RQF LEVEL 5

FOPSP503

FOOD PROCESSING

Sugarcane Processing

TRAINER'S MANUAL

October, 2024

SUGARCANE PROCESSING

KOICA Korea International Cooperation Agency

TQUM TVET Quality Management Project

2024

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TABLE OF CONTENT

ACRONYMS

°Bx: Brix

°F: Degree Fahrenheit

^{0}C: Degree Celsius

CBT/A: Competency-Based Training and Assessment

DCH: Direct Contact Heater

GMO: Genetically Modified Organism

HPLC: High-performance liquid chromatography

IER: Ion exchange resins

KOICA: Korea International Cooperation Agency

MCS: Melt Clarification System

PAC: Powdered activated carbon

PE: Polyethylene

pH: Hydrogen Potential

PP: Polypropylene

PPE: Personal protective equipment

RTB: Rwanda TVET Board

SCS: Syrup Clarification System

TLC: Thin-layer chromatography

TQUM: TVET Quality Management

TVET: Technical and Vocational Education and Training

INTRODUCTION

This trainer's manual includes all the methodologies required to effectively deliver the module titled **"Sugarcane processing."** 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 students 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 students review the key reading and the points to remember section.

MODULE CODE AND TITLE: FOPSP503 SUGARCANE PROCESSING

Learning Outcome 1: Prepare workplace and sugarcane
Learning Outcome 2: Make syrup
Learning Outcome 3: Crystallize syrup
Learning Outcome 4: Refine brown sugar

Indicative contents

1.1 Selecting materials, tools and equipment used in sugarcane processing

1.2 Arranging workplace

1.3 Receiving the sugarcane

Key Competencies for Learning Outcome 1: Prepare workplace and sugarcane

Knowledge	Skills	Attitudes
• Identification of tools and equipment used in sugarcane processing • Explanation of the sugar processing flow diagram • Identification of quality parameters of sugarcane used in sugar processing	• Selecting tools and equipment • Adjusting tools and equipment • Cleaning workplace, tools and equipment • Arranging the workplace • Preparing sugar packaging materials • Receiving sugarcane	• Paying attention while adjusting tools and equipment • Being responsible when using tools and equipment • Being honest while receiving sugarcane •

Duration: 10 hrs

Learning outcome 1 objectives:

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

1. Identify properly tools and equipment used in sugarcane processing
2. Select properly materials, tools and equipment for sugarcane processing
3. Adjust correctly tools and equipment for sugarcane processing
4. Clean effectively workplace, tools and equipment for sugarcane processing
5. Prepare correctly sugar packaging materials for sugar packaging
6. Explain correctly the sugar processing flow diagram used in sugarcane processing
7. Arrange appropriately the workplace for sugarcane processing
8. Receive properly materials used in sugarcane processing

Resources

Equipment	Tools	Materials
• Weighbridge • Balance • Air blower • Unloader machine • Conveyor belt • Air condenser • Boiler • Water tanks • Turbine • Cutters • Fibrizor • Mills • Evaporation bodies • Heaters,	• Polarimeter or saccharimeter • refractometer • Squeegee • Mop • White towel • Wooden brush • Thermometer • pH meter • analytic balance • metallic brushes	• Sugarcane • Disinfectant • Single use gloves • Detergents • Magadi soda • Packaging materials • Lime • Biocide • Flocculent • Caustic soda • Sulphurous acid

• Clarifier tank, • Vacuum filter, • Pumps, • PPEs, • Vacuum pump, • Crystallizer, • Vacuum pans, • Centrifugal machine, • Hopper, • Bins, • Weighing scale		

Advance Preparation:

Before delivering this learning outcome, you are recommended to:

- Avail sugarcane processing workshop.
- Avail labelled and not expired materials (cleaning product, chemicals used in sugarcane processing)
- Have manuals/guide, pictures, videos, illustrations related to sugarcane processing
- Avail sugarcanes
- Ensure that tools and equipment for sugarcane processing are available and are in good working conditions.
- Avail sugar packaging materials

Indicative content 1.1: Selecting materials, tools and equipment used in sugarcane processing

Duration: 3hrs

Theoretical Activity 1.1.1: Identification of tools and equipment used in sugarcane processing

Notes to the trainer:

- Trainer may use small groups to identify tools and equipment used in sugarcane processing
- Avail drawings, pictures showing tools and equipment for sugarcane processing to be used as didactic materials.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainee to answer the following questions:
- **i.** What could be the tools and equipment used in sugarcane processing?
- **ii.** What can be the uses of those tools and equipment?
- **iii.** What could be the safety precautions when using those tools and equipment?

Step 2: Ask trainees to write the findings on papers, flip chart, blackboard or white boards

Step 3: Facilitate trainees to present their findings

Step 4: Provide expert view and clarify ideas 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

- Each tool or equipment plays a vital role in ensuring that sugarcane is processed efficiently from reception to the final product.
- It is strictly recommended to adhere to safety precautions while processing sugarcane to avoid accidents and injuries.

Practical Activity 1.1.2: Selecting and adjusting tools and equipment for sugarcane processing

Notes to the trainer

- Facilitate each trainee in selecting and adjusting tools and equipment used in sugarcane processing
- Avail tools and equipment required for sugarcane processing.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to go in the sugarcane processing workshop to select and adjust tools and equipment to be used in sugarcane processing.

Step 2: Explain the task and provide clear work instructions (PPE, Time allocated)

Step 3: Demonstrate how to select tools and equipment for sugarcane processing. While demonstrating, explain clearly the selection criteria for selecting tools and equipment for sugarcane processing.

Step 4: Ask trainees to do the task individually and monitor trainees' activities.

Step 5: Verify whether tools and equipment are properly selected and provide feedback on each trainee's work.

Step 6: Ask trainees to read key reading 1.1.2 in trainee manual

Step 7: Ask trainees to perform the task provided in application of learning 1.1

Points to Remember

- While selecting tools and equipment for sugarcane processing bear in mind the selection criteria.
- Selecting the right tools and equipment helps optimizing their operations while ensuring product quality meets consumer demands
- Wear all necessary PPE before selecting tools and equipment for sugarcane processing
- Unplug electrical equipment when not in use.
- Beware to follow the manufacturer's instructions when using or adjusting tools or equipment.

Practical Activity 1.1.3: Selecting materials and preparing packaging materials used in sugarcane processing

Notes to the trainer

- Facilitate each trainee in selecting materials and prepare the sugar packaging material to be used in sugarcane processing
- Avail materials required in sugarcane processing.
- Avail packaging materials used in sugarcane processing

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to go in the sugarcane processing workshop to select materials and prepare the sugar packaging materials to be used in sugarcane processing.

Step 2: Explain the task and provide clear work instructions (PPE, Time allocated)

Step 3: Demonstrate how to select materials and prepare packaging materials for sugarcane processing. While demonstrating, explain clearly the selection criteria for materials required in sugarcane processing.

