MODULE 1

INTRODUCTION TO FOOD SAFETY
Learning Objectives

After reading this module, you should be able to:

1. List and define the terms related to food safety.
2. Explain on the significance of sanitation in the food service industry.
3. Explain on the routes of food contamination.

1.0 Introduction

- Man quest for knowledge to keep the body healthy can be traced right back long time ago.
- Importance of sanitary practices was recognized in those early ages and now form an integral part of the operations encountered in the food industry.
- Vast changes in the social and cultural practices have been brought about by rapid modernization and influenced by the media.
- We are now faced with a situation where people venture out of their homes more often than previously, to savor the delicacies and the ambience provided by the ever expanding food industry.
- Increase in buying power and long hours spent away from home commuting to work places make eating out a necessary part of people's daily life.
- Thus, eating out besides being social event, can also be a matter of convenience such as the catering facilities available at hospitals, schools, colleges, industries and also while travelling by rail, ship, road and air.
- The ever-increasing market for convenience foods - canned, chilled, frozen and preserved foods presents a whole array of complex operations in food processing.
- This weaning away from the traditional fare of yesteryears provides a tremendous challenge to the food industry.
- More so because the responsibility is not only to serve attractive and nutritious food to the public but to ensure that it is wholesome and bacteriological safe.
- Understanding the important role that sanitation plays in every aspect of food storage, processing and its holding and disposal of wastes is the responsibility of every food service personnel.
- Effective use of sanitary procedures and their proper implementation is the only way of maintaining hygienic conditions, enabling food served to be safe and socially accepted.

1.1 Definitions

- The word Sanitation derived from the Latin word Sanus meaning 'sound and healthy' or 'clean and whole', encompasses the knowledge as well as the acceptance and effective application of sanitary measures these measures ensure maintenance of good health.
- Health is a state of complete physical, mental and social well being and not merely the absence of disease or infirmity.
- The art and branch of science that deals in preserving good health is hygiene derived from Hygieia, the Goddess of health.
1.2 Food Safety Issues

- Many centuries earlier bacteriologists and chemists discovered the fact that breaking the chain of infectious contact from person to person, from person to spoon, cup or plate to person, or from person to food to person is the most certain way of restricting food-borne illness (FBI).
- Thus prevention of food contamination by employees, safe handling of food and its subsequent storage till consumption and sanitary washing of mouthed dishes and utensils and proper waste disposal are the major steps in maintaining hygienic conditions and a clean environment.
- Despite the fact that sufficient information is now available on sanitary techniques and measures, it is not effective due to improper application.
- Since food sanitation has a direct effect on the health of individuals patronizing the catering facility, it is obligatory on the part of the management to lay down definite guidelines for maintaining hygienic conditions and ensuring their proper implementation.
- The food handler is the biggest threat to the safety of food.
- Cleanliness should be the basis of all food sanitation programs and should be aimed at food protection as well as improving and maintaining the quality of food.
- The onus is on the food service worker to break the chain of transmission of disease causing organism from carrier to food and from food to the victim or consumer.
- This in turn would:
  - prevent outbreaks of food-borne diseases
  - reduce chances of spoilage of food
  - enhance the rate of patronage
  - control wastage of money and food due to spoilage
- As the catering industry grows, so does the problem of food-borne illness, unless all food handlers are trained in safe food handling practices.

![Figure 1: Sources of Contamination](image-url)
Figure 2: Elements of Food Safety

Figure 3: Where is The Greatest Risk of Contracting a Food Poisoning or Foodborne Illness?
MODULE 2

FOOD RELATED ILLNESS
Learning Objectives

After reading this module, you should be able to:
1. Explain the definition of foodborne illness.
2. Identify the three main types of foodborne illness and give examples of each.
3. Discuss how the three classes of foodborne illness cause disease.
4. List the factors that promote bacterial growth in foods.
5. Identify the food temperature danger zone.
6. Explain how temperatures in the danger zone affect bacterial growth.
7. Identify the major types of potentially hazardous foods and the characteristics that are common to this group of foods.

2.1 Foodborne Illness

- There are many areas within the food production chain, from the farm to the retail establishment, where foods may be contaminated and/or mishandled.
- It is therefore important for all areas of food production to be carefully monitored and controlled so that the risk of foodborne illness is decreased.
- Foodborne illness is an **illness from consuming food that contains a harmful substance, harmful microorganisms or their toxins.** (figure 1)
- Many foodborne illnesses occur because of mishandled foods in foodservice and food retail establishments.
- Since foods prepared in these establishments are the closest link to ingestion by the consumer, monitoring, and control of foodborne hazards is most critical at the foodservice and food retail end of the food production.
- Foods can be contaminated by biological, chemical, or physical hazards.
- This module will briefly address each type of foodborne hazard and will focus primarily on biological hazards since they are the most common hazard in foodservice and food retail.
- Symptoms of foodborne illness are not pleasant and usually include one or more of the following: diarrhea, vomiting, headache, nausea, and dehydration.
- Foodborne illness is generally classified as infection, intoxication, or toxico-infection.

![Figure 1: Common FBI](image-url)
There are 3 Classification of Foodborne Illness which are:-

I. Infection
   • Ingestion of a harmful microorganism within a food.
   • An infection is caused when a living microorganism is ingested as part of a food.
   • After ingestion, the microorganism can then attach to the gastro-intestinal tract and begin to grow.
   • This can lead to the common symptoms of foodborne illness like diarrhea. In some instances, the microorganisms may be carried in the blood stream from the gastro-intestinal tract to other parts of the body.
   • Foodborne viruses and parasites are good examples of microorganisms that can cause infection. An example of a bacterial infection is Salmonella spp.

II. Intoxication
   • Ingestion of a harmful toxin produced within a food.
   • Intoxication is caused when a living microorganism grows in or on a food and produces a toxin.
   • The food containing the toxin is then ingested and the toxin itself causes illness. The example of food intoxication is bacteria like Clostridium botulinum and Staphylococcus aureus.
   • Intoxication may also occur due to the consumption of a toxic chemical such as a cleaning chemical.

III. Toxico-infection
   • Ingestion of a harmful microorganism within a food that produces a toxin in the human body.
   • A toxico-infection is caused when a living microorganism is consumed (like on infection) and then the microorganism produces a toxin in the body, as opposed to in the food, that leads to illness. It is different from intoxication.
   • A good example of a food toxico-infection is from Clostridium perfringens.

It is important to understand that, under the right set of circumstances, anyone can become ill due to eating contaminated foods. A healthy adult may be without symptoms or may have gastro-intestinal symptoms. In most cases, the healthy adult host will recover in a few days. However, the risks and dangers associated with foodborne illness are much greater for the elderly, infants, pregnant women, and people who have a weakened immune system, (figure 2). For these groups of people, symptoms and length of foodborne illness can be much more severe, even life threatening.

Figure 2: People who have Greater Risk of FBI

Infants  Pregnant Women  Immune-compromised/Weakened immune system  Elderly
Foodborne illness not only affects the health of individuals who become ill, but it can also have a dramatic economic impact to the eating establishment. An estimated $7.7-23 billion dollars every year spent each year on foodborne illness in the food industry (1995 Food Code). The costs associated with foodborne disease and the damage to the reputation of the establishment can be a high price to pay.

2.2 Foodborne Hazards

- Foodborne hazards are generally classified as biological, chemical or physical.
- Among these, there are over 200 foodborne hazards known that due to foodborne illness.
- **Biological hazards** are dangers from disease causing microorganisms and from poisonous toxins that they may produce. They are causing the most foodborne illnesses, and include bacteria, viruses, and parasites, (figure 3). These include invisible and visible. These hazards are the most important foodborne hazard in foodservice and food retail, (figure 4 and 5).
- **Chemical hazards** include unwanted substances such as cleaning solution and pesticides. It also include others chemicals which is non food substances, (figure 6).
- **Physical hazards** are dangers posed by the presence of particles that are not supposed to be a part of the food, such as glass, metal, or bone, (figure 7).

![Figure 3: Variation of Invisible Biological Hazards](image)

### Table: Common Biological Hazards in Food Retail Operations

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>Viruses</th>
<th>Parasites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacillus cereus</td>
<td>Hepatitis A</td>
<td>Anisakis spp.</td>
</tr>
<tr>
<td>Campylobacter jejuni</td>
<td>Norwalk virus group</td>
<td>Cryptosporidium parvum</td>
</tr>
<tr>
<td>Clostridium perfringens</td>
<td>Rotavirus</td>
<td>Giardia lamblia</td>
</tr>
<tr>
<td>Clostridium botulinum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Escherichia coli</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Listeria monocytogenes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salmonella spp.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shigella spp.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vibrio spp.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 5: Variation of Visible Biological Hazards

Figure 6: Variation of Chemical Hazards
2.3 Bacteria Growth in Foods

- Bacteria are the most troublesome and important biological foodborne hazard for the foodservice and food retail establishment.
- Bacteria are living microorganisms that are single cell.
- Bacterial cells can exist in two different states: the vegetative state and the spore state, (figure 8).
- All bacteria live in a vegetative state which can grow and reproduce.
- Few bacteria are able to change into a special state called the spore state.
- Spores are produced when the bacterial cell is in an environment where it cannot grow (frozen foods, dried foods).
- Spores are not able to grow or reproduce.
- Instead, spores are a means of protection when bacteria are in an environmental they cannot grow.

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>Vegetative State</th>
<th>Spore State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presence</td>
<td>Optimal Condition</td>
<td>Stress Condition</td>
</tr>
<tr>
<td>Reproduction</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Growth</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Produce toxin</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Resistance to stress</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Dangerous if ingested</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

- Bacteria are usually classified by their requirements needed for growth and as a spoilage or pathogenic microorganism.
• Spoilage bacteria break down foods so that they look, taste and smell bad. They affect quality.
• Pathogenic bacteria are disease-causing microorganisms and, if ingested in a food, can make people ill.
• Both spoilage and pathogenic bacteria are important to those preparing and serving foods.
• Since pathogens affect food safety, they will be emphasized.
• Keep in mind, however, that the more effort taken to ensure that foods are safe will generally lead to a better quality food as well.
• Bacteria have different required temperatures for growth, (figure 9).
• Psychrophiles (cod-loving) bacteria grow within a temperature range off 6-70°F (<7 °C).
• These microorganisms are particularly important since they can grow at room temperature and at refrigerated temperatures.
• Most psychrophilic bacteria are spoilage microorganisms, but some are pathogenic.
• The next group, mesophiles, grows between 70°F and 110°F (30 – 40°C) with best growth at human body temperature (98.6°F). There are many examples of spoilage and pathogenic mesophiles.
• Bacteria growing above 110°F (55 - 65°C) are called thermophiles. All thermophiles are spoilage microorganisms.

Figure 9: Growth Requirements for Bacterial Cells.

<table>
<thead>
<tr>
<th>Classification of Bacteria</th>
<th>Temperature Range</th>
<th>Gas Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psychrophile</td>
<td>6 – 70°F</td>
<td>-</td>
</tr>
<tr>
<td>Mesophile</td>
<td>70 – 110°F</td>
<td>-</td>
</tr>
<tr>
<td>Thermophile</td>
<td>above 110°F</td>
<td>-</td>
</tr>
<tr>
<td>Aerobic</td>
<td>-</td>
<td>21% oxygen</td>
</tr>
<tr>
<td>Anaerobic</td>
<td>-</td>
<td>No oxygen</td>
</tr>
<tr>
<td>Facultative Anaerobe</td>
<td>-</td>
<td>0 - 21% oxygen</td>
</tr>
<tr>
<td>Microaerophilic</td>
<td>-</td>
<td>3 - 6% oxygen</td>
</tr>
</tbody>
</table>

• Bacteria also differ in their requirements for oxygen.
• Aerobic bacteria require an oxygen level normally present in the air (about 21%) for growth.
• These microorganisms grow only when exposed to air.
• Anaerobic bacteria, on the other hand, cannot tolerate any oxygen; it is toxic to them.
• Anaerobic bacteria grow well in vacuum packaged foods or canned foods where oxygen is not available.
• Facultative anaerobic bacteria can grow with or without oxygen (0-21% Oxygen).
• Most pathogenic foodborne microorganisms are facultative anaerobes.
• Microaerophilic bacteria require a specific amount of oxygen for growth. They must have between 3-6% oxygen to grow and will not grow outside this narrow oxygen range.
2.4 Bacterial Growth Cycle

- Bacteria reproduce by dividing.
- During each cycle of growth, each bacterial cell divides into two cells.
- This is called binary fission. The reproduction of bacteria, or increase in number, is referred to as bacterial growth. This means that during each growth generation, each cell gives rise to another cell, (figure 10).

