

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
**COLLEGE OF NATURAL SCIENCES**  
**DEPARTMENT OF MICROBIOLOGY**

**Course Code:** MCB 401

**Course Lecturers:** Dr. O. R. Afolabi, & Dr. F. Oluwafemi

## **Food Microbiology**

### **COURSE OBJECTIVES:**

- i) Enable students understand microorganisms can be found in and around the food environment.
- ii) Ways of effectively reducing the numbers of microorganisms in food
- iii) Causative agents of food spoilage : bacteria, fungi, viruses, protozoa, helminthes, algae & chemicals
- iv) How to ensure food safety in the home and industry using food hygiene laws

### **Microbiology of local foodstuffs**

Fermented foods: Fermented legumes, fermented animal protein, fermented milk, cereal, alcoholic beverages, etc.

Benefits of fermentation:

- Preservation
- Variety in flavor, types
- Inedible food become edible
- Improved digestibility
- Enhanced nutrient level
- Anti-viricidal, anti-tumour, anti-microbial etc.

### **Principles of food preservation**

- \* Asepsis
- \* Removal of microorganisms e.g. filtration
- \* Maintenance of anaerobic condition
- \* Use of high temperature
- \* Use of low temperature
- \* Drying

- \* Chemical preservation
- \* Irradiation
- \* Combination of 2 or more methods

### **Food-borne illness:**

Definition-----Food-borne illness has been defined by WHO as a disease of an infectious or toxic nature caused by or thought to be caused by the consumption of food or water. Most of food-borne diseases are microbial in origin and an important cause of reduced economic productivity.

### **Types of food-borne diseases**

1. Food intoxication: an illness caused by a toxin or poison in food The toxin is an exotoxin, extracellular, gram +ve bacteria and occasionally gram –ve. It is protein in nature and present in filtrates of growing cell
2. Food infection: An illness caused by infection produced by organisms present in food when consumed. The toxin is an endotoxin and is cell-associated. It is a complex lipopolysaccharide of gram-ve bacteria. Toxin is intracytoplasmic and only released on autolysis or extraction of cell. The endotoxin is less potent and more specific in their action than the exotoxins

Possible causes of foodborne illness: Bacteria, Fungi, Chemicals, Viruses, Protozoa, Helminths & Algae.

### **Microbiological agents of foodborne illness:**

#### **BACTERIA:**

*Aeromonas, Bacillus cereus, Brucella species, Campylobacter jejuni, Clostridium botulinum, Cl. Perfringens, Escherichia coli, listeria monocytogenes, Mycobacterium bovis, Salmonella Typhi, Salmonella (non-Typhi), Shigella, Staphylococcus aureus, Vibrio cholera 01, Vibrio cholerae, non-01, Vibrio parahaemolyticus, Yersinia enterocolitica*

#### **VIRUSES:**

Hepatitis A virus, Norovirus, Rotavirus

#### **PROTOZOA:**

*Cryptosporidium parvum, Entamoeba histolytica, Giardia lamblia*

#### **HELMINTHS:**

*Ascaris lumbricoides, Taenia saginata and T. solium, Trichinella spiralis, Trichuris trichiura*

### **Factors contributing to outbreaks of food poisoning:**

Preparation too far in advance, Storage at ambient temperature, inadequate cooling, contaminated processed food, undercooking, contaminated canned food, inadequate thawing, cross contamination, food consumed raw, improper warm handling, infected food handlers, use of left over, extra large quantities prepared

### **The pathogenesis of diarrhoeal disease:**

Causative agents confined to gut and its immediate vicinity

Patient presents acute gastroenteritis characterized by diarrhea and vomiting.

Common features of mechanisms involved in diarrhea:

Excessive evacuation of too-fluid faeces

Gut unable to absorb 8-10 litres of fluid it receives daily

Illness due to damage to host by microorganisms

Toxins are the direct cause of diarrhea (Exotoxins & Endotoxins)

Typical example is cholera toxin produced by *Vibrio cholerae*.

Toxin (MW84,000) comprises five B subunits and a single A subunit

B subunits bind to specific ganglioside receptors and creates hydrophilic channel

A subunit passes through the hydrophilic channel thus stimulating several biochemical reactions

Na<sup>+</sup> and Cl<sup>-</sup> inhibited

Cl<sup>-</sup>, HCO<sub>3</sub><sup>-</sup> and Na<sup>+</sup> stimulated

Creates osmotic imbalance

Balancing osmosis requires massive outflow of water into intestinal lumen

Results in profuse watery diarrhoea

### **Investigation of food-borne disease**

Necessary information obtained from the following:

Persons who ingested suspected food

Surveys of food preparation

Survey of food storage

Survey of serving operations

Samples taken and processed rapidly in the laboratory

Complete questionnaires from infected persons

Collect remnant of suspected food aseptically

Identify origin of sample, date, time of collection, name of Scientist

Brief description of symptoms of patients & suspected organism or chemical

Water samples should be taken

All sewage and plumbing be evaluated

Presence of insects and rodents must be determined

Determine any ill food handler(6-8 weeks) prior to outbreak

Any diarrhea or vomiting from food handlers, boils, carbuncles and respiratory infections

***Mycotoxins***: mostly food-borne, natural toxic metabolites of fungi, potent carcinogens, mutagens, teratogens, immunosuppressants

### **Common *mycotoxins* and corresponding *mycoflora***

Mycotoxin

Mycoflora

Aflatoxin	<i>Aspergillus flavus, A. parasiticus, A. nomius</i>
Fumonisin	<i>Fusarium verticilloides</i>
Zearalenone	<i>F. graminearum</i>
Ochratoxin	<i>A. Ochraceus, Penicillium verrucosum</i>
Patulin	<i>Penicillium expansum</i>
Ergot alkaloids	<i>Claviceps purpurea</i>

## Toxicity of aflatoxins:

High doses-----lethal, affects lungs, myocardial and kidney tissues

Sub-lethal doses----- causes chronic toxicity e.g liver cirrhosis

Low dose----- human hepatocellular carcinoma

Mutagenicity: Aflatoxin B<sub>1</sub> binds to DNA, induces G to T transversions (p53 mutations)

Teratogenicity: embryonic abnormalities

Forms synergy with hepatitis B virus to cause liver cancer

Stunted growth in children

Immunosuppression

## **Hazard Analysis Critical Control Point:**

Detailed surveillance of a production process

Control of known hazards at specific critical stages

Objective assessment of hazards using a flow-chart

Identification of Critical Control Points (CCPs)

Monitoring at CCPs to ensure process continues within pre-determined tolerance limit