RWANDA POLYTECHNIC

TVET LEVEL II

AGRICULTURE

Flour Processing

TRAINEE MANUAL

RWANDA POLYTECHNIC

Approved by: Workforce Development Authority

USAID FROM THE AMERICAN PEOPLE

EDC Education Development Center

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FLOUR PROCESSING

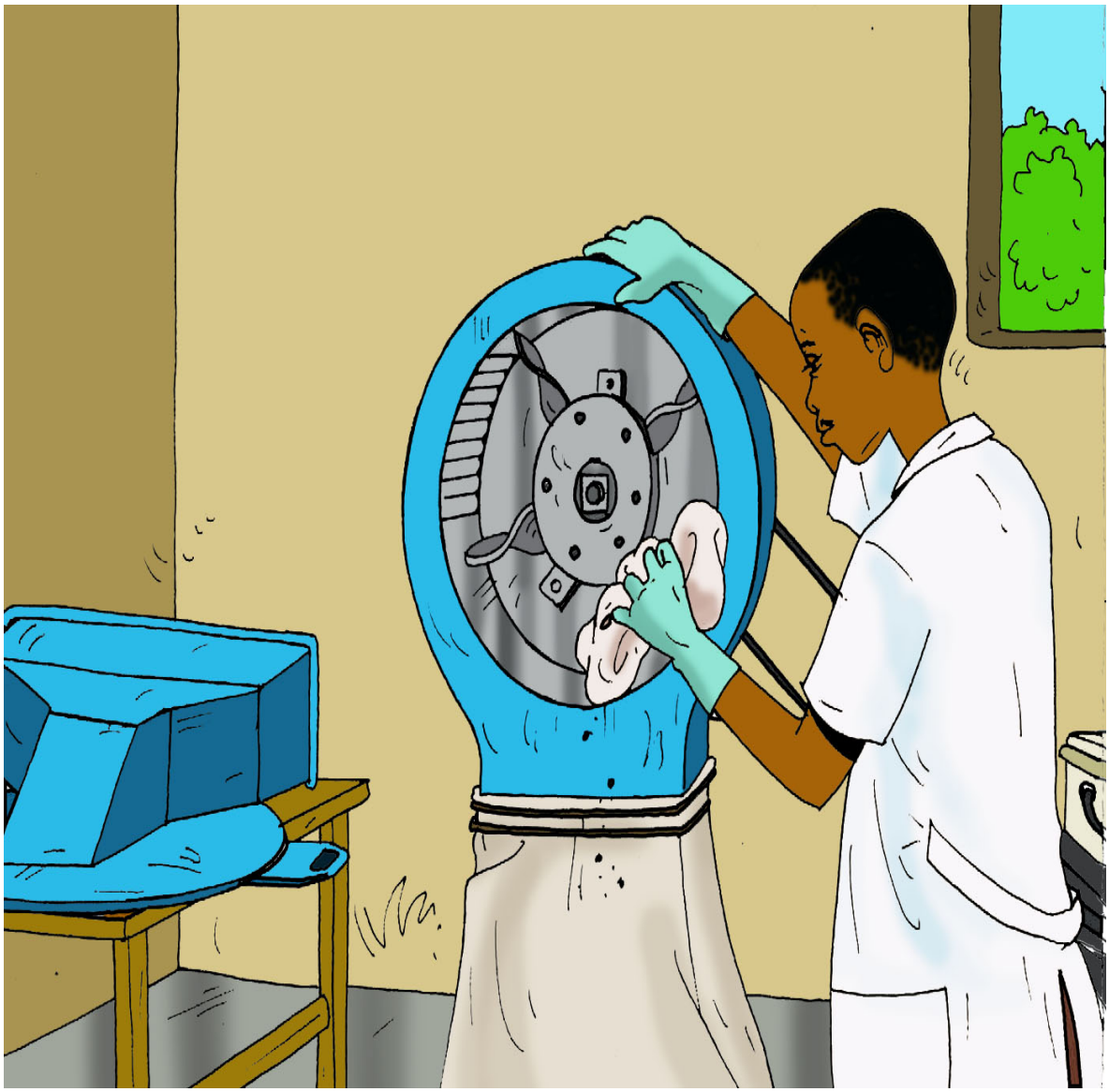
Unit 1: Preparation of tools, utensils, instruments, equipment and consumables

Unit 2: Processing roots and tubers into flour

Unit 3: Operation of grain mill

Unit 4: Packaging flour

Unit 1: Preparation of tools, utensils, instruments, equipment, and consumables



Topics

1.1 Cleaning tools, utensils, instruments, and equipment

1.2 Checking the tools, utensils, instruments, and equipment

1.3 Maintenance of tools, utensils, instruments, and equipment

Unit Summary:

This unit describes the skills, knowledge, and attitudes required to prepare tools, utensils, instruments, equipment and consumables. At the end of this unit, you will be able to clean tools, utensils, instruments and equipment, check the tools, utensils, instruments and equipment and maintain tools, utensils, instruments and equipment.

Self-Assessment: Unit 1

1. Look at the Unit 1 illustration above. What do you see? What do you think this unit will be about?

2. Fill in the self-assessment below.

There are no right or wrong ways to answer this self-assessment. It is for your own use during this course. Do you think you can do this? How well? Read the statements across the top. Put a check in column that best represents your situation. At the end of this unit, you will take this self-assessment again.

My experience **Knowledge, skills, and attitudes**	**I don't have any experience doing this.**	**I know a little about this.**	**I have some experience doing this.**	**I have a lot of experience with this.**	**I am confident in my ability to do this.**
Select cleaning products for different tools, utensils, instruments, and equipment					
Use different techniques to clean tools, utensils, equipment, and instruments					
Describe the installation techniques of the equipment					
Describe the SOPs (standard operating procedures) for each equipment					
Perform safety precautions of the equipment (effect on the user and product)					
Maintain equipment					

Topic 1.1: Cleaning tools, utensils, instruments, and equipment

Key Competencies:

Knowledge	Skills	Attitudes
1. Explain the importance of cleaning tools, utensils, instruments and equipment	**1.** Select cleaning products for different tools, utensils, instruments and equipment	**1.** Discerning
2. Identify cleaning products for different tools, utensils, instruments and equipment	**2.** Use different techniques to clean tools, utensils, equipment and instruments	**2.** Thorough
3. Describe cleaning techniques for tools, utensils, instruments, equipment	**3.** Clean tools, utensils, instruments and equipment properly	**3.** Safety oriented

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

Topic 1.1 Task 1:

1. Read the and answer the following questions with your group:

a. What types of flour are commonly used in your community?

b. Have you ever participated in or observed flour being processed?

c. What equipment and tools are typically used in the process of making flour?

d. How are these tools and equipment maintained?

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

3. Read the Key Competencies table together.

Problem Solving Activity

Topic 1.1 Task 2:

1. Read the following scenario and answer the questions that follow:

Kagabo is the owner of Cassava processing unit located in Muhanga district, the management of the unit has received the order from Tembera Hotel of supplying 600 kg of cassava flour. They need to meet the deadline while providing safe and quality products.

The management has called upon you as a technician in the unit of cleaning tools, utensils, instruments and equipment.

a. Mention the tools, utensils, equipment and instruments that will be needed in the processing the cassava.

b. Explain to the management the need to clean the tools, utensils, instruments and equipment before, during and after processing the cassava.

c. Describe to the management the procedure to be followed while cleaning the tools, utensils, instruments and equipment during the cleaning process.

d. Describe to the management the types of cleaning products for each tools, utensils, equipment and instruments to be used while cleaning.

2. Refer to **1.1 Key Facts** to supplement your responses.

3. Present your group's main points to the rest of the class. Contribute to other groups' points as well.

4. Ask any questions you have.

1.1 Key Facts

- **Equipment, tools, utensils and instruments:**[1]
  - The main machine used in producing flour is the milling machine.
  - The major equipment tools, utensils and instruments used in cassava processing plants include graters, dewatering machines / press, chippers, dryers and grinding / milling machines. Others are weighing scales, filling and bagging equipment.

Grater/chippers

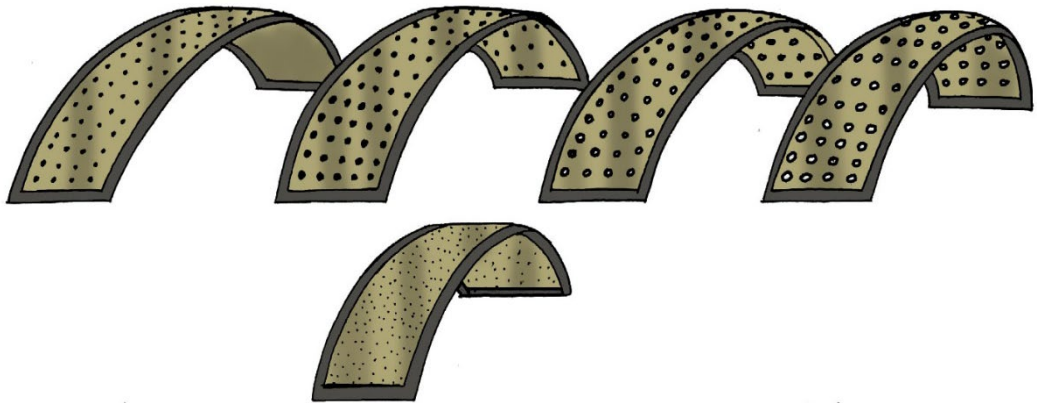
Dewatering/press machine

- **Milling machine: Parts and processes**[2]
  - Milling machine is used for processing the following flour products: cassava flour, maize flour, sorghum flour and wheat flour
  - Hammer mills are very common in Rwanda. As the name implies, hammers in the mill grind either grains or cassava through impact. The grains or cassava are placed into a holding hopper on top of the hammer mill, and a small control gate allows the grains to trickle into the grinding chamber.
  - The grains or cassava roots feed into the path of the hammers either through the centre of the front plate or through the top side of the case. The hammers strike the grains or cassava roots and shatter them before they can pass through the screen surrounding the hammers.
  - The flour produced either falls by gravity into a chamber or sack below or is propelled by air flow up through a cyclone into a holding container. The airflow is provided by either the fan effect of the hammers or by extra fan blades mounted on the hammer shaft.

[1] Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA). (2014). *Quality Assurance for cassava flour processing: A training manual*. https://hqcf.iita.org/wp-content/uploads/2016/04/5_harmonized-standards-_cassava.pdf

[2] Clarke, B., & Rottger, A. (2006). *Small mills in Africa: Selection, installation and operation of equipment*. Food and Agriculture Organization of the United Nations. https://www.fao.org/3/j8482e/j8482e.pdf

- A hammer mill consists of a large cylinder with a horizontal shaft that drives a rotor with several rows of free-swinging hammers. The hammers rotate inside a perforated metal screen through which the flour is drawn. The hammers are driven by two or four sets of V-section belts between the engine and the mill. The hammers spin at high speed, usually between 2 000 and 4 000 revolutions per minute to achieve a hammer-tip speed of about 60 m/second. The speed of the mill has to be matched to the size of the mill as a small mill needs to run at higher revolutions than does a larger mill.
- Some hammer mills have screens that cover the mill around 360 degrees. More popular designs have screens around 180 degrees of the lower periphery as this allows easily made replacement screens to be used. Beater bars are often incorporated into the upper semi-circle against which the grain or cassava roots impact.
- Milling machine can be used for different product such as millet, cassava, sorghum, wheat. The only difference is the size of screens. Here the operator changes the screen depending on the product to be processed, it means the size of sieve that operator changes makes the difference. Screens are made by perforating blank sheets of steel.
  - For cassava, a 1 mm sieve is recommended.
  - For maize, a 0.7 mm sieve is recommended.
  - For millet and sorghum, 0.5 mm sieve is recommended.



- **When is a milling machine cleaned?**
  - Before a period of rest, in order not to leave residuals that will attract insects and rodents.
  - Before the machine is used for milling to ensure flour is not contaminated.

- **How is a milling machine cleaned?[3]**

[3] Duville, K. E. (2012). *Sorghum flour production manual for Compatible Technology International (CTI) burr grinders*. Digital Commons - University of Nebraska Lincoln. https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1008&context=intsormilpubs

- Disconnect the milling machine from the power supply before cleaning.
- If dry ingredients were used (e.g. to make flour) the milling machine can be cleaned with a brush and dry towel.
- Take off the front burr, the rotating burr, and pulling out the helix.
- Use a dry brush, a piece of hose, and a long, thin piece of metal to remove flour left in the milling machine.
- If the burrs were choked up, take them out and wash with water.
- Dry the burrs after washing to avoid rusting.
- Do not use water on other parts of the milling machine.
- Use a moist piece of cloth if grease is to be removed.
- Do not take out the shaft for motorized milling machine.

Helix[4]

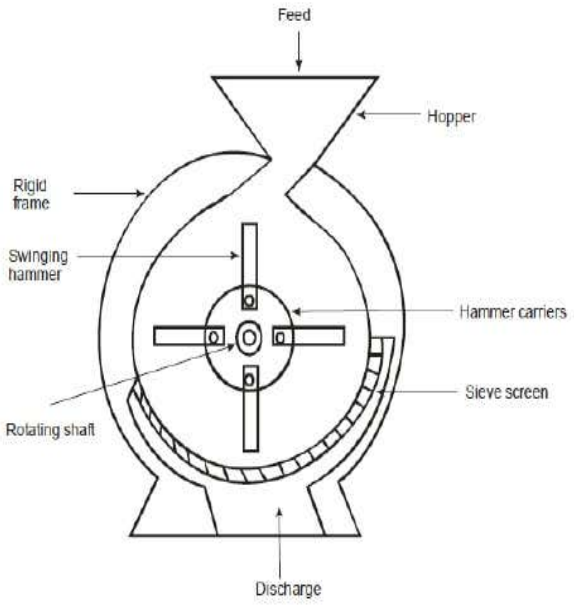
Hopper[5]

Plate with hole[6]

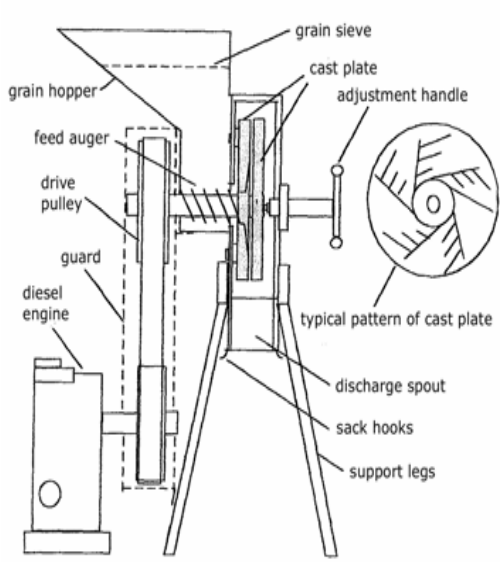
[4] University of Nebraska - Lincoln. (2012). *Helix* [Photograph]. DigitalCommons@UNL. https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1008&context=intsormilpubs

[5] University of Nebraska - Lincoln. (2012). *Hopper* [Photograph]. DigitalCommons@UNL. https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1008&context=intsormilpubs

[6] University of Nebraska - Lincoln. (2012). *Third pass* [Photograph]. DigitalCommons@UNL. https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1008&context=intsormilpubs



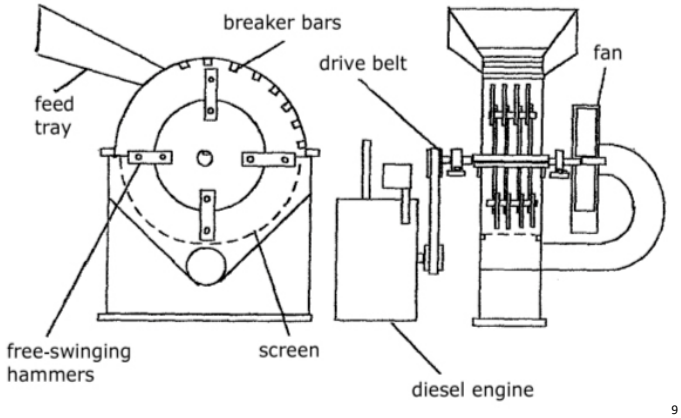
[7]



[8]

[7] *Mill feeder* [Drawing]. (n.d.). https://html1-f.scribdassets.com/21mdqnq81s5mxyqp/images/4-18bfb9ab29.jpg

[8] Food and Agriculture Organization of the United Nations. (2006). *Typical construction of plate mill* [Drawing]. http://www.fao.org/3/j8482e/j8482e.pdf



[9]

- **Note: To work properly the milling machines must be cleaned AFTER EVERY USE.**
- **What else should be cleaned:**
  - The milling room needs sweeping every day.
  - This is best done at the end of the working day in order to prevent rodents and insects from infesting the mill and its surroundings overnight.

Guided Practice Activity

Topic 1.1 Task 3:

1. Your group will be assigned one of the following flour products: maize, soya beans, or cassava roots. Observe the materials, tools, and equipment found in the school milling room and use the information in **1.1** and **1.2 Key Facts** to:

a. Identify the tools, utensils, equipment and instruments used in processing the identified flour.

b. Describe the procedure for cleaning the tools, utensils, equipment or instruments.

c. Identify the products for cleaning the tools, equipment, utensils and instruments identified.

Use the table below to answer the questions above:

Flour Product	**Maize**	**Soya beans**	**Cassava Roots**
Tools, utensils, equipment and instruments used in			

[9] Food and Agriculture Organization of the United Nations. (2006). *Typical construction of hammer mill* [Drawing]. http://www.fao.org/3/j8482e/j8482e.pdf

processing the product			
Procedure for cleaning tools, utensils, equipment and instruments used in processing the product			
Materials needed to clean tools and equipment			

2. After your discussion, share your type of flour and your responses to the questions.

3. Observe as the trainer identifies the different parts of a milling machine and demonstrates how to clean it.

4. Refer to **1.2 Key Facts** and review them together.

1.2 Key Facts

- If wet or oily ingredients were used (e.g. peanuts) parts must be cleaned with soap and water. Wash parts individually, never submerge the body of the milling machine in water as this will cause the bearings to rust.

- Follow the disassembly instructions to take apart the milling machine.

- If cleaning after grinding a greasy or wet product, wash the following items with a hard brush, soap and water:
  - Turning Burr
  - Fixed Burr
  - Spherical Washers
  - Helix
  - Shaft

- Dry burrs with a towel, complete drying by laying burrs in the sun, make sure not to place them on a metal surface.

- Clean the inside of the body with a wet, soapy cloth and brush. Never immerse the body in water as this will rust the bearings.
- Clean the grooves in the body channel with a brush. If the channel grooves are caked with hardened material, use the Scraper to clean
- Any material remaining in the grooves reduces production and causes contamination.
- Clean the outside of the body with a dry cloth. Never submerge the bearings in water.
- Clean front cover with a dry cloth.

Application Activity

Topic 1.1 Task 4:

During your free time after school, choose one facility in your neighbourhood and:

1. Choose one facility in your neighbourhood, fix an appointment with a grinding operator or cleaner focusing on cleaning grinding facilities, room floor. and grinding room generally.

2. Ask the permission to assist cleaner for that particular day.

3. Upon completion, elaborate a short report (preferably ½ page or more) on the experience you gained. Your report should include:
   a. Flour products processed

   b. Tools, utensils, equipment, and instruments used in processing the product

   c. Procedure for cleaning tools, utensils, equipment, and instruments used in processing the product

   d. Cleaning products for tools, utensils, equipment, and instruments used in processing the product

   e. During which periods was the cleaning done? What was cleaned?

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

Points to Remember

When cleaning tools, utensils, instruments, and equipment:

- Disconnect the milling machine from the power supply before cleaning.
- Never use solvents to clean the machine.
- Never submerge the bearings in water.

Formative Assessment

Read the statements provided below and circle ONLY ONE response.

1. Sweep the mill room once every 2 working days.
   a. True
   b. False

2. The mill must be cleaned before a period of rest.
   a. True
   b. False

3. If grease must be removed, a moist piece of cloth with some soap can be used.
   a. True
   b. False

4. Clean the outside of the body with water.
   a. True
   b. False

5. Always disconnect the machine before cleaning.
   a. True
   b. False

6. Always use solvents to clean the machine.
   a. True
   b. False

7. Never submerge the bearings in water.
   a. True
   b. False

Read the statements provided below and circle ONLY ONE response.