![Figure 10: Reproduction of Bacteria](image)

- Generation time or time for call numbers to double, for bacterial cells are typically 20-30 minutes but can be as quick as 15 minutes.
- Under optimal conditions, this means that a single cell can generate over 1 million cells in just 5 hours, (figure 11).
- That’s why it is very important not to give bacteria an opportunity to grow. Proper storage and handling of foods helps to prevent bacterial growth.

<table>
<thead>
<tr>
<th># of cells</th>
<th>1</th>
<th>2</th>
<th>4</th>
<th>16</th>
<th>&gt;1000</th>
<th>&gt;1 million</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>0</td>
<td>15min</td>
<td>30min</td>
<td>60min</td>
<td>3hr</td>
<td>5hr</td>
</tr>
</tbody>
</table>

2.5 What Do Bacteria Need to Grow?

**There are 6 factors influence the growth of bacteria**
- Bacteria need 6 conditions in order to grow in foods, (figure 12).
- They need a source of Food, on Acidic environment above pH 4.6, a Temperature between 41 and 140°F, 5 hours Time, different Oxygen requiring environments, and Moisture.
- Remember the requirements with the acronym F . A . T . T . O . M.
- Since many foods inherently contain microorganisms, we need to be sure to control these six conditions to prevent bacterial growth.

![Figure 12: Bacterial Growth Needs](image)

**Food**  | High protein
**Acid** | Foods with pH 4.6 or higher
**Temperature** | 41 -140°F (5°C – 63°C) Temperature Danger Zone (TDZ)
**Time** | About 3 million for 5 hours in ideal condition.
**Oxygen** | Aerobic, Anaerobic, Facultative anaerobic, Microaerophile.
**Moisture** | Water activity (Aw) greater than 0.85
A. Source of Food

- The presence of a suitable food supply is the most important condition affecting bacteria growth. The food must contain the appropriate nutrients needed for grow.
- Bacteria generally prefer foods that are high in protein like meats, eggs, fish and dairy items (milk).

B. Acidity

- Disease-causing bacteria grow at a pH of more than 4.6. The term pH is used as a symbol to designate the degree of acidity of a food. The scale for measuring pH is from 0 to 14. A pH of a food that is 7.0 is either acidic or basic and is considered "neutral". A pH less than 7.0 indicates that a food is "acidic." A pH range greater than 7.0 refers to a food that is "basic".
- Most foods are in the acidic range, or less than 7.0 pH. Bacteria grow best in an environment that is neutral or slightly acidic. Most bacterial growth is inhibited in very acidic conditions. That is why acidic foods, like vinegar and fresh fruits (especially citrus), seldom provide a favorable climate for pathogenic bacteria.
- Most bacteria will not grow at pH levels below 4.6. Microorganisms thrive in a pH range between 6.6 and 7.5.
C. Temperature

- Temperature is probably the most critical factor affecting growth of bacteria in foods. Most disease causing bacteria grow within a temperature range of 5°C – 63°C. This is commonly referred to as the "Temperature Danger Zone".

![Temperature Danger Zone Diagram]

D. Time

- Because bacteria grow in such a fast manner, it doesn't take long before many cells are produced. A rule of thumb in the food industry is that bacteria need about 4 hours to grow to high enough numbers to cause illness. This includes total time that a food is between 41 -140°F. Remember, a single bacterial cell can produce over 3 million cells in just 5 hours under ideal conditions.

![Bacterial Growth Diagram]
E. Oxygen

• As discussed earlier, different bacteria require different amounts of oxygen to grow. Some require a lot of oxygen (aerobic), others cannot tolerate oxygen (anaerobic), some only grow within a narrow oxygen range (microaerophilic), while others can grow with or without oxygen (facultative anaerobes).

F. Moisture

• Just like most other forms of life, moisture is an important factor affecting bacterial growth. That's why humans have been preserving foods for thousands of years by drying them. Scientists have determined that it isn't how much moisture is in a food that most affects bacterial growth. Growth is influenced most by the amount of "available water" which is designated with the symbol Aw.
• Aw is water that is not bound to the food and is available for bacterial growth. Aw is measured on a scale from 0 - 1.0. Disease causing bacteria can only grow in foods with Aw greater than 0.85. There are many preservation processes that can be done to reduce the Aw of foods including sun drying and freeze drying. The addition of salt or sugar can also be used as a means to reduce available water. However, very high amounts need to be used making this method impractical.

2.6 Potentially Hazardous Foods

• Foods that are high in protein, contain a pH greater than 4.6, and have an Aw greater than 0.85 are called potentially hazardous foods.
• If these foods are stored between 41-140°F for enough time, they can permit the growth and/or toxin production of disease-causing foodborne bacteria.
• Potentially hazardous foods pose the highest risk of foodborne illness.
• There are many examples at potentially hazardous foods prepared in food retail establishments. For example beef, chicken, milk, eggs, seafood etc.
• Therefore, it is critical to control the handling and storage of potentially hazardous foods to prevent bacterial growth.

Ready to Eat Foods

• Ready to eat foods can also cause foodborne illness.
• Include raw or processed products that can be eaten immediately.
• Examples:
  • Vegetables
  • Salad Items
  • Hard – boiled eggs
  • Delicatessen Items
What is the most common cause of foodborne illness?

The most commonly reported causes of foodborne illness are:

- Preparation of food by an ill food service worker.
- Poor personal hygiene of food service workers.
- Failure to cooks and/or holds foods at proper temperature.
- Failure to properly cool foods.
- Issues of cross-contamination.

2.7 What is Cross Contamination?

Cross Contamination is the term used to indicate as to how bacteria are spread from one food product to another. This is especially true when handling raw meat, seafood, so keep these foods and their juices away from ready-to-eat foods!

Here's How to Fight Bacterial?

- Separate raw meat, poultry and seafood from other foods in your grocery shopping bag and also in your refrigerator.
- If possible, use a different cutting board for raw vegetables and meat products.
- Always wash hands, cutting boards, dishes and utensils with hot water and cleaning agents come in contact with raw meat, poultry and seafood.
- Never place cooked food on a plate which previously held raw vegetables, meat, poultry and seafood.
There are three (3) main ways cross contamination can occur:

- Food to food
- Equipment/Utensil to food
- People to food

| Food to Food | • Food can become contaminated by bacteria from other food.  
|             | • This type of cross contamination is especially dangerous if raw foods come into contact with cooked foods.  
|             | • Here are some examples of food to food cross contamination.  
|             | • In a refrigerator, meat drippings from raw meat stored on a top shelf might drip onto cooked vegetables placed on a lower shelf.  
|             | • Raw chicken placed on a grill touching a steak that is being cooked.  |
| People to Food | People can also be a source of cross contamination to foods.  
|               | Some examples are:  
|               | • Handling foods after using the toilet without properly washing your hands.  
|               | • Touching raw meats and then preparing vegetables washing hands between tasks.  
|               | • Using an apron to wipe your hands between handling different foods, or wiping a counter with a towel then using the towel to dry hands.  |
| Equipment to Food | Contamination can also be passed from kitchen equipment and utensils to food.  
|                   | This type of contamination occurs because the equipment or utensils were not properly cleaned and sanitized between each use.  
|                   | Some examples are:  
|                   | • Using unclean equipment such as slicers, can openers and utensils to prepare food.  
|                   | • Using cutting boards and the same knife when cutting different types of foods, such as cutting raw chicken followed by salad preparation.  
|                   | • Storing a cooked product, such as a sauce, in an un-sanitized container that previously stored raw meat.  |

Preventing Cross Contamination

Follow these steps to prevent cross contamination and reduce hazards to food:

I. Wash your hands between handling different foods.
II. Wash and sanitize all equipment and utensils that come in contact with food.
III. Avoid touching your face, skin, and hair or wiping your hands on cleaning cloths.
IV. Store foods properly by separating washed or prepared foods from unwashed or raw foods.
V. Try preparing each type of food at different times and then clean and sanitize food contact surfaces between each task.
MODULE 3
HAZARDS TO FOOD SAFETY
Learning Objectives

After reading this module, you should be able to:

8. Identify the three main types of foodborne hazards and give examples of each.
9. Discuss how the three classes of foodborne illness cause disease.
10. List the factors that promote bacterial growth in foods.
11. Identify the food temperature danger zone.
12. Explain how temperatures in the danger zone affect bacterial growth.
13. Identify the major types of potentially hazardous foods and the characteristics that are common to this group of foods.

3.1 Foodborne Hazards

- **What is a Hazard?**
- A biological, chemical or physical agent that is reasonably likely to cause illness or injury in the absence of its control or
- biological, chemical or physical hazard that can grow in, or be carried by, food and causes illness or injury when consumed along with the food

I. **Biological hazards** - A pathogenic bacterium (or its toxin), virus or parasite that is reasonably likely to result in foodborne illness if not properly controlled. A great concern in HACCP plans because they are capable of causing widespread foodborne illness.

II. **Chemical hazards** - toxic substances that may occur naturally or may be added during the processing of food.

III. **Physical hazards** - hard or soft foreign objects in food that can cause illness and injury.

Among all illnesses attributable to foodborne transmission:

a. 30% caused by bacteria
b. 3% caused by parasites
c. 67% caused by viruses

Of the deaths associated with foodborne transmission:

a. 72% due to bacteria
b. 21% due to parasites
c. 7% due to viruses

Foodborne Disease Outbreaks

a. Two or more people developing the same illness after consuming the same food.
b. Most cases of foodborne disease are single cases not associated with a recognized outbreak.

Foods involved in Outbreaks

- Primarily of animal origin (48% from Beef, Poultry, Eggs, Pork, Fish, Dairy Products)

Why animal products?

I. High in nutrients
II. High water activity
III. Provide an excellent "Food" for microorganisms
IV. Intestinal tract is a source of pathogens

- Type of microorganisms are found virtually everywhere

I. Bacteria - Soil, water, plants, animals, GI tract.
II. Yeast - Soil, fruit.
III. Mold - Soil, water, produce.
3.2 Basic Microbiology

Microorganisms
- Microorganisms are living organisms that are individually too small to see with the naked eye.
- The unit of measurement used for microorganisms is the micrometer (µm); 1 µm = 0.001 millimeter; 1 nanometer (nm) = 0.001 µm.
- Microorganisms are found everywhere (ubiquitous) and are essential to many of our planets life processes.
- With regards to the food industry, they can cause spoilage, prevent spoilage through fermentation, or can be the cause of human illness.
- There are several classes of microorganisms, of which bacteria and fungi (yeasts and moulds) will be discussed in some detail.
- Another type of microorganism, the bacterial viruses or bacteriophage.

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Bacteria
Bacteria are relatively simple single-celled organisms. Bacteria come in a wide variety of shapes. One method of classification is by shape or morphology:

- **Cocci**: spherical shape (0.4 - 1.5 µm)
  Examples: *staphylococci* - form grape-like clusters; *streptococci* - form bead-like chains.
- **Rod**: (0.25 - 1.0 µm width by 0.5 - 6.0 µm long)
  Examples: *bacilli* - straight rod.
- **Spirally**: spiral rod.

There exists a bacterial system of taxonomy, or classification system, that is internationally recognized with family, genera and species divisions based on genetics. Classification Based on the Activity:

- **Beneficial Microbes** - Used in process of making foods.
- **Spoilage Microbes** - Spoil foods; not harmful to humans.
- **Pathogenic Microbes** - Disease causing microorganisms, organism or toxin must be consumed to cause symptoms.

Yeast
- Yeasts are members of a higher group of microorganisms called fungi.
- They are single cell organisms of spherical, elliptical or cylindrical shape.
- Their sizes vary greatly but are generally larger than bacterial cells.
- Unlike bacterial spores, yeast form spores as a method of reproduction.

Molds
- Molds are filamentous, multi-celled fungi with an average size larger than both bacteria and yeasts (10 X 40 µm).
- Each filament is referred to as a *hypha*. The mass of hyphae that can quickly spread over a food substrate is called the *mycelium*. 
2.3.1 Bacteria

- The most important biological foodborne hazard for any foodservice establishment.
- All bacteria exist in a **vegetative state** (the active state of a bacterium where the cell takes in nourishment grows and produce wastes).
- Some bacteria have the ability to form **spores** (the inactive or dormant state of some rod-shaped bacteria).
- Stress conditions for bacteria
  1. **Spoilage bacteria** - degrade (break down) foods so that they look, taste & smell bad. They reduce the quality of food to unacceptable levels which cause waste.
  2. **Pathogenic bacteria** - disease-causing microorganisms that can make people ill if they or their toxins are consumed with food.

