MODULE 3: FOOD SAFETY, STORAGE & PRESERVATION

Introduction

Ensuring food safety and hygiene is important at individual, household and community level. It ensures that foods are safe for human consumption and that individuals do not develop any food-borne illnesses. This module equips participants with an understanding of key food safety and food hygiene issues and how these can be maintained within households and communities. The module explores different areas with regards to food safety including: food spoilage, food storage and food poisoning.

An assessment of the food handling, safety, storage and hygiene practices by workers in Rwenzori and Mpanga tea estates revealed that:

- Household ownership of food storage facilities varied with only 63% of households reportedly storing food
- Households that stored food made use of cupboards, containers, baskets, sacks and open floors to store food. Those that did not own food storage facilities mentioned the lack of storage space, consumption of all food prepared and the lack of money to buy food storage facilities as being limiting factors to food storage.
- Respondents identified the following food hygiene practices: proper covering of food (68% of respondents), cooking of food (22% of respondents), use of clean utensils in food preparation (5% of respondents), warming of leftover food before consumption (4% of respondents) and keeping cooked and raw foods separately (1% of the respondents)
- Main challenges in ensuring food safety included the lack of adequate food storage facilities and poor storage methods that result in the destruction of stored food by pests, including cockroaches and rats

Objectives of the module

By the end of this module, participants should be able to demonstrate good practices with respect to food safety and hygiene, including through food storage and preservation techniques. They will also learn how to prevent food poisoning.

Overview

1. The concept of food safety and hygiene
2. Food storage and preservation
3. Food poisoning

3.1. The concept of food safety and hygiene

Once food has been harvested, gathered or slaughtered, enzymes and bacteria become active in this food which cause it to deteriorate in texture and composition until it eventually becomes unfit for consumption. This deterioration is known as decay and leads to eventual food spoilage. **Food safety and hygiene entail undertaking a series of measures to avoid spoilage and contamination of food.**

At the core of maintaining food safety is the need for **proper food handling (incl cooking), storage and preservation** as these greatly influence how long a food can stay fit for consumption.

Food is considered safe for human consumption when it is free from substances like contaminants, toxins and micro-organisms that can cause undesirable reactions in the body when such foods are eaten. To ensure that food is safe for consumption, it should be:

- Protected from contamination by harmful bacteria, poison and other foreign bodies
- Prevented from having any bacteria present multiplying to an extent which would result in the illness of consumers or the early spoilage of the food
- For some foods: thoroughly cooked to destroy any harmful bacteria present
- Discarded when spoilt and/or contaminated

The benefits of proper food safety and hygiene are:

- More efficient utilization of food consumed by the body contributing to improved health and nutrition outcomes
- Prevention of food-borne illnesses (and sometimes death)
- Less food wastage

Causes of food spoilage

Contamination of food stuffs can occur through different ways, including: inappropriate food handling at different stages throughout the food chain; poor hygienic conditions of the places where food is placed, prepared and/or stored; intentional or non-intentional mixing of food with other foods or non-food substances that are unhygienic (also known as food adulteration) and general poor environmental hygiene. Food can also be contaminated when put together with other foods that have already undergone spoilage.

It is normal for food to spoil when no measures are undertaken to prevent its spoilage. Naturally, foods spoil over time due to the presence of either naturally occurring enzymes in particular foods or due to other external organisms or factors. Fruits and vegetables spoil over time because of the presence of naturally occurring enzymes that cause ripening and eventually, decay. Food spoilage may also be caused by micro-organisms such as moulds (commonly seen on bread), or yeasts and bacteria. These cause the food to break down, rot or go sour. The food may then discolour, smell bad or become sticky and slimy. Chemical hazards like pesticides and toxic metals may also lead to food contamination and spoilage.