8. If cleaning after grinding a greasy or wet product, wash turning burr, fixed burr, spherical washers, helix, and shaft with:
   a. Hard brush
   b. Soap
   c. Water
   d. a, b, and c
   e. a and b

9. After washing the burrs…
   a. Dry them with a towel, complete drying by laying burrs under shade, make sure not to place them on a metal surface.
   b. Dry them with a towel, complete drying by laying burrs in the sun, make sure they are not placed on a metal surface.
   c. Dry them with a towel, complete drying by laying burrs in the sun, make sure they are placed on a metal surface.

10. Clean the inside of the body with:
   a. A dry cloth
   b. A wet, soapy cloth
   c. A brush
   d. a, b, and c
   e. b and c
   f. None are true

Topic 1.2: Checking tools, utensils, instruments, and equipment

Key Competencies:

Knowledge	Skills	Attitudes
1. Describe functionality of small-scale instruments	**1.** Use tools, utensils, instruments, and equipment	**1.** Mindful
2. Explain what to check for the milling machine if a given situation happens	**2.** check the milling machine if a given situation happens	**2.** Attentive
3. Describe possible malfunction of small-scale milling machine	**3.** Monitor functionality of tools, utensils, instruments, and equipment	**3.** Detail-oriented

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

Topic 1.2 Task 1:

1. With a partner, discuss the following:
   a. Why do you think checking tools, utensils, instruments and equipment in a milling facility is important?

   b. What types of problems might one encounter with the equipment?

   c. What types of experience have you had with equipment that is not functioning properly and what steps did you take to try and resolve the problem?

2. Volunteer to share your answers with the class.

3. Review to the Key Competencies table and review it together.

Problem Solving Activity

Topic 1.2 Task 2:

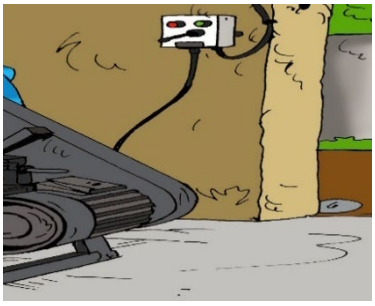
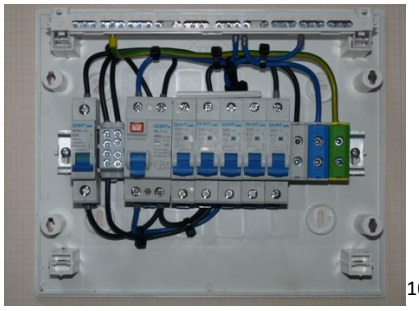
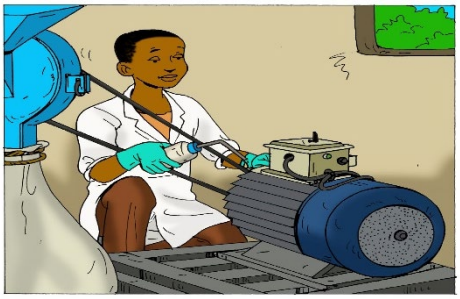
1. The table below shows on one side the common faults in tools, utensils, instruments, and equipment in milling facility.

2. Complete the table by describing what to check for in the tools, utensils, instruments, and equipment when a given situation happens.

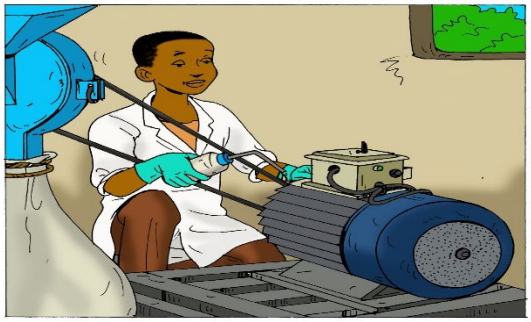
Faults	What to check for?
Motor stops running	
Motor running but blows fuse	
Motor running but blows fuse when under load	
Motor develops unusual noise	
Motor over-heating	
Vibration of the mill	

3. After discussing, share your responses with the rest of the class.

4. Then, refer to **1.3 Key Facts** and review them together.

1.3 Key Facts	
Faults	**What to check for?**
Motor stops running	• If power is there at the correct voltage • For a burned smell from motor • For burning of electrical cables • If the isolation system is working (have fuses blown?) • If the motor can run without the mill • Where there is more than one machine, check the other to see if it is working
Motor running but blows fuse	• If neighbours' machines are working • That the load is below the rated load. • If the fuse is the correct size  Fuse  Fuse box[10] • Insulation resistance of cables and motor windings  motor of milling machine
Motor running but blows fuse when under load	• If motor is overloaded • For correct feed rate of grain into the mill • If connections on the motor are satisfactory • That the fuse rating is correct
Motor smoking	• If varnish on motor windings is intact • For worn bearings • Starter

[10] *Fuse box*. (n.d.). Wikimedia. https://upload.wikimedia.org/wikipedia/commons/2/28/Pae_64_-_fuse_box.JPG

	• For loose connections • For burnt out motor
Motor over-heating	• For correct loading on the motor • Motor wiring • Motor rating (The power capacity of the motor, e.g.: 0.56 kW or 0.75 kW or 1.1 kW or 1.5 kW) • If fan is working • Maintenance book (is motor due for service?) • Power supply • That alignment of pulleys/belts is correct  Pulley/belt • Grease (is the quantity and quality correct?)
Vibration of the mill	• If bearings are worn • If there is a loose fan, rotor or pulley • If shaft has bent • If hammers are unbalanced, loose, broken or wrong type • For wrong type of bearings

Guided Practice Activity

Topic 1.2 Task 3:

1. Separate into 4 small groups.

2. Visit the warehouse of your school. Ask the operator if the milling machine is currently running well and what problems the milling machine typically has and what s/he does to resolve these issues.

3. Perform the following tasks to help the operator fix any problems:

a. Observe how the milling machine is functioning.

b. Take the necessary steps to check the functionality of different parts of the milling machine.

c. Identify and take steps to fix any problems.

4. Afterwards, share your findings with the rest of the class. Give comments to other groups.

Application Activity

Topic 1.2 Task 4:

1. Read the following scenario and answer questions that follow with your group:

Your school milling equipment has stopped running. Prior, the motor was running, but blew a fuse under load. It developed and unusual noise, released smoke, and was over-heated. The mill was also vibrating, and the belts and bearings could have overheated.

2. Describe the procedure you will follow to help the school:

a. Observe how well the milling machine is functioning.

b. Take the necessary steps to check the functionality of different parts of the milling machine.

c. Identify and take steps to fix the problem.

Points to Remember

When checking tools, utensils, instruments, and equipment in a milling facility:

- Never handle any parts with bare hands.
- Never put your hands in machines when still running.
- Do not operate the motor if it doesn´t work well.
- Please remember to disconnect the milling machine from the power supply before checking.

Formative Assessment

Read the machinery faults in Table 1 and choose a letter that matches with the corresponding causes from Table 2.

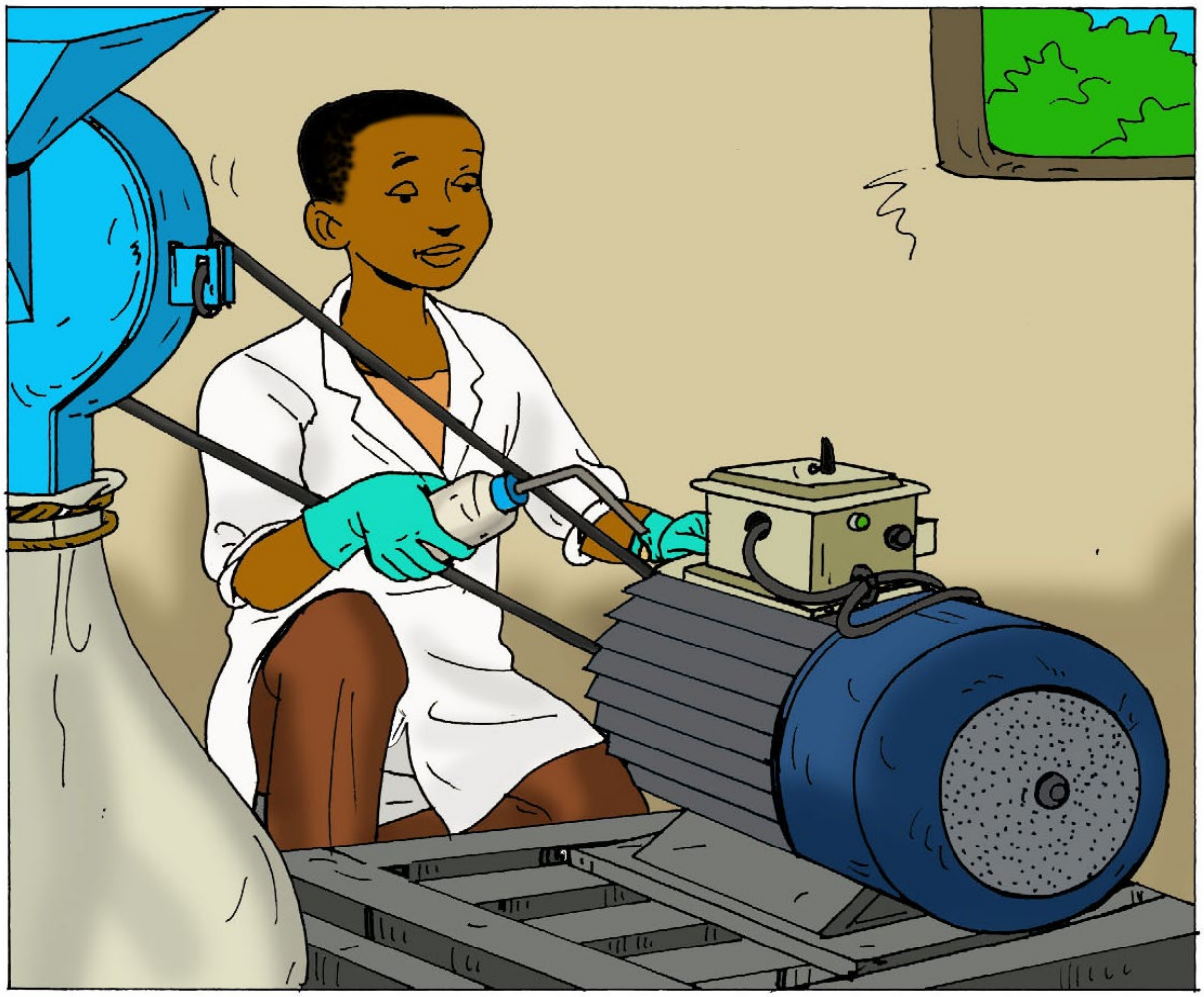
Table 1

Faults
1. Motor stops running
2. Motor running but blows fuse when under load
3. Motor running but blows fuse
4. Motor over-heating, in this case check
5. Vibration of the mill

Table 2

Main causes	
a.	• When power is at incorrect voltage • When electrical cables have burned • When fuses have blown • When there are imbalances in case of more than one machine in power consumption
b.	• When neighbours' machines are working and cause imbalances of power • When the load is below the rated load. • When the fuse is incorrect size
c.	• If motor is overloaded • If connections on the motor are not satisfactory
d.	• If there is a loose fan, rotor or pulley • If shaft has bent • If hammers are unbalanced, loose, broken or wrong type • For wrong type of bearings
e.	• Motor wiring • Motor rating • If fan is working • Maintenance book (is motor due for service?) • Power supply • If Alignment of pulleys/belts is correct • Grease (is the quantity and quality correct?)

Topic 1.3: Maintenance of tools, utensils, instruments, and equipment



Key Competencies:

Knowledge	Skills	Attitudes
1. Describe the installation techniques of the equipment	**1.** Carry out daily maintenance and adjustment of milling machines	**1.** Proactive
2. Describe the SOPs (standard operating procedures) for processing	**2.** Perform safety precautions of the equipment (effect on the user and product)	**2.** Creative
3. Describe the safety precautions for milling equipment	**3.** Correctly maintain equipment	**3.** Cautious

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

Topic 1.3 Task 1:

1. Study the illustration above and answers questions below.
   a. What do you observe in the illustration?

   b. What do you think the person is doing in the illustration?

   c. Why is it important to perform the activity identified above?

   d. What do you think might happen to equipment in the milling facility in case the activity identified above is not done?

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

3. Refer to the Key Competencies table and review it together.

Problem Solving Activity

Topic 1.3 Task 2:

1. Read the following scenario and respond to the questions with a partner:

   Tapixa, a flour processing company, had a very urgent task to supply a hotel with maize flour which was ordered on very short notice. Due to the fact that the said hotel is normally a loyal customer of them, Tapixa management decided they had to honour the request and commit themselves to quality, the quantity requested and the deadline. While the company was in middle of processing the flour, the milling machine shut down itself. It took a while to fix the problem and resume processing which eventually resulted in a delay of the supply.

   While they were packaging the processed flour, the management received a notice from the hotel that the contract to supply the flour was cancelled due to noncompliance of deadline on the side of the supplier. The hotel had gone ahead and accepted a proposal to work with another supplier.

   a. In your opinion, what was wrong with Tapixa company?

   b. What would you recommend to the Tapixa company from now on?

2. Read through **1.4 Key Facts** on the maintenance of tools, utensils, instruments, and equipment in a milling facility.

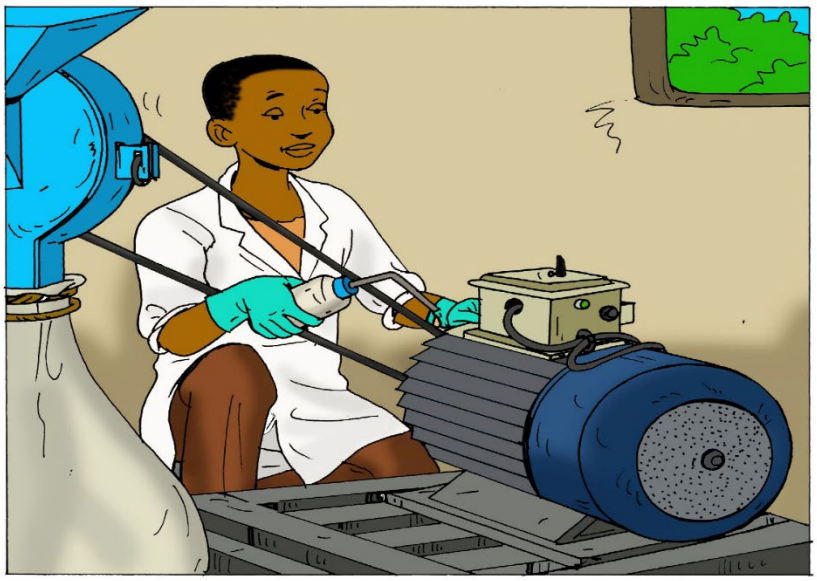
3. Working in a small group, you will be assigned a section of **1.4 Key Facts**. With your group members, your task is to:

   a. Read through and discuss the information provided.

   b. Create a poster or use some other creative way to present the information to the rest of the class.

4. After all groups have finished, share your presentation with the class. Ask other groups questions about their presentations. Ask the trainer for clarification as needed.

1.4 Key Facts



Installation: Building, site selection and plant layout

- **Buildings:**[11]
  - Includes production rooms, stores, dressing rooms and toilets.
  - Buildings shall be designed and constructed to facilitate easy cleaning and maintenance i.e. smooth walls, floors and ceiling.
  - The building shall be spacious enough to allow for free movement of staff, materials and installation of machinery.
  - Bulbs and fixtures above processing lines and packing rooms shall be shielded to prevent glass fragments from contaminating the flour.
  - Construction of the building shall ensure building does not allow the entrance of rodents, insects and dust into the processing area.
  - Building shall be high enough and with adequate windows or openings to ensure maximum ventilation.

[11] Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA). (2014). *Quality assurance for cassava flour processing: A training manual*. https://hqcf.iita.org/wp-content/uploads/2016/04/5_harmonized-standards-_cassava.pdf

- **For cassava flour:**[12]
  - Ideally, cassava flour should be processed very near to or in an area where cassava is grown. This is to:
    - Ensure timely or regular delivery of sufficient quantity of fresh cassava to the processing plan
    - Avoid spoilage during transportation
    - Reduce transportation costs (processed flour less bulky than whole cassava)
  - Specifically, the site should be selected with the following considerations in mind:
    - Availability of required quantities of cassava roots all year round.
    - Easy and low cost of transportation of fresh roots to the plant.
    - Easy access to clean water.
    - Availability of labour.
    - Access to electricity, if electrically powered machinery is to be used.

- **Plant layout:**[13]
  - **Note: This describes a cassava processing plant but applies to other flours as well. For other flours such as maize or sorghum, they would not need the steps regarding peeling, pressing/dewatering and granulating)**
  - The layout of the cassava flour processing plant shall be such that operational processes from the reception of raw materials to finished product including packaging and storage can be executed smoothly. Interruption in the sequence of flow of raw materials and intermediate products during processing shall be very minimal. However, the following shall be observed in the layout of the cassava flour production plant:
    - Separate the area by temporal structures or by constructing a concrete wall
    - Separate areas for storage of raw materials and intermediate products as well as finished product in turn.
    - Separate the peeling section of the plant from the other unit operations.
    - Allow reasonable distance between the wet (peeling, grating, pressing, fermentation) and dry (drying, milling and packaging) sections.
    - Prevent movement of dust into the production room, packing and storage of the finished product by fixing appropriate fittings.
    - Ensure adequate supply of clean water, drainage system, facilities for cleaning and hand washing.
    - Ensure that toilets are located away from the processing, drying, packaging and storage areas.

[12] Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA). (2014). *Quality assurance for cassava flour processing: A training manual*. https://hqcf.iita.org/wp-content/uploads/2016/04/5_harmonized-standards-_cassava.pdf

[13] Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA). (2014). *Quality assurance for cassava flour processing: A training manual*. https://hqcf.iita.org/wp-content/uploads/2016/04/5_harmonized-standards-_cassava.pdf

- **Separations/demarcation:**[14]
  - This applies to the flow of the product (raw material, processing, finished product and by product) as well as the people.
  - Cross-contamination of food may arise from the machinery, people or mixing of the finished product with either raw material or by products. To avoid cross-contamination of cassava flour, clear demarcation of areas for different functions such as cleaning area, storage of raw materials, finished product, packaging material and processing area is recommended.
  - Best recommended practices
  - Install machines in such a manner that the product, including the movement of persons flows in one direction without any crisscrossing.
  - Do not allow by- product (peels, water) to share the same outlet with the product. However, the two (peels, water) should move in one direction, parallel to each other.
  - Separate the sections by either temporal structures or permanent wall.
  - Clean the packaging area thoroughly and restrict movement of unauthorized persons using posters such as, "UNAUTHORIZED PERSONS NOT ALLOWED."
  - Do not allow people to eat, smoke or sleep within the processing room.
  - The layout applies to cassava processing whereas for other products, the washing area is replaced by sorting area some steps are skipped such as step of peeling area, pressing/dewatering, and granulating area.

- **Daily maintenance of milling equipment:**[15]
  - Press the oil pump button 2-3 times while the machine is running until you see oil flowing through the feeder tube. This should be done every 2 hours of machine use.
  - Check the level of the oil pump, always replacing the cap to prevent oil lines becoming contaminated with dust and getting blocked.
  - Remove any dust with a brush especially around the bottom of the machine, the loop and the knives.
  - Check and grease bearings replace if faulty.
  - Check pulley wheels for cracks or chips and replace if necessary, to avoid damaging belts.
  - Check bolts and nuts for tightness.
  - Check the oil level in diesel engines and top up with the correct oil if required.

[14] Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA). (2014). *Quality assurance for cassava flour processing: A training manual*. https://hqcf.iita.org/wp-content/uploads/2016/04/5_harmonized-standards-_cassava.pdf

[15] Patil, K. (2015, April 9). *Milling and milling equipments*. LinkedIn SlideShare. https://www.slideshare.net/ketaki8938/milling-and-milling-equipments

- Clean flour dust off motors and other electrical equipment.
- When a machine is not in use, make sure that power is switched off at the mains and that equipment has not been left switched on.
- This is very important when power cuts occur, because when power returns a machine that has been left on can injure an operator or cause a fire.
- Clean diesel engine cooling fins every day to prevent dust settling and causing the engine to overheat and eventually seize.
- When re-fuelling diesel engines, pour the fuel through a filter to prevent rust deposits in the fuel drum getting mixed with the fuel and damaging the engine.