**Bacterial growth**

- Bacteria reproduce when one bacterial cell divides to form two new cells (**binary fission**)
- The reproduction of bacteria and an increase in the number of organisms, is referred to as bacterial growth. What bacteria need for growth? **FAT TOM** foodborne illness caused by bacteria
  - **sporeforming bacteria**
    1. Bacillus cereus
    2. Clostridium perfringens
    3. Clostridium botulinum
  - **non-sporeforming bacteria**
    1. Campylobacter jejuni
    2. Escherichia coli 0157:7
    3. Listeria monocytogenes
    4. Salmonella spp.
    5. Shigella spp.
    6. Staphylococcus aureus
    7. Vibrio spp.

2.3.2 Viruses

- Any of a group of infectious microorganisms that reproduce only in living cells and can be transmitted through food.
- Three viruses that are of primary importance to food establishment which are:
  1. Hepatitis A
  2. Norwalk
  3. Rotavirus

2.3.3 Parasites

- An animal or plant that lives in or on another from whose body it obtains nourishments.
- Types of parasites such as:
  2. Cryptosporidium Parvum, Giardia Lamblia
  3. Trichinella Spiralis
The following group of bacteria can produce a spore structure. Recall that a spore structure allows a cell to withstand environmental stress such as cooking, freezing, high salt foods, dried foods, and very acidic foods. Generally, bacterial spores are not harmful if ingested. However, if conditions of the food are changed that permit the spore to turn into a vegetative cell, the vegetative cell can grow in the food and cause illness if eaten.

Spore-forming bacteria are generally found in ingredients that are grown near the soil like vegetables and spices. They can be particularly troublesome in food retail-type environments because they can survive on foods as a spore. When conditions are improved, such as the addition of dried spices to a beef stew mixture, spores can become vegetative cells.

For example, imagine that a restaurant was preparing a 10-gallon pot of chili for the next day's lunch special. All the ingredients (beans, meat, spices, tomato base) of the chili are mixed together and cooked to a rapid boil. A rapid boil will destroy all vegetative cells, but spores may survive. The chili is then kept in the 10-gallon container and allowed to cool overnight in a walk-in refrigerator. If takes the chili 8 hours to cool from 140 to below 41°F. If given enough time at the right temperature during the cooling process, spore-forming bacteria that survived the cooking process may change into vegetative cells and grow.

To keep spore-forming bacteria from changing to the dangerous vegetative state, it is critical that hot foods be maintained at 140°F or above and cold foods be maintained at less than 41°F. Cooking, reheating, and cooling of foods should also be done as quickly as possible. Important spore-forming pathogens in the food retail industry include Bacillus cereus, Clostridium perfringens, and Clostridium botulinum.

**Bacillus cereus**

**Description:** Bacillus cereus is facultative anaerobic, spore-forming bacterium that has been associated with two very different types of illnesses. Depending on the toxin that is produced from the bacteria onto the food, illness can either be associated with diarrhea or vomiting. The diarrhea illness is due to a toxico infection and the vomiting illness is due to an intoxication.

**Common foods:** A wide variety of foods, including meats, milk, vegetables, and fish have been associated with the diarrheal-type disease. The vomiting-type illness is usually associated with starchy foods such as rice, potatoes, and pasta products.

**Transmission in foods:** Illness due to Bacillus cereus is most often attributed to foods that are improperly stored (cooled, hot-held) to permit the conversion of spores to vegetative cells. Vegetative cells then produce the toxin or grow to high enough numbers in the food to cause illness.

**Prevention:** Foods must be cooked and cooled rapidly.
**Clostridium perfringens**

**Description:** Clostridium perfringens is an anaerobic, spore-forming bacterium that is one of the most commonly reported causes of foodborne illness, especially for foods that have been temperature abused. Clostridium perfringens causes illness due to a toxic infection where the ingested cells produce a toxin in the human intestinal tract.

**Common foods:** The microorganism is widely distributed in foods, especially spices. It is often implicated in meat dishes and dishes containing gravy. Gravy can create an anaerobic environment which allows the microorganism to grow.

**Transmission in foods:** Illness due to Clostridium perfringens is most often attributed to foods that are temperature abused. Foods that are improperly cooled food in the temperature danger zone for greater than 4hrs.) and then not reheated properly create an ideal condition for the growth of Clostridium perfringens.

**Prevention:** Foods must be cooked and cooled rapidly.

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**Clostridium botulinum**

**Description:** Clostridium botulinum is an anaerobic, spore-forming bacterium that causes foodborne intoxication due to improperly heat processed foods (especially home-canning). The microorganism produces a neurotoxin which is one of the most toxic biological substances known to humans.

**Common foods:** Foods with a pH greater than 4.6, that are not properly heat processed and then packaged anaerobically (can or vacuum pouch), and held at above 41 F. A good example would be improperly home-canned foods.

**Transmission in foods:** Illness due to Clostridium botulinum is almost always attributed to ingestion of foods that were not heat processed correctly and packaged anaerobically.

**Prevention:** Discard damaged cans. Do not can or vacuum package foods in a food retail establishment.
Non spore – Forming Foodborne Bacteria

The following group of bacteria is not capable of producing a spore structure; they are always in the vegetative state. Compared to spore-forming bacteria that are in the spore state, vegetative cells are easily destroyed by proper cooking. There are numerous examples of non spore-forming foodborne bacteria that are important in the food retail industry.

**Campylobacter jejuni**

**Description:** Campylobacter jejuni is considered by many food scientists as the number one agent that causes foodborne illness. The microorganism, which causes infection, is unique compared to most other foodborne pathogens because it has a very strict gaseous requirement for growth. It is classified as a microaerophile because it can tolerate only 3-6% oxygen for growth. The infective dose for Campylobacter jejuni is foods is low.

**Common foods:** This microorganism is commonly found in raw milk and in raw chicken. Some scientists estimate that Campylobacter jejuni may be present in nearly 100% of retail chickens.

**Transmission in foods:** Campylobacter jejuni is often transferred from raw meats to other foods by cross-contamination. This is typically done by transfer from a food contact surface (such as a cutting board) or from food worker’s hands.

**Prevention:** Cook raw meats properly. Do not use raw (unpasteurized) milk. Thoroughly clean food contact surfaces (cuffing boards) and hands after handling raw foods.

**Escherichia coli**

**Description:** The Escherichia coli (or E. coli) group of bacteria includes four strains of foodborne pathogens; enterotoxigenic E. coli, enter pathogenic E. coli, enterohemorrhagic E. coli, and enter invasive E. coli. The most important of the group is a particular type of enterohemorrhagic E. coli coiled E. coli 0157:H7. This is a facultative anaerobic bacterium that can be found in the intestines of warm blooded animals. Illness can be due to an infection and a toxico infection. Illness due to E. coli 0157:H7 is particularly serious in infants because it can cause kidney failure and bloody diarrhea.

**Common foods:** This microorganism has been isolated from raw milk and raw ground beef.

**Transmission in foods:** E. coli is usually transferred to foods like beef by contact with the intestines of animals. Transmission can also occur if employees are carriers and do not wash their hands properly after going to the bathroom.

**Prevention:** Cook hamburger patties until well done or until all the juices run clear. Do not use raw milk products. Make sure that employees practice good personal hygiene.
Listeria monocytogenes

**Description:** Listeria monocytogenes is a facultative anaerobic bacterium that causes foodborne infection. It is important to food retail operations because it can survive under many conditions such as high salt foods. Unlike many other foodborne pathogens, it can grow at refrigerated temperatures below 41°F. Listeriasis, the illness caused by Listeria monocytogenes, usually causes gastrointestinal symptoms for the healthy adult. However, disease complications can be life threatening (septicemia, meningitis, encephalitis) for people with weakened immune systems.

**Common foods:** This microorganism has been isolated from many foods and is most common in raw meats, raw poultry, dairy products (cheeses, ice cream, and raw milk), raw vegetables, and seafood.

**Transmission in foods:** Transmission to foods can occur by cross-contamination. Also, foods that are not cooked properly can contain live cells.

**Prevention:** Cook foods thoroughly. Practice good personal hygiene.

Salmonella spp.

**Description:** Salmonella is a facultative anaerobic bacterium that frequently causes a foodborne infection. Like E. coli, the source for Salmonella is the intestinal tracts of warm blooded animals.

**Common foods:** This microorganism exists in many foods, especially raw meat and poultry products, eggs, milk, dairy products, pork, milk chocolate, and cream-filled desserts.

**Transmission in foods:** Transmission to foods is very common by cross contamination from raw foods (especially poultry), from food contact surfaces (cutting boards), or from food handlers.

**Prevention:** Cook foods thoroughly. Practice good personal hygiene, and clean and sanitize food contact surfaces after use with raw foods.
Shigella spp.

**Description:** Shigella is a facultative anaerobic bacterium that causes about 10% of foodborne illnesses in the U.S. The microorganism is frequently found in the intestines of humans and warm blooded animals. The microorganisms can cause an infection or toxico infection. A common illness caused by Shigella is bacillary dysentery.

**Common foods:** This microorganism is common in ready-to-eat salads (i.e. potato, chicken), milk and dairy products, poultry, and raw vegetables.

**Transmission in foods:** Water that is contaminated by fecal material and unsanitary handling by food workers are common transmission routes.

**Prevention:** Practice good personal hygiene and wash foods with potable water supply (suitable for drinking).

Staphylococcus aureus

**Description:** Staphylococcus aureus is a facultative anaerobic bacterium that produces a very heat-stable toxin as it grows on foods. It is therefore an example of intoxication. The microorganism is normally present on human skin, hands, and nasal passages, and can be transferred to foods easily. It also survives in high salt conditions.

**Common foods:** This microorganism is common to cooked ready-to-eat foods, salads, meats and poultry products, custards, and high salt foods (like ham), and milk and dairy products.

**Transmission in foods:** Since humans are the primary source, cross-contamination from the worker’s hands is the most common way the microorganism is introduced into foods. Foods requiring large amounts of food preparation and handling are especially susceptible.

**Prevention:** Practice good personal hygiene. Keep ready-to-eat foods out of the temperature danger zone.
**Vibrio spp.**

Description: There are three species within the Vibrio group at bacteria that cause been implicated in foodborne infections, they include Vibrio cholera, Vibrio parahaemolyticus, and Vibrio vulnificus. All are important since they are very resistant to salt and are common in seafood.

Common foods: Vibrio spp, are commonly found in raw, under-processed, improperly handled, contaminated fish and shellfish. These bacteria are generally found more in the summer months and from warmer waters.

Transmission in foods: Since the microorganism exists in much raw seafood, transmission to other foods by cross contamination is a concern. Most illnesses are caused due to eating raw or undercooked seafood, especially oysters.

Prevention: Cook seafood properly. Avoid consumption of raw seafood. Practice good personal hygiene.

**Foodborne Viruses**

Foodborne viruses differ from foodborne bacteria. They are the smallest and simplest form of life known. Viruses require a living host (animal, plant, or human) to grow and reproduce. Unlike bacteria, they do not reproduce or grow in foods.

They are usually transferred from one food to another, from a food handler to a food, or from a water supply to a food. There are three viruses that are important in food retail preparation; Hepatitis A, Norwalk virus, and Rotavirus.

**Hepatitis A**

Description: Hepatitis A is a foodborne virus that is associated with many foodborne infections. It is a particularly important hazard to retail food establishments because it has an incubation period of 10-45 days. This means that a food worker can harbor the microorganism for up to 6 weeks and not show symptoms of illness. However, during this time, the food worker can contaminate foods and other workers in the food retail establishment.

Common foods: Ready-to-eat foods that are washed with a non-potable water supply or foods that are handled excessively can be contaminated with Hepatitis A. Examples include raw vegetables and raw seafood. Due to the long incubation period, it is very difficult to identify the food source of a Hepatitis A infection.

Transmission in foods: The virus is primarily transmitted from person-to-person contact, by cross contamination, and by fecal contamination.

Prevention: Handle and cook foods properly. Avoid consumption of raw seafood. Practice good personal hygiene.
**Norwalk virus group, Rotavirus**

**Description:** The Norwalk virus and rotavirus are other common foodborne viruses that are associated with many foodborne infections, with some outbreaks involving up to 3000 people.

