MODULE 10

FOOD STORAGE AND HANDLING
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Objectives of the module
By the end of the module, participants should be able to:

(a) Describe the extent of post harvest food losses in the SADC region

(b) Describe the different types of food storage containers available

(c) Describe the causes and mechanism of food storage losses

(d) List the benefits of good food storage

(e) Explain the pest control measures necessary to reduce food losses during storage

(f) Identify for different food products, the appropriate type of packaging needed
FOOD STORAGE AND HANDLING

10.1 DEFINITION OF STORAGE.

Food storage and handling entail some amount or supply of food held or kept somewhere for use as needed currently or for the future.

Places for storage can be houses or containers of one kind or another. The atmosphere can be hot or cold depending on the type of food. It can also be in a household where supplies are kept, or a shop or warehouse where food items are sold.

Food handling operations occur along the food chain from harvesting to cleaning, processing, preservation, packaging, storage, transportation, marketing up to preparation and presentation for consumption.

Hygienic considerations are very important as we shall see later.

10.2 POST HARVEST FOOD LOSSES IN THE SOUTHERN AFRICAN DEVELOPMENT COMMUNITY REGION.

The SADC region is largely tropical, subtropical and temperate in climate. The major foods produced form the staple food items namely, cereals such as maize, sorghum, millets, rice and wheat. Pulses include beans, and peas. Common oil crops are groundnuts, sesame, bambara
nuts, coconut and cashew nuts. Generally these store well if treated and handled properly especially when stored as seeds for planting. The other group of food materials are perishable and need special treatment and handling. These are roots and tubers such as cassava, potatoes and yam. Animal products such as meat, fish, eggs and milk are highly perishable. Fruits and vegetables, abundant in the region, are also perishable.

Food storage losses in the region are therefore high in cereals, estimated at about 25% at household level, while they are higher in the perishable group of foods especially meat products. This worsens food insecurity at all levels. The next section deals with storage containers which partly contribute to the high food losses experienced where they are not properly used.

### QUESTIONS FOR DISCUSSION

- What is food storage?
- How is food generally stored?
- What is the food chain?
- Name six easily spoiled foods.
- Name five food crops that are not easily perishable.

### 10.3. FOOD STORAGE CONTAINERS
This section covers commonly used containers which vary from one country to another.

**10.3.1 Earthware pots and gourds**
In the region clay pots and gourds which are cheap, are usually used for storing small quantities of food materials such as grains, legumes, oil seeds, dried vegetables and fruit, herbs and seeds or milk. They must be sheltered, preferably indoors and off the ground to avoid moisture absorption from below. The containers perform better if sealed tight and smeared with smooth clay or oil. The contents should be regularly inspected to check for mould growth and infestation. If dried contents become moist, they may be removed and re-dried.

**10.3.2 Leaf containers.**
The containers are usually made from stems and leaves of selected plants like bananas and plantains or wide palm leaves. Some are woven together or bound with plant material, or strings available in the locality usually directed by local artisans. The containers are commonly used for dried vegetables and are hung in the house.

**10.3.3 Tree bark containers.**
Suitable tree barks are sewn into cylinders or boxes of various sizes and dried thoroughly ready for the storage of cereals, such as maize grain, sorghum, millet and rice, pulses and oil seeds. They are reasonably rat proof but not against small insect pests.

**10.3.4 Baskets**
These are usually made from palm leaves, grasses, reeds, bamboo or sliced tree barks. Food storage in baskets is very common in the region
especially for cereals, pulses, oilseeds; roots and tubers. The baskets are open for ventilation and should be stored under shelter and off the ground. Prevention against insect pests can be improved by covering the baskets with plaster, mud or clay on both the inside and outside. Lining the inside of the basket with a food grade plastic sheet can also help.

Large baskets, which are usually cylindrical can be used as small silos and are used for big capacity storage in warehouses or institutional storage.