- **Weekly maintenance:**
  - Check the motor brushes to ensure that they are more than 6 mm long. Replace if they are shorter than this, by lifting out the brush holders and fitting new brushes.
  - Clean the machine in an oil bath by filling a small tank to 6 cm deep with cleaning oil.
  - Remove the looper cover at the bottom of the machine and the belt/pulley cover and handle.
  - Plunge the machine vertically into the oil bath so that it is immersed to the level of the throat plate.
  - Turn the machine manually at the pulley so that moving parts are cleaned by the oil.
  - Remove and allow excess oil to drain back into the tank.
  - If necessary, loosen stubborn dirt with a brush and re-immerse the machine.
  - Clean the outside with a small oiled brush, wipe clean with a soft absorbent cloth
  - Check hammers for wear and replace if necessary.
  - Check the shaft (especially if locally manufactured machines are not tested for strength or alignment).
  - Check that locking nuts on the shaft are tight.
  - Check that fan bolts and nuts have not loosened as the fan then becomes very dangerous.
  - Check the bearing mountings as this area is prone to cracking.[16]
  - Check the engine oil and oil filter on diesel engines and change them every 160 working hours.
  - Change the fuel filter every 320 working hours.

[16] Patil, K. (2015, April 9). *Milling and milling equipments*. LinkedIn SlideShare. https://www.slideshare.net/ketaki8938/milling-and-milling-equipments

Guided Practice Activity

Topic 1.3 Task 3:

1. Visit the workshop where two machines are set. You can ask the operator if you can work with him/her to:
   a. Carry out daily maintenance of milling machine.

   b. Perform weekly maintenance of milling machine.

   c. Check fluid levels, filters and safety appliances for both milling machines.

2. Write a report for the activity and include the procedures you followed to perform the activities above.

3. With your group, read through **1.5 Key Facts** and develop a pamphlet or series of posters that can be used to provide the information to employees who work in a flour processing plant.

1.5 Key Facts

- **Periodic Maintenance:**[17]
  - The level of lubricating oil in the engine sump falls gradually and needs topping up as well as replacing from time to time.
  - The oil filter has to be replaced on a regular basis (about every 300 hours). Instructions from the manufacturer should be followed.
  - The drive belts grow slack after protracted use and have to be tightened according to the manufacturer's recommendations.
  - It is especially important to keep all the belts at the same tightness. Ideally, when one belt fails, all belts are replaced in order to keep them uniformly tight.
  - The mounting of the mill needs a periodic check-up. This needs attention to make sure that all holding-down bolts, beater bolts, plate-fixing bolts, etc. are tight.
  - All bearings need periodic lubrication.
  - The air-intake filter needs cleaning. As a mill environment is usually very dusty, the filter has to be checked periodically. A blocked air filter increases fuel consumption and eventually stops the engine.

[17] Clarke, B., & Rottger, A. (2006). *Small mills in Africa: Selection, installation and operation of equipment*. Food and Agriculture Organization of the United Nations. https://www.fao.org/3/j8482e/j8482e.pdf

- The hammers in hammer mills have to be repaired from time to time. Hammers are made from a rectangular-shaped piece of steel with holes at each end. As one corner of the hammer wears, it can be turned over to present the other corner.
- The hammers can be turned over until all four corners have worn away.
- Worn hammers can be repaired by welding on some layers of welding rod until they can be ground back to the original shape.
- Each set of hammers has to be placed equidistant from the balance point.

- **Safety Issues:**[18]
  - Accidents are usually caused by the power source or the transmission.
  - Electrically driven mills need good-quality fixed wiring, secure connection boxes, and correct fuses.
  - The transmission components of any mill need to be protected carefully by guards.
  - Belts or drive shafts have to be covered at all times by guards. These are provided by the manufacturer but are frequently removed by mill operators, causing many unnecessary accidents.
  - Mills also need to be kept clean inside and outside as dust in the air can be explosive.
  - Mills must be a no-smoking zone.

- **Standard operating procedures:**

Process step	Standards operating procedure
Wash	wear gloves, nose musk and head gear wash bowls thoroughly use clean water
Slice	Clean the slice Remove the components of slicer and clean Check sharpness of blade Fix back dismantled parts Check on movement of belt Power check Introduce product
Ferment	Wear gloves, nose musk and head gear Use clean water
Mill	Wear gloves, nose musk and headgear Clean filters

[18] Clarke, B., & Rottger, A. (2006). *Small mills in Africa: Selection, installation and operation of equipment*. Food and Agriculture Organization of the United Nations. https://www.fao.org/3/j8482e/j8482e.pdf

Application Activity

Topic 1.3 Task 4:

1. Visit a flour milling facility in your community. Ask the operator if you can assist in performing daily and weekly maintenance tools, utensils, instruments and equipment

2. Make a daily and weekly maintenance report which should include:
   a. Installation techniques of the equipment

   b. SOPs (standard operating procedures) for each equipment

   c. Maintenance and adjustment

   d. Effectiveness of the equipment

   e. Safety precautions of the equipment (effect on the user and product)

3. Prepare a class presentation and share your findings with the rest of the class.

Points to Remember

- If the wick that carries the oil becomes worn or thin, replace it immediately to avoid damage to the machine.
- If cleaning is done daily, it will increase the life of the machine.
- When a machine is not in use, make sure that power is switched off at the mains and that equipment has not been left switched on. This is very important when power cuts occur, because when power returns a machine that has been left on can injure an operator or cause a fire.
- Please remember to disconnect the milling machine from the power supply before maintenance.

Formative Assessment

Read the statements below and circle the false statement.

1. For daily maintenance:
   a. Press the oil pump button 2-3 times while the machine is running until you see oil flowing through the feeder tube.
   b. This should be done every 3 hours of machine use.
   c. This should be done every 4 hours of machine use.
   d. This should be done every 1 hours of machine use.
   e. None of the above is correct

2. For weekly maintenance
   a. Change the fuel filter every 340 working hours
   b. Change the fuel filter every 320 working hours
   c. Change the fuel filter every 360 working hours
   d. None of the above is correct

Determine if the following statements are true or false:

3. In daily maintenance we have to check the level of the oil pump, always replacing the cap to prevent oil lines becoming contaminated with dust and getting blocked
   a. True
   b. False

4. In daily maintenance we have to remove any dust with a brush especially around the bottom of the machine, the looper and the knives
   a. True
   b. False

Fill in the missing words to complete the following sentences:

5. Plunge the machine……. into the oil bath so that it is immersed to the level of the throat plate.

6. Turn the machine manually ……. so that moving parts are cleaned by the oil.

7. Clean the outside with a ……., wipe clean with a soft absorbent cloth.

Self-Reflection

1. You have come to the end of the unit. You are going to do the self-assessment you did at the beginning of the unit.

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

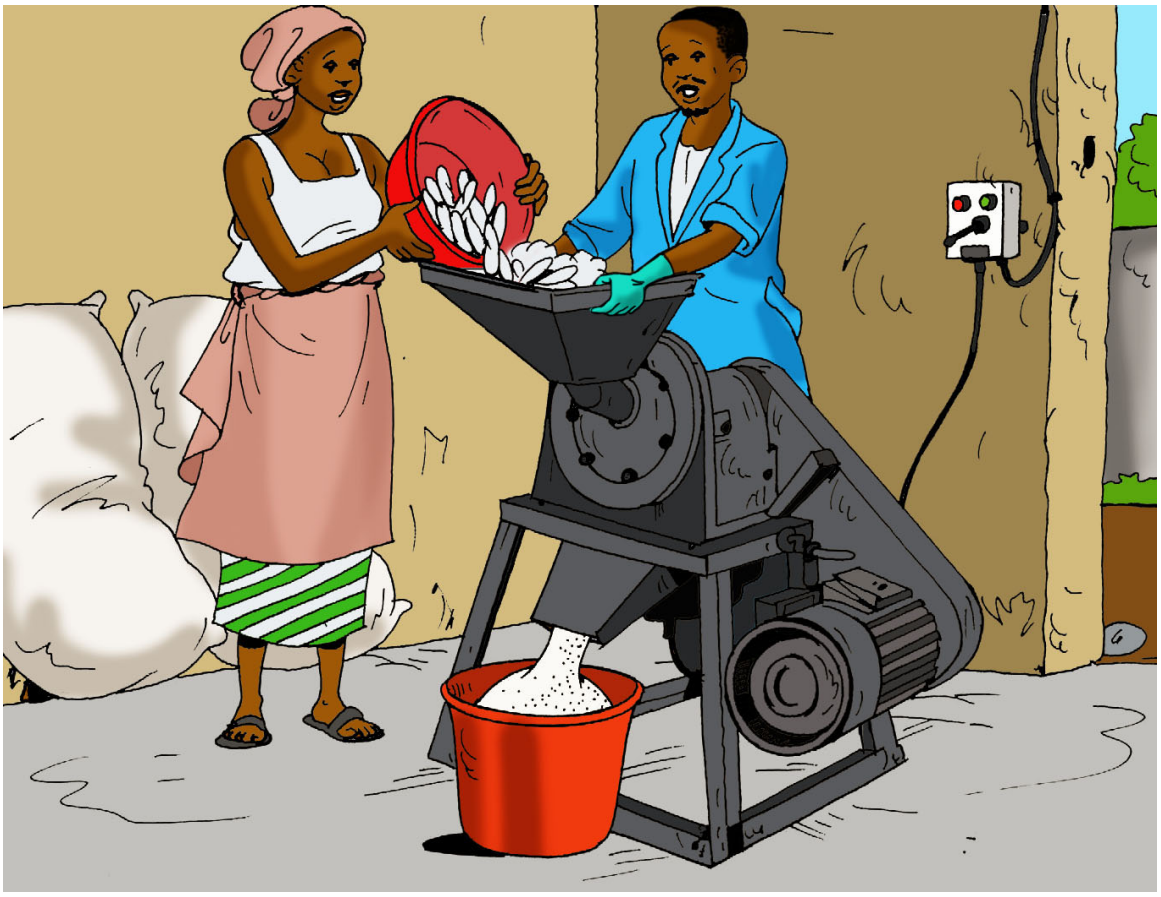
My experience **Knowledge, skills, and attitudes**	**I don't have any experience doing this.**	**I know a little about this.**	**I have some experience doing this.**	**I have a lot of experience with this.**	**I am confident in my ability to do this.**
Select cleaning products for different tools, utensils, instruments and equipment					
Use different techniques to clean tools, utensils, equipment and instruments					
Describe the consequences of a dirty milling room					
Demonstrate the calibration of small-scale tools, utensils, instruments and equipment					
Describe the parameters of visual inspection and effective use of the equipment and materials					
Perform functionality of tools, utensils, instruments and equipment					

My experience Knowledge, skills, and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Describe the installation techniques of the equipment					
Describe the SOPs (standard operating procedures) for each equipment					
Perform safety precautions of the equipment (effect on the user and product)					
Correctly maintain equipment					

2. Complete the table below by identifying areas from the unit where you have improved and those that you need improvement with the actions/strategies you will use to help you improve regarding receiving and interpreting information at workplace

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

Unit 2: Processing roots and tubers into flour



Topics

2.1 Preparation of roots and tubers

2.2 Soaking roots and tubers (cassava)

2.3 Fermenting roots and tubers (cassava)

2.4 Drying roots and tubers

2.5 Grinding and sieving roots and tubers

2.6 Checking flour quality

Unit Summary:

This unit describes the skills, knowledge, and attitudes required to process roots and tubers into flour. At the end of this unit, learners will be able to Prepare roots and tubers, Soak roots or tubers (Cassava), Ferment root and tubers (cassava), Dry roots and tubers, Grind and sieve roots and tubers and Check the flour quality under close supervision.

Self-Assessment: Unit 2

1. Look at the Unit 2 illustration above. What do you observe? What do you think this unit will be about?

2. Fill in the self-assessment below.

There are no right or wrong ways to answer this self-assessment. It is for your own use during this course. Do you think you can do this? How well? Read the statements across the top. Put a check in column that best represents your situation. At the end of this unit, you will take this self-assessment again.

My experience **Knowledge, skills, and attitudes**	**I don't have any experience doing this.**	**I know a little about this.**	**I have some experience doing this.**	**I have a lot of experience with this.**	**I am confident in my ability to do this.**
Use relevant materials to clean milling machine					
Prepare grinding room					
Clean grinding facilities					
Sort cassava roots for processing					
Peel cassava roots for processing					
Wash cassava roots for processing					
Perform soaking process					
Treat bitter cassava					
Carry out grating					
Perform pressing					
Ferment cassava mash					
Preserve cassava flour quality					
Dry cassava mash					

My experience Knowledge, skills, and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Perform cassava milling					
Sieve cassava flour					
Prepare cassava flour for consumption					
Classify flour					
Assess the particle size					
Check quality of flour					
Grade flour					

Topic 2.1: Preparation of roots and tubers

Key Competencies:

Knowledge	Skills	Attitudes
1. State compound of cassava root	**1.** Sort cassava roots for processing	**1.** Teamwork spirit
2. Recognize the consequences of poor prepared cassava root	**2.** Peel cassava roots for processing	**2.** Cleanliness
3. Explain benefit of effective preparation of cassava roots	**3.** Wash cassava roots for processing	**3.** Detail-oriented

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

Topic 2.1 Task 1:

1. In your respective group, study the illustration above and describe what you see in the picture.

2. Share your experience with preparing cassava roots with your teammates.

3. Share your ideas and experiences with the rest of the class.

4. Refer to the Key Competencies table and review it together.

Problem Solving Activity

Topic 2.1 Task 2

1. Read the following scenario and respond to the question associated with it.

   Coprexa Company Ltd has opened its door very recently, the main purpose of the business is to produce high quality cassava flour, while the company was recruiting production manager, one member of panel asked him the very pertinent question on which basis the quality of flour is based on, then he responded that quality of flour depend on the raw materials used and how it is prepared, he added on that poor

preparation of raw material is irreversible, all panel members kept quiet and got concentrated to assign the marks to the interview sheet.

a. From the scenario, do you think production manager was right regarding the quality of the flour?

b. Give reasons to support your response.

c. In your opinion, what do you think is the most effective way to prepare cassava raw material?

2. Present your group's findings to the rest of the class.

3. Read **2.1 Key Facts** about preparing cassava roots to verify your answers.

2.1 Key Facts

- **Compound of cassava roots:**[19]
  - Cassava contains highly toxic cyanogen compounds and antinutrients. Cyanogen are found in 3 forms in cassava; cyanogenic glucoside (95% linamarin and 5% lotaustratin), cyanohydrins, and free cyanide
  - Pounding or crushing is the most effective for cyanogenic glucoside removal because it ruptures cell compartments, thus allowing direct contact between linamarin and the enzyme linamarase that catalyses the hydrolytic breakdown.
  - Crushing and sun-drying cassava roots made into flour removes 96% to 99% of total cyanogen, whereas soaking and sun-drying into fufu, or soaking and fermenting and roasting into gari or farina, removes about 98% of cyanogen

The Process[20]

- **Sorting:** Select healthy roots from the lot for processing. Discard the unwholesome roots.

- **Washing:** Wash peeled roots in clean water at least twice to remove pieces of peel, sand and other dirt. Clean cloth and used sack can also be used to facilitate washing.

- **Cassava roots**: Use fresh cassava roots harvested 10-12 months after planting. The fresh roots must be healthy without rot and well-handled from farm.

[19] Food and Agriculture Organization of the United Nations. (2009). *Processing techniques to reduce toxicity and antinutrients of cassava for use as a staple food*. AGRIS: International Information System for the Agricultural Science and Technology. https://agris.fao.org/agris-search/search.do?recordID=GB2012104615

[20] CORAF/WECARD. (2011, May). *Training manual: Processing of cassava into gari and high quality cassava flour in West Africa*. https://www.coraf.org/pmb/opac_css/doc_num.php?explnum_id=71

- **Peeling:** Peel with clean stainless-steel knives and remove woody tips. Ensure that the rind is completely removed and avoid excessive waste of roots.

- **Notes:**
  - Discourage the use of mixed varieties in processing
  - Sorting and peeling can be done simultaneously in small scale processing.

Guided Practice Activity

Topic 2.1 Task 3:

1. With your group, imagine you are given a basket of cassava roots.

2. Describe how you will prepare cassava roots for processing in each of the processes below:

a. Sorting cassava roots for processing

b. Peeling cassava roots for processing

c. Washing cassava roots for processing

3. Come together to share your group's experience from this session.

4. Ask the trainer and refer to **2.1 Key Facts** for any clarification needed.

Application Activity

Topic 2.1 Task 4:

1. Fix an appointment with cassava flour processors in your community. As you join them for preparation of raw material, your role is to identify strength and shortcomings upon completion of raw material preparation activities. Tell the workers what you have learned in class about sorting, peeling, and washing.

2. Write a brief report describing the important points regarding:

a. Sorting cassava roots for processing

b. Peeling cassava roots for processing

c. Washing cassava roots for processing

3. Present your findings to the rest of the class.

Points to Remember

- Always discard unhealthy roots during the sorting process because unhealthy roots will ruin the flour.
- Always completely peel the cassava root before continuing with processing steps.

Formative Assessment

Read the statements below and determine if they are true or false.

1. Select healthy roots from the lot for processing.
   a. True
   b. False

2. Wash peeled roots in clean water at least once to remove pieces of peel, sand and other dirt.
   a. True
   b. False

3. Sorting and peeling can be done simultaneously in small scale processing.
   a. True
   b. False

4. Use fresh cassava roots harvested 5-10 months after planting.
   a. True
   b. False

5. Fresh roots must be healthy with rot and well-handled from farm.
   a. True
   b. False

6. Discourage the use of mixed varieties in processing
   a. True
   b. False

Read the statement below and respond in 2-3 sentences.

7. Discuss importance and process of peeling cassava roots prior to its processing.

Topic 2.2: Soaking roots and tubers (cassava)

Key Competencies

Knowledge	Skills	Attitudes
1. Identify cause of diseases associated to cassava	**1.** Perform soaking process	**1.** Diligent
2. Explain soaking process	**2.** Treat bitter cassava	**2.** Innovative
3. Define soaking length	**3.** Estimate number of days for soaking process	**3.** Detail-oriented

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

Topic 2.2 Task 1:

1. Brainstorm and write your ideas regarding the following questions:

a. What is the importance of processing cassava roots after soaking?

b. What are the consequences if cassava roots are processed without soaking?

2. Volunteer to share your ideas.

3. Refer to the Key Competencies to read what you will gain from this topic.

Problem Solving Activity

Topic 2.2 Task 2:

1. Read the following scenario:

Manuma visited the centre of Kirambura and was warmly welcomed by his old friend Kambaga, who lives in the region. During his stay, Manuma was surprised to see citizens consuming ugari. Kambaga asked him why he was surprised and Manuma told him that many people in their region do not consume it because 5 years ago, many people fell sick. They suffered from irreversible paralysis of the legs (especially children and young women), impaired neurocognition (in children), tropical ataxic neuropathy (in older people) and aggravation of iodine deficiency disorders (such as goitre and cretinism) in iodine deficient areas. Kambaga could not understand the scenario.

2. Discuss the following questions with your group:
   a. From the scenario, what do you think was the main cause of the sickness?

   b. What do you think could have been done to prevent the sickness?

3. Present your group's responses to the rest of the class.

4. Read **2.2 Key Facts** together to supplement your answers.

2.2 Key Facts

- **Results of poor processing:**[21]
  - When the usual detoxifying preparation of cassava are not followed it may result mainly into two neurological conditions mainly associated with bitter cassava: a myeloneuropathy and konzo.
  - The myeloneuropathy manifests as a slowly evolving bilateral sensory polyneuropathy, optic atrophy and sensorineural deafness, and sensory ataxia, is seen in adults (particularly elderly) who have a solely cassava diet.
  - Whereas Konzo is a condition with selective upper motor neuron damage, manifesting as an acute or subacute onset of an irreversible, non-progressive, and symmetrical spastic paraparesis or quadriparesis

- **Soaking:**[22]
  - The peeled cassava roots are soaked in water in a large vessel or a running stream for 3-4 days.
  - This causes the roots to soften and the enzyme breaks down linamarin and HCN gas bubbles off.
  - The roots are dried in the sun, pounded and sieved to produce flour.

