

Potential plant poisonings and mycotoxicoses in humans

CJ Botha

Department of Paraclinical Sciences

Faculty of Veterinary Science

University of Pretoria

Plant poisonings are of major economic importance in livestock production and thus in Veterinary Science, but may also be a potential problem in humans. Humans may be exposed when they unintentionally use poisonous plants as food; use plant material as phytomedicines or when ingested by young children, especially pre-school kids.

Plant poisonings have been recorded in history eg. Socrates (470-399 BC) was sentenced to death and drank poison hemlock (*Conium maculatum*) as it was the official state poison of the Greeks.

Cardiovascular system

Cardiac glycoside-containing plants are collectively the most important plant-associated poisoning of livestock in S.A. Chemically, 2 main groups are recognized the cardenolides and bufadienolides. Cardenolide-containing plants, although highly toxic, are not that important from a veterinary point of view, but may be very important in humans as a number of garden plants contain cardenolides.

The cardiac glycosides inhibit the Na^+/K^+ -ATPase and Na^+ accumulates intracellularly, the $\text{Na}^+/\text{Ca}^{2+}$ -exchanger is halted and subsequently Ca^{2+} accumulates intracellularly.

There are certain cardenolide-containing plants that are used medicinally. *Digitalis purpurea* or foxgloves contain digoxin, which is used for the treatment of congestive heart failure. Other plants in the garden that might contain cardenolides – *Acokanthera oppositifolia*, bushman poison bush and as the name implies the sap has been used as arrow poisons for hunting by the Bushmen.

Nerium oleander (oleander, selonsroos) is planted in a number of gardens and contains oleandrin. It is extremely toxic; apparently soldiers of Alexander the Great were fatally poisoned when they roasted meat on skewers made from oleander branches. Yellow oleander or *Thevetia peruviana* is also very toxic. Fruit is referred to as “*Be still nut*” and is even used to commit suicide.

Gomphocarpus fruticosa is a cosmopolitan weed, growing in disturbed places, that also contains cardenolides. Even insects feeding on these plants can be poisonous. *Danaus chryssipus*, the monarch butterfly or melkbosskoelapper. Other butterflies mimic the colour pattern and are then avoided by birds. *Phymateus leprosus* or stinksprinkaan also feeds on cardenolide-containing plants.

Plants containing bufadienolides are of major importance in intoxication of livestock. An example of a bufadienolide-containing plant is yellow tulip (*Moraea pallida*) and blue tulip (*M. polystachya*).

The name bufadienolide is derived from *Bufo* toads (skurwepaddas). These toads secrete bufadienolides as well as tryptamine alkaloids and catecholamines through the paratoid gland and the skin. Some people even keep these toads and after agitating them they lick the toads for “recreational purposes” as an euphoric effect is experienced.

Drimia (= *Urginea*) *sanguinea*, colloquially known as slangkop or sekanama, contains bufadienolides. Slangkop is used by traditional healers in the treatment of various ailments. It is also a very common poisoning of humans that have ingested this plant as “muti”.

Bowiea volubilis (climbing potato) has also been implicated in human poisoning. This plant also contains bufadienolides, including bovoside A. When the bulb is ingested for medicinal purposes poisoning may result.

Other plants that contain cardiac glycosides and more specifically cumulative bufadienolides are certain plakkies. *Cotyledon orbiculata*, a common succulent found in rockeries and gardens and *Tylecodon wallichii*, found in the dry, arid areas of the country are examples of members of the Crassulaceae. What is interesting about these plants is

that they may induce a chronic syndrome known as krimpsiekte, a paretic/paralytic condition of small stock. An aspect of great concern is that secondary poisoning might occur if the carcass of an animal that has died of krimpsiekte is consumed. Residues of this cumulative bufadienolide might remain in the edible tissues. Relay poisoning has been confirmed as far back as 1884 by feeding dogs the livers of goats that have died of the disease.

Digestive system

Toxic garden plants include chinkerinchees. *Ornithogalum thyrsoides*, star of Bethlehem, and *O. saundersiae*, Transvaal chinkerinchee. These are extremely toxic and it is reported that 8 flowerheads may kill a horse! They induce severe diarrhoea in animals and even blindness in cattle.

Ricinus communis or castor oil plant may sometimes be planted in a garden. The seeds are extremely toxic and contain the toxalbumin or plant lectin - ricin, one of the most toxic substances known. It has even been used to eliminate spies during the Cold War (refer to the Georgi Markov homicide).

In addition, other members of the Euphorbiaceae family such as *Jatropha curcas* and *J. multifida* also contain a toxalbumin, namely curcin, which can also cause severe diarrhoea. The brightly coloured seeds of *Abrus precatorius* are used to produce bracelets and necklaces and also contain a highly toxic substance named abrin.

Ingestion of the ripe berries of *Melia azedarach*, the exotic syringa tree introduced from India, has been associated with vomiting, diarrhoea, dyspnoea, muscle tremors and convulsions in children.

Members of the family Araceae, such as *Alocasia*, *Dieffenbachia*, *Philodendron*, *Monstera deliciosa* and *Zantedeschia aethiopica* (the only indigenous species) may cause severe stomatitis. These plants are grown for their beautiful foliage and contain insoluble calcium oxalate crystals (needle sharp raphides), which are packed in specialized ampoule-shaped ejector cells, each with an operculum, called idioblasts. On pressure such as crushing of the stem when chewed the needle-like crystals are

ejected and penetrate the surrounding tissue resulting in intense irritation, discomfort and histamine release.

