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Review Article

Plant Toxins

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Abstract

Plant toxins are generally the metabolites produce through plants to protect themselves against different threats like insects, predators and microorganisms These toxins found in food plants is due to natural or new reproduction methods which enhance defensive mechanism. The plant part which may cause toxic effects includes roots, tuber, stem, fruits, buds and foliage. Natural toxins are present in numerous types of plants and these are ingested as food and when consumed in large quantity and not cook properly leads to food poisoning. These toxic substances when ingested can be potentially harmful to human health. Some plants produce phytotoxins that can severely harm or destroy any herbivore. Such as toxic proteins which have a role in defense against pathogens and insects. Such as ricin and rRNA *N-glycosidase* which have the potential to be used as bio-threat agents. They can be modified to exemplify improved affinity and efficacy for health endorsement. Several of these plants are commonly consumed as food. They have been developed as an evolutionary movement for self-protection. These toxic substances when taken in considerable amount can be harmful to human health and cause discomfort.

Keywords: Plant Toxins; Effect; Mechanism

Introduction

Natural plant toxins may be present naturally in plants such as fruits and vegetables that are common food sources. They are usually secondary metabolites produced by plants to protect themselves against various threats such as bacteria, fungi, insects and predators [1]. Natural toxins may also be present in food plants because of natural selection and new breeding methods that enhance these protective mechanisms. Plants are usual cause of medical dilemma, generally due to the phytochemicals. The different flowering plant species differ not only in profile but also in limitless biochemical properties phytochemical substances were not only to compensate animal pollinators and seed distributors, but also to protect them from animals, which pose a risk. However, some phytochemical or secondary metabolites produced by plant are toxins like substances, which are alike to extracellular bacterial toxins in their properties and may cause problems in humans. These have both useful and harmful effects in human beings and animals. The problems are varying widely side-effect from skin irritation to thyroid problems and neurological syndromes.

Plant toxins may enter the body either by inhalation, swallowing or by contact. The action is mainly dependent on their Phyto -constituents like alkaloids, glycosides, proteins, tannins, volatile oils, terpenes, steroids They act in the animal or human body by varying specific mechanisms involving receptors, transporters, enzymes and even genetic material at specific cells and tissues [2,3]. In some plants, the poisonous constituents occur throughout the whole plant. In others, they are present in one or more parts. The doses of these substances are the most important factor.

Classification of Toxicity

1) Major toxicity: These plants may cause serious illness or death.

2) Minor toxicity: Ingestion of these plants may cause minor illnesses such as vomiting or diarrhea.

Natural plant toxins

Natural toxins may be present inherently in plants. They are usually metabolites produced by plants to defend themselves against various threats such as bacteria, fungi, insects and predators, which may be species specific and give the plant its particular characteristics, e.g. colours and flavors. Common examples of natural toxins in food plants include lectins in beans such as green beans, red kidney beans and white kidney beans; cyanogenic

glycosides in bitter apricot seed, bamboo shoots, cassava, and flaxseeds; glycoalkaloids in potatoes; 4-methoxypyridoxine in ginkgo seeds; colchicine in fresh lily flowers; and muscarine in some wild mushrooms

Classification of Plant Toxins

Alkaloids

These are some of organic compounds containing nitrogen in heterocyclic ring, basic in nature and derived from amino acid, most of which exhibit strong physiological activity. For example.: Indole alkaloids: beta-carbolines like harmine active on the central nervous system [4] Pyrrolizidine: veno-occlusive disease of the liver [5] Tropanes: atropine, scopolamine, hyoscyamine active on the autonomous nerve system Glycoalkaloid: The greatest worry for glycoalkaloid toxicity is its acute toxicity. There have been many reported cases of human poisonings (sometimes fatal) due to the ingestion of greened, damaged or sprouted potatoes as a consequence of high levels of glycoalkaloid. that is solanine (Maga 1980).

Glycosides

These substances consist of a non-sugar moiety that is, aglycone to which one or more sugar chains is bound. Cyanogenic glycosides release prussic acid. The cyanide ions (CN-) attach to the mitochondrial cytochrome oxidase and in this way blocks electron transport. The clinical symptoms of acute cyanide intoxication can include: rapid respiration, drop in blood pressure, rapid pulse, dizziness, headache, stomach pains, vomiting, diarrhea, mental confusion, stupor, cyanosis with twitching and convulsions followed by terminal coma [6]. Cardiac glycosides such as digitoxin from foxglove. Digoxin inhibits the enzyme Na-K-ATPase. Vomiting, confusion, changes in colour perception and in particular, cardiac arrhythmias are dominant symptoms. Goitrogenic glycosides: too much ingestion and simultaneous iodine deficiency may lead to thyroid disorders.

Tannins

These substances have the capability to precipitate proteins. They make the skin tough by deception of the proteins in the skin.

Proteins

A number of protein toxins produced by plants enter eukaryotic cells and inhibit protein synthesis enzymatically. Examples of poisonous proteins include ricin (castor plant), abrin (rosary pea) and white acacia. Lathyrism occurs due to a toxic amino acid that mimics glutamate [7].

Oxalic acid and oxalates

Oxalates: The juice or sap of crystals. These needle-shaped crystals can irritate the skin, mouth, tongue, and throat, resulting in throat swelling, breathing difficulties, burning pain, and stomach upset. These substances may be present in trichomes or in raphides (needle-like structures). They can provoke mechanical irritation. Ingested oxalate will be absorbed. Oxalate in blood binds calcium to form the insoluble calcium oxalate. Severe hypocalcemia with tetany can occur.