- **Importance of soaking:**[23]
  - Soaking allows fermentation take place that gives the chips the sour flavour favoured by some consumers.
  - Soaking also allows residual hydrocyanic acid in the cassava to diffuse out, making the product safer for human consumption.

[21] US National Library of Medicine, National Institutes of Health. (2017, September 1). *Cassava, konzo, and neurotoxicity*. Lancet Glob Health. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6995356/

[22] Bradbury, J. H., Cliff, J., & Banea, J. P. (2010). *Making cassava flour safe using the wetting method*. South Sudan Medical Journal. https://www.southsudanmedicaljournal.com/archive/february-2015/making-cassava-flour-safe-using-the-wetting-method.html

[23] Food and Agriculture Organization of the United Nations. (n.d.). *Chapter 5 - Processing of roots and tubers*. https://www.fao.org/3/x5415e/x5415e05.htm

- In communities where high cyanogenic potential (CNP) cassava varieties (CNP> 100mg/kg HCNeq) are cultivated and processed into flour, the peeled roots are soaked in water (submerged fermentation) for a number of days to ferment, soften and detoxify before they are partially dewatered, dried and milled into flour.
- In communities where low CNP cassava varieties (CNP < 100mg/kg HCNeq) are used, cassava flour is simply made by slicing or chipping the peeled roots and drying them in the sun.[24]

Guided Practice Activity

Topic 2.2 Task 3:

1. Read the following scenario:

Konzo is an upper motor neuron disease that occurs mainly in children and young women and is associated with high cyanogen intake amongst people living on a monotonous diet of bitter cassava.

In 2010, the wetting method was taught to the women in Kay Kalenge village, Popokabaka Health Zone, Bandundu Province, DRC, where there were 34 konzo cases. After the intervention there were no new cases of konzo and the urinary thiocyanate of the school children fell to safe levels. Fourteen months later they found no new cases of konzo in Kay Kalenge, the women were still using the soaking method.

2. Discuss the related questions with a partner:

a. What do you think was causing konzo?

b. What do you think reduced the konzo?

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

4. Ask questions and refer to **2.2 Key Facts** for clarification.

[24] Dziedzoave, N. T., Abass, A. B., Amoa-Awua, W. K., & Sablah, M. (n.d.). *Quality management manual for production of high quality cassava flour*. International Institute of Tropical Agriculture (IITA).

Application Activity

Topic 2.2 Task 4:

1. Go for a field trip to a nearby farm during the cassava soaking period. Ask as many questions as you can to the workers with the aim of understanding the various benefits of cassava soaking.

2. Make a report of your trip noting:
   a. The processing of soaking cassava.
   b. The importance of soaking cassava.

3. Present your findings to the rest of the class.

Points to Remember

- Peeled cassava roots should be soaked in water in a large vessel or a running stream for 3-4 days.

- Do not reduce soaking time to 1-2 days (called short soaking) because cyanogen is only partially removed, and cassava flour has high cyanide content.

Formative Assessment

Read the statements below and determine if each one is true or false.

1. Peeled cassava roots are soaked in water in a large vessel or a running stream for 1-2 days.
   a. True
   b. False

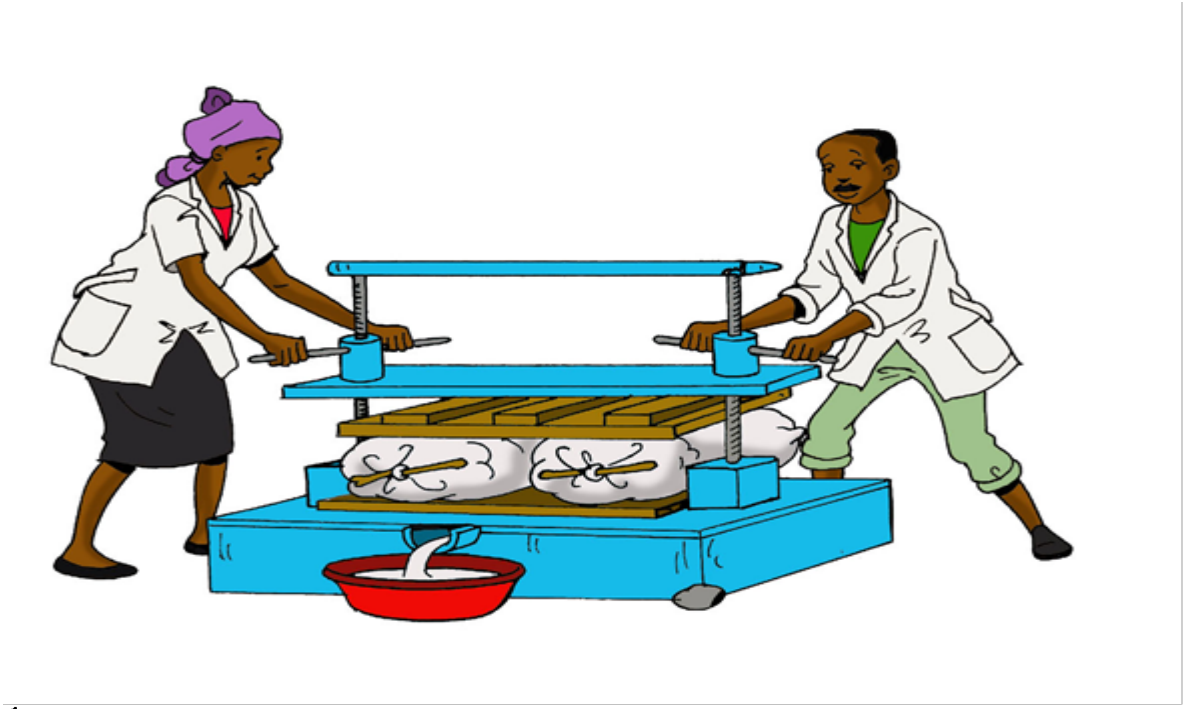
2. Soaking process causes roots to soften and enzyme breaks down Linamar and HCN gas bubbles off.
   a. True
   b. False

3. Soaking method removes cyanogen satisfactorily, but if the soaking time is reduced to 3-4 days (called short soaking) cyanogen are only partially removed and cassava flour has high cyanide content
   a. True
   b. False

Topic 2.3: Fermenting roots and tubers (cassava)

Key Competencies:

Knowledge	Skills	Attitudes
1. Explain fermentation process	**1.** Carry out grating	**1.** Critical thinking
2. Estimate fermentation length	**2.** Perform pressing	**2.** Teamwork spirit
3. Describe pressing process	**3.** Ferment cassava mash	**3.** Diligent



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

Topic 2.3 Task 1:

1. Observe the illustration above and answer the following questions:

a. What do you see?

b. What do you think the above picture displays?

c. Have you ever participated in such activities? If so, share with your partner.

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

3. Refer to the Key Competencies table and review it together.

Problem Solving Activity

Topic 2.3 Task 2:

1. Separate into four groups and your trainer will assign your group a category: fermenting, grating, de-watering/pressing, and granulating.

2. Carefully read the case study below:

Manuma has been learning a lot about how to safely process cassava from his friend Kambaga. He realizes the illnesses in his region have been caused by consuming grey or fufu high in cyanogen. He would like you to help him create flyers on how to properly and safely prepare cassava flour for farmers in his region.

3. With your group, complete the tasks below:

a. What key information would you include in the flyers?

b. Read **2.3 Key Facts** and add any information you missed in the previous question.

c. Create a flyer showing the safe way to prepare cassava for flour processing. Be creative!

4. Present your flyer to the class. Each group should provide the details for their assigned category: fermenting, grating, de-watering/pressing, and granulating.

2.3 Key Facts

- **Grating:**[25]
  - Grating is very efficient in hydrolysing more than 95% of the toxic compounds within 3 hours, after which the compounds can be almost entirely removed by dewatering.
  - The cassava is usually grated at least one hour after washing in order that excess water can drain off the peeled and washed cassava, otherwise the roots are too slippery and too difficult hold during grating.

[25] Abass, A., Towo, E., Mukuka, I., Okechukwu, R., Ranaivoson, R., Tarawali, G., & Kanju, E. (2014). *Growing cassava - A training manual from production to postharvest*. International Institute of Tropical Agriculture (IITA). https://hqcf.iita.org/wp-content/uploads/2016/04/1_cassava-training-manual.pdf

- Particular care has to be taken and some skill is required to not also grate the fingers, but still accidents sometimes happen.

- **Chipping:**[26]
  - This method, an alternative to grating, dewatering and granulation, is used to make flour from a low cyanide cassava variety.
  - Chip cassava roots into small and thin chips immediately after washing.
  - Collect the chips in a clean container for drying.

- **Fermenting:**[27]
  - The cassava mash may be allowed to ferment for 2 to 4 days if the end-users prefer aromatic and sour flour (for home cooking, for example). In this case, dewatering does not have to be done rapidly. This batch of flour must be labelled "Fermented Cassava Flour." Here are the basics steps to follow:
    - Put cassava mash into a clean sack and tie. Allow to stand in a fermenting trough for 2-4 days.
    - Arrange sacks in such a way that there is no contact with sand or dirt that can contaminate the mash.
    - Allow free seeping of water from the sacks.
    - Fermentation should not be less than 2 days (to allow development of the characteristic sour taste of gari).

- **De-watering/pressing**:[28]
  - The process of removing cyanide from grated cassava mash by pressing excess water out of the bags of cassava mash is known as dewatering or pressing. Hydraulic or screw presses are used in pressing the cassava mash from the graters. Here are basic steps to be followed in the process:
  - Place cassava mash in a sack and tie tightly before placing the sack on the platform of the pressing machine.
  - If using a jack, apply pressure onto the sack until it is tight.
  - Allow the liquor to drain out for 3 - 10 minutes.
  - Apply pressure repeatedly until the mash is well dewatered to form a cake that crumbles easily.

[26] Abass, A. (2006). *How to make high quality cassava flour (HQCF)*. International Institute of Tropical Agriculture (IITA). https://www.iita.org/wp-content/uploads/2016/06/How_to_make_high_quality_cassava_flour_HQCF.pdf

[27] Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA). (2014). *Quality assurance for cassava flour processing: A training manual*. https://hqcf.iita.org/wp-content/uploads/2016/04/5_harmonized-standards-_cassava.pdf

[28] Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA). (2014). *Quality assurance for cassava flour processing: A training manual*. https://hqcf.iita.org/wp-content/uploads/2016/04/5_harmonized-standards-_cassava.pdf

- Pressing takes place after fermentation.
- Pressing is done using one of a number of designs of screw or hydraulic press which need access to simple workshops for their construction
- With a parallel board press a pulp filled bag is placed between two parallel boards which are screwed together to apply pressure to the bag.
- The fermented mash in sacks is pressed to remove as much moisture as possible. Pressing is completed when water is no longer dripping from the sacks.
- The pressing time depends on the efficiency of the press and moisture content of the mash.
- Sacks should not be used for too long to prevent bursting during pressing.
- In some cases of light sacks or over-use of sacks, it is advisable to double the sacks.

- **Cake breaking/granulating:**[29]
  - Empty the cassava cake into clean pans, bowls or sacks.
  - Feed the cake into a dry cassava grater that will break it into granules.
  - Sift the resulting wet granules to remove lumps.
  - If a cassava grater is not available, a manual sifter may be used to break the cake and sift the granules at the same time.
  - Do not place sacks containing cake or granules on dirty surfaces (such as floors).
  - Use clean containers to hold the wet granules.

Guided Practice Activity

Topic 2.3 Task 3:

1. In your respective group and under directive and guidance of your trainer, go to the workshop of the school where four stations are set. First station is for grating, second station is for fermenting, the third station is for de-watering/pressing, and the fourth one is for granulating. The stations are labelled from one to four respectively.

2. Upon arrival to the workshop, obtain peeled fresh cassava roots from your trainer and perform the following tasks:
   a. Grate peeled fresh cassava roots
   b. Fermenting
   c. De-watering/pressing grated cassava mash
   d. Cake breaking/granulating

[29] Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA). (2014). *Quality assurance for cassava flour processing: A training manual*. https://hqcf.iita.org/wp-content/uploads/2016/04/5_harmonized-standards-_cassava.pdf

Application Activity

Topic 2.3 Task 4:

1. Visit any cassava processing unit in your community. Observe how they process their cassava and make a report regarding:
   a. Grating
   b. Fermenting
   c. De-watering/ Pressing
   d. Cake breaking / Granulating

2. Give a class presentation to share the experience gained from the visit.

Points to Remember

- Never chip high cyanide cassava to produce cassava flour meant for human consumption.
- Any cassava variety known to be bitter or to contain a high amount of cyanogen must be grated.
- Any variety whose level of bitterness or cyanogen content is unknown should be grated.

Formative Assessment

1. Name the main stages of processing low cyanide cassava variety and high cyanide cassava variety into flour and put them in order

Read the statements below and determine if each one is true or false.

2. Put cassava mash into a clean sack and tie. Allow to stand in a fermenting trough for 1-2 days.
   a. True
   b. False

3. Arrange sacks in such a way that there is contact with sand or dirt that can contaminate the mash.
   a. True
   b. False

4. Allow free seeping of water from the sacks
   a. True
   b. False

5. Fermentation should not be less than one day to develop Gari's sour taste.
   a. True
   b. false

6. Grating is very efficient in hydrolysing more than 95% of the toxic compounds within 3 hours, after which the compounds can be almost entirely removed by dewatering.
   a. True
   b. False

7. The cassava is usually grated at least 5 minutes after washing in order that excess water can drain off the peeled and washed cassava, otherwise the roots are too slippery and too difficult hold during grating.
   a. True
   b. False

8. Pressing takes place before fermentation.
   a. True
   b. False

9. With a parallel board press a pulp filled bag is placed between two parallel boards which are screwed together to apply pressure to the bag.
   a. True
   b. False

10. The fermented mash in sacks is pressed to remove as much moisture as possible. Pressing is completed when water is no longer dripping from the sacks.
   a. True
   b. False

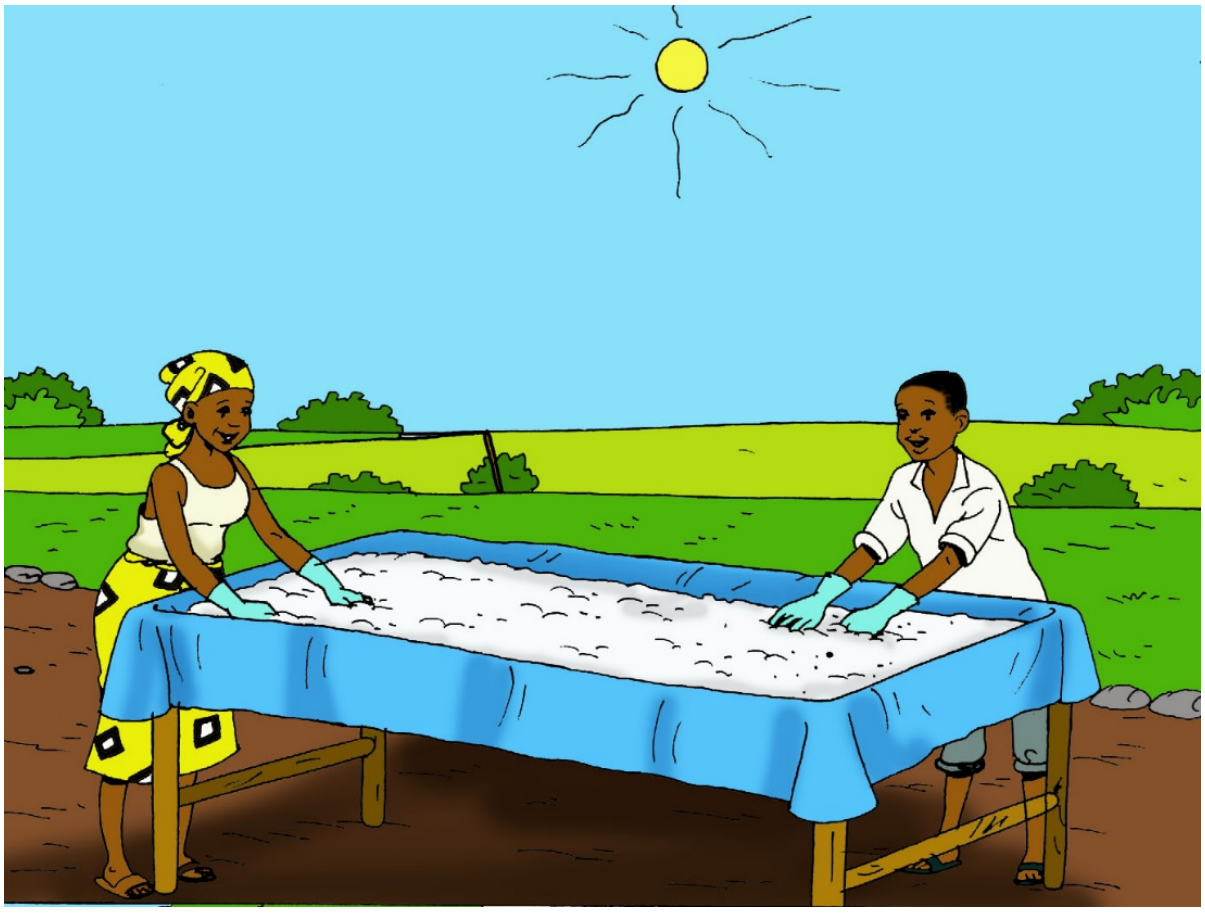
11. The pressing time depends on the efficiency of the press and moisture content of the mash.
   a. True
   b. False

12. Sacks should be used for too long and many times to maximize the profit.
   a. True
   b. False

Topic 2.4: Drying roots and tubers

Key Competencies:

Knowledge	Skills	Attitudes
1. Explain drying cassava flour process	**1.** Carry out cassava flour sun drying	**1.** Critical thinking
2. Identify acceptable percentage of moisture content	**2.** Spread cassava mash over black polyethylene sheet pressing	**2.** Teamwork spirit
3. Describe drying cassava flour process	**3.** Dry cassava mash	**3.** Safety conscious



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

Topic 2.4 Task 1:

1. Observe the illustration above and answer the following questions:
   a. What do you see?

   b. What do you think the above picture displays?

   c. Have you ever been involved in such activity? If so, share with your classmates experience you have acquired.
2. Refer to the Key Competencies table and read it together.

Problem Solving Activity

Topic 2.4 Task 2:

1. Read the following scenario:

   Mabura is cassava flour producer. One day he supplied 250 kg of cassava flour to retailers in Konko market, but the clients rejected the flour claiming it was poor quality due to the unusual colour and horrible smell. Some claimed that maybe it was due to the way the cassava was dried.

2. With your group, respond to the following questions:
   a. What are the signs of a poorly dried cassava?

   b. What drying methods do you think Mabura used that could have affected the quality of the cassava?

   c. Mention some good methods Mabura could have used while drying the cassava.

3. Share your group's responses with the rest of the class. Discuss as a large group. Then, review **2.4 Key Facts**.

2.4 Key Facts

- **Drying:**
  - Dry the disintegrated/sifted cake in a dryer to reduce moisture level to acceptable level
  - Sun-drying should be carried out by spreading the sifted mash or the chips on an elevated platform covered with a black polythene sheet.
  - The black polythene facilitates drying by absorption of solar heat and the elevated platform prevents dust and other dirt from contaminating the drying product.
  - Cassava is traditionally dried to increase storability.
  - Roots are dried to 12-14% moisture before storage.
  - The poor quality of the product (discoloured, changed tastes, offensive smell, etc.) lead to poor market acceptability and low prices.
  - An improvement to this is the drying of cassava on raised platforms on black polythene sheet
  - For large scale processing, mechanical drying of cassava is the most suitable. It hastens the drying operation thereby saving time, preventing insect infestation, and preserving colour, taste, and smell.[30]

- **Methods of drying:**
  - Tray Drier
  - Oven Drying
  - Sun Drying

Guided Practice Activity

Topic 2.4 Task 3:

1. Read the following scenario with your small group:

At the workshop of your school there is 200 kg of cassava wet granules prepared by your classmates. Your respective group must dry cassava wet granules under directive and guidance of your trainer.