Step 4: Ask trainees to do the task individually and monitor trainees' activities.

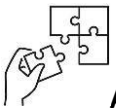
Step 5: Verify whether materials are correctly selected and if packaging materials are correctly prepared and provide feedback on each trainee's work

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

Step 7: Ask trainees to perform the task provided in application of learning 1.1

Points to Remember

- For safety issues, always wear PPE before selecting chemicals for sugarcane processing.
- Good packaging material for sugar must fulfil the requirements including inert to the product, moisture and gas barrier and provided with tamper-proof seals and closures.



Application of learning 1.1.

There is an exhibition in your district and your school will showcase brown and white sugar.

Ask trainees to go to the sugarcane processing workshop to:

- Select materials, tools and equipment to be used in sugarcane processing
- Adjust tools and equipment to be used in sugarcane processing

Checklist:

SN	Criteria	Indicators	Yes	No
1	Materials, tools and equipment are appropriately selected	1.1 Selection criteria of materials, tools and equipment are respected		
		1.2 Milling equipment are selected		
		1.3 Filtration equipment are selected		
		1.4. Packaging materials are selected		
		1.5. Safety precautions are respected		
2	Tools and equipment are adjusted	2.1.Adjusting procedures are respected		
		2.2. Records are kept		
		2.3 Safety precautions are respected		

Indicative content 1.2: Arranging workplace

Duration: 3 hrs

Practical Activity 1.2.1: Cleaning and arranging workplace, tools and equipment used in sugarcane processing

Notes to the trainer

- Facilitate each trainee in cleaning and arranging tools and equipment for sugarcane processing
- Avail cleaning products

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to go in the sugarcane processing workshop to clean and arrange the tools and equipment used in sugarcane processing.

Step 2: Explain the task and provide clear work instructions (PPE, Time allocated)

Step 3: Demonstrate how to clean and arrange tools and equipment for sugarcane processing. While demonstrating, explain clearly the cleaning techniques for tools and equipment.

Step 4: Ask trainees to do the task individually and monitor trainees' activities.

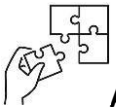
Step 5: Verify whether tools and equipment are properly cleaned and provide feedback on each trainee's work

Step 6: Ask trainees to read key reading 1.2.1 in trainee manual

Step 7: Ask trainees to perform the task provided in application of learning 1.2

Points to Remember

- For safety issues, clean thoroughly the workplace, tools and equipment for sugarcane processing
- While arranging the workplace, follow the sugarcane processing flow chart to avoid cross contamination, accidents and injuries.



Application of learning 1.2.

There is an open day at your school, trainees will showcase brown and white sugar. Ask trainee s to go to the sugarcane processing workshop to:

- Clean the workplace, tools and equipment for sugarcane processing
- Arrange workplace, tools and equipment for sugarcane processing.

Checklist:

SN	Criteria	Indicators	Yes	No
1	Workplace, tools and equipment are thoroughly cleaned	1.1 Cleaning techniques are applied		
		1.2 Cleaning materials are used		
		1.3. Cleanliness is checked		
2	Workplace, tools and equipment are properly arranged	2.1 Milling equipment are arranged		
		2.2 Filtration equipment are arranged		
		2.3 Tools and equipment are arranged based on the processing flow chart		

Indicative content 1.3: Receiving the sugarcane

Duration: 4 hrs

Practical Activity 1.3.1 Receiving sugarcane used in sugarcane processing

Notes to the trainer

- Facilitate each trainee in checking the quality parameters of sugarcane
- Avail mature sugarcane.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to go the sugarcane processing workshop to receive sugarcane.

Step 2: Explain the task and provide clear work instructions (PPE, Time allocated)

Step 3: Demonstrate how to receive sugarcane. While demonstrating, explain clearly the acceptance criteria of sugarcane for sugarcane processing.

Step 4: Ask trainees to do the task individually and monitor trainees' activities.

Step 5: Verify whether sugarcane is accurately received and provide feedback on each trainee's work

Step 6: Ask trainees to read key reading 1.3.1 in trainee manual

Step 7: Ask trainees to perform the task provided in application of learning 1.3

Points to Remember

- For high-quality sugar production, only receive sugarcanes with acceptable quality parameters.
- Weighing accurately sugarcane helps to calculate the yield and quality of the juice extracted, helping to identify any issues in the processing.

Application of learning 1.3.

The school 'supplier brought sugarcane for sugar making. request trainees to go in the sugarcane processing workshop to receive and weigh those sugarcanes.

Checklist:

SN	Criteria	Indicators	Yes	No
1	Sugarcanes are properly received	1.1 Age is checked		
		1.2. Brix is tested		
		1.3 Polarity is measured		
		1.4 Purity is calculated		
		1.5 pH of Juice is tested		

Learning outcome 1 end assessment

Theoretical assessment

1. Match each tool/equipment with its use by writing the letter corresponding to the correct answer in the column named **"Answer".**

Answer	Tool/Equipment	Use
1……c……	1. Crystallizer	a) It is used to measure the sugar content as (Brix) in sugarcane juice.
2……b……	2. Boiler	b) It used to produce steam for heating and sterilization.
3……d……	3. pH meter	c) It is a piece of equipment used in the sugar refining process to convert concentrated sugar syrup into sugar crystals
4……e……	4. Vacuum pan	d) It is used to measure the acidity of a sugarcane juice.
5……a……	5. . Saccharimeter	e) It is used to concentrate sugarcane juices by removing water through evaporation.
	6. Weighbridge	

2. Read carefully the following statements and choose by encircling the letter corresponding to the right answer

I. The following are the safety precautions of using tools and equipment except;

a) Handle chemicals safely and according to manufacturer's instructions

b) Have clear emergency procedures in place and ensure all workers are familiar with them.

c) Mill sugarcanes finely to extract juice

Answer: c)

II. The following are the selection criteria of tools and equipment for sugarcane processing except;

a) The tools and equipment should be made from high-quality materials that can withstand the harsh conditions of sugarcane processing
b) The tools and equipment should be very light weighted to enable their handling
c) The equipment should be easy to maintain and have readily available spare parts.

Answer: b)

3. Read carefully the following statements related to selection criteria of materials used in sugarcane processing and answer by "**True"** if it is correct or "**False"** if it is incorrect.

a) a) The chemical products should be of high quality and contain some impurities that could contaminate the sugar. … **False**
b) b) The products should be efficient in their intended use, ensuring optimal performance and minimal waste. … **False**
c) c) The products should be safe for use in food processing, ensuring that they do not pose any health risks to consumers. … **True**
d) d) The products should be expensive to be of high quality, considering factors such as initial cost, performance, and durability. … **True**
e) e) Sugarcane should be overripe to contain high quantity of sugar. …… **False**

Practical assessment

The school is organizing an open day. In that event, tea and coffee will be served and guests will use sugar made by trainees. Ask each trainee to go in the sugarcane processing workshop to perform the following tasks:

1. To select materials, tools and equipment for sugarcane processing
2. To clean the workplace, tools, and equipment for sugarcane processing
3. To arrange the workplace, tools and equipment for sugarcane processing
4. To receive sugarcanes for sugar production

The task should be completed within 3 hours.