**10.3.5 Bags**

Jute, sisal or cotton and plastic bags are suitable for use in our tropical climate, for storing cereals, pulses, roots, tubers and dried fruit and vegetables. However they are not very effective against insects, rodents, moisture and cross contaminants. They are easily damaged while handling or in transit operations.

Plastic bags are widely used for storage in the region for well dried cereals, legumes, and nuts as they are air tight. They are transparent and allow visual inspection.

For good hygiene and food safety, bags should be stored off the ground, under shelter, under dry conditions to avoid absorbing moisture. They are best placed on plastic sheets, waterproof canvas or on wooden pallets. Good air circulation should be allowed all around the bags. Bags should not be stacked against walls. Spaces should be left between the bags to allow free air movement and paths left between stacks to allow inspection, cleaning and insect and rodent control.

**10.3.6 Small Store Houses**
Small store houses constructed from sticks, reeds or bamboo and roofed with grass thatch, are airy and suitable for cereals and legumes. For good hygiene and pest proofing, clean the store thoroughly before filling with fresh grain, and fit rat guards or baffles.

**10.3.7 Cribs**

Traditional cribs are suitable for the storage of maize cobs. The container facilitates drying during storage due to natural air circulation.

**10.3.8 Drums.**

Small barrels, drums and tanks are often used for storing crops after thorough cleaning. They are suitable for cereals, legumes and oil seeds. They should be placed in the shade and insulated with suitable material to maintain stable temperature. A tightly closed drum provides a good medium to prevent the entry of insects and other pests. Grain should be well dried before storage.
CAUSES AND MECHANISMS OF FOOD STORAGE LOSSES.

Losses occur in dry and perishable food stuffs and are mainly due to the following factors:

- **Biological damage**
  By insects, rodents and micro-organisms. This is worsened by mixing old and new food materials, dirt and filth during harvesting, transportation, processing, preparation and storage of under-dried cereals and legumes.

- **Chemical damage**
  Through rancidity development and flavour changes, etc.

- **Physical damage**
  Through crushing, breaking and mishandling

QUESTIONS FOR DISCUSSION.

- Name six common storage containers used in your area.
- What food crops are stored in pots and gourds?
- What is best stored in leaf containers?
- What food crops store well in tree bark containers, baskets, and bags?
- Why are plastic bags good for inspection of stored food crops?
- What food materials are best stored in drums and barrels?
Good storage practices require proper methods and containers and the good control of the following factors:

- temperature and heat
- moisture
- light
- pests
- hygiene

**NOTE:**

*Heat and Moisture are the most important factors that affect food during handling and storage. Moisture is stressed in this part of the lesson.*

All micro-organisms, including moulds, require high moisture levels and warm conditions to grow. Some moulds produce toxic substances such as aflatoxins in maize, nuts, groundnuts, and cereals. Moisture should therefore be kept low and prevented from entering the store and the product.

Condensation of moisture can cause storage problems. If the walls of a store are cooled by low night temperatures, condensation can occur and increase the moisture in the layers of products near the edge of the store.

Moisture can also result in physical changes. Products such as sugar, salt and milk powder will absorb moisture from the atmosphere and “cake”. Absorption of moisture by dried fruits may lead to sugar crystallization.
QUESTIONS FOR DISCUSSION.

Name three ways food storage losses occur.
What is biological food damage?
What is chemical food damage?
Explain physical food damage.
10.5 BENEFITS OF GOOD FOOD STORAGE

Considerable losses can occur in the field, both before and during harvest, the greatest losses usually occur during storage.

The objective of good storage is to create the appropriate environmental conditions that will prevent **qualitative and quantitative losses** and eventually economic losses. Figure 9 summarises some of these losses.

**Figure 9 : Type of losses**

**ECONOMIC LOSSES**

**QUESTIONS FOR DISCUSSION.**

- Why is food storage important.
- What is quantitative food loss?
- What is qualitative food loss?
10.6 PEST CONTROL DURING STORAGE
The common pests in the food industry and major methods of pest control have been described in the Module “Sanitation, Waste disposal and Pest control”. In this section, specific measures during storage will be highlighted.

