

Foodborne pathogens, Clostridium botulinum food intoxication

Expected Learning Outcome

- Infective and intoxication type of food poisoning and organisms involved
- Gram positive and Gram negative bacteria involved in food poisoning, their distribution, activity, nature of food poisoning and preventive measures to control them.

5.1 Foodborne pathogens

Several human pathogenic microorganisms are associated with food and water in their natural environment, and foods also get contaminated with pathogens during handling and processing. Thus, ingestion of food or water contaminated with pathogens leads to food poisoning affecting the health of consumers.

Food poisoning

Food poisoning is an illness caused either by the ingestion of toxin elaborated by the pathogens or from the infection of the host through the intestinal tract due to ingestion of live organisms. Food poisoning by bacteria can be of two types;

- Bacterial food intoxication
- Bacterial food infections

Bacterial food intoxication

It is a food borne illness caused by the presence of a bacterial toxin formed in the food. It is caused due to consumption of food containing pre- formed toxin but not live bacteria. Two types of food intoxications are caused by bacteria.

- **Botulism:** Food poisoning caused by the ingestion of food containing toxin produced by *Clostridium botulinum*.
- **Sataphlococcal intoxication:** Food poisoning caused by the ingestion of food containing pre-formed toxins produced by *Staphylococcus aureus*

Bacterial food infections

This is a food borne illness caused by the entrance of live bacteria into the body through ingestion of contaminated food. The illness mainly results from the reaction of the body to pathogen's presence or their metabolites.

Ex: *Salmonellosis*, *C. perfringens* illness, *Cholera*, *V. parahaemolyticus* infection etc

Sources of Pathogens

Seafood/ foods of aquatic origin have potential to cause human illness. The entry of bacterial pathogens to aquatic environment /consumers results from the following:

- Pollution of aquatic environment from sewage or animal wastes.
- Consumption of raw or semi processed contaminated food/ water.
- Infected domestic animals used for food. (Ex: *Salmonella* in poultry)
- Unsanitary practices of product handling through food handlers.
- Presence of naturally associated human pathogens in aquatic foods/ environment

5.2. Clostridium botulinum food intoxication

Botulism is a food borne illness caused by the ingestion of food containing neurotoxin produced by *Clostridium botulinum*. It is a Gram positive rod shaped anaerobic spore forming soil bacterium which can grow in the pH range of 4.6 to 8.5. It produces highly potent exotoxin, a neurotoxin, and ingestion of a small quantity (few nanograms: 30-100 ng) can cause paralysis and death.

Toxin types

Seven neurological toxin types (Type A to G) have been recognized based on toxin specificity. Of these types A, B, E and F are pathogenic to man. These are further divided into 2 types.

- Proteolytic types: Includes A, B, and F type toxin producers. These are heat resistant, NaCl tolerant, mesophilic and soil is the general habitat.
- Non-proteolytic types: Includes some strains of B, E, and F. these are heat sensitive, psychrotolerant, NaCl sensitive and aquatic environment is the natural habitat.

Toxins produced by type A, B, E and F cause human botulism. Botulinal toxin is one of the most potent of all poisons and very low amounts (30 -100 ng) can cause death.

Clostridium botulinum Type E

C. Botulinum Type E is associated with fish and fishery products and is primarily of marine origin. It is ubiquitous in natural environment including marine sediment as well as animals, birds and fish intestine. Toxin production by *Cl. botulinum* depends on the ability of cells to grow in food and autolyse to release toxins.

Factors influencing toxin production

- Toxin production depends on the factors influencing spore germination and growth. These include composition of food, moisture content, pH, O-R potential, salt content and temperature and storage conditions.
- In heat processed foods *C. botulinum* are of great significance, as under-sterilization can lead to survival of spore, which under suitable conditions germinate and make food toxic. Even seafood held at low temperature (refrigerated temperature) the type E can grow (at about 3°C). But fail to grow under frozen temperature.
- For the intoxication to develop the preformed toxins should be consumed (food containing toxin). Food that has been eaten which was served without heating prior to serving can cause illness. The toxin is inactivated when heated at 60°C for 5 min. Botulism occurs rarely (incidence of botulism is not common) and most of the outbreaks are associated with fish (Type E).

Symptoms of food poisoning

Symptoms vary from mild illness to fatal condition within 24 hr, symptoms develop within 12-36 hr and include nausea and vomiting followed by neurological disorders like visual impairment, loss of normal function of mouth and throat, lack of muscle coordination, respiratory impairment leading the death. Onset of symptoms is rapid with type E botulism, while the severity is high with type A

Treatment

Only known method of treatment is by administration of antitoxin and is effective only when

administered before onset of symptoms.

Conditions necessary for outbreaks

- Presence of spores of type A, B, E or F in food being canned or processed.
- Food in which the spores can germinate and clostridia can grow and produce toxin.
- Survival of spores because of inadequate heating in canning or inadequate processing.
- Condition (environmental/storage) after processing that will permit germination of spores.
- Insufficient cooking of food to inactive the toxin.
- Ingestion of toxin bearing food.

Prevention of outbreaks

- Use of approved heat process for canned foods.
- Rejection of all swollen or spoiled canned foods.
- Refusal even to taste a doubtful food.
- Avoidance of foods that have been cooked held but not well heated.
- Boiling of suspected food for atleast 15 min to inactive toxin.