Checklist

SN	Criteria	Indicators	Yes	No
1	Materials, tools and equipment are appropriately selected	1.1 Age is checked		
		1.2. Brix is tested		
		1.3 Polarity is measured		
		1.4 Purity is calculated		
		1.5 pH of Juice is tested		
2	Tools and equipment are correctly adjusted	2.1 Adjusting procedures are respected		
		2.2. Records are kept		
		2.3 Safety precautions are respected		
3	Workplace, tools and equipment are thoroughly cleaned	3.1 Cleaning techniques are applied		
		3.2 Safety precautions for cleaning products are respected		
		3.3. Cleanliness is checked		
4		4.1 Arrangement criteria of workplace are respected		

	Workplace, tools and equipment are properly arranged	4.2 Sugarcane processing flow diagram is respected		
5	Sugarcane are properly received	5.1 Sugarcane acceptance criteria are respected		
		5.2. Weight of sugarcane is measured		
		5.3. Records are kept		
6	Sugarcane is accurately weighed	6.1 The sugarcane weighing tool is selected		
		6.2 The sugarcane weighing technique is applied		
		6.3 Records are kept		

END

Further information to the trainer

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CLEAR
JUICE

Indicative contents
2.1 Extracting raw juice from sugarcane **2.2 Heating of raw juice** **2.3 Clarifying treated juice for sugar processing** **2.4 Evaporation of clear juice**

Key Competencies for Learning Outcome 2: Make syrup

Knowledge	Skills	Attitudes
• Description of bagasse and raw juice • Identification of raw juices heating stages. • Description of the type of raw juice and quality parameter of clear juice	• Cutting sugarcane into small piece • Milling sugarcane • Analysing the bagasse and raw juice • Mixing and filtration of mixed juice • Liming of heated juice • Clarifying treated juice • Measuring the quality of clear juice • Evaporating clear juice • Checking the effectiveness of evaporation process	• Paying attention while operating machines • Being accurate when analysing the bagasse and raw juice • Being patient when clarifying treated juice • Being precise when measuring quantities •

Duration: 25hrs

Learning outcome 2 objectives:

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

1. Describe properly bagasse and raw juice for sugarcane processing
2. Cut precisely sugarcane into small pieces according to the size of hooper.
3. Mill properly sugarcane for juice extraction
4. Analyse effectively the bagasse and raw juice referring to quality specifications
5. Filter perfectly mixed juice according to filtration methods
6. Lime adequately heated juice referring to juice quality specifications
7. Clarify properly treated juice according to clarification techniques
8. Measure the quality of clear juice in accordance with clear juice quality specifications
9. Evaporate properly clear juice for sugar syrup making
10. Check correctly the effectiveness of evaporation process as used in sugar syrup making

Resources

Equipment	Tools	Materials
● Cutters ● Fibrizor ● Mills ● Evaporation bodies ● Heaters ● Clarifier tank ● Vacuum filter ● Pumps ● Condenser ● Boiler ● Water tanks ● Turbine ● PPE	● pH meter ● Thermometer ● Refractometer ● Spectrophotometer ● Measuring cylinder ● Polarimeter ● Sampler ● Conductometer	● Biocide, ● Lime, ● Flocculent, ● Water, ● Caustic soda, ● Sulphurous acid

• Vacuum pump		

Advance Preparation:

Before delivering this learning outcome, you are recommended to:

- Have a well-organized workshop
- Avail materials required to concentrate clear juice into sugar syrup
- Avail pictures and video related to the sugar syrup making
- Avail tools and equipment for extracting raw juice from sugarcane

Indicative content 2.1: Extracting raw juice from sugarcane

Duration: 7hrs

Theoretical Activity 2.1.1: Identification of type of raw juice

Notes to the trainer:

- Trainer may use small groups to describe type raw juice
- Avail some videos showing types of raw juices in sugarcane processing to be used as didactic materials

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the session and ask trainees to answer the following question:

i. What do you think could be the types of raw juices extracted from sugarcanes?
ii. What could be the characteristics of those types of juices?
iii. How do you think sugarcane raw juice is treated?

Step 2: Ask trainees to write the findings on papers, flip chart, blackboard or white boards

Step 3: Facilitate trainees to present their findings

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

Step 5: Address any questions or concerns

Step 6: Ask trainees to read the key reading 2.1.1 in trainee manual

Points to Remember

- It is recommended to filter the raw juice from sugarcane in order to remove impurities such as bagasse and mud.
- Mix different grades of sugarcane raw juice to effectively make a high-quality sugar.

Practical Activity 2.1.2: Extracting raw juice from sugarcane

Notes to the trainer

- Facilitate each trainee in the extracting raw juice from sugarcane.
- Avail sugarcanes and sugarcane miller.
- Avail video related to the extraction of raw juice from sugarcanes.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to go to the sugarcane processing workshop to extract the juice from sugarcane.

Step 2: Explain the task and provide clear work instructions (PPE, Time allocated)

Step 3: Demonstrate how to extract raw juice from sugarcanes . While demonstrating, explain clearly the extraction techniques.

Step 4: Ask trainees to do the task individually and monitor trainees' activities.

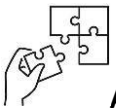
Step 5: Verify whether raw juice is perfectly extracted and provide feedback on each trainee's work

Step 6: Ask trainees to read key reading 2.1.2 in trainee manual

Step 7: Ask trainees to perform the task provided in application of learning 2.1

Points to Remember

- Milling is one of the most critical stage in sugarcane processing, monitor closely this stage while processing sugarcane
- For effective sugarcane juice extraction, imbibition is recommended.



Application of learning 2.1.

There are bunches sugarcane in the school's sugarcane processing workshop, ask each trainee to go to that workshop to extract the raw juice in sugarcane.

Checklist:

SN	Criteria	Indicators	Yes	No
1	Sugarcanes are precisely cut	1.1 PPE is worn		
		1.2. Cutting equipment are selected		
		1.3 Cutting technique is applied		
2	Sugarcanes are properly milled	2.1 Sugarcane miller is selected		
		2.2 Milling technique is respected		
		2.3 Imbibition is applied		
3	Raw juices are properly filtered	3.1 Filtration tools are selected		
		3.2 Filtration technique is applied		
		3.3 Types of raw juices are mixed		

Indicative content 2.2: Heating of raw juice

Duration: 6 hrs

Practical Activity 2.2.1: Heating of raw juice

Notes to the trainer

The trainer may:

- Facilitate each trainee in heating raw juice.
- Avail tools and equipment required in heating raw juice.
- Avail raw juice

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to go to the sugarcane processing workshop to heat raw juice.