2. With your group, complete the following tasks:

a. Choose appropriate method and describe why the method has been chosen to this particular exercise.

[30] CORAF/WECARD. (2011, May). *Training manual: Processing of cassava into gari and high quality cassava flour in West Africa*. https://www.coraf.org/pmb/opac_css/doc_num.php?explnum_id=71

b. Dry cassava wet granules.

3. Once all groups have finished, share your answers and discuss as a group.

Application Activity

Topic 2.4 Task 4:

1. Visit a cassava drying facilities in your neighbouring processors, seek an appointment with flour processor to assist him or her while drying cassava flour, upon completion discuss with him best practices for better drying method that attracts best prices. Make a report regarding:

a. The method of drying used

b. Importance of drying cassava

2. After the visit, share your findings and discuss as a large group.

Points to Remember

- The poor quality of the product (discoloured, changed tastes, offensive smell, etc.) lead to poor market acceptability and low prices.
- Roots are dried to 12-14% moisture before storage.

Formative Assessment

Read and complete the following sentences by filling in the missing words.

1. Dry the disintegrated/sifted cake in a dryer to reduce the ……. level to an acceptable level.

2. Sun-drying should be carried out by spreading ……..on an elevated platform covered with a ……. sheet.

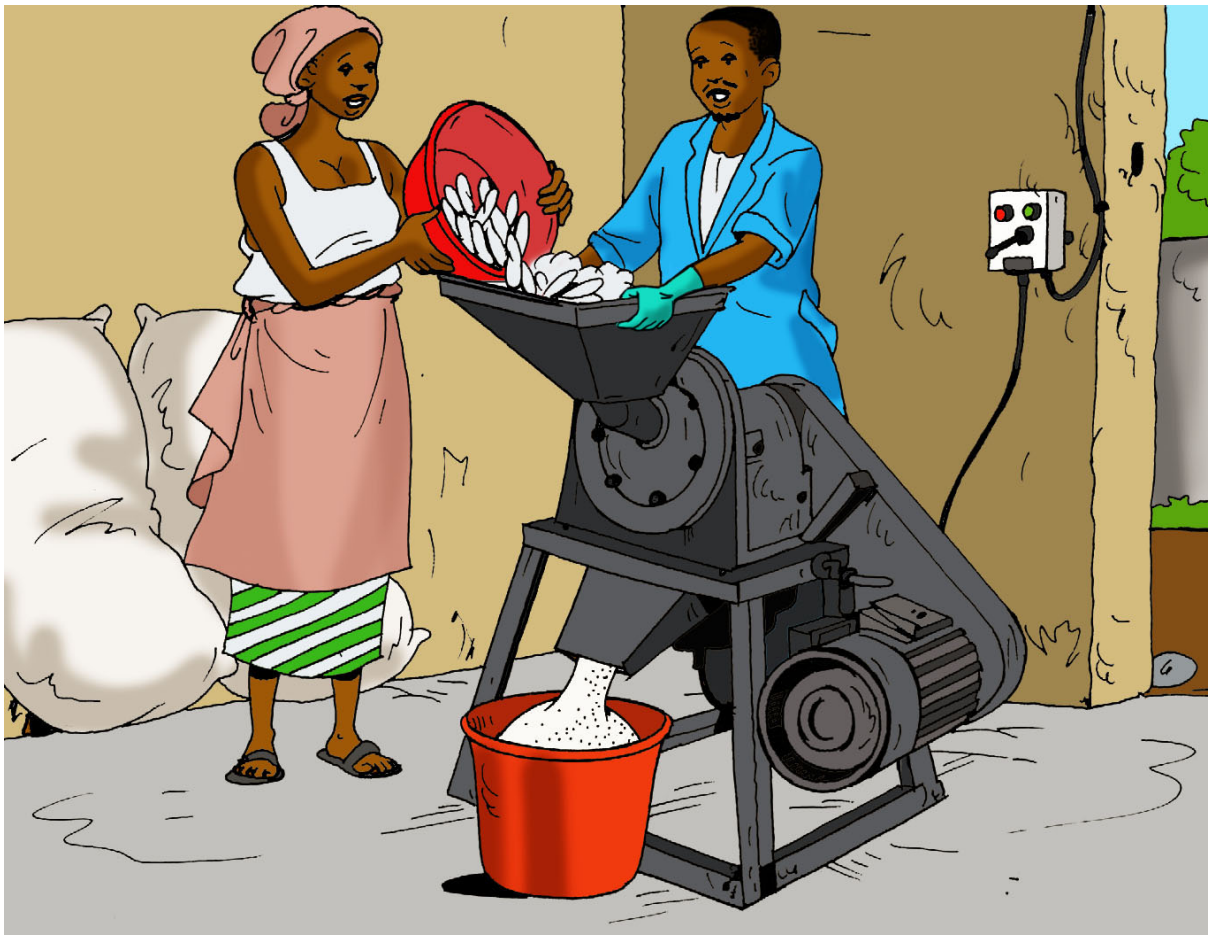
3. The black polythene facilitates drying by absorption of solar heat and the ……. prevents dust and other dirt from contaminating the drying product.

4. Roots are dried to ……..% moisture before storage.

Topic 2.5: Grinding and sieving roots and tubers

Key Competencies:

Knowledge	Skills	Attitudes
1. Describe milling cassava flour process	**1.** Perform cassava milling	**1.** Detail-oriented
2. Classify fineness of cassava flour based on its use	**2.** Sieve cassava flour	**2.** Attentive
3. Explain cassava flour sieving process	**3.** Prepare cassava flour for consumption	**3.** Flexible



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

Topic 2.5 Task 1:

1. Observe the illustration above and answer the following questions
   a. What do you see?

   b. What do you think the above picture displays?

   c. From your experience, how is prepared cassava ground in your community?

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

3. Refer to the Key Competencies table and review it together.

Problem Solving Activity

Topic 2.5 Task 2:

1. Individually reflect on your community and think about how different flour for different purposes is prepared.

2. With a partner, describe how flour is prepared for:
   a. Animal feed

   b. Home use

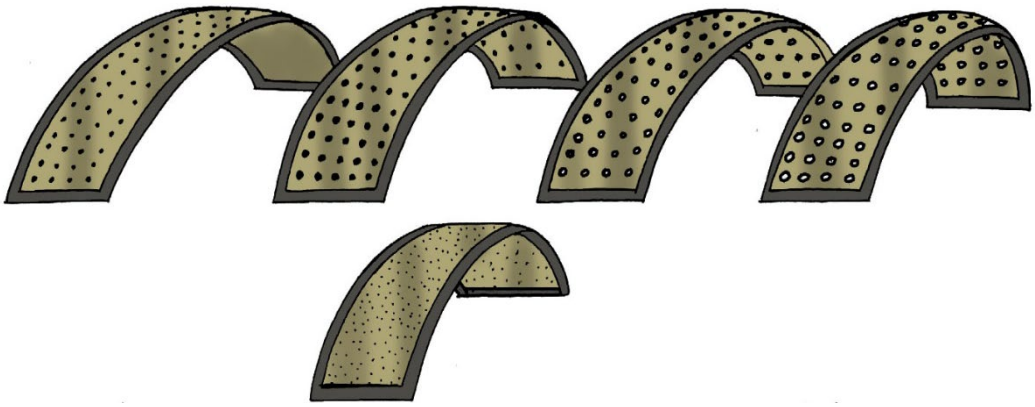
   c. Bread making

3. Share and discuss your responses with the large group. Then, review **2.5 Key Facts** together.

2.5 Key Facts

- **Milling:**
  - Milling is done where cassava roots are not mashed.
  - Fermented chips and well dried are passed through the milling machine
  - Dried cassava is mostly made into flour before home or industrial use.
  - The traditional method of milling dried cassava for home use is pounding. The method is labour-intensive and slow.

- Milling machines for grains and other crops are very common and are used for milling of cassava. The appropriate fineness of milled cassava depends on its final use.
- Cassava for animal feed should be milled gritty.
- Flour for home use needs to be fine while the flour for bread baking and starch must be very fine.
- Milling machine can be used for different product such as millet, cassava, sorghum, and wheat.
- The size of sieve that operator changes marks the difference; for well dried cassava a 1 mm sieve is recommended.[31]



- **How to use the milling machine:**
  - Pour dried cassava grits or chips into hopper of the mill.
  - Place a receptacle at the outlet of the machine to receive the milled flour
  - Start the motor/engine and manually feed the milling chamber with product from the hopper. Stop machine after milling
  - A harmer mill could be used with a sieve of appropriate aperture size to produce high quality cassava flour (HQCF) of required particle size of 250–500µ.
  - Sifting of flour will be necessary if a plate or attrition mill is used.
  - Sift the flour with a sifter. Avoid overloading sifter.
  - Receive the sifted flour with a clean container and stop the machine when sifting is complete.[32]

[31] Abass, A., Towo, E., Mukuka, I., Okechukwu, R., Ranaivoson, R., Tarawali, G., & Kanju, E. (2014). *Growing cassava - A training manual from production to postharvest*. International Institute of Tropical Agriculture (IITA). https://hqcf.iita.org/wp-content/uploads/2016/04/1_cassava-training-manual.pdf

[32] Dziedzoave, N. T., Abass, A. B., Amoa-Awua, W. K., & Sablah, M. (n.d.). *Quality management manual for production of high quality cassava flour*. International Institute of Tropical Agriculture (IITA).

Guided Practice Activity

Topic 2.5 Task 3:

1. Form small groups.

2. At the workshop of your school there is 50 kg of dried cassava chips. Under the guidance and directive of your trainer, your group must mill the dried cassava to fine flour for human consumption.

3. Ask for assistance from the trainer as needed.

4. After the activity has been completed, share your experiences.

Application Activity

Topic 2.5 Task 4:

1. Visit a cassava milling facility in your community. Make an appointment with the flour processor to assist him or her while grinding cassava. Upon completion, discuss best practices for grinding method that attracts best prices with the worker.

2. After the visit, write a report regarding:
   a. The process of grinding

   b. The cassava sieving process

3. Then, share and discuss your findings with the rest of the class.

Points to Remember

- Avoid overloading the mill.
- Cassava for animal feed should be milled gritty.
- Flour for home use needs to be fine while the flour for bread baking and starch must be very fine.

Formative Assessment

Carefully read the following statements and determine if each one is true or false.

1. Cassava for animal feed should be milled gritty.
   a. True
   b. False

2. Flour for home use needs to be very fine.
   a. True
   b. False

3. Flour for bread baking and starch must be fine.
   a. True
   b. False

4. What size of sieve that is recommended for cassava well dried, maize, millet and sorghum?

5. Write one paragraph on flour milling and sieving.

Topic 2.6: Checking flour quality

Key Competencies:

Knowledge	Skills	Attitudes
1. Identify types of flour based on its end consumption	**1.** Assess the particle size of flour	**1.** Detail-oriented
2. Compare flour colours	**2.** Check taste and cleanliness for quality of flour	**2.** Attentive
3. Classify flour	**3.** Grade flour	**3.** Flexible

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

Topic 2.6 Task 1:

1. Observe the illustration above and answer the following questions:
   a. What do you see?

   b. What do you think the above picture displays?

   c. From your experience, how do people assess the quality of cassava flour in your community?
2. Share your responses with the rest of the class.

3. Refer to the Key Competencies table and review it together.

Problem Solving Activity

Topic 2.6 Task 2:

1. Read the following scenario with your group:

   Skiver Milling Ltd has supplied to cassava flour to Kagote, but Kagote doubts that the flour is fine enough. Before processing the payment, he wants you to help him test the fineness of the flour and confirm him whether it is suitable for human consumption.

2. Discuss the following questions about the scenario with your group:
   a. Which methods would you use to come up with results as quickly as possible?"

   b. Why is important to check for the quality of the flour?

3. Share your group's points and discuss as a large group. Then, review **2.6 Key Facts** together.

2.6 Key Facts In order to check the quality of the flour several aspects must be considered:	
Characteristic	**Method**
Particle size	Standard sieves, balance
Colour (whiteness)	Spectrophotometer, colour charts, reference samples
Fibre content	Chemical analysis
Humidity	Laboratory analysis
Insects	Shelf life trials

- **Quick methods to assess the particle size:**[33]
  - **Method 1 - Feeling with fingers and mouth**
    - The size of the biggest particles can be detected by taking a bit of flour between the thumb and index finger or on the hand.
    - Put some flour in your mouth and press it between the tongue and mouth ceiling. Ideally it "dissolves" without leaving sandy particles.

  - **Method 2 - Mixing with water**
    - Mix a teaspoon of flour with two teaspoons of water in a plate or similar shallow deposit.
    - The big and dark particles become more visible as the fine particles are washed away.

  - **Method 3 - Washing flour in fine mesh pouches**
    - Put a teaspoon of flour into a small pouch made of a fine fabric. Keep the pouch closed and wash it in a deposit with a few litres of water or under faucet.
    - The water should wash away the fine particles and the coarse particles can be observed.
    - The pouches can be dried to keep the sample for weighing or comparing with standards.

- **Methods to compare the flours colour:**
  - Colour samples: In order to compare colours, a set of samples should be kept so that a new lot can be compared to previous ones or samples with the expected whiteness.

- **Fibre (insoluble cellulose) and foreign matter:**[34]
  - Two to three grams (2-3 g) of flour should be boiled with 100ml of 0.4% hydrochloric acid for one hour in a fume cupboard.
  - Filter the liquid through a weighed crucible fitted with filter paper or through a Jena glass filter.
  - After washing with hot water, dry the crucible at a temperature of 105°C - 110°C until a constant weight is obtained.

[33] Duville, K. E. (2012). *Sorghum flour production manual for Compatible Technology International (CTI) burr grinders*. Digital Commons - University of Nebraska Lincoln. https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1008&context=intsormilpubs

[34] Dziedzoave, N. T., Abass, A. B., Amoa-Awua, W. K., & Sablah, M. (n.d.). *Quality management manual for production of high quality cassava flour*. International Institute of Tropical Agriculture (IITA).

- The percentage of fibre and impurities are calculated as one hundred times the gain in weight of crucible divided by the weight of the test portion.
- A rough estimate of fibre is carried out by "crunch" of the flour. That is the sound given when a sample, packed tightly in a small bag is pinched between fingers. "Crunch" is strong in pure flours but above certain fibre content it is lost.

- **Cleanliness:**[35]
  - Add five millilitres of distilled water to 1 g of dried high-quality cassava flour.
  - Stir the mixture and then add 5ml of 0.7 M NaOH solution.
  - Examine the uniform gelatinized mixture for impurities.
  - The degree of whiteness and clearness depends on the quantity of pigment and dirt present in the flour.

- **Taste and smell:**[36]
  - High quality cassava flour should be bland in taste without indication of acidity or off-flavour. The smell should be typically that of freshly peeled cassava.

Guided Practice Activity

Topic 2.6 Task 3:

1. In your assigned group, get the samples of flour from your trainer, and under the directive and guidance of your trainer proceed to do the following:

a. Assess the particle size of flour.

b. Check taste and cleanliness for quality of flour.

c. Evaluate the colour of flour.

2. Refer to **2.6 Key Facts** as needed.

3. Share and discuss your experiences with the rest of the class.

[35] Dziedzoave, N. T., Abass, A. B., Amoa-Awua, W. K., & Sablah, M. (n.d.). *Quality management manual for production of high quality cassava flour*. International Institute of Tropical Agriculture (IITA).
[36] Dziedzoave, N. T., Abass, A. B., Amoa-Awua, W. K., & Sablah, M. (n.d.). *Quality management manual for production of high quality cassava flour*. International Institute of Tropical Agriculture (IITA).

Application Activity

Topic 2.6 Task 4:

1. In small groups, do the following:

Visit a cassava grinding facility in your community. Make an appointment with quality assurer to assist him or her while testing quality of produce. Upon completion, discuss best practices for quick methods to test flour quality with him or her.

2. With your group, write a report on:
   a. What the facility checks for to determine flour quality.

   b. The methods the facility uses to check for flour quality.

3. After the visit, share your report and findings with the rest of the class. Discuss your experiences as a large group.

Points to Remember

- In order to compare colours, keep a set of samples so that a new lot can be compared to previous ones.

- Quick method to test particle size are:
  - Sensing with fingers and mouth.
  - Mixing with water.
  - Washing flour in fine mesh pouches.

Formative Assessment

Carefully read the following statements and complete them with the missing words.

1. Method 1 - Feeling with fingers and mouth

The size of the biggest particles can be detected by taking a bit of flour between the …… and …….. or on the hand. Put some flour in your mouth and press it between the …… and ……. Ideally it “dissolves” without leaving sandy particles.

2. Method 2 - Mixing with water

Mix a teaspoon of flour with two teaspoons of water in a plate or similar shallow deposit. The …… become more visible as the ……. are washed away.

3. Method 3 - Washing flour in fine mesh pouches

Put a teaspoon of flour into a small pouch made of a fine fabric. Keep the pouch closed and wash it in a deposit with a few litres of water or under faucet. The water should wash away the …… and the ……. can be observed. The pouches can be dried to keep the sample for weighing or comparing with standards.

4. Methods to compare the flours' colours

In order to compare colours, a set of ……. should be kept so that a new lot can be compared to previous ones or samples with the expected whiteness.

Self-Reflection

1. You have come to the end of the unit. You are going to do the self-assessment you did at the beginning of the unit.

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

My experience **Knowledge, skills, and attitudes**	**I don't have any experience doing this.**	**I know a little about this.**	**I have some experience doing this.**	**I have a lot of experience with this.**	**I am confident in my ability to do this.**
Use relevant materials to clean milling machine					
Prepare grinding room					

My experience Knowledge, skills, and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Clean grinding facilities					
Sort cassava roots for processing					
Peel cassava roots for processing					
Wash cassava roots for processing					
Perform soaking process					
Treat bitter cassava					
Carry out grating					
Perform pressing					
Ferment cassava mash					
Preserve cassava flour quality					
Dry cassava mash					
Perform cassava milling					
Sieve cassava flour					
Prepare cassava flour for consumption					
Classify flour					
Assess the particle size					
Check quality of flour					
Grade flour					

2. Complete the table below by identifying areas from the unit where you have improved and those that you need improvement with the actions/strategies you will use to help you improve regarding receiving and interpreting information at workplace.

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

Unit 3: Operation of grain mill

Topics

3.1 Checking quality of incoming raw materials through physical parameters

3.2 Setting process parameters

3.3 Maintaining process parameters

3.4 Participating in checking flour quality

Unit Summary:

This unit describes the skills, knowledge, and attitudes required to operate grain milling mill. At the end of this unit, trainees will be able to check quality of incoming raw materials through physical parameters, set process parameters, maintain process parameters, and participate in checking flour quality.

Self-Assessment: Unit 3

1. Look at the Unit 3 illustration above. What do you observe? What do you think this unit will be about?

2. Fill in the self-assessment below.

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

My experience Knowledge, skills, and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
State compound of cassava root					
Assess quality of maize grains					
Recognize poor quality of maize grains					
Determine maize grades					
Explain parameters to classify maize grains					
Classify maize grains					
Maintain quality standards					
Improve the flow of flour					
Regulate the flow of material					
Check load of motor					
Charge motor to its full capacity					
Improve particle size and colour of flour					
Clean the milling machine, swiping or blowing residues out of the milling machine.					

My experience Knowledge, skills, and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Regulate flow of product to the helix and to the grinding burrs					
Maintain quality standards					
Explain grain conditioning process					
Adjust moisture content					
Identify moisture content rate					
Carry out tempering process					
Promote best practices of grain processing					
List tempering steps					
Determining moisture content					
Identify acceptable percentage of moisture content					
Carry out basic tests for Ash Content					
Determine overall mineral content of the wheat					
Assess the particle size of flour					

Topic 3.1: Checking quality of incoming raw materials through physical parameters

Key Competencies:

Knowledge	Skills	Attitudes
1. State standard requirement of maize grains	**1.** Assess quality of maize grains	**1.** Be pragmatic
2. Recognize poor quality of maize grains	**2.** Determine maize grades	**2.** Be safety oriented
3. Explain parameters to classify maize grain	**3.** Classify maize grains	**3.** Strive for quality standards

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

Topic 3.1 Task 1:

1. Consider your own community and discuss the following questions with a partner:
   a. How do people in your community check the quality of flour before processing?

   b. Why do you think it is important to this?

