in trainee manual



Points to Remember

- By selecting the right deoiling method and carefully controlling the process, you can produce crisps with optimal oil content and high-quality product.



Practical Activity 4.4.2: De-oiling crisps



Notes to the trainer

- The trainer may use individualized method for demonstrating how to de-oil crisps
- The use of photos and videos as didactic materials is required



Key steps:

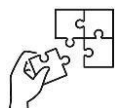
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in the roots and tubers processing workshop to de-oil crisps
- Step 2:** Explain the task and provide clear work instruction (PPE, Time allocated)
- Step 3:** Demonstrate how you can de-oil crisps While demonstrating, explain the methods and procedures.
- Step 4:** Ask trainees to de-oil crisps and monitor the procedures.
- Step 5:** Verify whether the crisps are properly de-oiled and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 4.4.2 in trainee manual



Points to Remember

- Regularly clean deoiling equipment to prevent contamination and ensure optimal performance.
- Follow manufacturer's recommendations for maintenance and calibration of de-oiling machine
- Seal the deoiled crisps in airtight containers to prevent oil reabsorption.
- Monitor and control the temperature during deoiling to prevent damage to the crisps.
- Ensure adequate deoiling time to achieve the desired oil content.



Application of learning 4.4.

You want to produce crisps, which do not contain oil, ask trainees to go to root and tubers processing workshop to de-oil Irish potatoes crisps

Checklist:

SN	Criteria	Indicators	Yes	No
1	Irish potatoes crisps are effectively de-oiled according to de-oiling methods	1.1 Crisps are de-oiled		
		1.2. De-oiler is adjusted		
		1.3. The chosen de-oiling method is used		



Indicative content 4.5: Seasoning of Crisps



Duration: 2hrs



Theoretical Activity 4.5.1: Description of seasoning methods of crisps



Notes to the trainer:

- Trainer may use small group for describing seasoning methods of crisps
- Trainer may avail photos and videos as didactic materials for describing seasoning methods of crisps



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to answer the following question:
(i)What do you understand by seasoning methods of crisp?
- Step 2:** Ask trainees to write the findings on papers, flip chart.
- Step 3:** Asks trainees to present their findings and choose the correct ones.
- Step 4:** Provide the expert view and clarify ideas by using didactic materials.
- Step 5:** Address any questions or concerns.
- Step 6:** Ask trainees to read the key reading 4.5.1 in trainee manual



Points to Remember

- Choosing the right seasoning method for crisps depends on various factors, including the desired flavor profile, texture, and production efficiency



Practical Activity 4.5.2: Seasoning crisps



Notes to the trainer

- The trainer may use individualized method to demonstrate how you can season crisps
- The trainer Avail seasoning ingredients for crisps
- The use of video, photos as didactic material is required



Key steps:

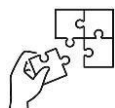
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in the roots and tubers processing workshop to season crisps
- Step 2:** Explain the task and provide clear work instruction (PPE, Time allocated)
- Step 3:** Demonstrate how you can season while demonstrating, explain the methods and procedures.
- Step 4:** Ask trainees to season crisps and monitor the procedures.
- Step 5:** Verify whether the crisps are properly seasoned and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 4.5.2 in trainee manual



Points to Remember

- Season immediately after frying while the crisps are still hot to ensure proper adhesion.
- Use a seasoning shaker or a drum tumbler for even distribution.
- Carefully control the amount of seasoning to avoid excessive saltiness or a flavor overload.



Application of learning 4.5.

Suppose you want to produce seasoned irish potatoes crisps, ask trainees to go in the root and tubers processing workshop to season irish potatoes crisps .

Checklist:

SN	Criteria	Indicators	Yes	No
1	Crisps are well seasoned according to product specification	1. 1 Dry ingredients are used		
		1.2. Liquid ingredients are used		
		1.3. Emulsion ingredients are used		
		1.4. Final flavor is matched to product characteristics		



Indicative content 4.6: Cooling of Crisps



Duration: 2 hrs.



Theoretical Activity 4.6.1: Description of cooling method of crisps



Notes to the trainer:

- Trainer may use small group for describing cooling methods of crisps
- Trainer may avail photos and videos as didactic materials for describing cooling methods of crisps



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to answer the following question:
- (i) What do you understand by cooling methods of crisp?
- Step 2:** Ask trainees to write the findings on papers, flip chart.
- Step 3:** Asks trainees to present their findings and choose the correct ones.
- Step 4:** Provide the expert view and clarify ideas by using didactic materials.
- Step 5:** Address any questions or concerns.
- Step 6:** Ask trainees to read the key reading 4.6.1 in trainee manual



Points to Remember

- Choose a cooling method that suits your needs and the type of crisps you are making. Options include air cooling, rapid cooling, or using a dehydrator.