Step 2: Explain the task and provide clear work instructions (PPE, Time allocated)

Step 3: Demonstrate how to heat raw juices. While demonstrating, explain clearly the techniques of heating raw juice.

Step 4: Ask trainees to do the task individually and monitor trainees' activities.

Step 5: Verify whether raw juice is heated and provide feedback on each trainee's work

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

- Heating raw juice before liming has several benefits including enhanced clarification, reduced lime consumption, improved juice quality and reduced scale formation.

Practical Activity 2.2.2: Liming of heated juice

Notes to the trainer

The trainer may:

- Facilitate each trainee in liming heated juice.
- Avail tools and equipment required in liming heated juice.
- Avail lime and heated juice

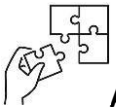
Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to go to the sugarcane processing workshop to lime heated juice.
Step 2: Explain the task and provide clear work instructions (PPE, Time allocated)
Step 3: Demonstrate how to lime heated juice. While demonstrating, explain clearly the liming process for raw juice.
Step 4: Ask trainees to do the task individually and monitor trainees' activities.
Step 5: Verify whether raw juice is properly limed and provide feedback on each trainee's work
Step 6: Ask trainees to read key reading 2.2.2 in trainee manual
Step 7: Ask trainees to perform the task provided in application of learning 2.2

Points to Remember

- Make sure to use milk of lime in sugarcane processing for the purpose of clarifying juice, adjusting pH, and precipitating impurities.
- Closely monitor the liming process to obtain a good sugar yield



Application of learning 2.2.

In sugarcane processing workshop there is raw juice of sugarcane. Ask each trainee to go in the sugarcane processing workshop to:

- Heat sugarcane raw juice
- Lime the heated juice.

Checklist:

SN	Criteria	Indicators	Yes	No
1	Sugarcanes raw juice is accurately heated	1.1 PPE is worn		
		1.2. Heaters are selected		
		1.3 Heating temperature is respected		
2	Heated sugarcane juice is correctly limed	2.1 Milk of lime is prepared		
		2.2 Liming procedure is respected		
		2.3 Liming temperature is respected		

Indicative content 2.3: Clarifying treated juice for sugar processing

Duration: 6hrs

Practical Activity 2.3.1: Clarifying treated juice

Notes to the trainer

The trainer may:

- Facilitate each trainee in clarifying treated juice.
- Avail tools and equipment required in clarifying juice.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to go to the sugarcane processing workshop to clarify treated juice.

Step 2: Explain the task and provide clear work instructions (PPE, Time allocated)

Step 3: Demonstrate how to clarify treated juice. While demonstrating, explain clearly the clarification process for treated juice.

Step 4: Ask trainees to do the task individually and monitor trainees' activities.

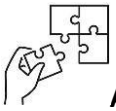
Step 5: Verify whether treated juice is correctly clarified and provide feedback on each trainee's work

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

- It is strictly recommended to clarify limed sugarcane juice to remove impurities, thus improve the quality of the final sugar.
- Sugarcane juice clarification helps to effectively evaporate water in the treated juice and crystallize sugar.



Application of learning 2.3.

During the peer to peer coaching, trainees from BDC school want to learn from your school how to process sugarcane. Ask each trainee to go in the sugarcane processing workshop to:

- Clarify sugarcane treated juice.

Checklist:

SN	Criteria	Indicators	Yes	No
1	Sugarcanes raw juice is accurately heated	1.1 PPE is worn		
		1.2. Heating equipment is selected		
		1.3 Heating temperature is respected		
2	Heated sugarcane juice is correctly limed	2.1 Milk of lime is prepared		
		2.2 Liming procedure is respected		
		2.3 Liming temperature is respected		

Indicative content 2.4: Evaporation of clear juice

Duration: 6hrs

Practical Activity 2.4.1: Evaporating clear juice

Notes to the trainer

- Facilitate each trainee in the evaporation of clear juice.
- Avail evaporators and clear juice

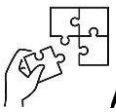
Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to go to the sugarcane processing workshop to evaporate clear juice.
Step 2: Explain the task and provide clear work instructions (PPE, Time allocated)
Step 3: Demonstrate how to evaporate clear juice.
Step 4: Ask trainees to do the task individually and monitor trainees' activities.
Step 5: Verify whether clear juice is properly evaporated and provide feedback on each trainee's product.
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

- Closely monitor evaporation process to effectively remove water in clear juice, thus preserving the quality of sugar.
- Use the evaporators that will effectively remove water while using less energy.
- It is recommended to test the juice properties such as viscosity and sugar concentration before evaporating the juice



Application of learning 2.4.

In sugarcane processing workshop, there is 100 litres of clear juice from sugarcane. Ask trainees to go in the sugarcane processing workshop to:

- Evaporate the clear juice so as to make sugar syrup

Checklist:

SN	Criteria	Indicators	Yes	No
1	Sugarcanes clear juice is properly evaporated	1.1 Evaporation equipment is selected		
		1.2 Evaporation method is applied		
		1.3 The required water content of the sugar syrup is achieved		

Learning outcome 2 end assessment

Theoretical assessment

1. Read carefully the following statements and choose by encircling the letter corresponding to the right answer

I. The following are the factors affecting sugarcane milling efficiency except:

a) The quality of the sugarcane, including maturity, fiber content, and Brix level.
b) The type and condition of the milling machines.
c) The cleaning products used before sugarcane milling

Answer: c)

II. The quality parameters to analyse in the sugarcane raw juice are the following except:

a) Acidity
b) Purity
c) Porosity
d) Brix

Answer: c)

2. Match the grades of sugarcane juice with their properties by writing the letter in the provided space in the column of **answer**.

Answer	**Properties of sugarcane raw juice**	**Grade of sugarcane raw juice**
1. ……B…….	1. It is considered good quality but with slightly lower sugar content. It may have a slightly darker colour and is slightly less sweet or may have some off-flavours	A
2. ……C…….	2. It is considered lower quality due to lower sugar content, higher impurity levels, or other defects. It is may have a darker colour and may be cloudy. It may have a bitter or off-flavour	B
3. ……A……..	3. It is considered the best quality juice, with high sugar content and minimal impurities. It is light in colour,	C

	often with a golden hue and is sweet and clean with minimal off-flavours	

3. Read carefully the following statement related to sugarcane processing and fill in the provided space with the appropriate missing words in bracket **(coagulation, clarification, evaporation, sterilization, centrifugation, pasteurization)**

a) …….. refers to the process of removing impurities from the extracted juice to improve its quality and prepare it for subsequent steps like evaporation and crystallization.

Answer: Clarification

b) ……. separates solid particles from the liquid juice. It involves spinning the juice at high speeds, which causes the denser solid particles to settle to the bottom while the lighter liquid remains on top.