2. Refer to the Key Competencies table and review it together.

Problem Solving Activity

Topic 3.1 Task 2:

1. Read the following scenario with your group:

Kanyamanza Company is a big supplier of maize flour to supermarkets in Kigali due to its processing unit. They normally process maize grains supplied by local farmers after being the grains have been accredited by its quality control staff in terms according to quality parameters. One day, the quality controller fell sick and the farmers supplied maize grains from different processing unit locations. Then, the management of Kanyamanza Company decided to hire a temporary quality controller staff in order to bridge the gap.

2. Imagine that you are among the candidates to compete for the job mentioned above. You are given a bag full of maize grains to accredit

a. What steps would you go through to convince the assessors panel that you are the best candidate and qualified for the job?

b. Why is it necessary to go through the steps identified above?

3. After discussing, share your group's responses with the rest of the class. Then, review **3.1 Key Facts** together.

3.1 Key Facts

- **Checking physical parameters for maize:**[37]
  - Physical parameters include: Colour, homogeneity, diseased grains, insect or vermin damaged maize, foreign matter, identification of inorganic matter
  - The following formula helps to determine which percentage the batch has in terms of physical parameters:

$$\text{(Physical parameters to be determined)} = \frac{Weight\ 1}{weight\ 2} * 100$$

  - Weight 1 is obtained by weighing 200 grams of a representative sample.
  - Weight 2 is a total weight of physical parameters to be determined from 200 grams of the representative sample.

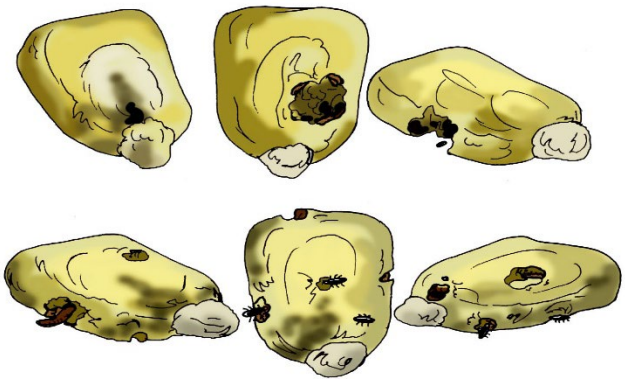
- **Checking discoloured grains:**[38]
  - Maize comes in different colours: white, yellow, red, blue, black, and mixed.
  - Maize is only classified as yellow, white, red, or mixed. A maize kernel is considered of a certain colour if 50% or more of its surface is of that colour.
    - For example, when grading white maize, maize which has yellow or pink coloration that is less than 50% of the surface is still considered white maize.

[37] East African Community. (2011). *Maize grains — Specification and grading*. East African Standard. https://law.resource.org/pub/eac/ibr/eas.2.2011.html

[38] East African Community. (2011). *Maize grains — Specification and grading*. East African Standard. https://law.resource.org/pub/eac/ibr/eas.2.2011.html

- **Checking for rotten or diseased grains:**[39]
  - Diseased grains appear rotten or unpleasing to the eye. They can often be observed without having to cut the grains to examine them.
  - Mouldy grains have various colours depending on the mould or yeasts that could have afflicted them, such as green, blue, black, or grey.
  - Diseased grains are unsafe for human consumption due to decay, moulding, bacterial decomposition, or other causes.

- **Checking for insect or vermin damaged maize:**[40]
  - Insect or vermin damaged maize kernels are those that have been partially eaten by weevils, grain borers or other crawling pests.
  - Some grains may have insects or insect webbing. Insects or their larvae may be present. The grain kernel may have the germ partly or wholly destroyed.
  - Insect parts or their waste may also be an indicator of infestation and renders the maize unsuitable for human consumption. The pictures below show some examples of insect or vermin damage.



[39] Musuga, M. (2019). *Maize grain quality standards*. Uganda National Bureau of Standards (UNBS). https://blog.unbs.go.ug/?p=10753

[40] Musuga, M. (2019). *Maize grain quality standards*. Uganda National Bureau of Standards (UNBS). https://blog.unbs.go.ug/?p=10753

- **Checking for foreign matter:**[41]
  - Foreign matter is all organic and inorganic material other than maize, broken kernels, and other grains.
  - Organic matter is material of plant origin and includes seed coats, parts of stems, pods, and leaves.
  - Inorganic matter includes lumps of earth, sand, soil, glass, and fibre.

- **Identifying inorganic matter**
  - These are foreign materials of non-biological origin e.g. metals, stones, glass, plastic, soil, sand, and dust.

- **Standards requirements:**

Defect	Maximum limits		
	Grade 1	Grade 2	Grade 3
Foreign matter, %	0.5	1.0	1.5
Inorganic matter, %	0.25	0.5	0.75
Broken grain, %	2.0	4.0	6.0
Pest damaged grain, %	1.0	3.0	5.0
Rotten and diseased grain %	2.0	4.0	5.0
Discoloured grains, %	0.5	1.0	1.5
Moisture, %	13.5	13.5	13.5
Immature/shrived grains, %	1.0	2.0	3.0

Guided Practice Activity

Topic 3.1 Task 3:

1. Form small groups. Your trainer will provide you with 50 kg of maize grains.

2. From your respective group assigned by your trainer, get 50kgs of maize grains from your trainer. Under his/her guidance, classify the maize grains based on percentage of the following items.
   a. % of foreign matter
   b. % of inorganic matter
   c. % of broken grain
   d. % of pest damaged grain
   e. % of rotten and diseased grain
   f. % of discoloured grains
   g. % moisture

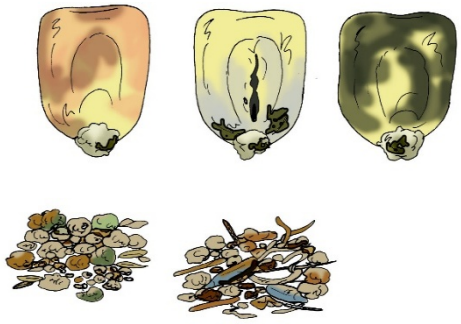
[41] East African Community. (2011). *Maize grains — Specification and grading*. East African Standard. https://law.resource.org/pub/eac/ibr/eas.2.2011.html

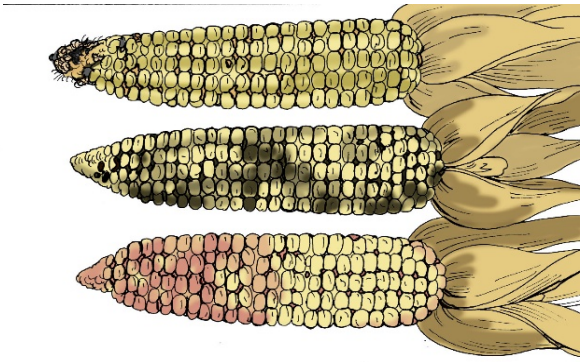
h. % of immature/shrived grains

3. Share and discuss your group's findings. Then, review **3.2 Key Facts** together.

3.2 Key Facts

- **Mouldy kernels:**[42]
  - These are maize grains that have visible blue, white, green, and/or mycelial growth on its tip or surface.
  - Moulds, especially Aspergillus flavus, are dangerous to humans and animals as they cause mycotoxins.
  - Aflatoxins can cause aflatoxicosis and are known to be cancer inducing. Aflatoxin contamination cannot be detected using eyesight. Good white maize could still have potentially high levels of Aflatoxin.
  - When grading, mouldy kernels should be counted as part of diseased grains.
  - Musty smell could indicate moulding. Grain with musty smell of generally appearing mouldy should be rejected.[43]





- **Method 1 - Testing for foreign odour:**[44]
  - Obtain a representative sample.
  - Spread out the sample on a flat surface and smell it.
  - If no odour is detected, return the sample into the container and seal it.
  - Leave the sealed container for 24 hours and re-examine the sample.
  - The smell should be typical of maize without other smells, such as chemicals, mouldiness, earthy, rotten, and/or musty smell.

[42] East African Community. (2011). *Maize grains — Specification and grading*. East African Standard. https://law.resource.org/pub/eac/ibr/eas.2.2011.html

[43] Musuga, M. (2019). *Maize grain quality standards*. Uganda National Bureau of Standards (UNBS). https://blog.unbs.go.ug/?p=10753

[44] Awulachew, M. T. (2020). *Understanding basics of wheat grain and flour quality*. Science Publishing Group. https://article.sciencepublishinggroup.com/pdf/10.11648.j.jher.20200601.12.pdf

- **Method 2 - Rapid test for foreign odour:**[45]
  - Obtain a representative sample.
  - Put a small quantity of ground or un-ground maize kernels in a container.
  - Pour some warm water (60-70 ˚C) onto the maize and cover the container.
  - After 2-3 minutes, decant the water and note whether foreign odour is present.
  - Any grain with objectionable odour should be rejected.

- **Determining moisture content:**[46]
  - Select random sample of maize.
  - Fill a glass half-way with the maize sample (the glass must be dry).
  - Add 2 teaspoons of dried salt (the salt should be previously dried in a pan over a fire for 15 minutes).
  - Shake the mixture for 2 minutes.
  - Leave to settle for 20 minutes.
  - Pour out the mixture.
  - Check for any salt clinging on the walls of the glass.
  - If any salt is found on the walls of the glass, then moisture content is greater than 14%.
  - Moisture meters are used for the estimation of moisture content.
    - To determine moisture content using moisture meters, follow the manufacturer's instructions.
    - Ensure that the moisture meters are maintained and calibrated often to get accurate results**.**

moisture meter

[45] Awulachew, M. T. (2020). *Understanding basics of wheat grain and flour quality*. Science Publishing Group. https://article.sciencepublishinggroup.com/pdf/10.11648.j.jher.20200601.12.pdf

[46] Awulachew, M. T. (2020). *Understanding basics of wheat grain and flour quality*. Science Publishing Group. https://article.sciencepublishinggroup.com/pdf/10.11648.j.jher.20200601.12.pdf

Application Activity

Topic 3.1 Task 4:

1. Make an appointment with a quality controller in one of your community's grain mill facilities.

2. Join him/her in checking incoming raw material. Your role is to identify the strengths and shortcomings of the process.

3. Upon completing the checking activities, discuss the best way to improve the quality controller's process.

4. After the visit, write a report which includes:
   a. What to check for in incoming materials.
   b. What methods to use while checking incoming materials.
   c. The importance of checking incoming materials.

5. Finally, share your findings and report with the rest of the class.

Points to Remember

- A maize kernel is considered of a certain colour if 50% or more of its surface is of that colour.

- Diseased grains are unsafe for human consumption due to decay, moulding, bacterial decomposition, or other causes.

Formative Assessment

Read the statements below and circle the **false** statements for the following tests.

1. **Method 1 - Testing for foreign odour**
   a. Obtain a representative sample.
   b. Spread out the sample on a flat surface and smell it.
   c. If odour is detected, return the sample into the container and seal it.
   d. Leave the sealed container for 2 hours and re-examine the sample.
   e. The smell should be typical of maize without other smells, such as chemicals, mouldiness, earthy, rotten, and/or musty smell.

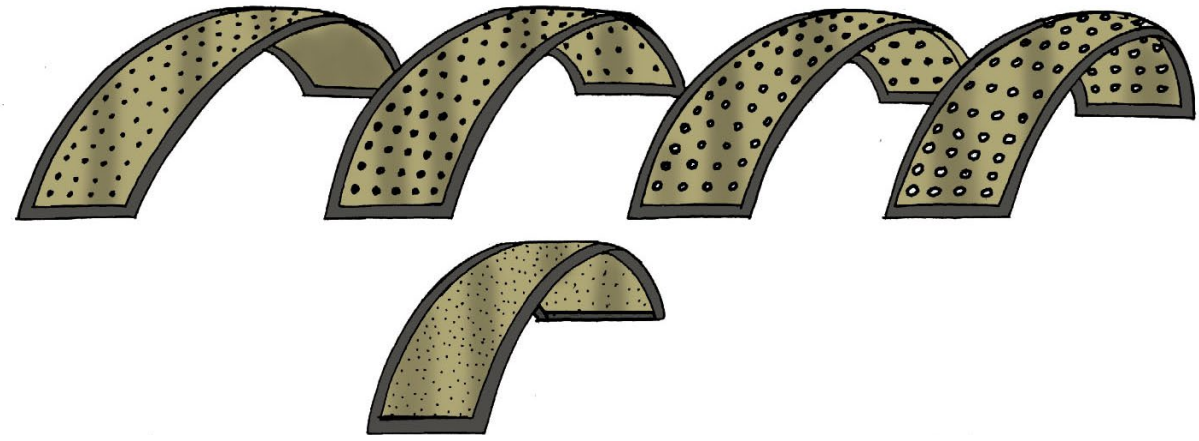
2. **Method 2 - Rapid test for foreign odour**
   a. Obtain a representative sample.
   b. Put a small quantity of ground or un-ground maize kernels in a container.
   c. Pour some cold water onto the maize and cover the container.
   d. After 40-60 minutes, decant the water and note whether foreign odour is present.

3. **Determining moisture content**
   a. Select a random sample of maize.
   b. Fill a glass half-way with the maize sample (the glass must be dry).
   c. Add 4 teaspoons of dried salt (the salt should be previously dried in a pan over a fire for 15 minutes).
   d. Shake the mixture for 2 minutes.
   e. Leave to settle for 4 minutes.
   f. Pour out the mixture.
   g. Check for any salt clinging on the walls of the glass.
   h. If any salt is found on the walls of the glass, then moisture content is greater than 14%.

Topic 3.2: Setting process parameters

Key Competencies

Knowledge	Skills	Attitudes
1. Identify types of sieves	**1.** Regulate the flow of material	**1.** Pragmatic
2. Describe process of charging motor to its full capacity	**2.** Select appropriate sieve	**2.** Safety oriented
3. Explain how to regulate flow of products	**3.** Regulate flow of products	**3.** Diligent



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

Topic 3.2 Task 1:

1. Observe the illustration above and answer the following questions in small groups:
   a. What do you see?
   b. What do you think the above picture displays?
   c. How does it relate to this topic?

2. Share your group's responses with the rest of the class.

3. Refer to the Key Competencies table and review it together.

Problem Solving Activity

Topic 3.2 Task 2:

1. Read the following scenario with your group:

Florex Company is a new company that established its flour processing unit in the village. One local supermarket wanted to test its performance and send sample of maize grains to be grinded. But when the processing was complete, the supermarket was not satisfied with the fineness of the flour and preferred to work with another grinding facility.

2. Then, with your group, discuss the following questions:

a. On your opinion, what do you think Florex did wrong that pushed away the clients?

b. What should Florex have done in the first place while processing the flour?

3. Select a representative from your group to present your group's points to the rest of the class.

4. After all groups have shared, discuss as a large group. Then, turn to **3.3 Key Facts** and review them together.

3.3 Key Facts

- **Cleaning:**
  - Use magnetic separators to remove iron particles.
  - Use vibrating separators to remove straw and dirt.
  - Use aspirators to remove dust.
  - Use de-stoners to remove stones.
  - Use disc separators for separating the various sizes of wheat kernels.

- **Sieving:**[47]
  - Sieves of different sizes can be used for targeting appropriate particles of the end product.
  - Particle size and flour colour can be improved by taking out coarse particles and fibre.

[47] Liu, K. (2009). *Some factors affecting sieving performance and efficiency*. Powder Technology. https://naldc.nal.usda.gov/download/55382/PDF

- After the initial passes, a portion of the pericarp may be sieved out, when only 5 to 10% of the product is retained on the sieve.
- The flour that passes through the sieve will be finer and whiter.
- With mesh numbers around 40, the sieving is relatively easy, but the flour will need to be passed through the milling machine repeatedly to reduce its particle size further.
- Meshes around 80 can do the final sieving but are much slower.
- Other helpful tools are scoops to charge the hopper, a plastic funnel to guide the product, and deposits to receive it.
- An amp meter is very useful to check the load of the motor and to charge it to its full capacity.

- **Setting sieves:**
  - For well dried maize, 0.7 mm sieve is recommended.
  - For millet and sorghum, 0.5 mm sieve is recommended.

Guided Practice Activity

Topic 3.2 Task 3:

1. Separate into small groups.

2. Visit the nearest flour milling machine or in the school workshop.

3. In your respective groups, get 1 kg of dried maize and 1 new sack.

4. Perform the following tasks with your group:
   a. Select appropriate sieve.
   b. Regulate the flow of material for feeder.
   c. Regulate the flow of product to the helix and to the milling burrs.

5. After completing the tasks, share your experience and what you have gained throughout the session.

6. Ask the trainer questions and refer back to **3.3 Key Facts** as needed.

Application Activity

Topic 3.2 Task 4:

1. Form small groups.

2. Visit a flour milling facility located in your community. Discuss best practices of setting parameters for the milling machine with the operators.

3. With your group, write a report regarding:
   a. Selection of appropriate sieve.
   b. Regulation of the flow of material for feeder.
   c. Regulation the flow of product to the helix and to the milling burrs.

4. After the visit, share your group's findings and report. Discuss as a large group.

Points to Remember

- Separators remove iron particles.
- Vibrating separators remove straw and dirt.
- Aspirators remove dust and de-stoners remove stones.
- Disc separators separate the various sizes of wheat kernels.

Formative Assessment

Read the statements below and determine if each one is true or false.

1. Cleaning of grains can involve Magnetic separators to remove iron particles,
   a. True
   b. False

2. Cleaning of grains can involve vibrating separators to remove straw and dirt
   a. True
   b. False

3. Cleaning of grains can involve aspirators to remove dust
   a. True
   b. False

4. Cleaning of grains can involve de-stoners to remove stones.
   a. True
   b. False

5. Which size sieves should be used on maize grains?

Topic 3.3: Maintaining process parameters

Key Competencies:

Knowledge	Skills	Attitudes
1. Explain grain conditioning process	**1.** Adjust moisture content	**1.** Precise
2. Identify moisture content rate	**2.** Carry out tempering process	**2.** Methodical
3. List tempering steps	**3.** Perform milling	**3.** Safety-oriented

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

Topic 3.3 Task 1:

1. Read the following individually:

Consider how often we go to the shop to buy bread and how there is often a long queue. Similarly, kids love to buy bread to go with their tea in the mornings before school.

2. Reflect and write down answers to the questions:

a. Where do you think the bread come from?

b. Where do the ingredients come from?

c. Who manages the production quality?

3. After reflecting, discuss your ideas with a partner.

4. Volunteer to share your ideas with the rest of the class while the trainer writes them on the board/flipchart.

5. Listen carefully as the trainer explains the correct answers.

6. Review the Key Competencies table together.

Problem Solving Activity

Topic 3.3 Task 2:

1. Read the following case study:

Homebred, a bakery located in Kigali city, employs the leading Rwandese bread makers. The bakery dominates the market with a 73% share, up from 63% in 2006. One day, the staff at Homebred ordered flour for processing bread as usual to the Falu Milling Company located in their neighbourhood. Surprisingly, the supplier delivered the flour that had a dark grey colour. Immediately, the flour was rejected because the flour did not meet the requirements they desire at the bakery.

2. With your partner, discuss and take notes on the following questions:

a. What does grey colour in flour mean to you and what seems to be the main cause?

b. What do you think caused the flour to turn grey?

c. What do you think Falu Milling Company could have done to meet the requirements?

d. In your opinion, what happened to the Falu Milling Company after supplying poor quality flour?

3. Volunteer to share your ideas as the trainer write them down on the board/flipchart.

4. Review **3.4 Key Facts** together. Observe closely as the trainer demonstrates and/or shows a video of some of the steps in the process.

3.4 Key Facts

- **Conditioning/Adjustment of moisture content:**[48]
  - Wheat conditioning and tempering (moisturizing) is the process of wheat preparation for milling. Moisture is added to toughen the bran and to facilitate easy separation of kernel parts. Tempered wheat is stored for about 8–20 hours, depending on the type of wheat, whether soft, medium, or hard.
  - Conditioning takes place before milling to produce a uniform moisture content throughout the grain.