Practical Activity 4.6.2: Cooling crisps



Notes to the trainer

- The trainer may use individualized method to demonstrate how to cool crisps
- The use of video, photos as didactic materials is required



Key steps:

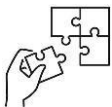
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in the roots and tubers processing workshop to cool crisps
- Step 2:** Explain the task and provide clear work instruction (PPE, Time allocated)
- Step 3:** Demonstrate how you can cool crisps while demonstrating, explain the methods and procedures.
- Step 4:** Ask trainees to cool crisps and monitor the procedures.
- Step 5:** Verify whether the crisps are properly cooled and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 4.6.2 in trainee manual



Points to Remember

- Proper airflow is essential for even cooling.
- Maintain a clean and hygienic environment during the cooling process to prevent contamination.



Application of learning 4.6.

You want to cool crisps from irish potatoes, ask trainees to go in the root and tubers processing workshop to cool irish potatoes crisps.

Checklist:

SN	Criteria	Indicators	Yes	No
1	Crisps is well cooled according to the cooling methods	1. 1 The crisps is cooled for the sufficient amount of time		
		1.2. Appropriate cooling method is used		



Indicative content 4.7: Analysing the Quality of Crisps



Duration: 2 hrs.



Theoretical Activity 4.7.1: Description of crisps quality requirements



Notes to the trainer:

- Trainer may use small group for describing quality requirements of crisps
- Trainer may avail photos and videos as didactic materials for describing quality requirements of crisps



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to answer the following question:
- (i) What could be the quality requirements of crisps?
- Step 2:** Ask trainees to write the findings on papers, flip chart.
- Step 3:** Asks trainees to present their findings and choose the correct ones.
- Step 4:** Provide the expert view and clarify ideas by using didactic materials.
- Step 5:** Address any questions or concerns.
- Step 6:** Ask trainees to read the key reading 4.7.1 in trainee manual



Points to Remember

- Physical quality requirements of crisps include aspects such as color, size, sogginess, oiliness, and texture.
- Chemical composition limits focus on moisture content, free fatty acids, acid insoluble ash, peroxide value, fat content, and sodium chloride.
- Microbiological standards involve total viable count, absence of pathogens like E. coli and Salmonella, and yeast and mould counts.



Practical Activity 4.7.2: Analysing crisps physical quality parameters



Notes to the trainer

- The trainer may use individualized method to demonstrate how to analyse physical quality parameters of crisps
- Avail crisps to be analysed
- The use of video, photos as didactic materials is required



Key steps:

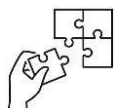
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in the roots and tubers processing workshop to analyse physical quality parameters of crisps
- Step 2:** Explain the task and provide clear work instruction (PPE, Time allocated)
- Step 3:** Demonstrate how you can analyse physical quality parameters of crisps while demonstrating, explain the methods and procedures.
- Step 4:** Ask trainees to analyse physical quality parameters of crisps and monitor the procedures.
- Step 5:** Verify whether the quality parameters of crisps are properly analysed and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 4.7.2 in trainee manual



Points to Remember

- By following the guidelines and using appropriate analytical methods, you can ensure that the crisps meet the highest quality standards and are safe for consumption.



Application of learning 4.7.

You want to know the physical quality parameters of irish potatoes crisps, ask trainees to go in the root and tubers processing workshop to analyse physical quality parameters of irish potatoes crisps.

Checklist:

SN	Criteria	Indicators	Yes	No
1	Physical quality parameters of crisps are properly analyzed according to the product specifications.	1. 1 Colour is analysed		
		1.2. Shape is analysed		
		1.3.Oiliness is analysed		
		1.4.Crispness is analysed		
		1.5.Texture is analysed		
		1.6. Thicknes is analysed		



Indicative content 4.8: Storing of Crisps



Duration: 2 hrs.