**Common foods:** Raw seafood. Raw fruits and vegetables were washed with a contaminated water supply. Non-heated foods that are handled by people who are shedding the virus.

**Transmission in foods:** The virus is transmitted from person-to-person contact and by fecal contamination.

**Prevention:** Handle and cook foods properly. Avoid consumption of raw seafood. Practice good personal hygiene.

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**Foodborne Parasites**

Foodborne parasites are another important foodborne biological hazard. Parasites are small or microscopic creatures that need to live on or inside a host to survive. There are many examples of parasites that can enter the food system and cause foodborne illness. Included here are lists of a few of the most troublesome ones that may appear in food retail establishments. Parasitic infection is far less common than bacterial or viral foodborne illness.

**Anisakis spp.**

**Description:** Anisakis spp. is nematodes or roundworms) that have been associated with foodborne infection.

**Common foods:** They generally cause foodborne disease through consumption of raw or undercooked seafood. The most common foods include seafood such as cod, haddock, fluke, salmon, herring, flounder and monkfish.

**Transmission in foods:** This parasite is transferred in the water in which the marine animal lives. This parasite may also be transferred to other foods by improper food handling.

**Prevention:** Handle and cook seafood properly.
**Crytosporidium parvum and Giardia lamblia**

**Description:** Crytosporidium parvum and Giardia lamblia are single cell microorganisms called protozoa. They can cause foodborne infections. These microorganisms are important because they are common causes of non-bacterial diarrhea in the United States.

**Common foods:** These parasites are most commonly associated with the consumption of contaminated water. Raw foods that are in contact with contaminated water, especially raw vegetables, can also be contaminated.

**Transmission in foods:** These parasites are transmitted from a contaminated water supply, person-to-person contact and by fecal contamination.

**Prevention:** Handle and cook foods properly.

**Trichinella spiralis**

**Description:** Trichinella spiralis is a foodborne roundworm that can cause parasitic infection.

**Common foods:** Pork is by far the most common food which carries Trichinella spiralis. It can also be found in bear meat.

**Transmission in foods:** This parasite is inherently carried by animals. It is generally thought that a possible route to the animal is through consumption torn eating infected tissues from other animals and garbage.

**Prevention:** Cook pork until there are no signs of pink and always cook meats properly.

**Parasitic worms**

- **Parasitic worms** have three groups which are:
  - Nematodes called roundworms.
  - Trematodes like the flukes.
  - Cestodes are the tapeworms.

- Worm parasites do not multiply in the human host.
- They need to pass through stages in the human host and other stages in one or more animals, in soil or water.
The Life Cycle of Roundworms
Ascaris Lumbricoides and Ascaris Suum

Adult males and females are in the small intestine.

Females produce eggs that are passed in the host’s feces.
(A single female can produce 200,000 eggs per day.)

Juveniles in eggs mature to the infective (second) stage.

Eggs ingested by host and hatch in the small intestine. The juveniles penetrate the tissues of the intestine and enter the bloodstream.

The juveniles are "coughed up" and swallowed. The juveniles complete their development in the small intestine.

The third stage juveniles migrate from the pulmonary capillaries into the alveoli (air sacs).

The juveniles migrate to the lungs and molt into third stage juveniles.

(Parasites and Parasitological Resources)

Life cycle of hookworms

L3 larvae enter lungs and alveolar spaces causing cough

L3 larvae penetrate skin causing "ground itch" and enter bloodstream

L3 larvae migrate to grass

Larvae reach small intestine, mature, and start feeding

Eggs are passed in feces

Larvae hatch and develop in soil

Coughed-up larvae are swallowed
3.4 Chemical Hazards

- Chemical hazards are usually classified as either naturally occurring or man-made chemicals.
- **Naturally occurring** - include toxin that are produced by a biological organisms;
  i. Ciguatoxin
  ii. Scrombrotoxin
  iii. Shellfish toxins
  iv. Mycotoxin
- Man-made include substances that are added, intentionally or accidentally, to a food during processing
  - intentionally added chemicals
    1. Food additives
    2. Food preservatives
    3. Pesticides
  - non-intentionally / accidentally added chemicals - contamination by chemicals such as:
    1. Cleaning & sanitary supplies
    2. Chemicals from containers or food contact surfaces of inferior metal that are misused
    3. Inferior-metal poisoning

3.4.1 Naturally Occurring Chemicals

i. Ciguatoxin

**Description:** Ciguatoxin is an example of a fish poisoning intoxication from the consumption of tropical fish. The origin of the toxin is from tiny sea creatures called algae. The Toxin is heat stable and is not destroyed by cooking. Different marine fish ingest algae containing toxin, and the toxin accumulates in the fish over time. Symptoms of ciguatoxin poisoning include common food borne illness symptoms and unique symptoms including weakness and slight paralysis of the mouth, tongue, throat, hands, and feet.

**Common foods:** Marine finfish most commonly caused ciguatoxin poisoning. Common marine species include barracudas, groupers, jacks, mackerel, snappers, and triggerfish.

**Transmission in foods:** The toxin is transferred to finfish after ingestion of toxin containing algae.

**Prevention:** The toxin is not destroyed by cooking; therefore, prevention can be very difficult. Purchasing seafood from a reputable supplier is the best preventative measure.
ii. **Scombrotoxin**  
**Description:** Scombrotoxin, also called histamine poisoning, is caused by eating foods high in a chemical compound called histamine. Histamine is usually produced by bacteria when they decompose foods. Histamine is not destroyed by cooking. Unique symptoms of illness include dizziness, a burning sensation, a facial rash or hives, and a peppery taste in the mouth.

**Common foods:** The most common foods causing scombrotoxin include tuna and mahi-mahi fish. Swiss cheese has also been implicated.

**Transmission in foods:** Over time, bacteria that are present in a particular food can break down histidine in food and cause the production of histamine. Temperature abuse also leads to more histamine production.

**Prevention:** Purchase seafood from a reputable supplier. Store seafood below 41°F and do not accept seafood that has been previously thawed.

iii. **Shellfish toxins**  
**Description:** There are numerous examples of shellfish toxins. The most common include Paralytic Shellfish Poisoning (PSP), Diarrheic Shellfish Poisoning (DSP), Amnesic Shellfish Poisoning (ASP), and Neurotoxic Shellfish Poisoning (NSP). All involve an accumulation of toxins produced in shellfish.

**Common foods:** Any shellfish may contain any of the toxins. PSP is more common with mussels, clams and scallops. DSP is more common with mussels, oysters, and scallops. ASP is more common with mussels. NSP is common for Gulf Coast marine animals (saltwater).

**Transmission in foods:** Inherent to marine shellfish.

**Prevention:** Purchasing food from a reputable supplier.

iv. **Mycotoxins**  
Another group of foodborne microorganisms that can cause disease include fungi. Fungi include both molds and yeasts. They differ from bacteria, whereas they are larger in size and usually prefer foods that are high in sugar or starches. They can often withstand more extreme conditions (highly acidic foods, lower Aw foods) compared to bacteria.

Foodborne molds are important because they can produce chemical compounds called mycotoxins. Mycotoxins have been linked to cancer. Yeasts do not cause foodborne illness.

There are several molds that produce mycotoxins. An important and common foodborne mycotoxin, called aflatoxin, is produced by Aspergillus spp. Mycotoxins are commonly found in dry and/or acidic foods. Common foods containing mycotoxins include corn, nuts, and grains. Many mycotoxins are not destroyed by cooking.
3.4.2 Added Chemicals

- There is a long list of chemicals that are added to foods, which can pose a health risk.

3.4.2.1 **Intentionally** added chemicals may include food additives, food preservatives, and pesticides (chemical poisoning).
  - Pesticides leave residues on fruits and vegetables, and can usually be removed by a vigorous washing procedure or by peeling off the skin.
  - Use of intended food additives is regulated by the Food Quality Division, MOH to assure that they are safe.
  - Symptom of chemical poisoning will vary depending on the type of poisoning and the amounts consumed, in many cases, if affects the nervous system.
  - Large amounts of the toxic substances - illness will occur quite quickly other cases (small amounts) - effects may be cumulative.

3.4.2.2 **Non-intentionally** added chemicals may include contamination by chemicals such as cleaning & sanitary supplies, chemicals from containers or food contact surfaces of inferior metal that are misused and inferior-metal poisoning (metal poisoning).
  - Metal poisoning will cause vomiting and abdominal pain within an hour (if sufficient quantities are eaten).
  - Metals can contaminate food during growth or during processing.
  - Examples of metal poisoning:
    1. Antimony - used in enamel coating of equipment.
    2. Cadmium - used to plate utensils and some parts of electric cookers and fridges.
    3. Copper - used in fittings for equipments such as drink machines.
    4. Lead - in petrol and used in the glaze of some earthenware.
    5. Tin - tinned foods.
    6. Mercury - used in a variety of industries.
3.5 Physical Hazards in Food

The majority of foodborne illness of injury actually comes from biological contaminants, but the type of hazard that restaurants are most frequently sued for or settle in a legal matter are the physical ones that show tangible evidence of damage to a customer by biting down on the object or swallowing it.

A. What are physical hazards?

Physical hazards are either foreign materials unintentionally introduced to food products (ex: metal fragments in mince meat) or naturally occurring objects (ex: bones in fish) that are a threat to the consumer. A physical hazard can enter a food product at any stage of production, hard or sharp objects are potential physical hazards and can cause:

- Cuts to the mouth or throat.
- Damage to the intestine.
- Damage to teeth or gums.

B. What are some common, physical hazards?

The main types of physical hazards in food include:

- Glass: common sources found in food processing facilities are light bulbs, glass containers and glass food containers.

- Metal: common sources of metal include metal from equipment such as splinters, blades, broken needles, fragments from worn utensils, staples; etc.

- Plastics: common sources of soft and hard plastics include material used for packaging, gloves worn by food handlers; utensils used for cleaning equipment or from tools used to remove processed food from equipment.

- Stones: field crops, such as peas and beans, are most likely to contain small stones picked up during harvesting. Concrete structures and floors in food processing facilities can also be a source of small stones.

- Wood: common sources of wood come from wood structures and wooden pallets used to store or transport ingredients or foot products.

C. How to develop an effective physical hazards plan for your facility.

- Every food process has its own specific and potential hazards. To develop an effective physical hazard identification program, processors need to collect detailed information for every step of every food process in the facility.

- Information on potential physical hazards can be obtained by closely observing each process during all phases of its operation.
D. How can common physical hazards be prevented?

There are many ways food processors can prevent physical hazards in food products, including:

- Inspect raw materials and food ingredients for field contaminants (ex: stones in cereals) that were not found during the initial receiving process.

- Follow good storage practices and evaluate potential risks in storage areas (ex: sources of breakable glass such as light bulbs, staples from cartons, etc.) and use protective acrylic bulbs or lamp covers.

- Develop specifications and controls for all ingredients and components, including raw materials and packaging materials: Specifications should contain standards for evaluating acceptability of ingredients or packaging materials (ex: recycled cardboard used for packaging sometimes contains traces of metals that can be detected by metal detectors. A limit for metal defection should be established to avoid false positive detection of metal in food).

- Set up an effective detection and elimination system for physical hazards in your facility (ex: metal detectors or magnets to detect metal fragments in the production line, filters or screens to remove foreign objects at the receiving point).

- Properly and regularly maintain the equipment in your facility to avoid sources of physical hazards such as foreign material that can came from worn out equipment.

- Periodic employee training on shipping, receiving, storing, handing, equipment maintenance and calibration will also help prevent physical hazards from being introduced into food products.

E. How are physical hazards detected and eliminated?

There are several methods available to detect foreign bodies in food on processing production lines:

- Metal detectors will detect metal in food products. They should be set up to reject products from the food production line if metal is detected. Proper maintenance should be given to this equipment to ensure they are always accurate and don't produce false positives.

- Magnets can be used with metal detectors on food production lines to attract and remove metal from products.

- X-Ray machines can be used on food production lines to identify hazards such as stones, bones and hard plastics, as well as metal.

