MARINE TOXINS

FST 526
FOOD TOXICOLOGY
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MODULE 1C
• All the toxicities to be discussed result from contamination of the marine food organism with alga or bacteria

• **Four groups of marine toxins**

1. Icthyotoxins- fish toxins found in reproductive organs (ovaries and testes)

2. Icthyosarcotoxins- fish toxins found in muscle, skin, liver and intestine

3. Icthyohemotoxins- fish toxins found in the circulatory (blood) system

4. Icthyohepatotoxins- fish toxins found in the liver
Scombroid Fish Poisoning

• Scombroid fish poisoning is the most common cause of ichthyotoxicosis worldwide.

• Scombroid poisoning results from the consumption of certain foods, most often fish, that contain unusually high levels of histamine.

• Spoiled fish from the family of *Scombridae*, such as tuna and mackerel, are most commonly implicated in incidents of scombroid poisoning.

• Toxins are produced by bacteria in the fish and is localized.

• Histamine is responsible for Scombroid poisoning.

\[
\text{Histidine} \xrightarrow{\text{Bacterial decarboxylation by decarboxylase}} \text{Histamine} + \text{CO}_2
\]
• Foods with histamine concentrations exceeding 50 mg per 100 g of food generally are considered to be hazardous.

• Proper handling and refrigerated storage can prevent histamine formation in fish.

• Methods of preservation such as cooking; canning and freezing does not kill toxin, if time/temperature are not adequate.

Figure 1: Types of fish in *Scombroidea* family. Source Google image, 2020
• The symptoms of scombroid poisoning are generally those of histamine poisoning and resemble an acute allergic response.

  **The symptoms include**

• nausea, vomiting, diarrhea, an oral burning sensation or peppery taste, hives, itching, red rashes, and hypotension.

• **The onset** of the symptoms usually occurs within a few minutes after ingestion of the implicated food, and the duration of symptoms ranges from a few hours to 24 hours.

• Neurological disturbances- headache, burning sensation to the throat, tingling, numbness may also result from scombroid poisoning
**Tetrodotoxin**

- Toxin produced by *Tetradontae* sp. (4 teeth), also known as puffer fish
- There are about 120 spp. in this category. Ex include blue fish, toad fish and porcupine fish

![Puffer Fish Images]

- High concentration of toxin is present in the ovaries and egg, skin, intestine and liver of fish
- Poisoning is due to improper processing or preparation and removal of the organs

- The toxic agent tetrodotoxin, is also widely distributed in nature, in both marine and terrestrial animals which include species as diverse as frogs, starfish, crabs, octopus, and marine snails.
• Toxins are: Heat stable but can be destroyed by alkali
• Female fish has high concentration compared to the male

• Mode of action of Tetrodotoxin
• It is a neurotoxin, can result in the paralysis of central nervous system and peripheral nerves
• Blocks the entry of Na$^+$ into the cells, disrupting the nerve impulses
• Symptoms can begin 5 to 20 minutes after ingestion, depending on the dose of toxin.

• Stages of Progression (4 stages of toxicity)
1. Numbness of lips, tongue and fingers with vomiting, nausea and anxiety
2. Numbness spreads throughout the body. Paralysis of extremities
3. Ataxia, where there is total loss of coordination of arms/legs
4. Loss of ability to speak and eventually consciousness and death
Amnesic Shellfish Poisoning (ASP)

- This results from consumption of contaminated shellfish is called amnesic shellfish poisoning.
- The primary sources of ASP toxin in shellfish are species of diatoms (*PseudoNitschia*), which can proliferate to high concentrations in the water.
- The diatoms are normally present in marine water in low concentration. However, high water temperatures mostly between March and June trigger the blooms.
- Filter feeding shellfish then accumulate the diatoms and associated toxins as a result of their normal feeding practice.
- The more algae the shellfish eats the more biotoxin produced

- The toxin produced is **domoic acid (DA)**, which is an analog of glutamic acid.
*Pseudo-nitschia*

Source: Abdullah et al., 2017
Symptoms of ASP

• Shellfish containing domoic toxin do not look or taste different and the toxin is not destroyed by cooking or freezing.

• Following consumption of toxic levels of DA of about 200 µg/g shellfish, patients first experience gastrointestinal distress within 24 hours after eating the contaminated shellfish.

• The toxin binds to glutamate receptors in the brain of the victim/consumer excites the brain cells until the cells die from overstimulation.

• Other reported symptoms have included dizziness, headache, and disorientation.

• A unique symptom of this poisoning is a permanent short-term memory loss, which is the basis for the name of this toxicosis.

• In severe poisoning, seizures, weakness or paralysis, violent head weaving, and death may occur.
References