Like other living things, micro-organisms such as bacteria, need food, warmth, moisture and time to grow and multiply. The ideal temperature for most bacteria is 30-45°C. Bacteria thrive best in damp conditions and in moist foods. When the correct conditions for growth are present, bacteria can double in number every 10 to 20 minutes, so that in about six hours 1 million could be produced from just one bacterium! As they increase in number, micro-organisms feed on nutrients present in a food leading to chemical and physical

changes in the natural composition of the food and eventually food spoilage. Boiling kills most bacteria and cold temperatures slow down their growth. Freezing does not kill bacteria, it only inactivates the enzymes (they stay dormant until they defrost).

Identifying spoilt food
Food that is spoilt can be identified in different ways:

- Off odours: Foods tend to develop undesirable off-flavours and/or odours as they spoil
- Discolouration: Food undergoing spoilage normally changes in colour
- Slime / Stickiness: Gravy or soups sometimes become thick and slippery to touch
- Unusual taste: Food that is undergoing spoilage often changes in taste
- The production of gas: Some foods - especially when stored in sealed containers develop some gases which will be noticeable when opening the container
- Mould growth: Other foods, e.g. bread develop fungi like growth which is easy to see with the naked eye

Foods at high risk of food spoilage
Some foods are prone to faster spoilage by micro-organisms than others. Foods that spoil fast are usually referred to as “high risk foods.” Most often these are ready to eat foods or rich protein foods and require refrigerated storage. Examples of these foods are:

- (Cooked) meat, including poultry
- (Cooked) meat products including gravy, stews
- Milk and milk products
- Eggs and products made from raw eggs
- (Cooked) Fish

Food cross-contamination
Previously safe food can spoil when it gets contaminated by bacteria from another food in a process known as cross- contamination. For example, it may occur when raw and cooked meat are cut on the same board or when fruits and vegetables are cut on a board previously used for cutting meat on but which was not cleaned. The main carriers of bacteria and causes of cross-contamination are:

- Humans
- Rubbish
- Pets and other animals
- Food, e.g. raw meat or poultry

In order to avoid cross-contamination:

- Do not let raw meat drip onto other food and keep raw meat separate from other food
- Never use the same chopping board for raw meat and ready-to-eat food without washing the board (and knife) thoroughly in between
- Maintain personal and environmental hygiene at all times. For example, always wash hands, chopping boards and utensils before starting food preparation

All individuals carry bacteria in their intestines, nose, mouth and on their hands. These micro-organisms can easily be passed on to food when individuals do not maintain good hygienic practices, such as washing hands before cooking and after using the latrine.

General tips for preventing food contamination and spoilage:

Food hygiene

- Keep raw and cooked meats separate to avoid cross- contamination

- It is useful to have a separate chopping board for raw meat. Do not put ready to eat food, such as bread, salad or fruit on a worktop or chopping board that has been touched by raw meat, unless it has been washed thoroughly first
- Cook eggs, meat, fish and poultry thoroughly to kill bacteria
- Thaw frozen meat and poultry thoroughly before cooking
- Cool and cover leftovers
- Preheat leftovers until piping hot to ensure that all bacteria are destroyed
- Wash fruits and raw vegetables before eating
- Prior to consumption, rinse fresh fruits and vegetables to remove possible pesticide residues, soil, and/or bacteria

Personal hygiene

- Wash hands thoroughly with soap and water and dry them at each of these times: before starting to prepare food; after touching raw meat, including poultry; after touching raw eggs; after going to the toilet; after touching the bin and after touching pets or other animals
- Cover or tie back hair and wear a clean apron/cloth whenever you are going to prepare food
- Avoid touching face or hair while preparing food
- Keep fingernails clean and short
- Do not cough or sneeze over food
- Avoid wearing rings, earrings or watches when preparing food
- Cuts and wounds should be covered with a waterproof dressing
- A person who has been ill, especially with food poisoning, should not work with food or be in the food preparation area

Kitchen hygiene

Cleaning the kitchen and all areas, surfaces and utensils used for food preparation is important to keep food safe and prevent bacteria from spreading. Avoiding the build-up of refuse also leads to better hygienic conditions in a kitchen. One must ensure that the area and utensils that have been used for food preparation are cleaned before doing anything else. ‘Clean as you go’: This provides a clean environment for other food preparations.