- Food radar systems transmit low - power microwaves through food products to identify foreign bodies such as metals, plastics, bones, kernels and organic materials in food on production lines.
F. Here are same other points of "physical" food contamination to look out for:

- DO NOT use glasses to scoop ice; use commercial scoops.
- DO NOT Store items (containers, juices, garnish, etc.) in ice that will be used in foods or in beverages.
- STORE toothpicks and non-edible garnishes below food storage and areas.
- INSTALL shields on lights.
- CLEAN can openers regularly and replace the blade.
- REMOVE staples, nails, twist ties, plastic bands or over-wrap, etc. from boxes or packages when food is received.
- DO NOT repair equipment temporarily with items that might fall into foods. For example, rubber bands, duct tape, a hair pin or nail in place of a cotter pin, etc.
- DO NOT wear nail polish, artificial nails, or jewelry if handling food.
- WEAR adequate hair and beard restraints.
- BANDAGES on hands or arms must be covered with a disposable glove. Keep the wound clean and use a brightly colored bandage that is more visible in case it does come off while working.
- BE CAUTIOUS with knives to prevent accidentally cutting the tip of a disposable glove into food, much less a fingertip.
- DO NOT store food in containers or bags that are not approved for food storage.

In summary, teach your crew to survey the food prep areas for unexpected physical hazards that can cause a potential problem to your restaurant - we certainly hope, before your customer does.
MODULE 4

FOOD SPOILAGE AND FOOD PETS
Learning Objectives

After reading this module, you should be able to:
1. Identify the types of food spoilage and give examples of each.
2. Discuss how the food spoilage takes place.
3. List the signs of spoilage in foods.
4. Identify the food pests in foodservice operation.
5. Identify & explain the sign of food pests and related hazards.

4.1 Food Spoilage

Why does Food Spoil?
- Food, just like humans, gradually deteriorates because of a natural aging process. Bacteria, yeasts and molds can all spoil food. In most cases, food spoilage will be obvious from the appearance, smell or taste of the food.

- However, there are a few things we can do that will have a positive effect on the shelf life and safety of our food. Some preservation is done at the food manufacturing level and some occurs naturally, but a better understanding of the processes may help you extend the shelf life.

- Preservation methods and storage conditions must be designed to reduce the rate of decomposition and protect the safety, appearance and taste of our food.

What is Food Spoilage?
- Food spoilage means the original nutritional value, texture, flavor of the food are damaged, the food become harmful to people and unsuitable to eat.

4.1.1 Causes of the Spoilage of Food

- Once food is harvested or slaughtered, its plant or animal tissue soon starts to decay. Microorganisms, such as fungi (molds & yeasts), spoilage bacteria, and their enzymes usually cause the spoilage process.

- Not all these changes in food are undesirable. Some people like aged beef and cheeses or very ripe fruit. The production of wine and beer involves conversion of sugars to alcohol, while souring of milk is essential in the production of cheese.

- However, it is important to remember that some of the conditions that accelerate spoilage, such as inappropriate temperature and moisture control, also encourage the growth of pathogenic microorganisms that cause foodborne illness.

- Consequently, spoiled food is not just an issue of quality; it is also often a question of food safety.
A. **Microbial spoilage**

There are three types of microorganisms that cause food spoilage which are *yeasts, molds* and *bacteria*.

- **Yeasts** growth causes fermentation which is the result of yeast metabolism. There are two types of yeasts *true* yeast and *false* yeast.
  
  i. True yeast metabolizes sugar producing alcohol and carbon dioxide gas. This is known as fermentation.
  ii. False yeast grows as a dry film on a food surface, such as on pickle brine. False yeast occurs in foods that have a high sugar or high acid environment.

- **Molds** grow in filaments forming a tough mass which is visible as ‘mold growth’. Molds form spores which, when dry, float through the air to find suitable conditions where they can start the growth cycle again.

- Mold can cause illness, especially if the person is allergic to molds. Usually though, the main symptoms from eating moldy food will be nausea or vomiting from the bad taste and smell of the moldy food.

- Both yeasts and molds can thrive in high acid foods like fruit, tomatoes, jams, jellies and pickles. Both are easily destroyed by heat. Processing high acid foods at a temperature of 100°C (212°F) in a boiling water canner for the appropriate length of time destroys yeasts and molds.

- Corn, nuts, breads, meat, cheeses, fruits and vegetables are all affected by mold. Do not try to salvage cheese that shows visible mold by cutting it away, unless of course it is a natural part of the cheese (i.e., bleu cheese, Brie, or Camembert).

- Mold forms a network of microscopic strands that extend into the foods which could cause allergic reactions or illness, so discarding them is the safest option. Most cheeses do not improve with age. Deli meats are the same, Yeast can cause discoloration, slime, and odors on sweet, acidic refrigerated foods or jams/jellies.
Fungal Spoilage

Storage rots in grapes caused by *Botrytis cinerea*.

Watery soft rots in apple caused by *Sclerotinia sclerotiorum*.

Storage rot in strawberry caused by *Botrytis cinerea*.

Black mummy rot of grapes caused by *Guignardia bidwellii*.

Blue mould on oranges caused by *Penicillium digitatum*.

Blue mould rot in tomato caused by *Penicillium* spp. (also by *Fusarium* spp.)

- **Bacteria** are round, rod or spiral shaped microorganisms. Bacteria may grow under a wide variety of conditions.

- There are many types of bacteria that cause spoilage. They can be divided into: **spore-forming** and **nonspore-forming**. Bacteria generally prefer low acid foods like vegetables and meat.

- In order to destroy bacteria spores in a relatively short period of time, low acid foods must be processed for the appropriate length of time at 116°C (240°F) in a pressure canner. (Temperatures higher than 100°C [212°F] can be obtained only by pressure canning.)

- Some spoilage bacteria are also pathogenic (disease causing). For example, *Clostridium perfringens* (a common cause of spoilage in meat & poultry) and *Bacillus cereus* (spoils milk & cream) are also responsible for causing foodborne illness. Most foods are subject to bacterial growth.
• Eating spoiled food caused by bacteria can cause food poisoning.

![Bacterial Spoilage](image)

Soft rots in tomato caused by *Erwinia carotovora*.

**B. Autolysis (natural process of food spoilage)**

i. **Enzymes**
   - Enzymes are proteins found in all plants and animals. If uncooked foods are not used while fresh, enzymes cause undesirable changes in color, texture and flavor. Enzymes are destroyed easily by heat processing.

ii. **Oxidation by air**
   - Atmospheric oxygen can react with some food components which may cause rancidity or color changes.

**C. Other factors**

- Infestations (invasions) by insects and rodents, which account for huge losses in food stocks.
- Low temperature injury - the internal structures of the food are damaged by very low temperature.

![Low Temperature Injury](image)

Low Temperature Injury

- Internal mahogany browning of potato caused by low temperature injury.
- Chilling injury in cucumber caused by low temperature. Note the watery surface.

• The bruising or piercing of vegetables, fruits or vacuum packaged food by rough handling.
• Adulteration through addition of leftover, inferior or undesirable food or ingredients to fresh food.
In the most cases, food spoilage will be obvious from the appearance, smell or taste of the food. Spoilage usually occurs as follow:

- Fruit is usually spoiled by molds or yeasts which can grow in acidic conditions, after being damaged during storage or transportation.
- Vegetables can be spoiled by molds or bacteria. Again, this is often as a result of damage during storage or transportation.
- Meats are broken down by enzymes in the meat, and can also be spoiled by bacteria.
- Fish is spoiled in a similar way to meat, though the process is usually much more rapid.
- Milk and milk products are usually spoiled by bacterial growth that causes the product to sour. These bacteria are present in the raw milk and survive processing. If left, molds can also grow.
- Bread and other flour products are usually affected by molds and yeasts because of the high sugar levels.
- Canned foods can spoil where bacteria have not been properly destroyed before canning, where the can is not properly sealed, and where the can itself is eroded by acids in the food.

### 4.1.2 Signs of Spoilage in Food

<table>
<thead>
<tr>
<th>Types of food</th>
<th>Common signs of spoilage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk</td>
<td>Smell and tastes ‘off’. Starts to curdle so bits are found in the milk.</td>
</tr>
<tr>
<td>Vegetables</td>
<td>Become soft and discolored. May have black spots.</td>
</tr>
<tr>
<td>Fish</td>
<td>Smells ‘off’ and discolor.</td>
</tr>
<tr>
<td>Processed/ cooked meats</td>
<td>Surface slime and discoloration. Smell ‘off’. Produce gases that may burst vacuum packs.</td>
</tr>
<tr>
<td>Bread</td>
<td>Fruity, sickly smell. Soft sticky texture. Internally bread discolors to yellow or brown.</td>
</tr>
</tbody>
</table>
## Example for Food Spoilage

### i. Microorganisms Involved in Food Spoilage

<table>
<thead>
<tr>
<th>Food</th>
<th>Types of Spoilage</th>
<th>Microorganisms involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bread</td>
<td>Moldy, Ropy</td>
<td>Rhizopus nigricans, Penicillium, Aspergillus niger</td>
</tr>
<tr>
<td>Maple sap and syrup</td>
<td>Ropy, Yeasty, Pink, Moldy</td>
<td>Enterobacter aerogenes, Saccharomyces, Zygosaccharomyces, Micrococcus roseus, Aspergillus, Penicillium</td>
</tr>
<tr>
<td>Fresh fruits and Vegetables</td>
<td>Soft rot, Gray mold rot, Black mold rot</td>
<td>Rhizopus, Erwinia, Botrytis, A.niger</td>
</tr>
<tr>
<td>Pickles, sauerkraut</td>
<td>Film yeast, pink yeast</td>
<td>Rhodotorula</td>
</tr>
<tr>
<td>Fresh meat</td>
<td>Putrefaction</td>
<td>Alcaligenes, Clostridium, Proteus vulgaris, Pseudomonas fluorescens</td>
</tr>
<tr>
<td>Cured meat</td>
<td>Moldy</td>
<td>Aspergillus, Rhizopus, Penicillium, Pseudomonas</td>
</tr>
<tr>
<td></td>
<td>Sourcing, Greening, slime</td>
<td>Micrococcus, Lactobacillus, Leuconostoc</td>
</tr>
<tr>
<td>Fish</td>
<td>Discoloration, Putrefaction</td>
<td>Pseudomonas, Alcaligenes, Flavobacterium</td>
</tr>
<tr>
<td>Eggs</td>
<td>Green rot, Colorless rots, Black rots</td>
<td>P.fluorescens, Pseudomonas, Alcaligenes, Proteus</td>
</tr>
<tr>
<td>Concentrated orange juice</td>
<td>“Off flavor”</td>
<td>Lactobacillus, Leuconostoc, Acetobacter</td>
</tr>
<tr>
<td>Poultry</td>
<td>Slime, Odor</td>
<td>Pseudomonas, Alcaligenes</td>
</tr>
</tbody>
</table>
ii. Common Mold on Bread
   - *Rhizopus stolonifer*

   - *Penicillium expansum*
iii. Canned Food Spoilage

ABOVE: Changes in cans as a result of microbial spoilage.

I. Normal can; note that the top of the can is indented due to negative pressure (vacuum) inside.
II. Slight swell resulting from minimal gas production. Note that the lid is slightly raised.
III. Severe swell due to extensive gas production. Note the great deformation of the can. This can is potentially dangerous, and could explode if dropped or hit!
IV. The can shown in above was dropped and the gas pressure resulted in a violent explosion. Note that the lid has been torn apart.

Detecting Spoilage

- Relies on being aware of the typical indicators, such as appearance (discoloration or slime), texture, smell or taste (obviously not recommended if any of the others are present).

