

Biological hazards in foods

The presence of human pathogenic microorganisms in food has potential human health risk as the consumption of such food could cause food poisoning. Besides bacteria, presence of human pathogenic viruses and several other organisms such as parasites and worms or accumulation of toxic metabolites produced by toxic microalgae in fish and shellfish, and consumption such food could be cause of health related problems. These hazards of biological origin cause a serious health related problems. Hence, there is a need to free the food meant for human consumption form these biological hazards.

Mycotoxins

- ✚ Mycotoxins are toxic substances produced by a large number of molds (fungi), and are highly toxic to animals and potentially toxic to human beings. These are mutagenic, carcinogenic and some show toxicity restricted to specific organs.
- ✚ Mycotoxicosis is the syndrome resulting from the ingestion of mold toxin contaminated food. Of the several mold, members of *Penicillium* and *Aspergillus sp* produce mycotoxins as secondary metabolites during the end of exponential growth. Among the mycotoxins, aflatoxin is very important.

Aflatoxins

Aflatoxins are among the several mycotoxins produced by fungi and are more potent and most widely studied toxin. First reported in 1960 in England, when more than 1 lakh turkey poults died after feeding imported peanut meal from Africa. The causative agent was identified as *Aspergillus flavus* and the toxin was designated as aflatoxin. Aflatoxin is produced by certain strains of *A. flavus* and *A. parasiticus*.

Foods supporting aflatoxin production

These fungi grow in a wide variety of foods/ substances – dairy products, bakery products, fruit juices, cereals, forage crops, dry fish etc. More common in peanuts, cotton seeds and corn as fungal invasion, growth and mycotoxin production takes place before harvesting. Generally, contamination and aflatoxin production is related to insect damage, humidity, weather condition and agriculture practices. These produce aflatoxin in mesophilic temperature range (25-40°C) and water activity of 0.85.

Aflatoxin types

Aflatoxin is composed of 4 major toxic substances (toxic metabolites responsible for aflatoxin) namely B1, G1 and B2 and G2 based on whether they fluoresce blue (B) or green (G) under UV light. *A. flavus* produces B1 and B2 (AFB1 and AFB2) while, *A. parasiticus* produces all four aflatoxins (B1, B2, G1, G2). AFB1 is most potent of all aflatoxins.

Fishes fed aflatoxin containing feed (contaminated fish meal and other feed ingredients, contaminated feed) affects growth and also carcinogenic in trout. International guidelines permit maximum of 30 ppb of aflatoxin in foods and feed ingredients.

Marine toxins

Marine toxins are natural toxins found in fish and shellfish. Consumption of toxin containing seafood results in various kinds of seafood borne illness. Marine toxins or biotoxins are produced by naturally occurring marine algae / phytoplankton and marine organisms become toxic by feeding on these toxic phytoplankton.

Seafood toxic types

1. Shellfish toxins
2. Ciguatera toxins
3. Tetradon toxins
4. Scombroid toxins

Shellfish toxins

Filter feeding bivalve mollusks become toxic by feeding on blooms of toxic algae (dinoflagellates). Though > 4000 species of marine phytoplankton are known, only about 2% produce toxins. Important shellfish associated illness are,

- ✚ Paralytic shellfish poisoning (PSP)
- ✚ Diarrhetic shellfish poisoning (DSP)
- ✚ Neurotic shellfish poisoning (NSP)
- ✚ Amnesic shellfish poisoning (ASP)

Paralytic shellfish poisoning (PSP)

- PSP is caused by eating toxic filter feeding molluscs such as clams, oysters, mussels and cockles.
- Bivalve molluscs become toxic by feeding on certain toxin dinoflagellates which form bloom (> 10⁶ cells/L) and discolor water (red tide).
- The dinoflagellates (toxic) involved are species of Alexandrium, Gonyaulax, Gymnodinium, Pyrodinium etc.
- Toxin associated with PSP is saxitoxin which is highly toxic and fatal in small doses (1-4 mg). This toxin is also resistant to heat and acid, and has no antidote. Generally gets destroyed when heated for 3-4 hours at pH 3.
- Symptoms of illness develop within 2 hours after ingestion of toxic molluscs.
- Toxin affects respiratory and cardiovascular regulating center and death occurs due to respiratory failure. Mortality rate is 1-22%.

Symptoms

Paresthesia (tingling, numbness and burning) which begins in mouth, lips, tongue and later spreads over face, scalp and neck, fingertips and toes.

Safe limits

Max allowable limit of PSP toxin in shellfish is 80 µg/ 100 g.

Prevention

- Avoiding eating toxin containing shellfishes.
- Regular monitoring of shellfish growing and harvesting water for toxic algae and toxin levels in shellfish.
- Detoxification of bivalves by natural depuration process or by keeping in clean water.

Diarrhetic shellfish poisoning (DSP)

DSP is caused by eating bivalve molluscs which have accumulated toxin by feeding on bloom of dinoflagellates such as *Dinophysis* and *Prorocentrum*. Toxin responsible for DSP is okadaic acid and its derivatives.

Symptoms

Acute diarrhea with vomiting and abdominal pains. Victims recover within 3-4 days. No mortalities have been reported. Tolerance level is 20 µg/100g.

Neurotoxic shellfish poisoning (NSP)

NSP is caused by consuming shellfish that have been exposed to toxic dinoflagellate bloom of *Ptychodiscus brevis* (*Gymnodinium brevis*). Toxin responsible for NSP is a family of brevetoxins which are lipophilic, relatively insoluble in water and soluble in non-aqueous solvents.

Symptoms

Resemble those of PSP except paralysis. It is not fatal and causes neurological symptoms.

Tolerance level:

20 µg /100g (MU: mouse units).

Amnesic shellfish poisoning (ASP)

ASP is caused by consuming bivalve molluscs that have accumulated toxin by feeding on toxic diatom, *Nitzschia*. This is the only shellfish poisoning caused by diatom. Toxin responsible is domoic acid.

Symptoms

Symptoms vary from slight nausea and vomiting to loss of balance, neurological disturbance resulting in confusion and short term memory loss. Tolerance level (as domoic acid) is 20mg/kg.