**Natural toxins**

Natural plant toxins may be present inherently in plants such as fruits and vegetables which are common food sources. They are usually metabolites produced by plants to defend themselves against various threats such as bacteria, fungi, insects and predators. Natural toxins may also be present in food plants as a result of natural selection and new breeding methods that enhance these protective mechanisms.

**Toxicological effects of plant toxins**

Toxicological effects following ingestion of plant toxins may range from acute effects of gastroenteritis to more severe toxicities in the central nervous system leading to death, as are seen in cases of poisoning due to cyanide or certain alkaloids. In addition to acute toxicities, some plant toxins such as pyrrolizidine alkaloids may also cause chronic systemic effects, organ toxicities or teratogenic effects.

**Food poisoning due to natural plant toxins**

Poisonings induced by plant toxins have long been known through consumption of foods such as beans that are not fully cooked, some cultivars of potatoes, and ingestion of plants picked from the wild not intended for human consumption such as poisonous berries and mushrooms. Acute poisoning cases caused by plant toxins are sometimes underestimated due to the fact that the toxicity symptoms can be rather non-specific. In the past, acute poisoning from a high intake of glycoalkaloid, such as solanine, from potatoes has been mis-diagnosed as microbial food poisoning.

Common classes of plant toxins include alkaloids such as pyrrolizidine alkaloids and glycoalkaloids, cyanogenic glycosides, lectins, saponins, and antinutrients.

**1. ALKALOIDS**

Alkaloids are the bitter components of plants found widely in nature and frequently have pharmacological properties. Mostly acting as secondary plant metabolites, alkaloids are often basic nitrogen–containing compounds able to form salts with acid.

Alkaloids have been isolated from the roots, seeds, leaves, or bark of some members of at least 40% of plant families.

**Alkaloids Found in Plants and in Common Foods**

**1. Pyrrolizidine alkaloids**

One type of alkaloid widely found in the plant kingdom is the pyrrolizidine alkaloids. These are chemicals found in as many as 6000 plant species or 3% of flowering plants. Plants containing these compounds are distributed in all climatic regions of the world

Ingestion of plants containing pyrrolizidine alkaloids are usually through contaminated crops since plants containing these alkaloids may grow as weeds in food crops such as wheat or corn and may be harvested with the grain. Another source of oral exposure to this group of toxins may be via intake of herbal foods and preparations containing these toxins. Prevention of poisoning can be achieved by reducing ingestion of alkaloid-containing foods and herbal preparations, and by applying effective measures in agriculture to reduce contamination of pyrrolizidine containing plants in food crops.

**1.1 Glycoalkaloids**

Other plant alkaloids such as the glycoalkaloids are found in common food plants acting like a natural pesticide against common pests. Common examples include solanine and tomatine. Solanine is an alkaloid present in small amounts in potatoes while tomatine is found in tomatoes

**Toxicity**

The amount of glycoalkaloids usually found in edible plants that are fresh and undamaged do not normally cause toxicity. However, glycoalkaloids can produce toxic effects at higher doses. Acute toxicity syndromes in humans have been observed at glycoalkaloid levels of more than 2.8 mg/kg body weight.

Glycoalkaloids also have saponin–like properties and can disrupt membrane function in the gastrointestinal tract leading to haemorrhagic damage. This damage can be severe enough to cause death with the extent of necrosis far outweighing the inhibitory effects on acetylcholinesterase activity.

**2 CYANOGENIC GLYCOSIDES**

Cyanogenic glycosides occur in at least 2000 plant species, of which a number of species are used as food. They are amino-acid-derived constituents of plants produced as secondary metabolites. There are approximately 25 cyanogenic glycosides known. Different kinds of cyanogenic glycosides may be found in different cyanogenic food plants, e.g. taxiphyllin in bamboo shoots, linamarin in cassava.

**Occurrence**

Important staple foods for some parts of the world (such as cassava and sorghum) contain cyanogenic glycosides. Other edible plants containing cyanogenic glycosides include bamboo shoot, flaxseeds, and seeds of stone fruits such as apricot and peach, seeds of peas and beans such as lima beans, and shell of soya beans. Other food products that may contain cyanogenic glycosides include some food ingredients with flavouring properties such as ground almonds powder or paste, mazipan, stone fruit preserves (cherry, plum, apricot, peach), and stone fruit juices, and alcoholic drinks made from stone fruits.

**Toxicity**

Toxicity of cyanogenic glycosides-containing plant is due to the cyanide produced on ingestion. The plant species that produce cyanogenic glycosides usually also has a corresponding hydrolytic enzyme (β-glucosidase). In the presence of water, the non-toxic cyanogenic glycosides are hydrolysed by the enzyme producing cyanohydrins which quickly decompose to the toxic hydrogen cyanide. In this way, cyanogenic plants are protected against predators. Cyanogenic glycosides, cyanohydrins and hydrogen cyanide are collectively known as cyanogens.

**Acute toxicity**

In humans, the clinical signs of acute cyanide intoxication can include: rapid respiration, drop in blood pressure, rapid pulse, dizziness, headache, stomach pains, vomiting, diarrhoea, mental confusion, stupor, cyanosis with twitching and convulsions followed by terminal coma. The acute lethal dose of hydrogen cyanide for humans is reported to be 0.5-3.5 mg/kg bw. Approximately 50-60 mg of free cyanide constitutes a lethal dose for an adult man.

**3. LECTINS**

Lectins (phytohaemagglutinins) are proteins or glycoproteins of non-immune origin which have multiple highly specific carbohydrate binding sites. They were originally identified in the castor bean but are now known to be widespread in the plant kingdom including grain products. Lectins are particularly concentrated in legume seeds and have been shown to cause gastroenteritis, nausea, and diarrhoea in men. Many types of beans contain lectins including green beans, red kidney beans and white kidney beans.

**Toxicity**

Symptoms of acute toxicity include severe stomachache, vomiting and diarrhoea. Lectins can destroy the epithelia of the gastrointestinal tract, interfere with cell mitosis, cause local haemorrhages, damage kidney, liver and heart and agglutinate red blood cells.

**Methods of reduction**

Cooking with moist heat can reduce the toxicity of lectins. Therefore, the use of lectin-containing plants as food in the human diets is not a cause for concern after adequate cooking. Special attention, however, should be paid when the lectin-containing food is prepared at high altitudes where the boiling point is reduced, when low heat cooking methods are employed, or in situations where heat transfer is uneven. To destroy the toxins, beans should be soaked and boiled thoroughly in fresh water. Beans should not be cooked at a low temperature, for example in a crock pot, since it may not destroy the toxin.

**4. SAPONINS**

Saponins are water-soluble plant constituents, which can form soapy foam even at low concentrations. They are glycosides with a non-sugar aglycone portion which is termed a sapogenin. Saponins are distinguished by their bitter taste, and ability to haemolyse red blood cells. They are classified according to the chemical nature of the sapogenin into two major groups: steroidal and triterpenoid saponins.

Saponins are widely distributed in the plant kingdom and can occur in all parts of plants, although the concentration is affected by variety and stage of growth. They are found in soybeans, sugar beets, peanuts, spinach, asparagus, broccoli, potatoes, apples, eggplants, alfalfa and ginseng root.

**Toxicity**

Saponins are capable of disrupting red blood cells and producing diarrhoea and vomiting. in large quantities they can be irritating to the gastrointestinal tract causing vomiting and diarrhoea.

**Consumption**

Consumption of saponin-containing plants should be limited to a moderate amount.