Answer: Centrifugation

c) ……is the process of removing water from the clarified juice to concentrate the sugar content. This concentrated solution is then further processed to crystallize sugar.

Answer: Evaporation

d) …….. refers to the process of killing all microorganisms, including bacteria, viruses, and spores, present in the raw juice.

Answer: Sterilization

4. Read the following statements related to sugarcane processing and answer by "**True"** if it is correct or "**False"** if it is incorrect

a) Sulphur dioxide (SO_2) is added to the treated juice to increase the pH and promote the precipitation of impurities. **Answer: False**

b) Polarity measures the purity of the juice, with higher polarity indicating a lower proportion of sucrose. **Answer: False**

c) Flocculants are added to the juice to form larger particles (flocs) that can be more easily removed through sedimentation. **Answer: True**

c) Brix indicates the total soluble solids content in the juice, which is directly related to the sugar content. Higher Brix levels generally indicate higher sugar quality. **Answer: True**

d) Turbidity indicates the presence of dissolved particles in the juice. Higher turbidity indicates a clearer and purer juice. **Answer: False**

Practical assessment

PRIME cooperative located in Rutsiro district has a sugarcane plantation, recently they established a sugarcane processing unit. However, the cooperative lacks a qualified technician to process sugarcane. The production manager asks you to perform the following tasks:

1. To extracting raw juice from sugarcane
2. To heat the sugarcane raw juice
3. To clarifying treated juice for sugar processing
4. To evaporate clear juice

The task should be completed in 4 hours

All materials, tools and equipment are available at PRIME cooperative

Checklist:

SN	Criteria	Indicators	Yes	No
1	Sugarcanes are precisely cut	1.1 PPE is worn		
		1.2. Cutting equipment are selected		
		1.3 Cutting technique is applied		
2	Sugarcanes are properly milled	2.1 Sugarcane mill is selected		
		2.2 Milling technique is respected		
		2.3 Imbibition is applied		
3	Raw juices are properly filtered	3.1 Filtration tools are selected		
		3.2 Filtration technique is applied		
		3.3 Types of raw juices are mixed		
4	Sugarcanes raw juice is accurately heated	4.1. Heating equipment is selected 4.2. Heating temperature is respected		
5	Heated sugarcane juice is correctly limed	5.1 Milk of lime is prepared		
		5.2 Liming procedure is respected		
		5.3 Liming temperature is respected		

6	Sugarcanes clear juice is properly evaporated	6.1 Evaporation equipment is selected		
		6.2 Evaporation method is applied		
		6.3 The required water content of the sugar syrup is achieved		

END

Further information to the trainer

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SUGAR
SUGAR

Indicative contents
3.1 Boiling of syrup **3.2 Centrifuging the Massecuite** **3.3 Drying of brown sugar crystals**

Key Competencies for Learning Outcome 3: Crystallize Syrup

Knowledge	Skills	Attitudes
• Description of types of massecuite • Description of centrifugation of Massecuite	• Boiling the syrup to form crystals in sugarcane processing • Centrifuging the Massecuite • Re-boiling of A-heavy and B-heavy molasses • Applying drying techniques • Screening of brown sugar crystals • Analysing of quality of brown sugar	• Being careful while forming crystals and checking the quality of massecuite and centrifuging • Paying attention while checking final molasses and analysing quality of brown sugar • Being responsible while re-boiling of a-heavy and b-heavy molasses

Duration: 25 hrs

Learning outcome 3 objectives:

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

1. Describe clearly types of massecuite in sugarcane processing
2. Boil effectively the syrup to form crystals according to boiling conditions
3. Centrifuge effectively the massecuite according to centrifugation methods
4. Check correctly final molasses (by product) according to molasses specification
5. Dry correctly brown sugar crystals process as required for sugar production
6. Describe properly drying techniques used in sugar production
7. Screen properly brown sugar crystals as required for sugar production
8. Analyse effectively quality of brown sugar according to product specification

Resources

Equipment	Tools	Materials
● Crystallizer ● Vacuum pans ● Pipes, pumps, centrifugal machine ● Oven ● Hopper ● Weighing scale (balance) ● Stitching machine	● Pressure gauge ● Vacuum gauge ● Thermometer ● Refractometer ● Spectrophotometer ● Polarimeter ● Beaker ● Analytical balance ● Bins ● Conductivity meter.	● Water ● Steam ● Heat resistant gloves

Advance Preparation:

Before delivering this learning outcome, you are recommended to:

- Avail organized workshop.
- Avail syrup
- Ensure that tools and equipment to crystallize syrup are in good working conditions.
- Avail picture and tutorial video related to crystallization of syrup

Indicative content 3.1: Boiling of syrup

Duration: 7hrs

Theoretical Activity 3.1.1 Description of type of massecuite in sugarcane processing

Notes to the trainer:

- Trainer may use small groups for describing types of massecuite in sugarcane processing
- The use of pictures or tutorial 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 answer the following questions:

i. What do you understand by:

a) Evaporation
b) Syrup
c) Crystals
d) Crystallization process
e) Massecuite

ii. What could be the purpose of boiling syrup?

iii. What could be the boiling conditions of syrup?

Step 2: Ask trainees to write the findings on papers, flip chart, blackboard or white board

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 key reading 3.1.1

Points to Remember

- The quality of good massecuite in sugar manufacturing hinges on high purity levels, controlled colour content, optimal crystal yield, consistency in composition, effective temperature control, and efficient mechanical circulation during processing.

Practical Activity 3.1.2: Boiling of syrup

Notes to the trainer

- Facilitate each trainee in the boiling of syrup for formation of crystals
- Avail vacuum pan, crystallizer and others tools for boiling syrup for formation of crystals
- Avail video related to the boiling of syrup for formation of crystals

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to go in the sugarcane processing workshop and boil syrup to form crystals

Step 2: Explain the task and provide clear work instruction

Step 3: Demonstrate how to boil syrup to form crystals

Step 4: Facilitate trainees to boil syrup to form crystals.

Step 5: Verify whether crystals are appropriately formed and provide clarification if any.

Step 6: Ask trainees to read the key reading 3.1.2 in trainee manual

Step 7: Ask trainees to perform the task provided in application 3.1

Points to Remember

- Controlling temperature, pressure, time, and brix levels. during these phase, manufactures can optimize both yield an quality of crystalline sugar.
- Syrup boiling conditions in sugar manufacturing are vital for ensuring high-quality sugar production from sugarcane processing plants.

Application of learning 3.1.

In your school after getting clarified juice from sugarcane, ask trainees to go in workshop and boil syrup into crystals and check quality of massecuite.

