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.

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 paralyses 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 current, pH, O-R potential, salt content and temperature and storage conditions.
- In heat processed foods *C.botulinum* are of great significance, as under-serilization 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^{o}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^{o}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.

***Staphylococcus* food intoxication**

Staphalococcal food poisoning is caused by the ingestion of enterotoxin formed in food during growth of certain strains of *Staphylococcus aureus*. This bacterium produces an exotoxin called enterotoxin which causes gastroenteritis or inflammation of intestinal tract. *S. aureus* is a Gram positive cocci appearing as bunch of grapes.

Most of the entertoxin producing strains are coagulase positive (coagulate blood plasma), produce thermostable nuclease, facultatively anaerobic and grow better aerobically than anaerobic condition. However, some coagulase negative strain also produces entertoxin. These produce six neurologically distinct entertoxin (A, B, C, C2 D and E) which differ in toxicity. Most food poising involves types A or D. Grow in the temperature range of 4–40^{o}C with rapid growth taking placing in the temperature rage of 20-45^{o}C.

Source of *Staphylococcus* to food

Source of staphylococci to foods are mainly from human and domestic animals (primary reservoirs). Commonly encountered in skin, hair, nasal passage, wound and throat. of humans. Food handlers are main source of food contamination with *S. aureus.* Besides, equipment and food contact surfaces also contribute for contaminatin with this organism.

Generally, conditions in foods that favour the growth of *S. aureus* (at about 40^{o}C) are more susceptible for food poisoning. Entertoxins are heat resistant and not inactivated at pasteurisation temperature. Normal cooking of food will not destroy toxin present in food. Seafoods support growth of *S. aureus* when contaminated. High salt tolerance and ability to grow at low water activity (0.86) helps this organism to have competitive advantage over other organisms especially in slat cured products such as smoked fish and salted fish.

Food involved in outbreaks

A variety of foods support the growth of *S. aureus*, and thus responsible for food poisoning outbreaks. The foods generally involved are Fish, meat, bakery products, salads etc.

Disease and symptoms

Individuals differ in their susceptibility to food poisoning and incubation period is more than 4 hrs. Symptoms of food poisoning is characterized by salivation, nausea, vomiting, abdominal cramps, diarrhoea, blood and mucus in stools, headache etc. Mortality is very low and infected persons recover except in extreme cases.

Condition necessary for outbreak

- Food must contain entertoxin producing staphylococci
- Food must support the growth and toxin production by staphylococci
- Temperature must be favorable for growth, and there should be enough time lapses since contamination for toxin production.
- Entertoxin bearing food must be ingested.

Prevention of food poising outbreaks

- Prevention of contamination of food with staphylococci
- Prevention of growth of staphylococci in foods.
- Avoiding consumption of contaminated food.