Anti-vitamins

Some substances work against the vitamins, for examples. thiaminases in horsetails and bracken (breakdown of thiamine) and anti-vitamin K such as coumarins.

Volatile oils

Volatile oils are liquid substances formed in special oil cells, glands, hairs, or channels. They are all soluble in alcohol. At certain concentrations, some are irritant (forming blisters) and emetic. Some volatile oils are nephrotoxic Omally [8].

Furocoumarins

These toxins are present in many plants such as parsnips (closely related to carrots and parsley), celery roots, citrus plants (lemon, lime, grapefruit, bergamot) and some medicinal plants. Furocoumarins are stress toxins and are released in response to stress, such as physical damage to the plant. Some of these toxins can cause gastrointestinal problems in susceptible people. Furocoumarins are phototoxic, they can cause severe skin reactions under sunlight (UVA exposure).

Lectins

Many types of beans contain toxins called lectins, and kidney beans have the highest concentrations especially red kidney beans. Raw beans can cause severe stomachache, vomiting and diarrhea. Lectins are destroyed when the dried beans are soaked for at least twelve hours and then boiled vigorously for at least 10 minutes in water.

Solanines and chaconine

All *solanacea* plants, which include tomatoes, potatoes, and eggplants, contain natural toxins called solanines and chaconine which are glycoalkaloids. While levels are generally low, higher concentrations are found in potato sprouts and bitter-tasting peel and green parts, as well as in green tomatoes. The plants produce the toxins in response to stresses like bruising, UV light, microorganisms and attacks from insect pests and herbivores.

Poisonous mushrooms

Wild mushrooms may contain several toxins, such as muscimol and muscarine, which can cause vomiting, diarrhea, confusion, visual disturbances, salivation, and hallucinations. Onset of symptoms occurs 6–24 hours or more after ingestion of mushrooms.

Mechanism of Action of Plant Toxins

The mechanism of toxicity of plant toxins is of great interest because they are present in foods [9] used in ethnomedicine in cosmetics [10, 11] and have broad range of medicinal applications.

Neurotoxins

The neuroactive alkaloids can function either as agonists which excite a neuroreceptor or as antagonists which would block a certain neuroreceptor. Receptors on neuron cells are another major target for many of alkaloids, such as glutamate, acetylcholine, dopamine, noradrenalin, and adrenaline. Some alkaloids inhibit the enzymes that break down neurotransmitters, such as cholinesterase and

monoamine oxidase. Neurotoxins also have an effect on significant ion channels of neuronal cells, such as Na+, K+ and Ca2+ channels, whichever by activating or inactivatingthem eternally.

Cytotoxins

Many Phyto constituents are regarded as cytotoxins as they obstruct important cellular functions. Bio-membrane are prime target of such compounds which are involved in the import and export of metabolites and ions in cells [12]. Membrane fluidity and integrity can be severely disturbed by both steroidal and triterpenoids saponins.

Plant Toxin Poisoning Occurrence

Consumption of plants not intended for human consumption: Some wild plants, such as wild mushrooms and giant elephant ears, contain potent toxins that are not easily destroyed by cooking. Cyanogenic plants such as bitter apricot seeds can cause food poisoning when eaten raw and in sufficient amount but are safe for consumption when thoroughly cooked in boiling water, such as in Chinese soups. For plants such as cassava and bamboo shoots, toxic cyanide can be removed more effectively by soaking in water or by cutting into small pieces before cooking.

Toxicological Effects of Plant Toxins

Phyto Dermatitis and Phyto Photodermatitis

Some substances secreted from plants have an irritant effect on the skin after being irradiated by UV light. Table 1, mango and many other trees known to cause irritation skin on contact. Phyto photo dermatitis also known as dermatitis. The skin lesions are similar to burns. There is a delay between the skin contact and the first signs of irritation.

Table 1: Plant toxins Phyto materials and actions.

Name	Phytoconstituents	Action
Manihot esculenta	Linamarin and lotaustralin Severe	Calcific Pancreatitis, Chronic Pancreatitis
Lathyrus sativus (grass pea)	Amino acid ODAP Neurolathyrism	A Neurodegenerative Disease
Phaseolus vulgaris (white beans)	Phyto haemagglutinin	Nausea, Vomiting, Diarrhea
Avocado persea spp.	Persin Equinecolic	Resp. Distress, Fluid Accumulate around
Asparagus.	Berries	Nausea, Vomiting, Diarrhea

Phyto Allergy

Hay fever caused by pollen from ragweed, birch, hazel, timothy grass and rye grass are common case of Phyto allergy. Urticarial resulting from eating strawberries and allergy to peanuts are some other recognized allergy conditions due to phytoconstituents. Some phytoconstituents cause certain forms of extrinsic allergic alveolitis.

Food Poisoning

Food poisonings provoked by plant toxins mainly due to consumption of foods such as beans that are partially cooked, some cultivars of potatoes, and ingestion of herbs selected from the wild not wished-for for human use such as poisonous berries and mushrooms.

Conclusion

Plant toxins are found widely in edible plants; apart from harmful effect, these also have nutritious and beneficial to health. These substances may be alkaloid, glycoside, proteins, tannins. These toxins are problem in correlation with different diseases, and they may be a risk as bioterror weapons. Still, it serves as superb tools to study cellular and other mechanisms, and enhanced knowledge about the plant toxins may give us new products for use in medicine.

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