The following should be noted:

- Ideally, the kitchen should have adequate lighting and ventilation
- Ensure having adequate supply of water and cleaning materials
- Always wash worktops/chopping tables and utensils before food preparation begins
- Regularly disinfect and change kitchen cloths as these are an ideal breeding ground for bacteria
- Use separate cloths for kitchen (dishes) and bathroom (hands and body)
- Keep kitchen bin covered, empty daily and disinfect once a week
- Disinfect worktops regularly
- Keep pets and all domesticated birds and animals out of the kitchen at all times-including night
- Sweep kitchen floor daily and wash and disinfect regularly
- Wipe up any spoilt foods straight away
- Sanitize worktops/chopping tables and utensils thoroughly (with detergent) after they have been touched by raw meat, including poultry or raw eggs
- Always ensure using clean utensils for serving food as this prevents the spread of bacteria

Disinfecting and sanitization of kitchen and kitchen equipments

Disinfection refers to the use of antimicrobial agents-referred to as **disinfectants** to destroy micro-organisms that live on different objects including kitchen utensils, working tops and floors. Sanitization on the other hand refers to the cleaning of something by disinfecting or sterilization. The most commonly available home disinfectant or sanitizer is JIK. JIK is sold inexpensively in a number of local shops in most trading centers.

To use JIK for disinfecting and or sanitization, follow the following diluting instructions:
Add 1 cup (250ml) of JIK to 1L of water. Wash the affected areas and rinse after 1 minute, or,
Add ¼ cup (62.5ml) of JIK to 5 liters of water. Wash the necessary areas and rinse after 30 seconds

Environmental hygiene

The environment in which we live has a big impact on the safety and hygiene of the food that we eat. For this reason, proper environmental hygiene should be maintained in our households, in the markets from where we buy household food, in homestead gardens where vegetables are grown and in all public and private areas and water sources.

At household/community level we should ensure:

- Proper refuse disposal in designated places
- We use clean pit latrines/toilets (defecating and urinating should happen in designated places only)
- We have sufficient supplies of water, soap and other disinfectants
- Water places are kept clean and not used by animals
- To keep public places clean at all times Failure to maintain environmental hygiene may lead to waste being washed into our sources of water and food. It also leads to rapid multiplication of flies that further spread germs and bacteria.

chemical that kills germs: a chemical that destroys or inhibits the growth of microorganisms that cause disease

Cooking Tips

- All foods that are not eaten raw should be properly cooked (includes boiling, frying, roasting)
- Especially meat (beef, pork, chicken) should be well cooked as eating undercooked meat can lead to worms
- Meat that is properly cooked does not have any pink parts. If meat has pink parts, one should continue cooking as this meat is still undercooked
- To check a whole chicken or other thick piece of meat, pierce the thickest part of the leg with a clean knife until the juices run out. The juices should not have any pink or red in them
- Leftover food should always be kept in clean covered containers and kept in cool temperatures. This food should be reheated (until piping hot) before eating. However, leftovers should not be reheated more than once and should be used within 1 – 2 days of cooking

3.2. Food storage and preservation

Storing food the right way can be a great help in ensuring a household's food security. This section discusses the importance of food storage and the different ways in which households can rightly store different types of foods.

Food storage broadly refers to the different means through which food can be kept for longer periods without the food spoiling. The shelf life of a food is the length of time a food remains safe and fit for human consumption.

It is essential to store food properly to ensure the following:

- Food remains in good condition for as long as possible
- Food is protected from flies, dust and other organisms that can spoil and/or contaminate food
- Food is protected from organisms like insects and rats that eat and spoil food. For instance, proper storage of grains protects it from rats and aphids which eat and spoil maize
- Reduction in post-harvest food losses

General guidelines for food storage
Foods should be stored differently on the basis of how fast they will spoil or develop off-flavours. Foods can be categorised into 3 groups:

1. Perishable (e.g. milk, meat, raw fish)
2. Semi-perishable (e.g. vegetables and grains)
3. Non-perishable foods (tinned or dried food)

Perishable foods: e.g. eggs, milk, cream, fresh meat. These have the shortest shelf life and must be used within a few days. These should be stored in a clean cool place. In the absence of refrigerators, such foods can be placed in clean containers, saucepans or pots. The containers can then be placed in a basin of cold water covered with a clean piece of cloth. In all circumstances, milk and meat should be consumed within 2 days.