Bottom Line Prevention

- When in doubt, throw it out. Food spoilage affects your bottom line in food waste costs. Prevention includes good receiving inspection practices, following the manufacturer’s instructions, unfailing temperature recording and control, being observant and of course good sanitation and personal hygiene by food handlers.
iv. Discoloration of Spoiled Meat

4.2 Food Pests

- Another hazard in food premises.
- Food pests include rodents, insects or birds that cause damage to, or contamination of, food products.
- They are attracted by the presence of food and the warmth and shelter offered by food premises.
- Bodies or body parts, fur, eggs and droppings can all contaminate food.
- Pests can also carry pathogenic and spoilage bacteria and viruses that will contaminate the food.
- Any deliveries need to be checked on arrival rejected if they are contaminated.
- Below table give details of the most common food pests. It describes the hazards from each type of pest and the signs to look for when you suspect infection.
### Sign of Food Pests and Related Hazards

<table>
<thead>
<tr>
<th>Pest</th>
<th>Characteristics</th>
<th>Hazards</th>
<th>Signs of Infestation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rodents</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black rat</td>
<td>An agile animal with pointed nose, long tail and large ears. Also known as the ship’ rat and tends to be confined to areas around ports. Prefers fruit and vegetables.</td>
<td>• All rodents can carry pathogenic and spoilage organisms which will contaminate foods.</td>
<td>• Dropping and urine smears.</td>
</tr>
<tr>
<td>Brown rat</td>
<td>Larger and more common than the black rat with small ears and shorter tail. Also known as the Norway or common rat. Lives in sewers and drains, wall or floor cavities or in piles of rubbish. Prefers cereal foods.</td>
<td>• Droppings, urine, fur or dead bodies may be deposited in food. • Damage to premises by gnawing woodwork, metal pipes, electric cables, etc.</td>
<td>• Runways worn tracks to feeding points. • Footprints and tail marks. • Damage to premises and equipment due gnawing. • Smell from nests.</td>
</tr>
<tr>
<td>House mouse</td>
<td>Small with pointed head, large ears and a very long tail. They breed rapidly and will nibble food and non-food items. They prefer cereal foods.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Flying insects</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flies</td>
<td>Houseflies, bluebottles, green bottles, and fruit flies are all of concern in food premises. They feed by regurgitating enzymes on to the food to break it down, and then suck up the food. They feed on rubbish, and human and animal feces as well as foodstuffs. They breed very rapidly in warm weather.</td>
<td>• Carry pathogens or spoilage bacteria on their bodies. • Defecate on food as they eat. • Regurgitate parts of previous meals which could be contaminated. • Lay eggs in food. • Maggots hatch, eat and pupate in the food. • Adult flies may die in the food.</td>
<td>• Live or dead insects in and around food. • Maggots or pupae on food.</td>
</tr>
<tr>
<td>Wasps</td>
<td>Wasps favor sweet foods and are particularly common around food premises in late summer and early autumn.</td>
<td>• Can carry pathogens picked up from rubbish. • Can cause panic among staff in busy food premises.</td>
<td>• Live or dead insects in or around food.</td>
</tr>
<tr>
<td><strong>Crawling insects</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ants</td>
<td>Food premises attract black ants (garden ants) and pharaoh’s ants. Black ants will infest food premises in their search for sweet foods. Pharaoh’s ants are smaller and pale yellow. They live in warm premises and, as well as sweet foods, will feed on high protein foodstuffs such as meat.</td>
<td>• Spread pathogenic organisms. • Dead bodies may contaminate food.</td>
<td>• Live or dead insects in or around food. • Presence of nests in premises though these may be difficult to detect.</td>
</tr>
</tbody>
</table>
| **Cock-roaches** | Two types are found in the UK: the oriental cockroach and the German cockroach. The oriental cockroach is brown with a flat body and about 25 mm in length. They are often found in damp conditions. The German cockroach is about 15 mm in a flat body and prefers humid conditions. Both species can fly and both feed on waste food. | • Carry pathogenic organisms including *Salmonella*.  
• Egg cases, fecal pellets and bodies in food. | • Live and dead insects.  
• Fecal pellets.  
• Egg cases or larvae.  
• Odor. |
| **Silverfish** | Fish shaped grey bodies with very long antennae. Live in damp conditions and often found carpets or wallpaper. | • Don’t contaminate food directly but can fall into food. | • Live and sead insects. |
| **Stored product insects** | | | |
| **Psocids** | Also known as book lice, they are very small and brown or cream in color. Generally feed on molds from walls, containers and food, though will eat foodstuffs such as flour. Breed quickly in warm, damp conditions. | • Not a direct health hazard but they can infest food particular where it is poorly stored. | • Live and dead insects.  
• Poor storage conditions. |
| **Grain weevils** | The most common of the weevils, they are generally found in stores gain on farms but will infest foods such as pasta and foods such as pasta and flour. Lay eggs in food and the pupae feed on it as they hatch. | • Not a direct health hazard, but can leave eggs, pupae and bodies in foodstuffs. | • Live and dead insects. |
| **Birds** | Any birds that gain access to food premises are a pest. Most often they are pigeons and sparrows, but other birds can cause problems. | • Carry pathogenic bacteria including *Salmonella*.  
• Leave contaminated droppings and feathers in food.  
• Can contaminate water supplies, particularly where dead birds fall into water tanks. | • Live and dead birds.  
• Droppings.  
• Nest sites.  
• Feathers. |
MODULE 5
CONTROL MEASURES
Learning Objectives

After reading this module, you should be able to:
1. Explain how microbiological, physical & chemical hazards can be reduced and prevented.
2. Discuss how temperature control can be used to eliminate, reduce or prevent hazards and risks to food safety.
3. List the different methods of food preservation and storage.
4. Explain the procedures for disposal of unsound foods.
5. Explain how food pests can be discouraged or eliminated and the risks involved in chemical control methods.

5.0 Reducing and Preventing Contamination of Food

All food handlers are responsible, to some extent, for controlling or eliminating all food hazards to ensure that the food they prepare and serve is fit for human consumption. Reduction or elimination of risks can be achieved by:
- General methods
- Temperature control
- Food storage & preservation
- Control of food pests

5.1 General Methods

A. Control for bacterial risks
   - Purchasing foods: especially high-risk foods (from reputable suppliers that should have good controls to prevent contamination).
   - Good standards of personal hygiene: particularly with regard to hand washing minimizing food handling wherever possible and using disposable gloves or clean utensils to handle, where appropriate.
   - Keeping raw and cooked foods apart in storage areas and food preparation areas.
   - Using separate equipment and utensils for raw and cooked foods or through cleaning between users.
   - Making sure equipment, utensils and surfaces are properly cleaned between uses proper disposal of empty food containers that may contain spoiled or contaminated waste.
   - Keeping displayed and stored foods properly covered keeping food areas free from waste.
   - Preventing staff with health problems from handling food.

B. Controls for chemical risks
   - Properly stored in appropriate containers.
   - Kept in locked cupboards away from food storage and preparation areas.
   - Used in accordance with given instructions.
   - Disposed carefully and safely after use.

C. Control for physical risks
   - Wearing appropriate clothing.
   - Proper maintenance of premises and equipment.
   - Preventing smoking in food preparation areas.
   - Controlling the entry of non-food handlers to food preparation and storage areas.
   - Use of metal detectors (for larger food premises).
• Use filters and sieves.
• Properly trained the food-handling staff to deal with these problems.

5.2 Temperature Controls

• The most effective way of controlling the growth of microorganisms in food.
• Kept foods, especially high-risk foods out of temperature danger zone (TDZ) as much as possible.
• Risks arise where foods are:
  i. Left at room temperature.
  ii. Left in sunlight.
  iii. Heated or cooled slowly.
• Microorganisms can be destroyed by heating food.
• Cooked and heated food using appropriate methods and temperatures.

• The rules for heating and cooling foods
  i. Liquids should be cooked in amounts small enough to ensure even temperatures throughout, and stirred frequently.
  ii. Re-heating of cooked foods is best done quickly in infrared units, microwave ovens or forced air-circulation ovens.
  iii. Food should be cooked or reheated to at least 75°C to destroy any organisms.
  iv. If food is to be eaten cold, it should be cooled quickly to prevent new bacterial growth.

• Using frozen foods (thawing procedures)
  i. Ensure that food is completely thawed before cooking (allow sufficient time).
  ii. Food that is being thawed should be kept separate from other foods.
  iii. Microwave ovens can be used to thaw some foods.
  iv. Food should not be re-frozen once thawed.

• Checking temperatures
  i. Checks should be carried out to make sure all foods are being stored at the right temperature.
  ii. Temperatures should be checked using appropriate measuring equipment.
  iii. Records should be kept of the readings.
  iv. All equipments should show temperatures but food temperature (surface & internal) should also be checked.
  v. Types of kitchen / food thermometers (refer to handout).

• When to check temperature (the number of temperature checks carried out will depend on the process or storage method)
  • Check frequently throughout the day food on display, hot/cold).
  • Daily checks - refrigerators, refrigerated display cabinets & freezers.
  • Checks as required - food that is delivered, thawed, cooked, reheated & cooled.
5.3 Food Storage

- The proper storage of foods is essential to ensure good food hygiene.
- If food is not stored correctly, there is risk of contamination and spoilage.
- This can also lead to unnecessary wastage of foods.
- There are three types of storage areas in foodservice operation;
  i. Dry storage.
  ii. Refrigerated / Chill / Cold storage.
  iii. Frozen storage.

A. Dry Storage
- Dry foods include pasta, rice, dried fruits, dried milk, flour and cereals, and canned foods.
- The storage is needs to be dry, cool and well ventilated.
- Internal surfaces should be well finished, so that, easy to clean the store should restrict any access by pests.
- Storage of food should be on open shelving which is raised from the floor.
- Flours and cereals should be stored in lidded bins rather than their original sacks which can allow access by pests.
- Canned foods should be regularly checked to identify damaged, dented or rusty cans.
- Other boxed foods will need checking for signs of deterioration, damage or infestation any spillage of food should be cleared up immediately to avoid attracting pests.
- Stock rotation is particularly important.
- A 'First In, First Out'(FIFO) system should be adopted.
- Stores should be organized so as to prevent old stock being lost at the back of shelves.

B. Refrigerated Storage
- Refrigerated stores include refrigerators, walk-in chill stores and chill cabinets they should be used to store high-risk foods.
- Used for storing perishable foods such as meat and dairy products for short periods.
- Should be set to operate at temperatures between 0°C and 4°C.
- Their temperature should be checked daily.
- Should be sited away from direct sunlight, and from any other source of heat.
- Motors should be readily accessible, regularly cleaned and well ventilated.
- Should be fitted with self-closing doors and plastic strip doors so the correct temperature can be properly maintained.
- Keep the stores clean, inside and out.
- Door seals should receive particular attention in order to prevent the build-up of dirt and damage.
- Should be separate refrigerators for raw and cooked foods, if not possible, foods should be stored as follows:
  i. Top shelves - butter, lard, margarine, cheeses, eggs, convenience foods, cooked items, preserves, salad dressings, spreads and sauces.
  ii. Centre shelves - cooked meats, milk products.
  iii. Bottom shelves - raw meats, poultry and fish.
  iv. Salad drawer - salad.
  v. Door racks - milk and fruit juices.
- It is a good idea to label shelves according to use.
- All foods should be stored in clean, labeled, covered containers.
- Stock rotation is important.
C. Freezers
- Freezers should operate at around -18°C or lower.
- Foods should be wrapped and can be tightly packed into freezers as this will prevent warm air entering when the freezer is opened.
- Freezers are generally designed to store ready-frozen foods.
- Freezers should be fitted with an automatic temperature device and preferably an alarm.
- All staff should be aware of procedures to be followed if freezers break down.
- Foods that have partially or fully thawed should never be re-frozen.

D. Chill Cabinets
- Refrigerated display units used in shops to display foods for sale.
- The food is cooled by cold air being circulated over the food.
- Draughts, sunlight and lighting can all affect food temperature and need careful control.
- The highest temperature allowed is 8°C but a lower temperature should be used if it is thought necessary for the foods being stored.
- Different foods will require different temperatures.

E. Hot Holding
- Hot cupboards are used to hold foods prior to serving.
- They are for foods that are already hot, not for re-heating food.
- Cabinets and containers should be heated prior to use to ensure food is not inadvertently cooled.
- Foods should be held for the minimum amount of time and must be kept at a temperature of at least 63°C.
- The temperature should be checked frequently.

F. Delivery of Food
- Managers need to ensure that delivery areas are kept clean and free from pests to reduce the risk of contamination.
- Foods should be transferred to proper storage areas as soon as possible. After delivery all foods should be checked before being moved to storage areas.
- Checking should cover:
  i. Ensuring the correct foods has been received.
  ii. Sell by/use by/best before/ expiry dates.
  iii. Checking for damage to packaging or food.
  iv. Looking for any signs of pest infestation.
  v. Checking that foods (particularly frozen & chilled foods) are supplied at the right temperature.
5.4 Storage of Non-Food Item on Food Premises

- The storage of non-food items on food premises is unavoidable.
- These include cleaning and maintenance materials, personal items belonging to employees, and waste from food production and preparation.
- All of these are hazards in food-handling areas and need to be properly stored;
  
  i. **Cleaning and maintenance materials**
  - Can taint and poison food if allowed to contaminate it.
  - All chemicals used in food-handling areas should be stored in suitable containers, clearly labeled and securely stored away from the food handling areas.
  - All materials and equipment used for cleaning and maintenance should be locked away when not in use.
  - Care should also be taken not to store together any chemicals which could react if mixed.
  - The control of such items should be the responsibility of a designated staff member.

  ii. **Personal items**
  - Include outdoor clothing, money, jewelry, handbags, etc.
  - Any food-handling establishment should provide storage facilities in which staff can store personal items.
  - Dirty clothing should be stored separately until it is sent to be laundered.

  iii. **Waste**
  - Use suitable waste bins with tight fitting lids.
  - Emptied inside waste bins several times during the day and always at the end of the day.
  - Clean thoroughly before being re-used.
  - External waste-storage areas need to be kept clean and tidy to prevent infestation by pests.
  - Surfaces should be regularly hosed down and waste bins washed out.

