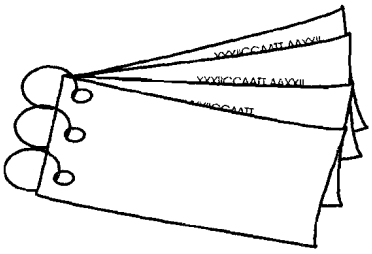


UNIT 9 FOOD CONTAMINANTS OF NATURAL ORIGIN

Contents

- A food contaminant has been defined as any substance not intentionally added to food, which is present in such food as a result of the production, manufacture, processing, preparation, treatment, packing, transport or storage of such food or as a result of environmental contamination.
- Foods may naturally contain certain toxic substances (toxicants) that can lead to serious health problems if consumed. Some of those toxins may be present in very small quantities and may produce delayed toxicity. We need to be aware of the kind of food products in which these toxicants are found to avoid consumption or adopt suitable detoxification procedures.
- Foods also contain a wide range of natural chemical compounds that may act as anti-nutritional factors, interfering with the way our body utilizes nutrients. These may be harmful resulting in serious illness if consumed in large quantities.
- Food contaminants of natural origin include toxicants in animal foods; toxicants in plant foods and anti-nutritional substances.

9.1 Toxicants in Animal Foods

Toxicants in animal foods include shellfish toxins, other seafood toxins and biogenic amines.

Shellfish toxicants

- Shellfish are aquatic mollusks or crustaceans with a shell covering their body e.g. clams, oysters, scallops, shrimps, mussels. Their intake has sometimes led to some of the worst cases of food poisoning.
- Most of the cases of sea food poisonings have been due to improper cleaning or cooking leading to bacterial or viral infections. Poisoning can also result from intake of shellfish which have fed on toxic plankton.
- Shellfish poisoning can result in different kinds of symptoms. The most common one is diarrhoea which may be accompanied by nausea, vomiting and

abdominal pain. In other cases the nerves may be affected resulting in a sensation of numbness, tingling and even paralysis. Pain in the muscles and joints can also be symptoms of shellfish poisoning.

- Paralytic shellfish poisoning (PSP) causes the most severe symptoms of all the shellfish poisonings. The causative agent is saxitoxin. Initial symptoms of poisoning can be seen within 30 minutes of consuming such shellfish including tingling, numbness in extremities spreading quickly throughout the body producing general lack of muscular coordination. It would result in death due to paralysis of the respiratory system.

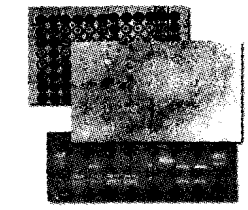
Other Types of Food Poisoning

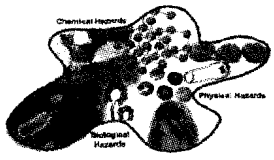
The following table summarizes details about other types of food poisoning such as ciguatera poisoning, scombroid poisoning, pufferfish/ blowfish poisoning, hallucinogenic fish poisoning.

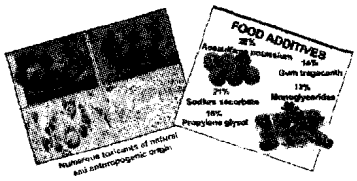
Type of Poisoning	**Toxin**	**Source**	**Symptoms**
1. Ciguatera	Ciguatoxin (heat-stable, odourless, tasteless)	Blue green algae and protozoan eaten by smaller fish and later eaten by larger fish.	Evident within 2-6 hours after ingestion and may last as long as 48 hours; abdominal pain, cramps, nausea, vomiting, profuse watery diarrhoea, pain in muscles, joints, weakness and pain during urination; upto 72 hours later neurologic symptoms may occur persisting for months e.g. tingling; bizarre neurologic symptoms include sensation of loose, painful teeth; tingling in lips; tongue and throat; vertigo, visual changes; seizures.
2. Scombroid Poisoning	Biogenic amines (e.g. histamine) (Heat-stable)	Improperly stored seafood (temperatures above 15°C)	Allergy, skin flushing, throbbing headache, oral burning, abdominal cramps, nausea, diarrhoea, palpitations, unease, prostration or loss of vision; physical signs including rash, rapid heart rate, wheezing and hypotension, hypertension
3. Pufferfish or blowfish poisoning	Tetrodotoxin	Toxin present in fish (organ meats, gonads)	One of the most poisonous substances found in nature; its consumption can result in

(Table contd.)

			rapid death; neurologic and cardiovascular symptoms including tingling sensation around the mouth, floating sensation, feeling of overall warmth, weakness, lack of coordination, slurred speech, slow heartbeat, hypotension, difficulty in breathing; decreased levels of consciousness, seizures, death in as few as 17 minutes.
4. Hallucinogenic fish poisoning	Indoles with similar effects to LSD (Lysergic acid diethylamide)	Fish fed on certain algae/ plankton	Hallucinations
5. Sea urchin poisoning	Acetylcholine like substance	Sea urchin gonads	Salivation, nausea, vomiting, diarrhoea, abdominal pain
6. Starfish	Asteriotoxin	Starfish	Nausea, vomiting