Semi-perishable foods: e.g. bread, cakes, fresh fruit and vegetables. Breads and cakes should be stored in a bread bin or tin. Fruit and vegetables may be stored in a rack or basket. When put in storage, care should always be taken to remove and discard the particular foods that start showing signs of spoilage so as to avoid cross-contamination.

Non-perishable foods: e.g. dry, bottled and tinned foods can be stored in a cupboard on their own or in airtight containers

Further food categories and their storage methods
The recommended storage conditions for foods often vary; the variations even differ for the same foods depending on the freshness or dryness of the particular food.

Storage of cereals, bread, flour, and rice

- Bread needs to be stored in its original package at room temperature. It should be used within 5 to 7 days or else it will grow moulds (a sign of spoilage)
- Cereals - depending on the quantities and level of dryness - may be stored at room temperature in tightly closed containers to keep out moisture and insects. Properly dried cereals packaged in sacs can be stacked on racks in a dedicated food store. Due attention should be taken to keep out rodents (rats) that normally feed on stored grain

- Raw rice can be stored in closed containers at room temperature and used within one year. Once cooked, rice should be eaten immediately in the absence of refrigeration

Storing fresh vegetables

- Proper storage of fresh vegetables helps to maintain their quality and retain nutrient value. Most fresh vegetables need to be stored under low temperatures in areas which are neither humid nor damp. If available, fresh vegetables can be stored in a clay pot fridge.

Constructing a clay pot fridge

This is made of a clay pot, a basin of water and a clean cloth. Place the pot in the basin of water. Put the vegetables inside it and cover the pot with a clean wet cloth. Place one corner of the cloth in the basin of water so that water is continuously sucked into the cloth as it dries out.

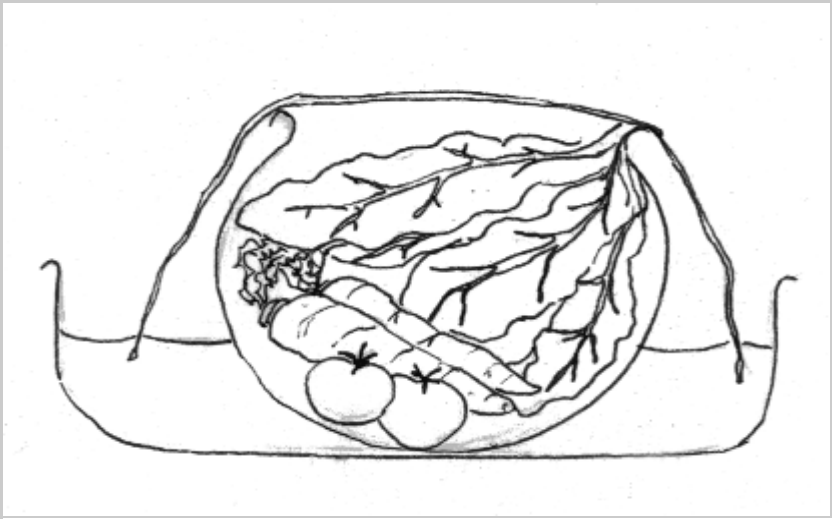

Figure 1: Demonstrating a clay pot fridge

- Root vegetables (potatoes, sweet potatoes, onions, etc.), squashes and eggplant can be stored in a cool, well-ventilated place between layers of grass
- Onions should be left to dry thoroughly under the sun to avoid rotting in storage and when well dried can be kept for about 3 months
- Tomatoes continue to ripen after harvesting and should be stored at room temperature

Storing fresh fruits

- All fresh fruits generally need to be stored in a cool area, preferably in a clay pot fridge
- Fruits have a tendency to either be contaminated by other foods and or to absorb odours from other foods. They therefore need to be kept separately