5.5 Food Preservation

- Preserving food extends its shelf life by limiting the growth of microorganisms.
- There are many different methods of preserving foods but there are no methods which can preserve food indefinitely.
- While it is useful to be able to prolong the shelf life of foods, the method of preservation often changes the taste, texture or nutritional value of the food.
- **Food Preservation**: processes involved in protecting food against microbes and other spoilage agents to permit its future consumption.
- The preserved food should retain a palatable appearance, flavor, and texture, as well as its original nutritional value.
- The following four points are the main reasons of food preservation:
  
  i. To protect food against microbes and other spoilage agents.
  ii. To ensure that food is safe for future consumption.
  iii. To prolong food storage time.
  iv. To allow many foods to be available year-round, in great quantity and the best-quality.
• **Principles of preservations**
  • Micro-organisms, enzyme, chemical reaction of food components are the main causes of food spoilage.
  • So the principles of preservations are:
    i. Killing of micro-organisms.
    ii. Inhibition of microbial growth.
    iii. Removing micro-organisms.
    iv. Destroying enzyme.
    v. Retardation of chemical changes.

• **Control of microbial growth in foods**
  i. By controlling temperature - freezing / heat (wet / dry).
  ii. By removing oxygen - airtight containers / vacuum packing.
  iii. By adding chemical preservatives.
  iv. By reducing the moisture content - evaporation / dehydration / desiccation.
  v. By exposure to ultraviolet rays - irradiation.

### 5.6 Control of Food Pests

• In any food premises, steps should be taken to prevent pests gaining entry and breeding.
• Once pest have infested premises, they are very difficult to remove.
• Discouraging pests;
  i. **Rodents**
     1. Ensuring there are no holes in walls, windows, drains, and around where cables or pipes enter the building.
     2. Maintaining the areas outside the building by clearing waste and weeds that could act as nest sites.
     3. Fixing metal kick plates on doors to prevent rodents gnawing holes.
     4. Restricting access to food and water by covering water tanks and storing food off the floor.
  ii. **Birds**
     1. Making all openings (windows, ventilation apertures, root spaces etc.) into the building bird-proof and filling all holes.
     2. Covering waste and clearing spillage of food.
  iii. **Insects**
     1. Keeping doors and windows screened or closed.
     2. Covering all foods in preparation areas and storing food in covered containers.
     3. Keeping all food preparation and toilets and washing areas clean and free from waste, cleaning up spillage immediately.
     4. Transferring all waste - food and any packaging or other materials - to bins as soon as possible.
     5. Keeping waste in covered bins, whether inside or outside the premises and ensuring they are emptied frequently.
     6. Placing dustbins off the ground.
     7. Checking all incoming food for signs of infestation.
• **Getting rid of pests**
  
  i. Should be carried out by experts (they will first assess the extent of the problem before deciding how it should be dealt with).
  
  ii. Infestations will often affect adjoining properties and all properties will need to be treated.
  
  iii. Rodents, cockroaches and ants are particularly difficult to eradicate and may require that the premises be closed down during treatment.
  
  iv. The usual method of eradication is by use of chemicals, which can be a hazard in themselves.
  
  v. Insecticides can be used to kill flying and crawling insects, though they will not kill the eggs of cockroaches.
  
  vi. Generally, a second application will be required to kill the newly hatched cockroaches.
  
  vii. Electrified ultra violet lights are used in food premises to kill flying insects.
  
  viii. Poisons based on anticoagulants are normally used to kill rats and mice (they stop the blood from clotting and cause internal bleeding which is fatal).
Proper Use of Gloves

When using gloves, you should:
1. Wash your hands before putting them on and when changing to a fresh pair.
2. Make sure they fit properly.
3. Change them when necessary.
4. Remove them properly.
5. Never wash and reuse them.
Personal Cleanliness & Proper Attire

As a food handler, you should:
1. Wear a clean hat or other hair restraint.
2. Wear clear clothing.
3. Remove your apron whenever you leave a food preparation area.
4. Remove jewelry while working in food preparation areas.

Employee Illness
Tell your manager if you have any of these symptoms:

- Fever
- Diarrhea
- Vomiting
- Sore throat with fever
## Thermometer Types and Uses

<table>
<thead>
<tr>
<th>Thermometer</th>
<th>Features/ Uses</th>
</tr>
</thead>
</table>
| Infrared          | **Measures the surface temperature of food without actually touching the food.**  
                   | • Can measure many different products without cross contamination.  
                   | • Check the accuracy frequently.  
                   | • Potential for thermal shock – (i.e., needs about 20 minutes to adjust between hot and cold temperature).                                                                                                     |
| T – Sticks (melt device) | **Single – use disposable thermometer measures only one temperature.**  
                   | • Wax coating melts when the temperature reaches or exceeds a set point.  
                   | • Used to monitor product temperature and sanitizing temperature in dishwashing machines.                                                                                                                   |
| Built - In        | **Refrigerated and frozen food cases contain built – in thermometers to check temperatures for food storage.**                                                                                             |
| Maximum Registering (Holding) | **Measures the temperature of hot water used to sanitize dishware and utensils in mechanical ware washing machines. This device is becoming less popular because it contains mercury which can be a contaminant of food and the general environment.** |
| Storage/ Appliance | **Used to check internal temperature of refrigerators and coolers - range of -40°F to 80°F.**  
                   | **Used to check internal temperature of freezers - range of -40°F to 80°F.**  
                   | **Used to check the temperature of storerooms - range of -60°F to 120°F.**                                                                                                                                  |
### Thermometer Types and Uses

<table>
<thead>
<tr>
<th>Thermometer</th>
<th>Features/ Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dial Faced, Metal Stem Type (bi-metallic)</strong></td>
<td>Used to measure internal food temperatures at every stage of food preparation. Dial faced – most common type of thermometer used.</td>
</tr>
<tr>
<td></td>
<td>• Measures temperatures ranging from 0 °F ( -18°C) to 220 °F (104°C) with 2 °F increments.</td>
</tr>
<tr>
<td></td>
<td>• To ensure accurate measurements, the stem of a bi – metallic thermometer must be inserted at least 2 inches into the food item being measured.</td>
</tr>
<tr>
<td><strong>Digital</strong></td>
<td>Displays the temperature numerically.</td>
</tr>
<tr>
<td></td>
<td>• Measures a wider range of temperature than a dial faced.</td>
</tr>
<tr>
<td><strong>Thermocouple</strong></td>
<td>Provides a digital readout of the temperature and has a variety of interchangeable probes for different application.</td>
</tr>
<tr>
<td><strong>Bimetallic Stemmed/ Digital Stemmed (Thermistor)</strong></td>
<td>Used to check the internal temperature of food - range of 0°F to 220°F.</td>
</tr>
<tr>
<td><strong>Meat (Bimetallic Stemmed)</strong></td>
<td>Used to check the internal temperature of meats during cooking – range of 130°F to 190°F.</td>
</tr>
<tr>
<td><strong>Equipment</strong></td>
<td>Used to check the internal temperature of ovens - range of 150°F to 600°F.</td>
</tr>
<tr>
<td></td>
<td>Used to check the internal temperature of hot holding cabinets - range of 100°F to 175°F.</td>
</tr>
</tbody>
</table>
Use a Thermometer

A burger starting to edge up on medium-rare

Guide to Gauge When Your Meat is Done

Confirm it is at 170 degrees F with instant-read thermometer

Use a jam thermometer - the mixture should reach about 104.5 degrees C

Maverick Oven and Roasting Digital Thermometer with Timer

Built – In Temperature Salad Bar
**Thermometer Guidelines**

- Food temperature – measuring devices scaled only in Celsius or dually scaled in Celsius and Fahrenheit must be accurate to ±1.8°F (± 1°C). Food temperature – measuring devices scaled in Fahrenheit only must be accurate to ±2°F.
- Mercury – filled and glass thermometers should not be used in food establishments.
- Clean and sanitize thermometers properly to avoid contaminating food that is being tested. This is very important when testing raw and then ready – to – food items. To clean and sanitize a thermometer, wipe off any food particles, place the solution for at least 5 seconds, then air – dry.
- When monitoring only raw foods or only cooked foods being held at 135°F (57°C), wipe the stem of the thermometer with an alcohol swab between measurements.
MODULE 6

SUPERVISORY ISSUES
Learning Objectives

After reading this module, you should be able to;
1. Explain the supervisor's role in the management of food hygiene.
2. Explain the importance and methods of good food hygiene and safety training for food handlers.
3. Explain the principles for selecting hygienic food premises, designing suitable layouts, and installing appropriate equipment.
4. Explain the importance and methods of cleaning and maintaining food premises.
5. Discuss the principles and application of HACCP systems.

6.0 Food Hygiene Training

- By law, food handlers are required to have some food hygiene training.
- Managers should ensure that training is updated at appropriate intervals or when changes in role, tasks or processes require it.
- Training should cover all general aspects of food hygiene including the causes and prevention of food poisoning (FBI).
- Staff should understand enough about microbiology to realize why the procedures they are required to follow are necessary.
- Managers should ensure that all training is carried out at the appropriate level, using methods suited to the staffs that are being trained.
- Updates will be required at regular intervals and also in relation to specific new roles, processes, tasks or products.
- 'On the job' instruction will help staff understand the importance of hygienic practices specifically in relation to their own role.
- Managers and supervisors will need to ensure that records are kept of the level, coverage and date of training for each member of staff (provide as evidence and a reference for keeping training up to date and relevant).

6.1 Design and Construction of Food Premises and Equipments

- Food premises are defined as any site where food is prepared, stored or sold.
- This includes a wide variety of organizations at every stage of the food chain (production, processing, preparing, serving and selling).
- Food hygiene is a principal concern when designing and constructing food premises.
- Up-to-date regulations and guidance on design and construction of food premises should always be consulted before any construction or improvement work takes place.
- Site
  - Access to the site for staff, deliveries of raw materials, distribution of the product & removal of waste.
  - Provision of mains gas, electricity & telephone as well as a clean water Supply (for appropriate usage - drinking, washing & preparing food, cleaning food contact surfaces & equipments, hot) & sufficient sewage disposal facilities.
  - Possible contamination by industrial fumes, dust or smoke, refuse sites, derelict areas or by flooding.
• Design (should allow for hygienic operations)
  ♦ Work flow - should allow for food to move quickly through the processing stages, minimizing the time that is left at room temperature.
  ♦ Space - sufficient space for each separate food-processing task.
  ♦ Cleaning - easily accessible for frequent cleaning.
  ♦ Pests - to restrict access to rodents, insects and birds.
  ♦ Storage areas - suitable storage areas for each different type of food.
  ♦ Hygiene facilities - sufficient and appropriate toilet & washing facilities.
  ♦ Ventilation - to reduce the build up of heat and odors.
  ♦ Lighting - good lighting is essential to make working conditions safer, to allow thorough cleaning, and to discourage pests.
  ♦ Refuse disposal - allow for hygienic disposal of all refuse.

• Construction (suitable materials, waterproof, minimize access for pests)
  ♦ Walls & foundations - solidly built.
  ♦ Roof - not provide roosting sites or pooled water.
  ♦ Floor surfaces - hardwearing, non-slip.
  ♦ Drainage - smooth & curved gullies, not overflowing, grease trap, covers & traps.
  ♦ Internal wall surfaces - easily cleaned, resistant to hot fat, light colored.
  ♦ Ceilings - washable, suitable height.
  ♦ Doors - washable, restrict access for pests.

• Equipment
  ♦ Any surfaces do not react with food and drink or absorb any liquids.
  ♦ Easy to clean, no cracks, crevices.
  ♦ Easy to maintain and repair.
  ♦ The food is protected from the external environment.
  ♦ Mobile, so it can be moved for cleaning.