### 10.6.1 Control of Pests in Stores

A wide range of measures is available to control pests during storage.

**Controlling infestation**

Infestation can be controlled by

- Ensuring that the raw material is not infested
- Good store management
- Maintaining hygienic conditions in the store

**Denying access to stores**

All holes and entrances to the store should be fitted with fine wire mesh. The building should, if possible, be on poles, with rat baffles around them. If the building is situated under a tree, rats can readily gain access on to the roof. The ground around the store should be cleared and sources of water denied to rodents. They can easily gnaw through wooden doors so sheet tin should be fixed to the bottom 30cms of the door.

**Use of chemicals**
Many natural products are used in traditional storage systems, but nowadays they are being replaced by commercial pesticides and poisons. Great care should be taken over the selection and use of such chemicals and advice should be sought from experts in the field.

Rodent poisons should be placed in containers and never allowed to come into contact with the food. They should be changed regularly to avoid the pests developing resistance. It should be remembered that rodents, after eating some types of poison, will often hide away and die. Others make the animals very thirsty and so they leave the store in search of water and may contaminate open food stuffs. In view of the dangers associated with rodent poisons, if their use is not properly controlled, consideration should be given to simpler traditional measures such as the use of cats.

The use of chemicals or traditional methods, while important, is no replacement for good store management and regular inspection. General cleanliness and care in handling containers is essential and any damage that results must be rectified immediately.

**QUESTIONS FOR DISCUSSION.**

What animals are most common in stores?

How do you control rodents?

What does insect control entail?
10.6.2 **Requirements for hygiene during storage**

High standards of hygiene from “farm to table” should be observed to

- Ensure that the food consumed is safe
- Minimise food spoilage

Good hygiene implies

- Strict hygienic and sanitary practices at **all** times.
- Good personal hygiene
- Clean utensils, equipment and ingredients used.
- Regular cleaning and disinfection of premises and equipment
- Pest control
- Proper layout of premise to avoid contamination
- Correct storage procedures and methods should be observed.
- Rotate stored stock properly and timely (eg. FIFO-First In First Out)

What is the role of clean water in food hygiene?

Why is smoking and eating while handling stored food bad?

Similarly why are good sanitation, personal hygiene and good health important for people handling and storing food?
10.7 FOOD HANDLING AND DAMAGE

Different food materials require a variety of handling methods to avoid damage. This depends to a large extent on the type and composition of the food products.

**Cereals** such as maize, millet sorghum and rice; and legumes such as beans, peas and grams are hardy and when *properly dried* (low moisture foods) can be stored for up to a year under adequate conditions.

**Oil seeds and nuts** such as soya beans, sunflower, sim sim, groundnuts, cashew nuts and coconuts, *contain oil* and when damaged by mishandling, turn rancid and off flavour. This is worsened by high temperatures, which promote fungal growth which causes the production of poisonous substances.

**Root and tuber crops** are *high in moisture* content. So rott ing and drying out must be prevented. Damage by bruising or cutting during harvesting or storage must be avoided. Proper drying is essential to avoid rotting. When used fresh, they dry out and lose weight if not properly kept.
**Animal products** are highly perishable. During handling and storage, animal products such as meat and milk *have ideal conditions for the growth of micro organisms* including bacteria which cause diseases. Fish spoils easily because of bacteria which occurs on and in the fish. They need to be chilled or frozen. Otherwise they should be kept adequately processed, and packaged before storage.

Fruit and vegetables *have high moisture content*. They are easily bruised, if mishandled and are *perishable*. They should be eaten fresh quickly or processed rapidly. Fresh produce stores better if cooled but they wilt in dry air. They have different storage characteristics. For example, tomatoes, onions, oranges and carrots keep longer and are easy to handle.

**QUESTIONS FOR DISCUSSION.**

What food stuffs are easy to handle and store?

Why are oil seeds hard to store in hot conditions?

Why do root crops spoil easily?

Do animal products spoil fast? If yes. Why?