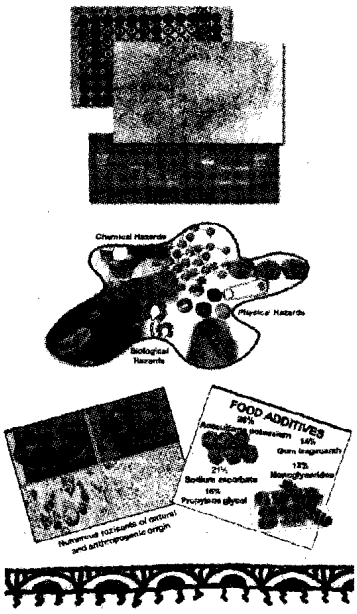


9.2 Toxicants in Plant Foods

- Several plant foods have toxic compounds in them. Examples are:
  - — Fava beans consumption is a hazard for those individuals with deficiency of enzyme glucose-6-phosphate dehydrogenase. Initial symptoms include headache, nausea, vomiting, pain, fever followed by haemoglobin in urine caused by rapid breakdown of red blood cells, jaundice and death.
  - — Cottonseed contains gossypol which can come into the cottonseed oil if not treated properly.
  - — Mustard and rapeseed oil contain erucic acid which has been linked to heart disease.
  - — Bitter cucumber contains cucurbitacins resulting in severe cramps, diarrhoea and collapse.
- Some of the other toxicants identified in plant foods include amino acids, alkaloids or cyanogenic glycosides. Details about these toxicants are given in the following table.

Toxicant	Source/ Toxin	Adverse Effects	Prevention
1. Toxic amino acids	Kesari dal contains the toxin Beta-oxalyl amino alanine (BOAA)	The toxic amino acid destroys nerves especially those that regulate leg movement. Painful spasms in the calf muscles, heaviness of lower limbs, pain in the knee and ankle joints, difficulty in walking are typical symptoms. In advanced cases the victim's lower limbs become useless – locked in a cross-legged, fixed position. Men 18-40 years old are most vulnerable.	Avoiding consumption of pulse, boiling seeds in water, steepifig in water can reduce the toxin content, cultivation of low-toxin varieties of the pulse.
2. Toxic alkaloids	Green portions and peels of potatoes contain Solanine	Apathy, restlessness, drowsiness, visual disturbance	Avoiding consumption of green potatoes or potato peels.
	Seed of *Argemone mexicana* contains Sanguinarine	Epidemic dropsy – oedema over ankles, gastrointestinal disturbances, vascular and cardiac complications which can result in death.	Avoiding consumption of mustard oil contaminated/ adulterated with argemone oil i.e. consuming only trustworthy brands of oil in sealed packs.
	Toxic seeds of the weed *Crotalaria nanaburn* contain Pyrrolizidine group of alkaloids	Liver injury, veno-occlusive disease (VOD) of liver	Avoiding consumption of millet (called gondhli) contaminated with the toxic weed seeds.

Toxicant	Source/ Toxin	Adverse Effects	Prevention
3. Cyanogenic glycosides	Cassava, tapioca, sorghum plants contain cyanogenic glycosides, cassava contains Linamarin	Cyanogenic glycosides break down to give poisonous hydrogen cyanide; breathlessness, gasping, paralysis, coma, death.	Consumption of cassava only after chopping, grinding under running water, soaking, fermentation and drying which minimize the amount of toxin.
4. Mushroom poisoning	Raw or cooked mushrooms or toadstools	Acute poisoning with symptoms including profuse sweating, coma, convulsions, hallucinations, excitement, depression, nausea, vomiting, abdominal cramping and diarrhoea; no symptoms may be seen unless alcohol is consumed within 72 hours after eating mushrooms.	Avoiding consumption; toxins cannot be removed by cooking, canning, freezing or any other processing.



9.3 Anti-Nutritional Factors in Foods

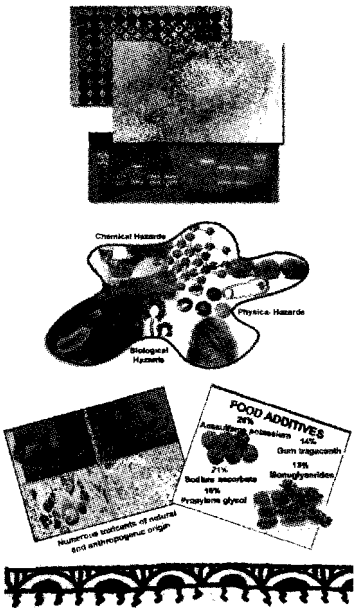
Many foods particularly those of plant origin contain a wide range of anti-nutritional factors interfering with utilization of nutrients by our body. Some of the important anti-nutritional factors are trypsin inhibitors, phytates, oxalates, tannins, lectins and goitrogens. Details are mentioned in the following table:

Anti-nutritional Factor	Source	Effects	Measures for Removal or Reduction of Factor
1. Trypsin inhibitors	Legumes, peanuts, wheat, onion, maize, oats, barley, egg white	Inhibit trypsin activity, interfere with breakdown of dietary proteins.	Easily inactivated by normal cooking procedures; however drastic heat treatment is required to inactivate these inhibitors in soyabeans, lima, kidney beans, duck egg white.
2. Phytates	Unrefined cereals, millets richest sources	Bind iron, zinc, magnesium, calcium to form insoluble complexes – therefore poor absorption may result in deficiency	Soaking grains overnight; germination of grains because of breakdown of phytate by enzymes.
3. Tannins	Seed coat of legumes, spices, tamarind, turmeric, certain vegetables, fruits, tea	Interfere with absorption of minerals like iron, reduce availability of proteins by binding to them.	Removal of seed coat of legumes, exclusion of tamarind, avoiding tea with meals to reduce tannin content of diet.
4. Oxalates	Rich sources are green, leafy vegetables, some legumes, like horsegram, kesari dal.	Interfere with calcium absorption; high intake of oxalates increases excretion in urine predisposing to urinary stones.	Consuming in limited quantities, not keeping it long after cooking.
5. Goitrogens	Leaves and vegetables like radish, cabbage, cauliflower, rapeseed,	Interfere with uptake of iodine by thyroid gland, contribute to development of iodine deficiency	Cooking destroys enzymes required for production of goitrogens; also lost in water used for cooking.

(Table contd.)

(Table contd.)

Anti-nutritional Factor	Source	Effects	Measures for Removal or Reduction of Factor
	mustard, broccoli, soyabean, bajra, peanuts, lentils; Thiocyanates, isothiocyanates and their derivatives are main goitrogens	disorders when intake is low.	
6. Haemag-glutinins	Seeds of double bean, field bean, white bean, horsegram	Combine with cell lining of intestinal walls interfering with absorption of important nutrients and resulting in nausea, vomiting, diarrhoea; consumption can reduce food intake and growth even leading to death.	Processing beans thoroughly



- Legumes contain a wide range of some other biologically active and anti-nutritional components including:
  - — Oestrogenic isoflavones and coumarone (linked with reproductive disturbance in mammals),
  - — Saponins and haemagglutinins (which affect the mucosal lining of the lower intestine and interfere with the absorption of essential nutrients),
  - — Enzyme inhibitors as has been discussed earlier under trypsin inhibitors, and
  - — Oligosaccharides (which cause excessive intestinal gas production and flatulence).

However legumes are a rich source of proteins and minerals for humans and can be safely eaten daily.

- Proper processing can reduce/ destroy most anti-nutritional factors. Cooking destroys trypsin inhibitors, reduces goitrogen content; germination of grains reduces phytate content, removing the seed coat of legumes. Decreasing intake of tea and tamarind can easily decrease intake of tannins.

Key Terms

Acute: Severe

Agglutinate: Stick

Algae: Group of primitive mainly aquatic non- flowering plants

Apathy: Lack of interest or feeling, indifference

Ascites: Fluid accumulation in the abdominal region

Biogenic: Produced by living organisms

Cardiovascular: Relating to the heart and blood vessels

Edema or Oedema: Swelling due to watery fluid collecting in the cavities or tissues of the body

Fatal: Causing or ending in death

Gonads: Testis or ovary of an animal

Hallucination: Apparent perception of an object not actually present

Hypertension: Abnormally high blood pressure

Hypotension: Abnormally low blood pressure

Legume: Seed pod of a leguminous plant e.g. peas and beans

Neurologic: Relating to the nerve systems

Palpitation: Throbbing

Plankton: Microscopic organisms drifting or floating in the sea or fresh water

Prostration: Lying horizontally

Protozoa: Unicellular and microscopic organisms e.g. ciliates, amoeba, flagellates

Seizures: Sudden attack or fit

Spasticity: Condition in which individual has muscle spasms

Toxicant: A poisonous substance

Toxin: A poison

Vascular: Pertaining to the blood vessels

Vertigo: Dizziness, giddiness

Wheezing: Breathing with a whistling sound

Winnowing: Blowing (grain) free of undesirable foreign particles, husk etc. by an air current

PLEASE COMPLETE "CHECK YOUR PROGRESS EXERCISES" GIVEN IN THIS UNIT IN THE ONLINE VERSION FOR ASSESSING YOUR OWN PROGRESS.

YOU MUST REMEMBER TO STUDY THE COMPLETE UNITS GIVEN BOTH ONLINE AND ON CD-ROM. THEY MAY CONTAIN FURTHER DETAILS NOT GIVEN IN THIS SUMMARY VERSION. THE EXAMINATIONS WILL TEST YOU ON THE COMPLETE UNITS NOT ON THE SUMMARY VERSION.