Biological hazards in foods

Ciguatera fish poisoning (CFP)

- CFP is caused from the ingestion of variety of tropical and subtropical carnivorous reef fishes such as Barracuda, Groupers, Seabass, Snappers etc.
- There are over 300 fish species responsible for CFP.
- The herbivorous reef fishes feeding on toxic dinoflagellates (Gambierdiscus toxicus) are in turn fed by carnivorous fishes which accumulate toxins in their tissue.
- Toxin accumulation is more in liver followed by viscera and muscle tissue.

Symptoms

- Upon ingestion of toxin containing fishes, symptoms occur within 3-6 hours.
- Symptoms are similar to PSP with gastrointestinal disturbances and neurological disorders. These include vomiting, diarrhea, tingling and burning sensation in mouth, lips and throat, muscle cramping and weakness.
- Death generally occurs due to respiratory failure.
- Levels as low as 1ppb in fish can cause illness.

Tetrodotoxin / pufferfish poisoning

- Puffer fish poisoning is caused due to the consumption of puffer fish (tetradon fish or fugu) which have toxic tissues or organs.
- Pufferfish toxin is thought to be produced by the symbiont bacteria (*Pseudomonas*) associated with the fish.
- Tetradotoxin is chemically aminoperhydroquinazoline which is similar to saxitoxin of PSP and cause symptoms similar to PSP but of varying degree.
- Only certain species of puffer fish are toxic and toxin is restricted to the skin, liver, viscera, gonads, intestine and muscle.
- Since the fugue is a delicacy in Japan, most cases of intoxication are reported from Japan with instances of death.

Symptoms

Causes neurological symptoms similar to PSP – tingling in lips and extremities, paralysis and death by respiratory arrest and/ or cardiovascular collapse. Mortality rate is high. Cardiovascular effects are more severe than PSP with high death rates.

Scombroid poisoning

Scombroid poisoning or histamine poisoning is caused by the consumption of fishes containing high levels of histamine. Scombroid fishes (tuna, seer fishes, mackerel) containing red meat are implicated in scromboid pisoning. Other fishes like carangids, herrings, sardines and anchovies are also involved in histamine poisoning.

Source of histamine

Scombroid fishes have high levels of histidine which is converted to histamine by the growth of microorganisms pocessing the enzyme histidine decarboxylase. Conversion of histidine to histamine by microorganisms results in the accumulation of histamine in fish. Bacteria involved in decorboxylation are *Morganella morgani, Klebsiella pnemoniae, Enterobacter aerogenes and Haffnia alvei*. The main source of these bacteria to fish is from post harvest contamination. Though these bacteria grow well at 10^{o}C, highest histamine production occurs at 37^{o}c. Histamine is heat resistant.

Symptoms

- Symptoms of poisoning occur with short incubation period (few minutes to few hours), the illness is mild and self limiting lasting for only few hours.
- Gastrointestinal disturbance (nausea, vomiting, diarrhea), facial flushing, labial edema, itching of the skin and rashes on skin are the common symptoms of illness.
- Maximum permissible limit in seafood is 50 ppm.

Foodborne parasites

Several human parasites are associated with fish and shellfish and consumption of such foods leads to transmission of parasites to humans. These include members belonging to the group protozoans, flat worms and round worms. These parasites are easily detectable in food because of their larger size than bacteria, unable to proliferate in food, not possible to grow on culture media, and complete life cycle by passing through one or more animal hosts. Consumption of foods contain these parasites could lead to health risks.

Protozoan parasites

The important protozoan parasites involved in human illness are members of the genus *Giardia, Entamoeba, Toxoplasma, Sarcocystis and Cryptosporidium.*

Giardia Sp

The flagellated protozoan *Giardia lamblia* exists naturally in aquatic environment and causes human illness called giardiasis.

Characters

- The *Giardia* cells (trophozoites) produce cysts which infect humans through water and food. *T rophozoites* are characterized by the presence of eight flagella arising on the ventral surface near the paired nuclei.
- The cysts are pear shaped, with the size ranging from 8-20 µm in length and 5-12 µm in width.

- The excystation of ingested cysts in upper small intestine releases the trophozoites which invade intestinal wall and bile duct.
- Growth is generally favoured by high levels of bile juice in the duodenum and upper jejunum.

Symptoms of illness

- Giardiasis is highly contagiouis.
- The disease symptoms appear after a incubation period of 6-13 days, cysts appear in stools in 3-4 weeks, and symptoms may last for months to a year or more.
- The leading symptoms of infection are diarrhea, fatigue, abdominal cramps, fever, nausea, vomiting and weight loss.
- The minimum dose required for infection in humans is 10 cysts or less.

Control measures

- Avoiding sewage contamination of natural waters.
- Avoiding consumption of sewage contaminated water and fish harvested from sewage polluted waters.

Entamoeba histolytica

This protozoan parasite is responsible for amebiasis or amoebic dysentery and is transmitted mainly through fecal-oral route, and also through water, food handlers and foods.

Characters

- Entamoeba histolytica is an motile aerotolerant anaerobe, trophozoites are of 10-60 µm in size and lack mitochondria, cysts non motile and are of 10-20 µm in size.
- Trophozoites do not persist in the environment but cysyts can survive in sewage sludge for up to 3 months and transmitted through water and food.
- The trophozoites in intestine adhere to host cell glycoprotein, cause abscesses in intestinal mucosal cells and ulcers in colon, multiply by binary fission in large intestine, encysts in ileum, and produce enterotoxic protein.

Disease symptoms

- After ingestion of the parasite
- The symptoms of disease occur after 2-4 weeks of incubation of ingested parasite and symptoms persist for several months.
- The common symptoms include mucus and blood in stool, abdominal pain, fever, severe diarrhea, and vomiting and weight loss.
- Affected persons can be treated using amebicidal drugs such as metronidazole and chloroquine.

Toxoplasma gondii

The obligate intracellural protozoan, *Toxoplasma gondii*, is responsible for causing a disease calld toxoplasmosis.

Characters

- Domestic and wild cats are the definitive hosts for this parasite and serve as primary source of human infection.
- Oocysts are transmitted from cat to cat and infect all other animals, and survive over a year in warm, moist environment.
- Clinical symptoms in humans are caused by as few as 100 oocytes. Encysted form can remain latent in humans.

Disease symptoms

- Toxoplasmosis is regarded as universal infection and symptomless in most individuals.
- When severe, symptoms of fever with rash, headache, muscle ache and pain and swelling of lymph nodes is noticed.

Control measures

- Avoiding environmental contamination with cat feces.
- Avoiding consumption of meat and meat products containing viable tissue cysts.
- Heating food above 600c which destroys cysts.

Sarcocystis sp

- *Sarcocystis sp* cause sarcocystosis in humans.
- Cattle and pigs serve as intermediate host while humans are definitive hosts.
- Species involved in disease include Sarcocystis hominis which is associated with cattle, and Sarcocystis suihomonis, associated with pigs.
- Infection occurs through consumption of infected porcine and bovin meat, contaminated food and water.
- Sarcocysts in humans transform to bradyzoites which penetrate small intestine, reproduce sexually resulting in sporocysts and pass out through feces.
- The sporocysts when ingested by pigs or bovines release sporozoites and spread throughout the body.
- These multiply asexually in skeletal and cardiac muscle producing sarcocysts.
- Sarcocysts are visible to naked eye as they reach a size of about 1cm.

Disease symptoms

- Symptoms occur within 3-6 hr of infection and consist of nausea, stomachache, and diarrhea.