Storing milk and milk products

- Milk is a highly perishable food and yet very nutritious. To prolong its shelf life, milk should never be left at room temperature for a long time as it spoils quickly

- Care must be taken to keep milk in clean covered containers that should be left to stand in a cool place. Unrefrigerated milk should be used within a day

Storing meat and fish

- Meat (including poultry), fish, eggs and milk are the best sources of proteins in the human diet. Given their high protein and moisture content, these products are highly perishable. It is for this reason that these products will spoil faster than others - however well prepared and stored. One big contributor to the faster spoilage of fresh cuts of meat is the fact that these usually contain spoilage bacteria on the surface that can grow quickly, producing slime and causing spoilage after a few days. Meat should be prepared and eaten within 24 hours of purchase/slaughter.
- Ground and thinly cut pieces of meat are more susceptible to spoilage given the larger surface area for bacterial action. Meat and meat products should be used within a few days. If the meat cannot be used within a day, it is advisable to dry, smoke or salt it before storing it
- Like meat, fresh fish should be eaten immediately. Never store fish in water as this leads to loss of nutrients from the fish. In order to store fish for longer, it should be smoked.

Storing Root Tubers (Cassava, Sweet Potatoes)

- Most root tubers may not be stored well for long after harvest, however root tubers keep longer than other vegetables, fruits, meat, milk, etc.
- When tubers will not be prepared within a few days, care should be taken to avoid bruising them. It is advisable to harvest cassava before it becomes fibrous, with part of the aerial stem still attached. This helps preserve the tubers in good condition.
- Cassava tubers can also be piled into heaps and watered daily to keep them fresh or coated with a paste of mud to preserve their freshness. They can keep for about 4-7 days.
- Unbruised sweet potatoes can be kept in a cool, dry place for up to 4-7 days. Care should be taken to remove any sprouting buds.
- In times of bumper harvests, tubers cannot be kept for long; it is advisable that these are peeled and sliced in small pieces and then sun dried on canvas or cleaned floors. Once well dried, the sliced dry tubers can be kept in sacks and stored for up to 3-4 months without spoiling.

Food preservation refers to the different techniques that are applied to food to prevent it from spoiling. The science behind food preservation involves either:

- The destruction of micro-organisms responsible for causing food spoilage
- Reducing/eliminating the water (moisture) content from food
- Altering the temperature and other conditions that favour the growth of food micro-organisms, and thereby retarding microbial growth and replication (thus delaying food spoilage).

Simple household food preservation techniques

Drying

A number of foods (fruits, vegetables, tubers-cassava, and potatoes) which cannot be stored for long in their fresh state without spoiling can be preserved by drying. Before drying, there should be enough sunshine and foods should be sliced in small pieces for them to dry faster. Dried fruits can be eaten in their dry state (e.g. dried jackfruit), vegetables and potatoes need to be cooked by boiling in water while dried cassava can be ground into flour and used later.

Smoking
Smoking meat and fish is a highly recommended method for prolonging their storage life. The fish is first cooked over a high fire and then smoke-dried in one to five days (and nights) over a low fire. Fresh-dried fish keeps for up to a week, while hard-dried fish (keeping fish in salt for several weeks) keeps for several months.

Salting
Salting is a simple food preservation method that can be used to prolong the shelf life of food for a few days. When added to foods, salt takes out moisture and retards microbial growth and replication.

Boiling
Boiling of foods kills food microbes. Perishable foods can be boiled, cooled and kept in clean containers and then used within a day.

3.3. Food poisoning

Food that has not been stored or prepared well has a high chance of containing a lot of micro-organisms. Depending on the level of micro-organisms, this food becomes unsafe for human consumption. When individuals consume spoilt or contaminated food, they develop food-borne illnesses; a condition usually referred to as food poisoning.

Food poisoning is an acute illness, which usually occurs within 1 to 36 hours of eating contaminated or poisonous food. Symptoms of food-borne illnesses normally last from 1 to 7 days and may include one or more of the following:

- Abdominal pain
- Diarrhoea
- Vomiting
- Fever
- Dizziness

We can avoid most food-borne illnesses through observing strict hygiene and sanitary measures in preparing and storing food, serving food soon after preparation, and only eating pre-heated (very hot) leftover foods.