Check list:

SN	Criteria	Indicators	Yes	No
1	Boiling of syrup is properly performed	1.1 vacuum pan is used		
		1.2 Syrup boiling Temperature is respected		
		1.3 Boiling time is respected		
		1.4 Quality of massecuite is checked		
		1.5 Crystals are formed		

Indicative content 3.2: Centrifuging the Massecuite

Duration: 10 hrs

Theoretical Activity 3.2.1: Description of centrifugation and molasses in sugarcane processing

Notes to the trainer:

- Trainer may use groups to describe molasses in sugar processing
- The use of pictures or tutorial 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 answer the following questions:

i. How do you understand by the following terms?
   a. Centrifugation?
   b. Molasses
   c. Brix
   d. Polarity
   e. Purity

ii. What could be the criteria of selecting suitable centrifugal machine

iii. What could be the quality parameters of molasses in sugarcane processing?

Step 2: Ask trainees to write the findings on papers, flip chart, blackboard or white board.

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 key reading 3.2.1 for more clarification

Points to Remember

- Centrifugation plays a vital role in achieving high efficiency and productivity in sugar production by ensuring that maximum amounts of sugar are extracted from each batch of massecuite while minimizing crystal breakage and maintaining product quality.

Practical Activity 3.2.2: Centrifuging the massecuite

Notes to the trainer

- Facilitate each trainee in centrifuging the massecuite.
- Avail centrifugal machine, refractometer and other tools required for centrifuging the massecuite.
- Avail video related to the centrifuging the massecuite.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to go in the sugarcane processing workshop and centrifuge massecuite and check quality molasses

Step 2: Explain the task and provide clear work instruction

Step 3: Demonstrate how to centrifuge massecuite and to check the quality molasses

Step 4: Facilitate trainees to centrifuge massecuite and check the quality molasses

Step 5: Verify whether centrifugation of massecuite and checking the quality molasses are appropriately performed and provide clarification if any.

Step 6: Ask trainees to read the key reading 3.2.2 in trainee manual

Step 7: Ask trainees to perform the task provided in application 3.2

Points to Remember

- The accuracy and reliability of the measurements (Brix, polarity, and purity) are critical for optimizing production processes and ensuring product quality in sugar manufacturing.

Practical Activity 3.2.3: Re-boiling of A-heavy and B-heavy molasses

Notes to the trainer

- Avail A-heavy and B-heavy molasses in the workshop
- Avail video related to re-boiling of A-heavy and B-heavy molasses
- Ensure that tools and equipment for re-boiling A-heavy and B-heavy molasses are there in the workshop

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to go in the sugarcane processing workshop to re-boil A-heavy and B-heavy molasses

Step 2: Explain the task and provide clear work instructions

Step 3: Demonstrate how to re-boil A-heavy and B-heavy molasses

Step 4: Facilitate trainees to re-boil A-heavy and B-heavy molasses

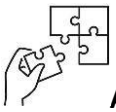
Step 5: Verify whether A-heavy and B-heavy molasses are properly re-boiled and provide clarification if any.

Step 6: Ask trainees to read the key reading 3.2.4 in trainee manual

Step 7: Ask trainees to perform the task provided in application 3.2

Points to Remember

- The re-boiling process of A-heavy and B-heavy molasses significantly impacts their final quality and usability as a product. Careful monitor throughout this process ensures that undesirable characteristics are minimized while maximizing beneficial properties.



Application of learning 3.2.

There are molasses obtained after centrifuging the massecuite in the sugarcane processing workshop, ask trainees to go in the workshop and re-boil A-heavy and B-heavy molasses and check final molasses (by-product).

Checklist:

SN	Criteria	Indicators	Yes	No
1	Massecuite is properly centrifuged	1.1 Centrifugal machine is selected		
		1.2 Quality molasses is checked (Brix, polarity and purity)		
		1.3 A-heavy and B-heavy molasses is re-boiled		
		1.4 Boiling conditions are respected		
		1.6 Final molasses (By product) are checked		

Indicative content 3.3: Drying of brown sugar crystals

Duration: 8 hrs

Theoretical Activity 3.3.1: Description of drying brown sugar crystals process

Notes to the trainer:

- Trainer may use groups for describing the process of drying brown sugar crystals process.
- The use of pictures or tutorial 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 answer the following questions:

i. What do you understand by the following terms:
   a. Brown sugar crystals
   b. Screening
ii. What could be the purpose of drying brown sugar crystals?
iii. What could be the drying techniques of brown sugar crystals?
iv. How can you analyse the quality of brown sugar?
v. What could be the good quality brown sugar specifications?

Step 2: Ask trainees to write the findings on papers, flip chart, Blackboard or white board.

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 key reading 3.3.1 for more clarification

Points to Remember

- If hot sugar is bagged directly without adequate cooling and drying, it can absorb ambient moisture, leading to undesirable reactions such as melanoidin formation, which alters its colour and quality.

Practical Activity 3.3.2: Drying brown sugar crystals

Notes to the trainer

- Facilitate each trainee in drying brown sugar crystals
- Avail oven
- Avail video related to the drying brown sugar crystals

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to go in the sugarcane processing workshop to dry brown sugar crystals

Step 2: Explain the task and provide clear work instruction

Step 3: Demonstrate how to dry brown sugar crystals

Step 4: Ask trainees to dry brown sugar crystals

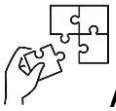
Step 5: Verify whether brown sugar crystals are appropriately dried and provide clarification if any.

Step 6: Ask trainees to read the key reading 3.3.2 in trainee manual

Step 7: Ask trainees to perform the task provided in application 3.3

Points to Remember

- The choice among the rotary drum drying, solar drying, and heat exchanger drying will depend on factors such as production scale, available resources, environmental considerations, and economic viability.
- Brown sugar typically ranges from light tan to dark brown; darker sugars generally contain more molasses, which contributes additional flavours but may also indicate higher impurity levels if not processed correctly.
- The acceptable moisture content for brown sugar typically ranges from 0.5% to 2%. Higher moisture levels can lead to clumping and spoilage.



Application of learning 3.3.

Your school prepare an open day for presenting different products made in the school. Ask trainees to go in sugarcane processing workshop to dry brown sugar crystals to be presented.

Checklist

SN	Criteria	Indicators	Yes	No
1	Drying of brown sugar crystals is properly performed	1.1 Drying techniques (rotary drum drying, solar drying, heat exchanger drying) is applied		
		1.2 Screening of brown sugar crystals is applied		
		1.3 Quality of brown sugar (polarity, moisture content, suspended and insoluble matters, sugar) is analysed		

Learning outcome 3 end assessment

Theoretical assessment

i. Read carefully the statements in table below and match the definitions with their appropriate terms and write your answer in column named "**Answers**."