Practical Activity 4.8.1: Packaging crisps



Notes to the trainer

- The trainer may use individualized method for demonstrate how to package crisps
- Avail packaging materials for crisps
- Avail crisps
- The use of video and photos as didactic materials is required



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in the roots and tubers processing workshop to package crisps
- Step 2:** Explain the task and provide clear work instruction (PPE, Time allocated)
- Step 3:** Demonstrate how you can package crisps while demonstrating, explain the methods and procedures.
- Step 4:** Ask trainees to package crisps and monitor the procedures.
- Step 5:** Verify whether the crisps are properly packaged and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 4.8.1 in trainee manual



Points to Remember

- Vacuum nitrogen packaging is a highly effective method for keeping crisps fresh and appealing, protecting them from the elements that cause spoilage and maintaining their desirable qualities for an extended period.



Practical Activity 4.8.2: Sealing crisps



Notes to the trainer

- The trainer may use individualized method for demonstrate how to seal crisps
- The use of video and photos as didactic materials is required



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in the roots and tubers processing workshop to seal crisps
- Step 2:** Explain the task and provide clear work instruction (PPE, Time allocated)
- Step 3:** Demonstrate how you can seal crisps while demonstrating, explain the methods and procedures.
- Step 4:** Ask trainees to seal crisps and monitor the procedures.
- Step 5:** Verify whether the crisps are properly sealed and provide feedback where necessary.
- Step 6:** Ask trainees to read key reading 4.8.2 in trainee manual



Points to Remember

- By following the sealing guidelines, you can effectively seal crisps to maintain their quality, freshness, and crispiness.



Theoretical Activity 4.8.3: Description of labelling requirements of crisps



Notes to the trainer:

- Trainer may use small group for describing labelling requirements of crisps
- Trainer may avail photos and videos as didactic materials for describing labelling requirements of crisps



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to answer the following question:
(i)What could be the labelling requirements of crisps?
- Step 2:** Ask trainees to write the findings on papers, flip chart.
- Step 3:** Asks trainees to present their findings and choose the correct ones.
- Step 4:** Provide the expert view and clarify ideas by using didactic materials.
- Step 5:** Address any questions or concerns.
- Step 6:** Ask trainees to read the key reading 4.8.3 in trainee manual



Points to Remember

- By adhering to the labelling requirements, you can ensure that the crisp products meet legal standards and provide consumers with the necessary information to make informed purchasing decisions.



Practical Activity 4.8.4: Storing Crisps



Notes to the trainer

- The trainer may use individualized method for demonstrate how to store crisps
- The use of video and photos as didactic materials is required



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to go in the roots and tubers processing workshop to store crisps
- Step 2:** Explain the task and provide clear work instruction (PPE, Time allocated)
- Step 3:** Demonstrate how you can monitor store crisps while demonstrating, explain the methods and procedures.
- Step 4:** Ask trainees to store crisps and monitor the procedures.

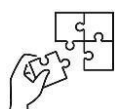
Step 5: Verify whether the crisps are properly stored and provide feedback where necessary.

Step 6: Ask trainees to read key reading 4.8.4 in trainee manual



Points to Remember

- By following the storage procedures, you can help preserve the quality and freshness of crisps and enjoy them at their best.



Application of learning 4.8.

Suppose you want to store crisps from Irish potatoes, ask trainees to go in the root and tubers processing workshop to store Irish potatoes crisps.

Checklist:

SN	Criteria	Indicators	Yes	No
1	Crisps are properly stored according to storage conditions	1. 1 The crisps are packaged in airtight containers		
		1.2. Crisps are stored in a cool, dry, and dark place		
		1.3. Crisps storage conditions are monitored		
		1.4. Crisps are labelled		
		1.5. Preservatives(Nitrogen) are used		



Learning outcome 4 end assessment

Written assessment

I. Ready carefully the statements below related to making crisps and answer by encircling the letter corresponding to the correct answer

1. Which of the following is **NOT** a common blanching method for sliced roots and tubers?

- A. Steam Blanching
- B. Hot Water Blanching
- C. Freeze Blanching
- D. Microwave Blanching

Answer: C. Freeze Blanching

2. Which method of frying is commonly used for commercial production of crisps?

- A. Deep Frying
- B. Pan Frying
- C. Air Frying
- D. Grilling

Answer: A. Deep Frying

3. During frying, which chemical reaction is primarily responsible for the browning of slices?

- A. Caramelization
- B. Lipid Oxidation
- C. Maillard Reaction
- D. Starch Gelatinization

Answer: C. Maillard Reaction

4. What is the main purpose of cooling crisps after frying?

- A. To enhance flavor
- B. To prevent sogginess
- C. To increase moisture content
- D. To soften texture

Answer: B. To prevent sogginess

5. Which test is commonly used to evaluate the crispiness of finished crisps?

- A. Texture Analysis
- B. Colorimeter Test
- C. Moisture Content Test
- D. Flavor Profile Analysis

Answer: A. Texture Analysis

6. What is a common method for sealing bags of crisps to maintain freshness?

- A. Heat Sealing
- B. Vacuum Sealing
- C. Zip-Locking
- D. Clip Sealing

Answer: B. Vacuum Sealing

II. Ready the statements below related to making crisps and answer by True if the statement is correct and answer by False if the statement is wrong.