Who is at risk of food poisoning?
Anyone is prone to developing food poisoning if he/she eats contaminated food. Groups with an increased risk include:

- Young children
- Pregnant women
- Elderly people
- Individuals with autoimmune disorders, liver disease or decreased stomach acidity
- Alcoholics – because of possible liver damage/disease
- People weakened by malnutrition and illness, including chronic diseases
- Individuals eating meals within institutionalised settings who share utensils and where the risk of unhygienic food handling practices is increased

What to do when food poisoning arises?
When symptoms of food poisoning manifest themselves for less than 24 hours (such as short episodes of vomiting and small amounts of diarrhoea) then this can usually be cared

for at home. If it persists for longer, then medical attention should be sought. The following is recommended:

- Do not eat solid food while nauseous or vomiting but drink plenty of fluids and cereal gruels/porridges
- Sip small, frequent sips of clear liquids, including water to stay hydrated
- Avoid alcoholic and caffeinated drinks
- If available, Oral Rehydration Solution can be used. Mix one sachet of ORS powder into one litre of boiled or treated water in a clean container and stir well until it fully dissolves into a solution. Where this is not available it can be made from 1 litre of clean boiled/treated water, 6 level table spoonful of sugar, half level tablespoon of salt, and stir until sugar and salt dissolve and give to the person experiencing vomiting or diarrhoea.
- After successfully tolerating fluids, eating should begin slowly from the moment nausea and vomiting have stopped. One is encouraged to start by eating cereals

SUMMARY MODULE 3: Food Safety, Storage & Preservation

Food spoils. It is in our power however to prolong the shelf life of food through correct handling, storage and preservation. Once food has spoilt it should be thrown away as it can make us sick.

HOW TO HANDLE FOOD?

Cook with clean hands, utensils and cooking area

Meat, eggs, fish contain a lot of bacteria. Cook these foods thoroughly to kill the bacteria

Avoid these foods from contaminating other food, for example by washing your chopping board before cutting vegetables

Throw away spoilt food = food that has changed in colour, is mouldy/gaseous, smells badly and/or has changed in taste

Wash fruits and raw vegetables before eating

HOW TO STORE FOOD?

Keep perishable foods COOL, e.g. in 'clay pot fridge' and use within a few days or less

Remove fruits/vegetables that show signs of spoilage as they will spoil the other fruits/veg they are mixed with

Keep dry foods in closed containers

HOW TO PRESERVE FOOD?

Drying (e.g cassava, sweet potatoes, leafy vegetables)

Smoking (e.g. meat and fish)

Salting (e.g meat and fish)

Boiling (all foods with exception of fruits)

Food Poisoning

When we consume spoilt food, we can develop food poisoning. Symptoms normally last from 1 to 7 days and may include abdominal pain, diarrhoea, vomiting, fever, dizziness. We can avoid it through observing strict hygiene and sanitary measures in preparing and storing food, eating food soon after preparation, and only eating pre-heated (very hot) leftover foods.

What to do when food poisoning arises?

When symptoms of food poisoning manifest themselves for less than 24 hours (such as short episodes of vomiting and small amounts of diarrhoea) then this can usually be cared for at home. If it persists for longer, medical attention should be sought. The following is recommended:

- Do not eat solid food while nauseous or vomiting but drink plenty of fluids and cereal gruels/porridges
- Sip small, frequent sips of clear liquids, including water to stay hydrated
- Avoid alcoholic and caffeinated drinks
- If available, use Oral Rehydration Solution. Mix one sachet of ORS powder into one litre of boiled or treated water in a clean container and stir well until it fully dissolves into a solution. Where this is not available it can be made from 1 litre of clean boiled/treated water, 6 level table spoonful of sugar, half level tablespoon of salt, and stir until sugar and salt dissolve and give to the sick person
- After successfully tolerating fluids, eating should begin slowly from the moment nausea and vomiting have stopped. We should start by eating cereals