Answers	Definitions	Terms
1…….F…….	1. refers to a mixture of crystals suspended in a liquid known as mother liquor, which is produced during the crystallization phase of sugar manufacturing.	A. Crystallization process
2……A…….	**2.** is the process of making crystals	B. Crystals
3……E…….	3. refers to the process of removing water from sugar cane juice to concentrate the sugar content before crystallization occurs.	C. Syrup
4…..G…….	4. The fibrous residue left after juice extraction	D. Molasses
5……B……	5. refer to the solid forms of sucrose that are produced during the crystallization phase of sugar manufacturing.	E. Evaporation
6…..C…….	6. Is the concentrated sugarcane juice with a solid content between 72-75% cane syrup usually concentrated by evaporation after clarification	F. Massecuite
7……D……	7. Is a by-product of sugar obtained after sugar centrifugation	G. Bagasse

ii. Read carefully the following statements and choose by encircling the letter corresponding to the right answer

i. A-Massecuite contains about:

a. 30-40% solids

b. 40-50% solids

c. 50-60% solids

d. 60-70% solids

ii. B-Massecuite contains around
    a. 30.40% solids
    b. 40-50% solids
    c. 50-60% solids
    d. 60-70% solids
iii. C-Massecuite contains around
    a. 30.40% solids
    b. 40-50% solids
    c. 50-60% solids
    d. 60-70% solids
iv. Bagasse, molasses, pressmud are some of the types of:
    a. Refined sugar
    b. By product of sugar
    c. Raw sugar
    d. None of the above

Answer:

i. A
ii. C
iii. A
iv. B

3. Read the following statements related to sugarcane processing and write "**True**" if the statement is correct or "**False**" if the statement is incorrect.
    a. In refined sugar production, the purity of the final product is often targeted at around 99.9%. **Answer: True**
    b. Centrifugation is defined as the method used to separate sugar crystals from the surrounding molasses or syrup. **Answer: True**
    c. Batch centrifugation, in this method a specific quantity of massecuite is loaded into a centrifuge bowl, which is then spun at high speeds. The centrifugal force generated causes the denser sugar crystals to move outward against the bowl wall, while the lighter syrup (molasses) remains closer to the center. **Answer: True**

Practical assessment

KUNDWA company located in Nyanza district has a sugarcane plantation, recently they established a sugarcane processing unit. However, the cooperative lacks a qualified technician to process sugarcane. The production manager asks you to perform the following tasks:

1. To boil syrup and check quality of massecuite
2. To re-boil A-heavy and B-heavy molasses to check final molasses (by product)
3. To dry brown sugar crystals

The task should be completed in 4 hours

All materials, tools and equipment are available at KUNDWA company.

Checklist:

SN	Criteria	Indicators	Yes	No
1	Boiling of syrup is properly performed	1.1 Vacuum pan is used		
		1.2 Syrup boiling Temperature is respected		
		1.3 Boiling time is respected		
		1.4 Formation of crystals is achieved		
		1.5 Quality of massecuite is checked		
2	Centrifuging massecuite is properly performed	2.1 Centrifugal machine is selected		
		2.2 Quality molasses is checked (Brix, polarity and purity)		
		2.3 A-heavy and B-heavy molasses is re-boiled		
		2.4 Boiling conditions are respected		
		2.6 Final molasses (By product) are checked		
3	Drying of brown sugar crystals is properly performed	3.1 Drying techniques is applied		
		3.2 Screening of brown sugar crystals is applied		

		3.3 Quality of brown sugar is analysed		

Further information to the trainer

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Indicative contents
4.1 Melting of brown sugar
4.2 Clarifying melt sugar
4.3 Decolorizing clarified sugar melt
4.4 Crystallizing refined syrup

Key Competencies for Learning Outcome 4: Refine brown sugar

Knowledge	Skills	Attitudes
● Explanation of affination of brown sugar ● Explanation of white sugar quality requirements ● Description of types of decolourization reagents and their working principle	● Melting brown sugar ● Clarifying melt sugar ● Decolourizing melt sugar ● Crystallizing refined syrup	● Being careful while melting affinized sugar ● Paying attention while clarifying melt sugar, decolourized melt sugar and crystallizing refined syrup

Duration: 10hrs

Learning outcome 4 objectives:

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

1. Explain correctly white sugar quality requirements in sugar manufacturing
2. Describe clearly decolourization reagents and their working principle
3. Melt effectively affined sugar according to the melting condition
4. Clarify properly melt sugar to make white sugar
5. Decolourize effectively sugar melt in sugar manufacturing
6. Crystallize correctly refined syrup in sugar manufacturing

Resources

Equipment	Tools	Materials
• Crystallizer • Vacuum pans • Pipes • Pumps • Centrifugal machine • Oven • Hopper • Weighing scale (balance) • Stitching machine	• Pressure gauge • Vacuum gauge • Thermometer • Spectrophotometer • Polarimeter • Beaker • pH meter • Bins • Analytical balance • Conductivity meter.	• Water • Steam • Brown sugar

Advance Preparation:

Before delivering this learning outcome, you are recommended to:

- Have an arranged workshop
- Avail brown sugar
- Avail tools and equipment used to refine brown sugar
- Avail picture and tutorial video related to refining sugar

Indicative content 4.1: Melting of brown sugar

Duration: 2hrs

Practical Activity 4.1.1: Melting of affinized sugar

Notes to the trainer

- Facilitate each trainee in the melting of affinized sugar
- Avail tools and equipment for melting affined sugar.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to go in sugarcane processing workshop and melt affinized sugar
Step 2: Explain the task and provide clear work instruction
Step 3: Demonstrate how to melt of affinized sugar
Step 4: Facilitate trainees to melt affinized sugar
Step 5: Verify whether affinized sugar are properly melted and provide clarification if any.
Step 6: Ask trainees to read the key reading 4.1.2 in trainee manual
Step 7: Ask trainees to perform the task provided in application 4.1

Points to Remember

- For melting of sugar use hot water or sweet water and maintain the concentration of melt liquor of 64 to 65° Brix.

Application of learning 4.1.

The production unit in your school receive a demand for supplying a white sugar to the neighbouring primary school. Ask trainees to go in food processing workshop and melt affined sugar.

Checklist

SN	Criteria	Indicators	Yes	No
1	Affined sugar is effectively Melted	1.1 Melting equipment is selected		
		1.2 Melting temperature is respected		
		1.3 Hot water is used		

Indicative content 4.2: Clarifying melt sugar

Duration: 2 hrs

Practical Activity 4.2.1:Clarification of melted sugar

Notes to the trainer

- Facilitate each trainee in clarifying of melted sugar
- Avail tools and equipment for sugar clarification
- Avail video related to the clarification of melted sugar

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to go in sugarcane processing workshop and clarify melted sugar

Step 2: Explain the task and provide clear work instruction

Step 3: Demonstrate how to clarify melted sugar

Step 4: Facilitate trainees to clarify melted sugar

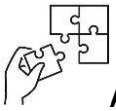
Step 5: Verify whether melted sugar are properly clarified and provide clarification if any.