Vegetables such as green tomatoes, potatoes and brinjals may contain high concentrations of solanine, which can cause irritation of the digestive tract. On the other hand, onions and garlic contain n-propyl disulphide, which inhibits glucose-6-phosphate dehydrogenase in the pentose-phosphate pathway in the red blood cell. Haemoglobin is then susceptible to oxidative damage and methaemoglobinaemia, Heinz body formation and haemolysis result.

Pteridium aquilinum, bracken fern or adelaarsvaring, the only fern that we know that is toxic, may be involved in secondary poisoning in humans. Bracken contains ptaquiloside, a known carcinogen. In cattle urinary bladder and upper alimentary tract carcinomas are encountered. Humans may be exposed indirectly by drinking milk from dairy cows grazing on the plant. In Japan, Brazil, northeastern USA and Canada people consume the uncurled fronds or crosiers, as a delicacy (fiddlesticks) and it is of great concern as a carcinogen in humans. This may explain the high incidence of throat cancer amongst the Japanese.

Skin

The candelabra tree or naboom, *Euphorbia ingens* and the rubber hedge euphorbia, *E. tirrucalli* contain highly irritant milky latex, when in contact with skin and especially moist mucous membranes it results in severe irritation and inflammation.

African poison ivy or pynboom (*Smodingium argutum*) causes an allergic dermatitis and pruritis in sensitive individuals. It even occurs when the individual just passes near the tree.

Nervous system

There are numerous plants that contain cyanogenic glycosides, which are of veterinary importance and may result in peracute poisoning in ruminants, such as sorghum and *Acacia* species. Cassava (*Manihot esculenta*) is cultivated as a crop for human

consumption in large parts of Africa. The tubers are utilized, but they may still contain high concentrations of a cyanogenic glycoside. When consumed by protein-deficient subjects, where sulphur amino acids are low, neurological conditions such as konzo (cassava-associated spastic paraparesis) in Mozambique and East Africa and mantakassa (cassava-associated tropical ataxic myeloneuropathy) in Nigeria may arise. Long-term ingestion of *Lathyrus sativa* (chickling pea) may result in lathyrism, which is a peripheral neuropathy caused by excitatory amino acids contained by this plant. The disease manifests as a spastic muscle weakness and is clinically very similar to konzo.

Datura stramonium and *D. ferox* are also known as moon flower, jimson weed, stinkblaar or olieborne. These cosmopolitan weeds contain parasympatholytic alkaloids such as atropine and hyoscyne. Humans are extremely susceptible and hallucinations may occur, and the proverb “blind as a bat, red as a beet, dry as a bone and mad as a hatter” aptly describes atropine poisoning in humans. On occasion, young children have been forced to swallow seeds (“malpitte”) during initiation ceremonies at schools. These seeds may also end up in harvested maize and is not suitable for human consumption. Sometimes these plants are collected inadvertently, instead of *Amaranthus*, and prepared as “marog” which resulted in severe intoxication.

Accidental ingestion of *Nicotiana glauca* (wild tobacco) has also been reported when the young seedlings have mistakenly been collected as “marog”. *Nicotiana glauca* contains a pyridine alkaloid, anabasine, which is very similar to nicotine. Ingestion may result in nausea, vomiting, gait abnormalities, tremors, confusion and convulsive seizures.

Boopha disticha (seeroogblom, bushman poison bulb) contains various alkaloids such as buphanidine, buphanisine and buphanamine. Poisoning usually occurs in humans that utilizes the bulb as “muti”. Acute poisoning induces vomiting, weakness, coma and mortality.

Liver

Senecio species and *Crotalaria* species contain pyrrolizidine alkaloids. In the 1930's bread poisoning occurred in poor whites when they consumed wheat flour contaminated with *Senecio* plant material. They suffered from hepatotoxicity and veno-occlusive

disease. Another plant that contains pyrrolizidine alkaloids which is often used as herbal medicine is comfrey (*Symphytum officinale*).

Callilepis laureola (impila, ox-eye daisy, wildemagriet) is widely used as herbal medicine (“muti”) and upon ingestion induces severe hepatotoxicity, nephrotoxicity and hypoglycaemia. An atractyloside has been isolated from the roots.

Other plants that may contain hepatotoxins are cycads (broodbome). They contain different glycosides and following ingestion are converted in the intestinal tract to methylazoxymethanol (MAM), which is hepatotoxic and even carcinogenic. Reitz described that during the Anglo-Boer War hungry soldiers ate the fruit of an *Encephalartos* species and were severely affected. Cycads also contain an unusual non-protein amino acid (BMAA), which is linked to Parkinsonism, dementia and amyotrophic lateral sclerosis in the indigenous population in Guam.

Mycotoxicoeses

When we think about fungi or moulds we must mention *Aspergillus flavus*, a common mould on peanuts and other grains. Aflatoxins may be produced and are also hepatotoxic and potentially carcinogenic to humans.

Another mould is *Fusarium verticillioides*, the most prevalent fungus on maize all over the world. Environmental factors contribute to the accumulation of the mycotoxin fumonisin B₁ in the maize, which is the staple diet of the people in the Transkei. Consumption of mouldy maize by local populations in Transkei has been linked to oesophageal cancer. In equidae nervous signs due to leukoencephalomalacia are seen.

Lastly, I would just like to mention the highly poisonous mushroom *Amanita phalloides* (death cap). It contains cytotoxins (amatoxins and phallotoxins) and soon after ingestion, gastro-enteritis is evident, but a few days later hepato- and nephrotoxicity occur which is invariably fatal.

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