

FOOD AND TOXICITY:

Food toxicant can be divided into three categories, namely endogenous, naturally occurring and synthetic.

1. Endogenous toxicants:

- Substances produced by tissue cells in plants and other biological raw materials.
- Chemical substances often serve the purpose of protecting plant tissues from pests, as well as from pathogenic organism.
- Transmission to man can be direct consumption of toxic plants or from animals who have consumed the plant that are used for human foods.
- Examples include flavonoids, cyanogenic compounds, and mushroom toxins.
- Toxicological effects range from acute effects of gastroenteritis to more severe toxicities in the CNS leading to death.

2. Synthetic toxicants:

- Synthetically produced.
- Found their way into food supply through contamination of the food processing environment e.g pesticides, additives, preservatives.
- Pesticides include insecticides, herbicides, rodenticides, fungicides, etc.
- Amide herbicides (propanil) which is used extensively to control harmful weeds in rice crops could cause liver damage, CNS depression and death.

3. Naturally occurring toxicants.

- They are produced by organism that contaminate the food products.
- Microorganism such as fungi, and bacteria can produce toxicants that upon consumption can cause diseases.

Risks of toxins in food

- Carcinogenic
- Mutagenic
- Teratogenic
- Endocrine disrupters (hormones)
- Microbial pathogens

Endogenous Toxins of Plant Origin

➤ Flavonoids

- A class of plant pigments that are widely present in human food, are the flavonoids
- Sources of flavonoids include: apples, apricots, blueberries, raspberries, strawberries
- At low concentrations → the effects of flavonoids are thought to be potentially anticarcinogenic because flavonoids can block and inhibit the excessive cell division characterized by cancer.
- High concentrations of flavonoids may promote cancer formation → □ can damage the chromosomes and DNA in cells, leaving them more susceptible to cancer.

- Can interfere with the metabolism of drugs and with mineral absorption in body.

- Daily intake: 150-250 mg/day

➤ **Tannins**

- Tannins are a heterogeneous group of broadly distributed substances of plant origin.
- Source of Tannins
Fruits, tea (highest content), coffee, cocoa, grape, wine.
- Toxicity: cause acute liver injury, i.e., liver necrosis and fatty liver.
- If ingested in excessive quantities → □ inhibit the absorption of minerals such as iron → □ lead to anemia
- In sensitive individuals, a large intake of tannins may cause bowel irritation, kidney irritation, liver damage, irritation of the stomach and gastrointestinal pain.

➤ **Cyanogenic glycosides**

- Sources: lima beans, peas, bitter almonds
- Cyanogenic glycoside is not toxic on its own.
- When fresh plant material is damaged by chewing, cutting, insect attack → it will be subsequently broken down to sugar and a cyanohydrin which rapidly decomposes to an aldehyde or a ketone and releases the toxic hydrogen cyanide.
- Toxic cyanide is released when the plant is cut into small pieces during food preparation, and the resulting hydrogen cyanide is easily removed by cooking in water since its volatile.
- It can be fatal if those food are eaten raw or prepared improperly.

- Peeling, washing in running water and cooking or fermenting can remove and volatilize the cyanide.
- Acute and chronic biochemical effects in biological system: inhibition of the antioxidant defense, alteration of cellular ion homeostasis and inhibition of cellular respiration
- Symptoms: mental confusion, muscular paralysis, respiratory distress.

➤ **Glucosinolates**

- Substances that can be considered as natural toxins, but also as antinutritives
- Source: cabbage and turnips.
- Toxicity: cytotoxic and mutagenic.

➤ **Mushroom toxins**

- Caused by the high content of amatoxins in mushrooms.
- There are four categories of mushroom toxins:

1. Neurotoxins

Cause neurological symptoms such as profuse sweating, hallucinations, depression, spastic colon, excitement, convulsions, and coma.

2. Protoplasmic poisons

Cause generalized destruction of cells, which is followed by organ failure.

3. Gastrointestinal irritants

Produce rapid, transient nausea, abdominal cramping, vomiting, and diarrhea.

4. Disulfiram-like toxins

Disulfiram-like toxins are usually nontoxic and produce no symptoms. However, if alcohol is consumed within 72 hours after eating them, they may produce vomiting, nausea, headache, flushing, and cardiovascular disturbances.

- The first symptoms of mushroom poisoning occur within 6-24 hr. after ingestion of the mushroom(**phase one**)
- **Phase two**, also called the gastrointestinal phase, involves severe vomiting, abdominal cramps, nausea, and diarrhea.
- **Phase three** lasts about 12-24 hr. and is characterized by improved clinical symptoms; however, it is also the beginning of liver necrosis.
- **Phase four (the last phase)**, result in hepatic failure, encephalopathy, internal bleeding, and acute renal failure.
- Patients usually die within 5-20 days after ingestion of the mushrooms.

Natural Contaminants

- There are three important sources:
 - Raw materials of plant origin can become contaminated if they are mixed with toxic non-nutritive plant species.
 - Raw materials of animal origin, mainly fish and milk, can also become contaminated if the animal has ingested toxic substances of natural origin.
 - Contaminants of natural origin can be the products of microorganisms.

Microbial Toxin: Mycotoxin

- Mycotoxins are secondary metabolites of fungi which can induce acute as well as chronic toxic effects.
- Toxic syndromes resulting from the intake of mycotoxins by man and animals are known as mycotoxicoses.

- Aflatoxins are the most important mycotoxins, which is produced by certain species of *Aspergillus*
- Aflatoxins are carcinogenic substances and may be present in a large number of foods. This toxin can cause cancer, cirrhosis of the liver.

Methods of reduction of plant toxins:

1. For some types of natural toxins, post- harvest processing treatments and cooking of the plant result in destroying the endogenous toxic substances or reduction of its toxicity.
2. Special care has to be exercised in selecting the food plants in limiting the amount of intake.