Why do fruits and vegetables bruise easily?
10.8 PROTECTIVE FOOD PACKAGING.

Foodstuffs can be packaged fresh or processed for storage. Spoilage occurs due to the factors that have already been dealt with. Dry foods which do not absorb much water from the air, such as grains, beans, tea, dry fish and spices do not spoil easily so simple packages such as baskets, bags, boxes and tins can be used for storage.

Other foods like salt, sugar and dried fruit absorb water from the air and may spoil. They need to be packaged in moisture proof containers such as ceramic or glass jars, tins or plastic films.

Foods which contain oil spoil from the oxygen in the air and require air exclusion preferably by packing in air-tight containers. Since oily foods go rancid by reacting with oxygen, suitable containers for oil are: sealed
glass or plastic bottles preferably made from colored glass or kept in the
dark away from light and heat, coated tins or ceramic pots.

Fruit and vegetable processed products like fruit pulp, juice, squash,
wine, preserves, jams and pickles, are best packaged in glass containers,
plastic bottles and jars, plastic films, cans and sealed pots. There is a
need to ensure that the containers are safe, clean and properly sealed.

Cereal products such as maize, wheat, rice, sorghum and millet flour
and processed derived products like bread, buns, cakes, chapati, noodle
etc. are variable and are best packaged according to their oil content
and other ingredients. Flour is packaged in jute sacks or plastic bags.

Pulses, pop corn, noodles, biscuits, chapati etc., are best packaged in
strong well sealed moisture proof plastic bags and kept in a dry cool
place. The same applies to pulse flour.

Processed dry root crop products like cassava flour, chips or pellets store
well in jute or plastic bags. Oil containing root or tuber crop based
products must be put in moisture proof and air tight plastic bags.

Oil seed products like roasted groundnuts, groundnut flour and derived
products, must be packaged in sealed, strong moisture proof plastic
bags and stored in a cool dry place.

Processed fish products like dried or smoked fish must be kept in sealed
polythene bags and stored in a cool dry place away from sun shine to
minimize spoilage.
Dairy products differ. Package cheese in suitable cloth or wrap in polyethene material and keep under low temperature conditions. Yogurt does not need special containers, just care against contamination and consume quickly due to the short shelf life of the product. Milk and derived products require special care as they are highly perishable. Suitable traditional, glass and plastic containers are suitable and must be stored for short periods under low temperature conditions like refrigerators where available. Sour milk can be kept in pots, gourds, wooden, ceramic or plastic containers, as long as, good hygiene is practised and maintained.

<table>
<thead>
<tr>
<th>FOOD ITEMS</th>
<th>PROTECTIVE PACKAGING</th>
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<tbody>
<tr>
<td>Oil, oil seeds, bread, bun, cakes, noodles, chapati, biscuits etc</td>
<td>Air tight containers</td>
</tr>
<tr>
<td>Cereals: maize, wheat, sorghum flour, millet</td>
<td>Moisture proof containers, jute bags, plastic bags</td>
</tr>
<tr>
<td>Dry foods like grains, beans, tea, spices, dry fish</td>
<td>Baskets, boxes, bags</td>
</tr>
<tr>
<td>Salt, sugar, dried fruits</td>
<td>Moisture proof containers</td>
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**QUESTIONS. FOR DISCUSSIONS**

Why can dry products be stored in simple containers?

Why should sugar and salt be stored in sealed containers?

How do we best store cooking oil?

Why do we store fruit and vegetable products in glass containers?

What is the best way to store, roasted groundnuts, fish, meat and milk?
FIELD VISITS

Trainees to visit

1. Typical household pantry and kitchen, Food stores, Village shops
   Warehouses, School food store, Hospital food store etc
   Street vendor environment and the village market to
   - observe different types of containers.
   - observe the same and discuss storage with villagers
   - observe the storage losses
   - observe moisture condensation in stores

2. Visit local pharmacies, cooperative stores and shops which stock
   and sell storage containers and pest control materials

REFERENCES