[48] Food and Agriculture Organization of the United Nations. (2009). *Agribusiness handbook: Wheat flour*. https://www.fao.org/3/al376e/al376e.pdf

- Moistening helps to prevent break-up of the bran (hard outer layer) during milling and improves separation from the floury endosperm (the mass that forms the white flour of the grain).

- **Tempering:**[49]
  - Controlled addition of water and heat.
  - Intensive mixing to ensure uniform distribution.
  - Rest for 3-36 hours.
  - Optimal distribution in different parts of kernel.
  - Reduce hydration differences.

- **Recommended tempering time and moisture content:**

Type of wheat	Hours	Moisture content
Hard wheat	24-36	16-17 %
Semi-hard	18-24	15.5-16 %
Semi-soft	12-18	15-15.5 %
Soft wheat	6-12	14.5-15 %

moisture meter

[49] Bockstaele, F. V. (2017, May 16). *Milling technology for cereals*. Ghent University. http://ffinetwork.org/about/calendar/2017/documents/Zambia_6.1_Milling_technology_for_cereals_Bockstaele.pdf

- **Wheat with specified amount of water**
  - Water in % = 100 * (F2-F1) / 100 - F2
    F1= incoming wheat moisture
    F2= Desired wheat moisture

  - Water in l/h= water in % * Capacity kg/h

  - Blending of different wheat types and qualities can be done at this stage to achieve a specific flour quality.
  - The wheat is then milled in roller mills. The modern mills use the process of gradual reduction of the wheat kernels with the goal to obtain middlings (coarse particles of endosperm). The middlings are then separated from the bran by sieves and returned to the appropriate rollers until the desired flour is obtained. Proper adjustment and settings of the rolls ensure maximum output of high-quality flour. Grinding that is too hard will result in bran particles getting into the flour, while grinding that is too light will result in the waste of endosperm.
  - From the rolls, the milled products are sent by pneumatic systems to rotate box-type sifters. The sifters separate the larger particles from the smaller particles. Larger particles are shaken off at the top, leaving the finer flour particles to sift to the bottom.[50]

- **Milling/grinding:**
  - Remove bran and germ flour with specific particle size distribution.
  - Extract as much white flour as possible.

- **Milling process:**[51]
  - Multi-stage process: Size reduction, separation/sieving, and purification operations.
  - Different materials at different stages but no fraction completely pure.
  - Succession of 3 systems:
    1. Breaking
       - Breaks up grain in large pieces
       - Removing endosperm from bran
       - As little flour and bran powder as possible

[50] Food and Agriculture Organization of the United Nations. (2009). *Agribusiness handbook: Wheat flour*. https://www.fao.org/3/al376e/al376e.pdf
[51] Bockstaele, F. V. (2017, May 16). *Milling technology for cereals*. Ghent University. http://ffinetwork.org/about/calendar/2017/documents/Zambia_6.1_Milling_technology_for_cereals_Bockstaele.pdf

2. Coarse reduction (scratching or sizing)
   - Removing small pieces of bran and embryo from endosperm
   - Smaller particles endosperm

3. Fine reduction
   - Grinding endosperm into flour
   - Minimum in crushed germ and bran powder
   - Optimum in damaged starch granules

Guided Practice Activity

Topic 3.3 Task 3:

1. Form small groups and read the following scenario:

Imagine you oversee maintaining process parameters in a grain milling facility.

2. Work together with your group to write answers in response to the following questions/tasks:

a. Describe the kind of parameters that you will maintain.

b. How will you maintain the following?

- Grain conditioning process
- Adjustment of moisture content
- Moisture content rate
- Tempering steps

3. Share your answers and ideas with the rest of the class.

Application Activity

Topic 3.3 Task 4:

1. Separate into small groups.

2. Make an appointment and visit a flour milling facility in your community. Arrange the visit to that you are there before the facility begins processing wheat flour and just after the wheat grain has arrived at the site.

3. During the visit, participate actively throughout the process. Upon completion, discuss with operators the pros and cons of the process you witnessed.

4. With your group, write a report regarding:
   a. Grain conditioning process
   b. Adjustment of moisture content
   c. Moisture content rate
   d. Tempering steps

5. Present your group's report to the rest of the class.

Points to Remember

- Conditioning is the adjustment of moisture content.
- Conditioning takes place before milling to produce a uniform moisture content throughout the grain.

Formative Assessment

Read the following statements and determine whether they are true or false.

1. During conditioning bran should become elastic to avoid splintering and contamination of flour.
   a. True
   b. False

2. During conditioning a lot of power is required to grind to flour.
   a. True
   b. False

3. Conditioning takes place after milling to produce a uniform moisture content throughout the grain.
   a. True
   b. False

4. Moistening helps to increase break-up of the bran (hard outer layer) during milling and prevent separation from the floury endosperm (the mass that forms the white flour of the grain).

a. True

b. False

5. What is moisture content interval desirable during tempering?

Topic 3.4: Participating in checking flour quality

Key Competencies:

Knowledge	Skills	Attitudes
1. Determining moisture content	**1.** Carry out basic test for Moisture Content	**1.** Strive for wheat flour quality
2. Identify acceptable percentage of moisture content	**2.** Carry out basic tests for Ash Content	**2.** Adhere to quality standards
3. Determine overall mineral content of the wheat	**3.** Assess the particle size of flour	**3.** Maintain positive perception of clients towards organization

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

Topic 3.4 Task 1:

1. Observe the illustration above and discuss the following questions with a partner:

a. Describe what you see.

b. Why do you think they are doing the task in the illustration?

c. Before making ugali or buying flour:
- What do you do?
- Why do you it?
- How do you it?

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

3. Turn to the Key Competencies table and review it together.

Problem Solving Activity

Topic 3.4 Task 2:

1. Read the following scenario with your group:

Kagaya Milling has supplied wheat flour to Compa Bakery, but Compa Bakery is doubting the moisture content and the overall flour quality. Before processing the payment, he wants you to help him to test the moisture and mineral content of the flour as quickly as possible and to confirm whether is suitable for human consumption.

2. With your group, discuss and note your answers to the questions below:

a. What do you think Compa Bakery will check for in the flour?

b. How will Compa Bakery check for the moisture content in the flour?

c. Who else should be involved in the process?

3. Share your group's answers and ideas with the rest of the class. Then, review **3.5 Key Facts** together to verify your answers.

3.5 Key Facts

Basic test for moisture content:[52]

- **Method**
  - Weigh and place a small sample of flour or ground wheat (2–3 grams) in a moisture dish.
  - Heat the sample at 130°C in an ash oven for 1 hour.

[52] Wheat Marketing Center, Inc. (2004). *Wheat and flour testing method: A guide to understanding wheat and flour quality*. Nebraska Wheat. https://nebraskawheat.com/wp-content/uploads/2014/01/WheatFlourTestingMethods.pdf

- Cool the sample to room temperature and weigh the residue.

- **Results**
  - Determine moisture content by heating a flour or ground wheat sample in an air oven and comparing the weight of the sample before and after heating.
  - The moisture content is the amount of weight loss.
  - Moisture content results are expressed as a percentage. An example of a wheat moisture content is 12%.

Basic test for ash content:[53]

- High temperature incineration: Measures mineral (ash) content

- **Method**
  - Weigh a sample of flour or ground wheat (3–5 grams) and place it in an ash cup.
  - Heat the sample at 585°C in an ash oven until its weight is stable (usually overnight).
  - Cool the residue to room temperature and then weigh it.

- **Results**
  - Determine the ash content by high temperature incineration in an electric muffle furnace.
  - When a sample is incinerated in an ash oven, the high temperature drives out the moisture and burns away all the organic materials (starch, protein, and oil), leaving only the ash.
  - The residue (ash) is composed of the non-combustible, inorganic minerals that are concentrated in the bran layer. Ash content results for wheat or flour ash are expressed as a percentage of the initial sample weight; for example, wheat ash of 1.58% or flour ash of 0.52%.
  - Wheat or flour ash is usually expressed on a common moisture basis of 14%.

Quick methods to assess particle size:[54]

- **Method 1: Sensing with fingers and mouth**
  - The size of the biggest particles can be detected by taking a bit of flour between the thumb and index finger or on the hand. Put some flour in the mouth and

[53] Wheat Marketing Center, Inc. (2004). *Wheat and flour testing method: A guide to understanding wheat and flour quality*. Nebraska Wheat. https://nebraskawheat.com/wp-content/uploads/2014/01/WheatFlourTestingMethods.pdf

[54] Duville, K. E. (2012). *Sorghum flour production manual for Compatible Technology International (CTI) burr grinders*. Digital Commons - University of Nebraska Lincoln. https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1008&context=intsormilpubs

sensing between tongue and mouth ceiling. Ideally it "dissolves" without leaving sandy particles.

- **Method 2: Mixing with water**
  - Mix a teaspoon of flour with two teaspoons of water in a plate or similar shallow deposit. The big and dark particles become more visible as the fine particles are washed away.

- **Method 3: Washing flour in fine mesh pouches**
  - Put a teaspoon of flour into a small pouch made of a fine fabric. Keep the pouch closed and wash it in a deposit with a few litres of water or under the faucet. The fine particles are washed away by the water and the coarse particles can be observed. The pouches can be dried to keep the sample for weighing or comparing with standards.

Methods to compare flour colour:[55]

- **Method 1: Colour samples**
  - In order to compare colours, keep a set of samples so that a new lot can be compared to previous ones or samples with the expected whiteness.

Guided Practice Activity

Topic 3.4 Task 3:

1. With your class, visit the laboratory which contains an ash oven and moisture dish.

2. Your trainer will provide your small group with 2 kg of wheat flour.

3. With your group, perform the following tasks:

a. Identify the tools you will use to measure the flour.

b. Identify the tools you will use to measure ash content.

c. Test for moisture content.

d. Test for ash content.

[55] Duville, K. E. (2012). *Sorghum flour production manual for Compatible Technology International (CTI) burr grinders*. Digital Commons - University of Nebraska Lincoln. https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1008&context=intsormilpubs

e. Assess the particle size of flour.

Note: For any tasks you are unable to perform, discuss and write a description of how you would perform these tasks instead.

4. After all groups have finished, share your group's experience and lessons with the rest of the class.

5. Display your group's work in front of the class. Compare and discuss each group's different findings.

Application Activity

Topic 3.4 Task 4:

1. Visit a wheat milling facility in your community. The trainer will make an appointment with flour processor to assist him or her while testing final products.

2. After assisting, discuss best practices and elaborate protocols for quality assurance.

3. With your group, write a report regarding:
- **a.** The tools used to measure contents.
- **b.** The tools used to measure ash content.
- **c.** How they tested for moisture content.
- **d.** How they tested for ash content.
- **e.** How they assessed the particle size of the flour.

4. Share your group's findings with the rest of the class and discuss as a large group.

Points to Remember

- Moisture content results are expressed as a percentage. Wheat or flour ash is usually expressed on a common moisture basis of 14%.

Quick methods to assess the particle size are:
- Method 1: Sensing with fingers and mouth
- Method 2: Mixing with water
- Method 3: Washing flour in fine mesh pouches

Formative Assessment

Read and complete the following sentences by filling in the missing words for the various quality assurance methods.

For a basic test for moisture content:

1. Weigh and place a sample of flour or ground wheat (……..) in an ash cup.

2. Heat the sample at …… in an ash oven for one hour.

3. Cool the residue to ……. and then weigh it.

Determine whether each statement is true or false regarding a basic test for ash content:

4. Weigh a sample of flour or ground wheat (3–5 grams) and placed it in an ash cup.
   a. True
   b. False

5. Heat the sample at 200°C in an ash oven until its weight is stable (usually overnight).
   a. True
   b. False

6. Cool the residue to room temperature and then weigh it.
   a. True
   b. False

7. Describe one of the methods that can be used to assess the particle size.

Self-Reflection

1. You have come to the end of the unit. You are going to do the self-assessment you did at the beginning of the unit.

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

My experience Knowledge, skills, and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
State compound of cassava root					
Assess quality of maize grains					
Recognize poor quality of maize grains					
Determine maize grades					
Explain parameters to classify maize grains					
Classify maize grains					
Maintain quality standards					
Improve the flow of flour					
Regulate the flow of material					
Check load of motor					
Charge motor to its full capacity					
Improve particle size and colour of flour					
Clean the milling machine, swiping or blowing residues out of the milling machine.					
Regulate flow of product to the helix and to the grinding burrs					
Maintain quality standards					
Explain grain conditioning process					
Adjust moisture content					
comply with grain processing quality standards					
Identify moisture content rate					
Carry out tempering process					

My experience Knowledge, skills, and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Promote best practices of grain processing					
List tempering steps					
Perform milling					
Safeguard maize grain					
Determining moisture content					
Carry out basic test for Moisture Content					
Preserve wheat flour quality					
Identify acceptable percentage of moisture content					
Carry out basic tests for Ash Content					
Adhere to quality standards					
Determine overall mineral content of the wheat					
Assess the particle size of flour					
Maintain positive perception of clients towards organization					

2. Complete the table below by identifying areas from the unit where you have improved and those that you need improvement with the actions/strategies you will use to help you improve regarding receiving and interpreting information at workplace.

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

Unit 4: Packaging processed flour

Topics

4.1 Selection of appropriate packages

4.2 Packaging products

4.3 Labelling products

Unit Summary:

This unit describes the skills, knowledge, and attitudes required to package processed flour. At the end of this unit, learners will be able to select appropriate packages, package products and label product under close supervision.

Self-Assessment: Unit 4

1. Look at the Unit 4 illustration above. What do you observe? What do you think this unit will be about?

2. Fill in the self-assessment below.

There are no right or wrong ways to answer this self-assessment. It is for your own use during this course. Do you think you can do this? How well? Read the statements across the top. Put a check in column that best represents your situation. At the end of this unit, you will take this self-assessment again.

My experience Knowledge, skills, and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
State benefits of cleaning grinding facilities					
Recognize the consequences of dirt grinding room					
Prepare grinding room					
Clean grinding facilities					
Develop culture of cleaning workplace					
State the main cause of fault					
Control functionality of grinding facilities					
Check functionality of grinding facilities					
Follow instructions to maintain grinding facility					

My experience Knowledge, skills, and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Contribute to well-functioning of grinding facility					
Prevent milling machine facility blockage before it happens					
Classify types of maintenance					
Discuss daily and weekly maintenance					
Carry out daily maintenance of milling machine					
Perform weekly maintenance of milling machine					
Check fluid levels, filters, and safety appliances					

Topic 4.1: Selection of appropriate packages

Key Competencies:

Knowledge	Skills	Attitudes
1. Identify types of packages	**1.** Maintain flour quality	**1.** Detail-oriented
2. Select packages according to client preferences	**2.** Package flour product	**2.** Precise
3. Prevent flour mycotoxin contamination	**3.** Prevent products from reabsorbing moisture	**3.** Diligent

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

Topic 4.1 Task 1:

1. Observe the illustration above and discuss the following questions with a partner:

a. What do you see?

b. How are products in the illustration handled or packed?

c. How is the sugar you buy from a shop packaged?

d. Do you care if you buy something and they give it you without covering? Why? Why not?

2. After discussing with your partner, share and compare your ideas with the rest of the class.

3. Turn to the Key Competencies table and review it together.

Problem Solving Activity

Topic 4.1 Task 2:

1. Read the following scenario and answer questions that follow

Kafaro is one of the Rwandese's favourite wholesalers of flour, recognized for offering choice, value, and convenience in terms of packaging. There are different packages from 0.5 kg up to 50 kg. Over 100,000 retailers are supplied by the company. They sell a wide range of flours such as maize flour, cassava flour, and wheat flour. They are commonly known to distribute their products all over the country.

On the other hand, there is another company named Fufuso Company, which produces the same varieties of flour as Kafaro. They have preferred to focus on 25 kg and 50 kg packaging.

Both companies were found by Tchat organization. They were launched at the time but had different managing. Eventually, Tchat decided to close Fufuso Company claiming that the company faced bankruptcy and decided to strengthen Kafaro for flourishing more.

2. Discuss and note the answers to the following questions with your group:

a. What do you understand by packaging?

b. Mention some types of packaging you know.

c. What criteria or factors do you consider when selecting packaging material?

3. After discussing, share your group's responses with the rest of the class and compare your answers. Then, review **4.1 Key Facts** together.

4.1 Key Facts

Types of packages

- **Suitable packages for premixes are:**
  - Multiwall paper bags for any sizes from 1kg to 40 kg.
  - Woven polypropylene bags for any sizes from 20 kg to 50 kg.
  - Small Polyethylene bags for premix sachets.
  - Corrugated cardboard boxes for sachets and 1 kg paper bags.

- **Why packaging?**[56]
  - Flour is hygroscopic. Moisture absorbed from the atmosphere leads to mould growth and spoilage.
  - Growth of mycotoxigenic fungi such as Aspergillus flavus may increase the risk of mycotoxin contamination of mouldy flour products.

- **Specifications of packages:**[57]
  - Proper packaging and appropriate storage conditions preserves quality characteristics and shelf life of flour.
  - Packaging materials and storage conditions to be used for flour products must prevent the products from reabsorbing moisture and should avoid infestation by pest insects.
  - Polythene bags, paper, or polypropylene bags lined with polythene are suitable for packaging of flour products.

- **Selection of packages based on requirements:**[58]
  - Pack desired quantities of flour in polythene bags and/or sacks, seal or stitch as appropriate. This avoids absorption of moisture of the flour from the environment.
  - Flour should be packaged in clean, insect- and moisture- proof materials that guarantee the wholesomeness of the product and the retention of its nutritional, physical, and sensory qualities.
  - The packaging should not impart any toxic substance or undesirable odour/flavour to the product.

[56] Food and Agriculture Organization of the United Nations. (n.d.). *Chapter 16: Grain crop drying, handling and storage*. https://www.fao.org/3/i2433e/i2433e10.pdf

[57] Butt, M. S., Nasir, M., Akhtar, S., Sharif, K., & Institute of Food Science & Technology, University of Agriculture, Faisalabad. (n.d.). *Effect of moisture and packaging on the shelf life of wheat flour*. Internet Journal of Food Safety. https://www.foodhaccp.com/internetjournal/ijfsv41.pdf

[58] CORAF/WECARD. (2011, May). *Training manual: Processing of cassava into gari and high quality cassava flour in West Africa*. https://www.coraf.org/pmb/opac_css/doc_num.php?explnum_id=71

- This product could be packaged in polypropylene sacs lined with thin polythene material for bulk sales, or in smaller bags (paper, polythene/polypropylene) as unit packages for retail market.
- The unit packages could be arranged into secondary packages of cardboard boxes.

Guided Practice Activity

Topic 4.1 Task 3:

1. Split into four groups.

2. Observe the flour given to you by the trainer.

3. Complete the following tasks with your group:
   a. Identify types of packages based on their product.

   b. Select appropriate packages.

4. After all the groups have finished, share the experience you and your group has gained from the session.

5. Post your work in front of the class. Engage in a discussion by agreeing and disagreeing with each other's findings.

Application Activity

Topic 4.1 Task 4:

1. Visit neighbourhood retailers' shops selling different products of flour with your group.

2. Discuss with shop owners with respect to the different packages in terms of size and specifications. Ask what gives them a competitive advantage regarding customers' preferences.

3. After, write a report with your group regarding:
   a. The types of packaging the shop owners use.

   b. What the criteria and factors shop owners consider when selecting packaging material.

4. After the visit, share your findings with the rest of the class.

Points to Remember

- Flour is hygroscopic.
- Moisture absorbed from the atmosphere leads to mould growth and spoilage.
- Polythene bags, paper, or polypropylene bags lined with polythene are suitable for packaging of flour products.

Suitable packages for premixes are:

- Multiwall paper bags for any sizes from 1kg to 40 kg.
- Woven polypropylene bags for any sizes from 20 kg to 50 kg.
- Small Polyethylene bags for premix sachets.
- Corrugated cardboard boxes for sachets and 1 kg paper bags.

Formative Assessment

Read the following statements and determine if each one is true or false.