1. Blanching helps in reducing microbial load and preserving the color of sliced roots and tubers.

Answer: True

2. Patting dry with paper towels is an effective method for removing deep-seated moisture from slices.

Answer: False

3. Frying sliced roots and tubers at too high a temperature can lead to acrylamide formation.

Answer: True

4. Air drying is the most effective method for removing moisture from slices when compared to centrifugal drying.

Answer: False

5. The use of excessive salt in the salting method can lead to undesirable health effects and requires thorough rinsing.

Answer: True

6. The cooling process for crisps is crucial to ensure they maintain a crispy texture by reducing the risk of moisture absorption.

Answer: True

7. Quality testing of crisps involves checking for uniformity in color and texture as well as flavor.

Answer: True

8. Blanching is only done to improve the texture of the slices and has no impact on flavor.

Answer: False

9. The primary function of seasoning is to enhance the flavor profile of the crisps.

Answer: True

10. Storage conditions for crisps should be cool and dry to prevent spoilage and maintain product quality.

Answer: True

Practical assessment

Two weeks ago, your school has received a gift of tools and equipment used in processing Irish potatoes into crisps. However, the school does not have a qualified technician in roots and tubers processing which will use those tools and equipment to make potato crisps. To overcome the above issue, the school manager decided to hire you as a qualified technician in roots and tubers processing to do the following task as a demonstration of how to make potato crisps.

Task 1: Blanch sliced Irish potatoes

Task 2: De-water sliced Irish potatoes

Task 3: Fry sliced Irish potatoes

Task 4: De-oil Irish potato crisps

Task 5: Season Irish potato crisps

Task 6: Cool Irish potato crisps

Task 7: Analyse quality of Irish potatoes

Task 8: Store Irish potato crisps

Note:

The tasks should be performed within five (5) hours

All materials, tools and equipment are available in the production area of your school.

Checklist:

SN	Criteria	Indicators	Yes	No
1	Sliced Irish potatoes are properly blanched according to blanching conditions	1.1 Sliced Irish potatoes are blanched		
		1.2. Blanching time is respected		
		1.3. Blanching temperature is respected		
2	Blanched Irish potatoes are properly de-watered according to de-watering methods	2.1 Blanched Irish potatoes are de-watered		
		2.2. Water is removed		
		2.3 De-water machine is used		
3	Sliced Irish potatoes are properly fried according to frying conditions	3.1 Sliced Irish potatoes are fried		
		3.2. Frying time is respected		
		3.3. Frying temperature is respected		

		3.4.Oil is heated		
4	Irish potatoes crisps are effectively de-oiled according to de-oiling methods	4. 1 Crisps are de-oiled		
		4.2. De-oiler is adjusted		
		4.3. The chosen de-oiling method is used		
5	Crisps are well seasoned according to product specification	5. 1 Dry ingredients are used		
		5.2. Liquid ingredients are used		
		5.3.Emulsion ingredients are used		
		5.4. Final flavor is matched to product characteristics		
6	Crisps are well cooled according to the cooling methods	6. 1 The crisps are cooled for the sufficient amount of time		
		6.2. Appropriate cooling method is used		
7	Physical quality parameters of crisps are properly analyzed according to the product specifications.	7. 1 colour is analysed		
		7.2. Shape is analysed		
		7.3.Oiliness is analysed		
		7.4.Crispness is analysed		
		7.5.Texture is analysed		
		7.6. Thickness is analysed		
8	Crisps are properly stored according to storage conditions	8. 1 The crisps are packaged in airtight containers		
		8.2. Crisps are stored in a cool, dry, and dark place		
		8.3. Crisps storage conditions are monitored		
		8.4.Crisps are labelled		
		8.5.Preservatives(Nitrogen) are used		

END



Further information to the trainer

Brown, L. A. (2015). Crispology: The science behind the perfect snack (pp. 88-105). Snack Science Publishing.

Smith, J. P. (2011). The art of crisp making: From farm to table pp45-67.

Taylor, H. L. (2017). Potato crisps: A guide to production and flavoring techniques (pp. 150-165). Snack Master Press.



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