6.2 Cleaning

• Cleaning is essential part of any food-related operation.
• Owners and managers have a legal responsibility to ensure premises and equipments are kept clean and in good repair.
• Food Debris - can harbour pathogenic bacteria, contaminate food and attract pests.
• Dirty premises - will discourage customers.
• Cleaning & disinfecting will help to reduce the hazards associated with food debris.
• Cleaning is achieved by physical effort (people / machines) by the use of hot water or chemicals definitions:
  ♦ Cleaning - the process of removing dirt.
  ♦ Disinfection - destructing of microorganism to a level not hazardous to health or likely to cause food spoilage.
• **Stages of cleaning & disinfection**
  1. **Pre-clean** - removing any loose dirt and heavy soiling.
  2. **Clean** - washing the equipment, utensils or surfaces with hot water & detergent.
  3. **Rinse** - to remove any detergent and remaining dirt (should be done with hot water).
  4. **Disinfect** - using chemical disinfectants / hot water (above 82°C).
  5. **Final rinse** - will make sure that any remaining detergents or cleaning fluids are removed (using clean, hot water).
  6. **Dry** - air drying is the most hygienic method of drying, if not, use absorbent disposable towels.
  7. **Clean & store cleaning equipment** - should be cleaned & disinfected, all equipments & chemicals should be returned to their appropriate storage areas.

• Not all surfaces & equipment require disinfection. Disinfection is appropriate for:
  ♦ Food contact surfaces such as work surfaces & chopping boards.
  ♦ Hand contact surfaces such as door handles.
  ♦ Cleaning materials & equipment.

• **Cleaning schedules**
  • Every food handling operation should have a written cleaning schedule.
  • The objectives - to ensure that cleaning is carried out as efficiently as possible, follows a routine and uses a minimum number of cleaning chemicals.
  • **Should identify:**
    1. All equipment, utensils, surfaces and areas that need cleaning & disinfection.
    2. How often each of the above should be cleaned & disinfected.
    3. When cleaning & disinfecting should be carried out in each case including during & after food preparation and when spillage occurs.
    4. The persons responsible for each cleaning task.
    5. Methods & materials that are to be used for each cleaning task, including the amounts and types of chemicals to be used for each task
    6. Any safety precautions that need to be considered with regard to the method of cleaning, the items being cleaned and the cleaning chemicals and equipment used.
  • Equipment for cleaning (sponge, mops & brushes, disposable cloths)
  • Cleaning chemicals (detergents, disinfectants, strong acids and alkalis)

6.3 **Hazard Analysis Critical Control Points**

• It is important for any food business to identify possible areas of risk and minimize or control them.
• HACCP is an approach that has been developed to systematically identify food hazards and take action to prevent, minimize or remedy them.
• The aim of HACCP is to focus on potential problems and put in place specific control measures to prevent them occurring.
• An appropriately qualified person should carry out the analysis.
• The approach has 7 principles.
• The implementation of HACCP will depend upon the type and size of food business, but there are some basic steps which will need to be taken in most cases i.e.:
  • Planning.
  • Appointment of suitable persons.
  • Documenting operations.
  • Introducing HACCP.
  • Checking the system.

• HACCP is a management system in which food safety is addressed through analysis and control of biological, chemical, and physical hazards from raw material production, procurement and handling, to manufacturing, distribution and consumption of the finished product.

• HACCP is a systematic approach to the identification, evaluation, and control of food safety hazards based on the following seven principles:

  Principle 1: Conduct a hazard analysis.
  Principle 2: Determine the Critical Control Points (CCPs).
  Principle 5: Establish Corrective Actions.
  Principle 7: Establish Record Keeping and Documentation Procedures.

• For successful implementation of a HACCP Plan, management must be strongly committed to the HACCP concept. A firm commitment to HACCP by top management provides company employees with a sense of the importance of producing safe food.

• HACCP is designed for use in all segments of the food industry from growing, harvesting, processing, manufacturing, distribution, and merchandising to preparing food for consumption.

• Prerequisite programs such as current Good Manufacturing Practices (GMPS) are an essential foundation for the development and implementation of successful HACCP Plans.

• Food safety systems based on the HACCP Principles have been successfully applied in food processing plants, retail food stores and food services operations.

• The seven principles of HACCP have been universally accepted by government agencies, trade associations and the food industry around the world.
Receiving Commodities

Larder
Butchery

Stores
1. Dry
2. Cold
3. Freezer

Kitchen
Preparation
(Perishables and Non-perishables)

Prepare

Cool
Cook

Portion Out

Refrigerat
Hot Holding

Pantry

Serve

Pot and pan store

Dishwashing
(Crockery and Cutlery)

Store
(Service dishes)

Cooking Waste

Cook

Trimmings refuse

Garbage

Yard

Plate Waste

Layout of a Kitchen Ensuring Smooth Flow of Work
1. Air Dry
2. Mechanical Wash, Rinse, Sanitize
3. Rack and sort properly
4. Scrape

Commercial Dishwasher
0: Garage
Sink 1: Wash - Soap, Warm Water & Dish Washing Soap.
Sink 2: Rinse - Clear Water at least 43°C (110°F).
Sink 3: Disinfect - Clean Water plus Disinfectant at 24°C (75°F).
4: Drain
General Guidelines for Implementation of HACCP in a Poultry Processing Plant
Fresh Cut product transferred to Fresh Cut cool store

Raw material & condiment storage

Product transferred to plant

Trimming & Coring

QAP 6

Baby Leaf Lettuce

Slicing/Shredding

Grading

Pre Wash in Middle Bath (if required)

Pre Wash

Washing & Mixing

CCP 2

Drying

Weighing

Bagging/Packing

HACCP Flowchart for Post Harvest

QAP 7

Packaging Transfer

HACCP A Post Harvest Facilities

Metal Detection/Weight

Boxing or Crating

Finished Product storage

Despatch

QAP 4

CCP 3

CCP 4
MODULE 7

FOOD REGULATION
Learning Objectives

Upon completion on this module, the students should be able to;
1. Explain the objective of food regulation.
2. List down systems, which relate to food regulation.
3. Explain on Food Act 1983 and Food Regulation 1985 and the requirements.
4. Explain on the Code of Practice for Food Hygiene and the requirements.

7.0 Introduction

- Main objectives of regulation / legislation are to;
  i. Protect the consumer/public from health hazards and fraud in the preparation, sale and use of foods and for matters connected.
  ii. To ensure that the food safe for consumption.
  iii. Upgrade the food quality.

- Systems which relate to the food regulation are:
  i. Good Manufacturing Practices (GMP).
  ii. Hazard Analysis Critical Control Point (HACCP).

- Examples of regulation set by the government to achieve the above mentioned objectives are:
  i. Food Act 1983
  ii. Food Regulation 1985
  iii. Food Hygiene Regulation 2009

- These legislations replace the Sale of Food and Drug Ordinance and Regulations 1952.
- The Food Act 1983 and the Food Regulations 1985 of Malaysia govern the various aspects of food safety and quality control including food standards, food hygiene, food import and export, food advertisement and accreditation of laboratories.
- The Food Act 1983 and the Food Regulations 1985 are the Malaysian food legislations that form the backbone of the food safety program.
- Other legislations that have an impact on food safety are the Pesticide Act 1974, the Fisheries Act 1983, the Veterinary Surgeon Act 1974 and the Animal Ordinance 1953, all under the Ministry of Agriculture and Agro-based Industry, the Trade Description Act under the Ministry of Domestic Trade and Consumer Affairs, etc.
- The enforcement of Food Act 1983 and the Food Regulations 1985 is targeted towards reducing food-borne hazard and ensuring that food is safe for human consumption.

- The Food Safety and Quality Division (FSQD) of the Ministry of Health (MOH) are charged with the implementation and enforcement of the law. FSQD implements an active food safety program which includes:
  • Routine compliance.
  • Sampling.
  • Food premises inspection.
  • Food import control activity and licensing of specified food substances required under Food Act 1983 and its Food Regulation 1985.
  • It also conducts a food monitoring activity on specific food contaminants and additives.
• As a preventive approach, the FSQD have been implementing:
  • Food handlers training program.
  • Vetting of food labels.
  • Giving advice to the industry and consumers.
  • Food safety certification scheme such Health Certificate, HACCP certification and Free Sale Certificate.
• Specific compositional and labeling requirements were developed for particular food products. The use of health claims on labels is very restrictive. The content requirements are not restrictive for U.S. products, but receiving approval for new food additives, especially those not currently recognized by Codex Alimentarius can be onerous. Since more than half of the Malaysian population is Muslim, labeling requirements for products containing pork and alcohol are very strict.
• Attention should be given to adhering to Malaysian labeling requirements to avoid any problems at the port of entry or on the retail level.

7.1 Food Act 1983

• Purpose is to protect the public against health hazards and fraud in the preparation, sale and the use of food.
• A set of law documentation approved by the DYMM SPB Yang Dipertuan Agong with the advice and consent of the Dewan Negara and Dewan Rakyat.
• This act gives the Ministry of Health the authority to;
  i. inspect any food premise,
  ii. take samples and
  iii. do the analysis to check the status of cleanliness and safety of a food.
• This act consists of 5 parts:
  i. Preliminary.
  ii. Administration & Enforcement.
  iii. Offences & Evidence.
  iv. Importation, Warranty & Defenses.
  v. Miscellaneous.

7.2 Food Regulation 1985

• Based on Section 34 in Food Act 1983, this regulation is set up by the authorized Minister.
• It consists of 10 parts:
  i. Preliminary.
  ii. Warranty.
  iii. Procedure for taking sample.
  iv. Labeling.
  v. Food additives & nutrient supplement.
  vi. Packages for food.
  vii. Incidental constituent.
  viii. Standards & particular labeling requirements for food.
  ix. Use of water, ice or steam.
  x. Miscellaneous.
7.3 Food Hygiene Regulation 2009

- Based on Section 34 in Food Act 1983, this regulation is set up by the authorized Minister.
- It consists of 7 parts:
  i. Commencement (name and interpretation).
  ii. Registration of food premises.
  iii. Conduct and maintenance of food premises.
  iv. Food handlers.
  v. Special handling requirements, preparation, packaging, presentation, storage and sale of food special.
  vi. Food transport.
  vii. Miscellaneous.

7.4 Code of Practice for Food

- Purpose is to serve as guidelines for food inspectors, food manufacturer and public in terms of the implementation of sanitation and good practices in a food premises or factory in Malaysia.
- The Code of Practice for Food Hygiene, which covers the registration and inspection of all food establishments, was approved in May 1980. In the same year, the Code of Practice for the Export of Frozen Cooked Prawns was introduced, and, in 1982, the Code of Practice Applying to School Canteens was adopted.
- It consists of 4 parts:
  i. General requirements - 3 parts (registration of premises, conduct & maintenance of food premises, conduct of workers).
  ii. Specific requirements - place of sale - 3 parts (meat & fish (sale), stalls, food vending machine).
  iii. Specific requirements - place of manufacture - 3 parts (meat & fish, manufacture of syrup, cordials, aerated water & other beverages, manufacture of ice-cream & frozen confections).
  iv. Miscellaneous requirements - 5 parts (packing & storage of milk, transport of food, requirements for registration of premises, evaluation schedule for food premises, evaluation schedule for stalls).

7.5 Conclusion

- In order to ensure that the food safety legislations are in tandem with the development in food technology as well as to keep abreast with the changing consumer demands, it has to be continuously revised and updated.
- The establishment and updating of food safety legislation throughout the food chain is essential in establishing an effective food safety system.
- Food safety legislation should be developed and updated taking into consideration specific needs of consumers and food producers, development in technology, emerging hazards, changing consumer demands and new requirements for trade, harmonization with international and regional standards, obligations under the World Trade Organization (WTO) agreements, as well as social, religious and cultural habits.
- The continuous revision and updating of the Food Regulations 1985 is conducted by the Technical Advisory Committee on the Food Regulations 1985 chaired by the Director of the FQCD, Ministry of Health.
• It is an inter-agency committee consisting of relevant government agencies involved in food safety from farm-to-table, the food industry, professional bodies and the consumers.
• Request for updating the food safety legislations is mainly made by the food industries (especially on the use of new ingredients and additives) and consumers (who demanded to be informed of new technology and new processes so as to be able to make an informed choice of the food they buy).
• To assist the Committee in ensuring that specific areas of concern in food safety is addressed, various working groups comprising experts in the specialized areas are established to undertake work, namely in the following areas:
  • Food Additives and Contaminants
  • Food Labeling
  • Food Commodity Standards
  • Nutrition and Claims
  • Microbiology
  • Pesticide Residue
  • Drug residue
  • Fats and Oils
• Currently new Acts and Regulations being drafted to enhance the implementation of the food safety program include:
  • Food Irradiation Regulations
  • Food Import Regulations
  • Food Analyst Act
  • Animal Feed Act