Step 6: Ask trainees to read the key reading 4.2.1 in trainee manual

Step 7: Ask trainees to perform the task provided in application 4.2

Points to Remember

- For clarifying melted sugar, white sugar quality requirement should be considered.
- In Clarification of raw melt process, colour reduction will be depended on type of process. It will be around in the range of 30% to 50%.



Application of learning 4.2.

The production unit of school receives a demand for supplying white sugar to the neighbouring primary school. Ask trainees to go in sugarcane processing workshop and clarify melted sugar.

Checklist

SN	Criteria	Indicators	Yes	No
1	Melt sugar is properly clarified	1.1 Pressure clarification method is used		
		1.2 the required pH is achieved		
		1.3 the required Brix is achieved		

Indicative content 4.3: Decolorizing clarified sugar melt

Duration: 3hrs

Theoretical Activity 4.3.1: Description of decolourization reagents and their working principle

Notes to the trainer:

- Trainer may use small groups for description of decolourization reagents and their working principle
- The use of pictures or tutorial 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 answer the following questions:

i. What do you understand by ion Exchanger Resin?
ii. What do you understand by Powdered Activated Carbon?

Step 2: Ask trainees to write the findings on papers, flip chart, Blackboard or white board.

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: For more clarification ask trainees to read key reading 4.3.1

Points to Remember

- Ion Exchanger resin and powdered activated carbon reagents are very important as decolorizing clarified sugar melt.

Practical Activity 4.3.2: Decolorizing clarified sugar

Notes to the trainer

- Facilitate each trainee in the decolorizing clarified sugar.
- Avail materials, tools and equipment for decolorizing clarified sugar
- Avail video related to decolorizing clarified sugar

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to go in sugarcane processing workshop and decolorize clarified sugar.

Step 2: Explain the task and provide clear work instruction

Step 3: Demonstrate how to decolorize clarified sugar.

Step 4: Facilitate trainees to decolorize clarified sugar.

Step 5: Verify whether clarified sugar are properly decolorized and provide clarification if any.

Step 6: Ask trainees to read the key reading 4.3.2 in trainee manual

Step 7: Ask trainees to perform the task provided in application 4.3

Points to Remember

- Decolourization process colour reduction will be depend on type of process. It will be around in the range of 60% to 70% on input of the melt.
- The quality requirements ensure that decolorized sugar products are safe for consumption and meet sugar standards for taste, appearance, and overall quality.

Application of learning 4.3.

The staff members of the sector where your school is located make a demand of 10kg white sugar per day. Ask trainees to go in the sugarcane processing workshop and decolorize clarified sugar melt.

Checklist

SN	Criteria	Indicators	Yes	No
1	Clarified sugar melt is properly decolorized	1.1 Ion Exchanger Resin is used		
		1.2 powdered activated carbon is used		
		1.3 sugar melt decolorization steps are respected		

Indicative content 4.4: Crystallizing refined syrup

Duration: 3 hrs

Practical Activity 4.4.1: Crystallizing refined syrup

Notes to the trainer

- Facilitate each trainee in crystallizing refined syrup
- Avail crystallizer machine
- Avail video related to the crystallizing refined syrup

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to go in sugarcane processing workshop and crystallise refined syrup

Step 2: Explain the task and provide clear work instruction

Step 3: Demonstrate how to crystallize refined syrup

Step 4: Facilitate trainees to crystallize refined syrup

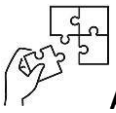
Step 5: Verify whether refined syrup is properly crystallized and provide clarification if any.

Step 6: Ask trainees to read the key reading 4.4.1 in trainee manual

Step 7: Ask trainees to perform the task provided in application 4.4

Points to Remember

- The boiling of refined syrup, involves several critical conditions that must be met to ensure the desired quality and consistency of the final product



Application of learning 4.4.

The food plant neighbouring your school that produce bakery products make a demand of white sugar to your school. Ask trainees to go in sugarcane processing workshop and crystallize refined syrup.

Checklist

SN	Criteria	Indicators	Yes	No
1	Crystallizing refined syrup is appropriately performed	1.1 Refined syrup is boiled		
		1.2 refined massecuite is centrifuged		
		1.3 White sugar drying conditions are respected		
		1.4 Packaging material are selected		
		1.5 white sugar is packed		

Learning outcome 4 end assessment

Written assessment

1. Read carefully the statements in table below and match the definitions with their appropriate terms. Write your answer in the column named "**Answer"**.

Answer	Term	Definition
1.....B.....	**1.**Affined sugar	A. is a process used in sugar refining that involves treating raw sugar crystals with warm heavy syrup to remove the molasses coating from the sugar crystals
2.....C.....	**2.**Affination	B. sugar is a process that involves the transformation of solid sugar into a liquid state.
3.....A.....	**3.**The melting of affinized	C. Sugar is produced after centrifugation/purging in affination process

2. Read the following statements carefully and select the best answer for each by encircling the letter corresponding to it.

   I. The following are the sugar melt decolourization steps except:

      a) Displacement
      b) Service run
      c) Boiling
      d) sweetening off
      e) Sweetening on

Answer: C

II. The following are the white sugar quality requirements except:

a) Polarity

b) Brix

c) Age

d) pH

e) Purity

Answer: C

3. Read carefully the following statements related to the benefits centrifuging refined massecuite and answer by "**True"** if the statement is correct or **"False"** if it is incorrect.

a) Centrifugation allows for a lower recovery of sugar crystals from the massecuite, which can lead to a higher overall sugar yield**……False……**

b) The centrifugal process can help to remove impurities from the sugar crystals, resulting in a higher quality product. **……True……**

c) By efficiently separating the sugar crystals from the molasses, centrifugation can help to reduce the amount of molasses that remains in the final product**……True……**

Practical assessment

Imberecyane cooperative located in Nyagatare district has a sugarcane plantation, recently they have established a sugarcane processing unit. However, the cooperative lacks a qualified technician to process sugarcane. The production manager asks you to perform the following tasks:

1. To melt affined sugar
2. To clarify melt sugar
3. To decolorize clarified sugar melt
4. To crystallizing refined syrup

The task should be completed in 4 hours

All materials, tools and equipment are available at Imberecyane cooperative

Checklist:

SN	Criteria	Indicators	Yes	No
1	Melting of affined sugar is effectively performed	1.1 Melting equipment is selected		
		1.2 Melting temperature is respected		
		1.3 Hot water is used		
2	Melt sugar is properly clarified	2.1 Pressure clarification method is used		
		2.2 The required pH is respected		
		2.3 The required Brix is respected		
3	Decolorizing clarified sugar melt is well applied	3.1 Ion Exchanger Resin is used		
		3.2 Powdered activated carbon is used		
		3.3 Sugar melt decolourization steps are respected		
4	Crystallizing refined syrup is appropriately performed	4.1 Refined syrup is boiled		
		4.2 Refined massecuite is centrifuged		

		4.3 White sugar drying conditions are respected		
		4.4 Packaging material are selected		

END

Further information to the trainer

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