1. Pack desired quantities of flour in polythene bags and/or sacks, seal or stitch as appropriate. This avoids absorption of moisture of the flour from the environment.
   a. True
   b. False

2. Flour should be packaged in clean, insect- and moisture- proof materials that guarantee the wholesomeness of the product and the retention of its nutritional, physical and sensory qualities.
   a. True
   b. False

3. Packaging should add toxic substances or unusual odours/flavours to the product.
   a. True
   b. False

4. Proper packaging and appropriate storage conditions preserves quality characteristics and shelf life of flour.

a. True

b. False

5. Packaging materials and storage conditions to be used for flour products must prevent the products from reabsorbing moisture and should avoid infestation by pest insects.

a. True

b. False

6. Polythene bags, paper, or polypropylene bags lined with polythene are not suitable for packaging of flour products.

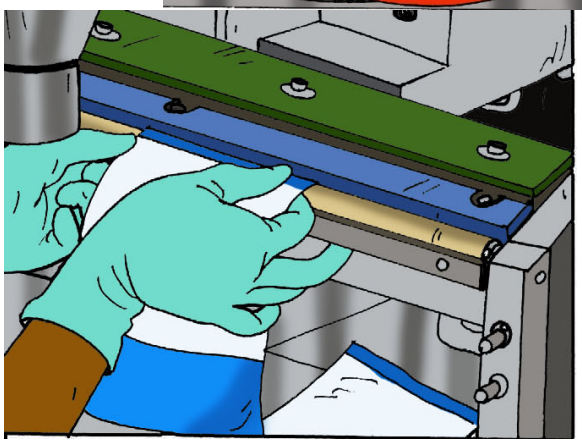
a. True

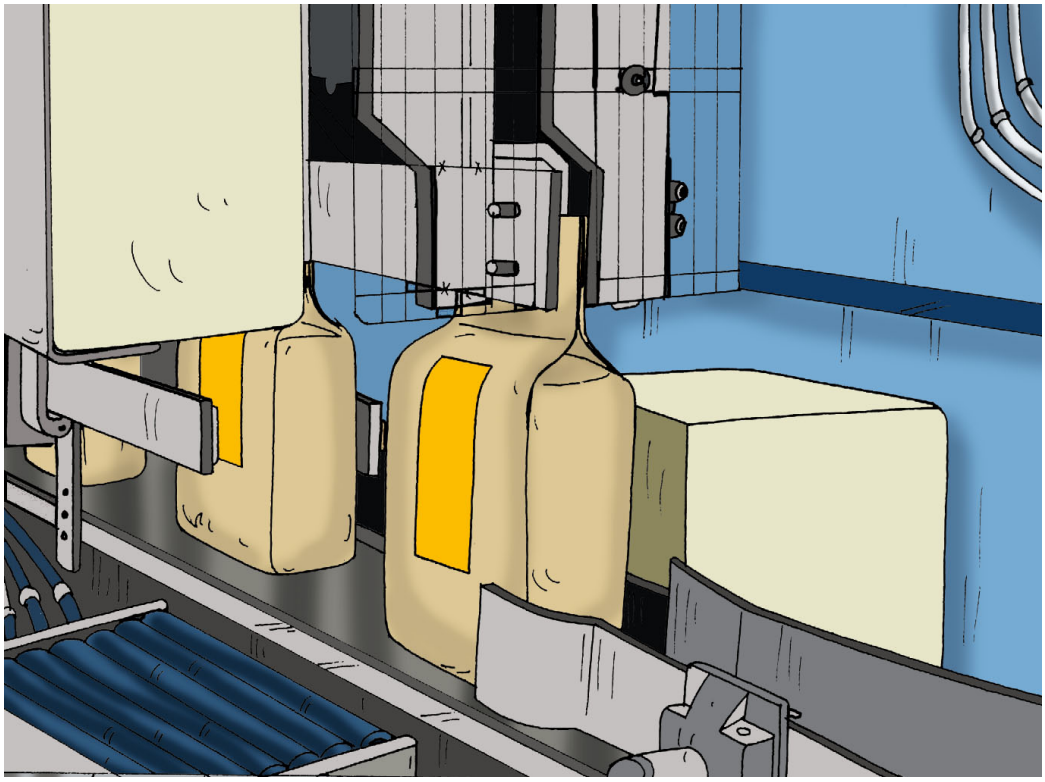
b. False

Topic 4.2: Packaging products

Key Competencies

Knowledge	Skills	Attitudes
1. Define packaging	**1.** Fill flour products into packages	**1.** Safety-oriented
2. Explain main purpose of packaging	**2.** Seal flour containers	**2.** Self-motivated
3. Describe packaging process	**3.** Accurately measure quantities required for individual packages	**3.** Detail-oriented





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

Topic 4.2 Task 1:

1. Form small groups.

2. Discuss the following questions with your group:
   a. In your opinion, why are flour products packaged?
   b. What is the importance of sealing flour products?

3. Then, look at the illustrations: What does each image portray and what seems to be the difference between them?

4. Volunteer to share your group's ideas with the rest of the class.

5. Refer to the Key Competencies table and review it together.

Problem Solving Activity

Topic 4.2 Task 2:

1. Read the following scenario with your group:

Karanga bought 2 bags of 25 kg each of cassava flour from YuA shop. He intended to share part with his 10 closest friends and family for Christian. He planned to distribute 5 kg to each family. Surprisingly, while he was dividing, he found out that 1 bag weighed only 23 kg. He brought the bag back to YuA shop to be replaced. The shop replaced the bag and immediately conducted a quick audit to check whether there were no other bags presenting the same problem. The findings revealed that out of 54 bags, 6 were not accurately measured. The shop management immediately contacted a lawyer to bring Kalu Milling Ltd—the main supplier of the shop—to court for attempting to cause bankruptcy to the shop through loss of trust from clients. With the court process, Kalu Milling Ltd was found guilty and fined 100 million Rwandan francs.

2. With your group, discuss and note your responses to the following questions:

a. What do you think caused the problem in the scenario?

b. How did Karanga know that one bag weighed less?

c. How did he know the amount of flour he bought initially?

3. Share and compare your group's responses with the rest of the class. Then, review **4.2 Key Facts** together.

4.2 Key Facts

Packaging: The art and technology of enclosing or protecting products for distribution, storage, sale, and use.

- **Main purposes of packaging:**[59]
  - **Physical protection**
    - The objects enclosed in the package may require protection from, among other things, mechanical shock, vibration, electrostatic discharge, compression, and temperature.

[59] *Packaging and labeling*. (n.d.). Marketing Management. https://mktngmanagement.blogspot.com/2012/06/packaging-and-labeling.html

- **Barrier protection**
  - A barrier from oxygen, water vapour, and/or dust is often required. Keeping the contents clean, fresh, sterile, and safe for the intended shelf life is a primary function.

- **Security**
  - Packaging can play an important role in reducing the security risks of shipment. Packages may include authentication seals and use security printing to help indicate that the package and contents are not counterfeit.

- **Convenience**
  - Packages can have features that add convenience in distribution, handling, stacking, display, sale, opening, reclosing, use, dispensing, and reuse.

- **Filling system:**[60]
  - Machine measures out the correct quantity of product required for each individual bag/closure.
  - The machine releases the product once a signal has been received from the bagging machine in the case of a fully automatic system, or on command from the operator, in a semi-automatic system whereas in manual system operator fill into package on scale for accuracy purpose.

- **Sealing:**
  - Machines make the closure/bag from a roll of plastic film by filling the bag with the required product and seal it into a completed bag.

Guided Practice Activity

Topic 4.2 Task 3:

1. With your group, consider the following:

Imagine you are a production manager in flour processing facility. One of your responsibilities is ensuring quality through packaging.

2. Discuss and write responses for the following.
   a. Describe the procedure for filling flour product into packages.
   b. Describe the procedure for sealing flour containers.
   c. Describe the procedure for accurately measuring the quantity required for individual package.

[60] Manalili, N. M., Dorado, M. A., & Van Otterdijk, R. (2014). *Appropriate food packaging solutions for developing countries*. Food and Agriculture Organization of the United Nations. https://www.fao.org/3/a-mb061e.pdf

3. After discussing, share and compare your group's ideas with the rest of the class.

Application Activity

Topic 4.2 Task 4:

1. Form small groups. Visit a flour milling facility located in your community. Your trainer will make an appointment with the operators.

2. Assist the operator during the packaging process.

3. At the end of the process, discuss best practices and shortcomings with the operator.

4. Write a report with your group regarding:
   a. The procedure for filling flour product into packages.

   b. The procedure for sealing flour containers.

   c. The procedure for accurately measuring the quantity required for individual package.

5. After the visit, share your findings. Discuss as a group.

Points to Remember

- In a manual system, the operator fills packages on scale in order to ensure accuracy.
- Use a machine that measures the correct quantity of product required for each individual bag/closure.

Formative Assessment

Read and write answers to the questions below using complete sentences.

1. What are two of the main purposes of packaging?

2. Discuss the pros and cons of packaging.

3. While filling packages manually, what should you pay close attention to?

Topic 4.3: Labelling products

Key Competencies:

Knowledge	Skills	Attitudes
1. List items necessary for flour labelling	**1.** Label flour product	**1.** Detail-oriented
2. Explain flour labelling process and terminologies	**2.** Provide consumers with the information they need and desire to make food choices	**2.** Methodical
3. Define flour labelling	**3.** Select necessary information for labelling	**3.** Diligent

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

Topic 4.3 Task 1:

1. Form small groups and nominate a group representative.

2. With your group, study the illustration above and answer questions that follow:
   a. What do you observe?

   b. What does the writing represent?

   c. What is the purpose of the writing?

   d. Why is it important to have the writing?

3. Your representative will present your group's findings. Listen carefully to other groups' representatives and their ideas.

4. Refer to the Key Competencies table and review it together.

Problem Solving Activity

Topic 4.3 Task 2:

1. Read the following scenario with your group:

   Cako is a company that produces flour and is the leader of distribution in its region. Recently, the company has developed an idea to expand its market share by exporting its product to Europe. In order to comply with exporting law, the company requested an export permit. Their request was rejected because the company's product does not display full information on its packaging to help consumers.

2. Discuss and note answers to the following with your group:
   a. List possible information that should have been put on package.

   b. Why is it important for Cako to have such information on the package?

3. Share and compare your ideas with the rest of the class. Then, read and review **4.3 Key Facts** together.

4.3 Key Facts

Information on the package:[61]

- **The name of the food:** The name shall indicate the true nature of the food and normally be specific and not generic
- **List of ingredients:** Except for single ingredient foods, a list of ingredients shall be declared on the label in descending order of weight
- **Net contents and drained weight:** The net contents shall be declared in the metric system
- **Name and address:** The name and address of the manufacturer, packer, distributor, importer, exporter or vendor of the food shall be declared.
- **Country of origin:** The country of origin of the food shall be declared if its omission would mislead or deceive the consumer.
- **Lot identification:** Each container shall be embossed or otherwise permanently marked in code or in clear to identify the producing factory and the lot.
- **Date marking and storage instructions.**
- **Instructions for use:** Instructions for use, including reconstitution, where applicable, shall be included on the label, as necessary, to ensure correct utilization of the food.

Guided Practice Activity

Topic 4.3 Task 3:

1. With a partner, read and consider the following scenario:

You have been asked to advise one of your community companies that produces different types of flour with respect to the labelling.

2. With your partner, create a sample label for the company.

[61] Food and Agriculture Organization of the United Nations. (1991). *Codex general standard for the labelling of prepackaged foods*. https://www.fao.org/3/Y2770E/y2770e02.htm

3. After the discussions, present your sample to the class, explaining the importance of what you have included. Listen carefully while other groups present.

Application Activity

Topic 4.3 Task 4:

1. Form small groups. Visit a flour milling facility in your community.

2. At the facility, participate in the labelling process and participate actively throughout the process.

3. Upon completion, discuss the pros and cons of the labelling process with the operator(s).

4. Finally, write a report with your group regarding:
   a. The processing involved in labelling.

   b. The information included on a label.

5. After the visit, share your findings. Discuss as a large group.

Points to Remember

Information on package must include:

- The name of the food
- List of ingredients
- Net contents and drained weight
- Name and address
- Country of origin
- Lot identification
- Date marking and storage instructions
- Instructions for use

Formative Assessment

Read the following statements and determine whether they are either true or false.

1. The name shall indicate the true nature of the food and normally be specific and not generic.
   a. True
   b. False

2. Except for single ingredient foods, a list of ingredients shall be declared on the label in ascending order of weight.
   a. True
   b. False

3. The net contents shall be declared in the metric system.
   a. True
   b. False

4. The name and address of the manufacturer, packer, distributor, importer, exporter, or vendor of the food shall be declared.
   a. True
   b. False

5. The country of destination of the food shall be declared if its omission would mislead or deceive the consumer.
   a. True
   b. False

6. Each container shall be embossed or otherwise permanently marked in code or in clear to identify the producing factory and the lot.
   a. True
   b. False

7. Instructions for use, including reconstitution, where applicable, shall be included on the label, as necessary, to ensure maximum utilization of the food.
   a. True
   b. False

Self-Reflection

1. You have come to the end of the unit. You are going to do the self-assessment you did at the beginning of the unit.

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

My experience **Knowledge, skills, and attitudes**	**I don't have any experience doing this.**	**I know a little about this.**	**I have some experience doing this.**	**I have a lot of experience with this.**	**I am confident in my ability to do this.**
State benefits of cleaning grinding facilities					
Recognize the consequences of dirt grinding room					
Describe how to clean grinding facility					
Use relevant materials to clean milling machine					
Prepare grinding room					
Clean grinding facilities					
Develop culture of cleaning workplace					
Keep hygiene at workplace					
Help team mates to stay in free from hazard workplace					

My experience Knowledge, skills, and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Describe functionality of grinding facility					
Recognize fault					
State the main cause of fault					
Control functionality of grinding facilities					
Check functionality of grinding facilities					
Follow instructions to maintain grinding facility					
Contribute to well-functioning of grinding facility					
Attend blockage of grinding facility					
Prevent milling machine facility blockage before it happens					
Explain daily maintenance purpose					
Classify types of maintenance					
Discuss daily and weekly maintenance					
Carry out daily maintenance of milling machine					

My experience Knowledge, skills, and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Perform weekly maintenance of milling machine					
check fluid levels, filters and safety appliances					
Implement contingency plan					

2. Complete the table below by identifying areas from the unit where you have improved and those that you need improvement with the actions/strategies you will use to help you improve regarding receiving and interpreting information at workplace.

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

REFERENCES

Abass, A. (2006). *How to make high quality cassava flour (HQCF)*. International Institute of Tropical Agriculture (IITA). https://www.iita.org/wp-content/uploads/2016/06/How_to_make_high_quality_cassava_flour_HQCF.pdf

Abass, A., Towo, E., Mukuka, I., Okechukwu, R., Ranaivoson, R., Tarawali, G., & Kanju, E. (2014). *Growing cassava - A training manual from production to postharvest*. International Institute of Tropical Agriculture (IITA). https://hqcf.iita.org/wp-content/uploads/2016/04/1_cassava-training-manual.pdf

Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA). (2014). *Quality assurance for cassava flour processing: A training manual*. https://hqcf.iita.org/wp-content/uploads/2016/04/5_harmonized-standards-_cassava.pdf

Awulachew, M. T. (2020). *Understanding basics of wheat grain and flour quality*. Science Publishing Group. https://article.sciencepublishinggroup.com/pdf/10.11648.j.jher.20200601.12.pdf

Bockstaele, F. V. (2017, May 16). *Milling technology for cereals*. Ghent University. http://ffinetwork.org/about/calendar/2017/documents/Zambia_6.1_Milling_technology_for_cereals_Bockstaele.pdf

Bradbury, J. H., Cliff, J., & Banea, J. P. (2010). *Making cassava flour safe using the wetting method*. South Sudan Medical Journal. https://www.southsudanmedicaljournal.com/archive/february-2015/making-cassava-flour-safe-using-the-wetting-method.html

Butt, M. S., Nasir, M., Akhtar, S., Sharif, K., & Institute of Food Science & Technology, University of Agriculture, Faisalabad. (n.d.). *Effect of moisture and packaging on the shelf life of*

wheat flour. Internet Journal of Food Safety. https://www.foodhaccp.com/internetjournal/ijfsv41.pdf

Clarke, B., & Rottger, A. (2006). *Small mills in Africa: Selection, installation and operation of equipment*. Food and Agriculture Organization of the United Nations. https://www.fao.org/3/j8482e/j8482e.pdf

CORAF/WECARD. (2011, May). *Training manual: Processing of cassava into gari and high quality cassava flour in West Africa*. https://www.coraf.org/pmb/opac_css/doc_num.php?explnum_id=71

Duville, K. E. (2012). *Sorghum flour production manual for Compatible Technology International (CTI) burr grinders*. Digital Commons - University of Nebraska Lincoln. https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1008&context=intsormilpubs

Dziedzoave, N. T., Abass, A. B., Amoa-Awua, W. K., & Sablah, M. (n.d.). *Quality management manual for production of high quality cassava flour*. International Institute of Tropical Agriculture (IITA).

East African Community. (2011). *Maize grains — Specification and grading*. East African Standard. https://law.resource.org/pub/eac/ibr/eas.2.2011.html

Food and Agriculture Organization of the United Nations. (1991). *Codex general standard for the labelling of prepackaged foods*. https://www.fao.org/3/Y2770E/y2770e02.htm

Food and Agriculture Organization of the United Nations. (2006). *Typical construction of hammer mill* [Drawing]. http://www.fao.org/3/j8482e/j8482e.pdf

Food and Agriculture Organization of the United Nations. (2006). *Typical construction of plate mill* [Drawing]. http://www.fao.org/3/j8482e/j8482e.pdf

Food and Agriculture Organization of the United Nations. (2009). *Processing techniques to reduce toxicity and antinutrients of cassava for use as a staple food*. AGRIS:

International Information System for the Agricultural Science and Technology. https://agris.fao.org/agris-search/search.do?recordID=GB2012104615

Food and Agriculture Organization of the United Nations. (2009). *Agribusiness handbook: Wheat flour*. https://www.fao.org/3/al376e/al376e.pdf

Food and Agriculture Organization of the United Nations. (n.d.). *Chapter 16: Grain crop drying, handling and storage*. https://www.fao.org/3/i2433e/i2433e10.pdf

Food and Agriculture Organization of the United Nations. (n.d.). *Chapter 5 - Processing of roots and tubers*. https://www.fao.org/3/x5415e/x5415e05.htm

Fuse box. (n.d.). Wikimedia. https://upload.wikimedia.org/wikipedia/commons/2/28/Pae_64_-_fuse_box.JPG

Liu, K. (2009). *Some factors affecting sieving performance and efficiency*. Powder Technology. https://naldc.nal.usda.gov/download/55382/PDF

Manalili, N. M., Dorado, M. A., & Van Otterdijk, R. (2014). *Appropriate food packaging solutions for developing countries*. Food and Agriculture Organization of the United Nations. https://www.fao.org/3/a-mb061e.pdf

Mill feeder [Drawing]. (n.d.). https://html1-f.scribdassets.com/21mdqnq81s5mxyqp/images/4-18bfb9ab29.jpg

Musuga, M. (2019). *Maize grain quality standards*. Uganda National Bureau of Standards (UNBS). https://blog.unbs.go.ug/?p=10753

Packaging and labeling. (n.d.). Marketing Management. https://mktngmanagement.blogspot.com/2012/06/packaging-and-labeling.html

Patil, K. (2015, April 9). *Milling and milling equipments*. LinkedIn SlideShare. https://www.slideshare.net/ketaki8938/milling-and-milling-equipments

University of Nebraska - Lincoln. (2012). *Helix* [Photograph]. DigitalCommons@UNL. https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1008&context=intsormilpubs

University of Nebraska - Lincoln. (2012). *Hopper* [Photograph]. DigitalCommons@UNL. https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1008&context=intsormilpubs

University of Nebraska - Lincoln. (2012). *Third pass* [Photograph]. DigitalCommons@UNL. https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1008&context=intsormilpubs

US National Library of Medicine, National Institutes of Health. (2017, September 1). *Cassava, konzo, and neurotoxicity*. Lancet Glob Health. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6995356/

Wheat Marketing Center, Inc. (2004). *Wheat and flour testing method: A guide to understanding wheat and flour quality*. Nebraska Wheat. https://nebraskawheat.com/wp-content/uploads/2014/01/WheatFlourTestingMethods.pdf

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