

Practice No. 7

Phytotoxins

- Poisonings by toxic plants are very common
- Keepers usually can't recognise the kind of eaten plant, ask them to bring the rest of the plant or take a proper photo of it
- Vets need to have an atlas of poisonous and medicinal plants in the clinic or internet connection to a reliable online database
- No specific antidotes or they are usually not used in a veterinary practice, treatment is mainly symptomatic and supportive
- Many types of plant toxins, they may affect most of the organs and body systems
- Some of the substances are not poisons to all intents and purposes – many have allergic potential or plants or their parts may cause mechanical irritation

Plants causing photosensitivity:

- Two types of such chemicals:

- Primary phototoxic agents: furanocoumarins and anthraquinones- substances that have this properties themselves. After ingestion cumulation of them in skin or passage of them through skin capillaries = exposure to UV light follows and a rash and damage of skin cells due to oxygen radicals released occurs. Most affected places – mouth, eyes, ears, udder
(St. John's wort – Hypericum, cow parsnip - Heracleum, buckwheat – Fagopyrum, Ruta, etc.)

Cow parsnip (Heracleum mantegazzianum)

- Contains furanocoumarins, which are highly locally irritating – cause strong inflammation of the skin and subcutaneous tissues which is compared to yperit (chemical war agent).
- Treatment is very difficult, a necrosis occurs very often, a secondary bacterial infection of the place is also typical, a strong hyperpigmentation of the scar remains for months or years.
- Secondary phototoxic agents: due to bacterial microflora chlorophyll can be changed into phototoxic derivate phylloerythrin – in animals with hepatic diseases it is not metabolised (conjugated) and excreted, but passes to systemic circulation and again cumulates in skin. Symptoms are the same (especially in herbivores, ruminants).

Terpenic substances:

Monoterpens (essential, aromatic oils)

Tansy (Tanacetum vulgare)

- Essential oil with thujone, which is neurotoxic (inhibition of GABA) and hepatotoxic. Formerly found in an alcoholic drink called absinth (Artemisia plant, absinthe, wormwood) .
- The powder made from tansy was used as an antiparasitic agent against fleas.
- Now it is obsolete, so poisonings are less common and appear mainly in ruminants.

White cedar (*Thuja occidentalis*)

- Contains essential oil, main substance is thujone – similar to tansy.
- Locally irritating and after ingestion causes GIT problems – vomiting, diarrhoea, damage of liver tissue, increase in blood pressure, lung oedema that can result in death.
- Therapy is in both thujone containing plants only symptomatic.

Diterpens

Wolf 's milk (family Euphorbiaceae)

- Contains latex milk with diterpens, which are highly toxic (liver, kidney). Diterpens cause also local irritation, allergies (even fierce allergic reaction with a rash and a necrosis of mucosae and skin within short time) and can promote skin cancer development.
- On the other hand, their taste is so bitter that animals don't eat them, so most often only mouth and skin become the affected parts of the body.
- Specific care should be taken in case latex comes into contact with eyes, which might be superficially damaged and healing with scars can cause blindness.
- Treatment is only symptomatic.

Triterpens

- Many types, most common are saponines.
- Saponines have steroid structure and can exchange with cholesterol in the membranes of the cells, which leads to changed surface tension, permeability and can lead to cell lysis.
- Mainly enterocytes and erythrocytes are affected, also kidneys can be damaged by released hemoglobin.
- Among plants containing triterpens/saponines belong cyclamen (*Cyclamen persicum*), common ivy (*Hedera helix*) or dracaena.

Cardioactive glucosides

- All these glucosides are toxic especially for monogastric animals. In ruminants, they are partially destroyed by bacterial microflora in a paunch (rumen).
- All of them have the same mechanism of action – inhibition of Na/K ATPase and cummulation of Na⁺ and Ca²⁺ in heart muscle, which leads to increased contractility, bradycardia and arrhythmias, in severe cases also heart failure.

Crownvetch (*Coronilla varia*)

- Contains cardioactive glucosides – coronilline + hyrcanoside.
- Signs are arrhythmias, and because of the presence of nitrites (3-nitropropionic acid) in the plant, methaemoglobinemia occurs too.

- Treatment is symptomatic (antiarrhythmics, fluids, minerals and AB balance corrections etc.), but if the dose is not lethal, full recovery is possible, because these agents don't damage tissues.

Oleander (*Nerium oleander*)

- Cardioactive glucosides oleandrine and neriine, very potent.
- Signs and treatment are the same as described above.

Foxglove (*Digitalis ssp.*)

- Contains cardioactive glucosides – digoxin, digitoxin and others.
- Digitalis plant is very bitter and strong vomiting follows eating, so there are only a few intoxications in wild animals.
- More common is overdose with pure glucosides used for treatment (pills).
- There are antidotes available for this intoxication – specific antibodies against digoxin – but they are very expensive and side effects can be harmful too.

Also found in lilly of the valley (*Convallaria majalis*), sea onion (*Scilla maritima*), hellebore (*Helleborus niger*) etc.

Alkaloids

Yew (*Taxus baccata*)

- Contains alkaloid taxine (cardiotoxic effect) and antimetabolic agents called taxans.
- Taxine inhibits sodium and calcium channels on myocardium leading to decreased contractility.
- The whole plant is toxic except the red aril surrounding the seed.
- Signs of intoxication are: nausea, vomiting, diarrhoea, mydriasis, decrease in blood pressure, decrease in temperature, bradycardia and bradypnoe, heart collapse and death.
- Most sensitive are horses, which may die within a few minutes after ingestion.
- Treatment is only symptomatic.

Horsetail (*Equisetum palustre*)

- Contains alkaloids palustrine and nicotine, and enzyme thiaminase.
- Alkaloids activate nicotinic receptors and lead to excitation, lack of thiamine leads to neurological signs.
- Poisonings mainly in cattle, usually after chronic intake.
- Signs of chronic intake: decrease of body weight, decrease of milk yield, diarrhoea, paralysis of muscles.
- Treatment: change of the diet and a supplement of vitamin B1 (thiamine)

Hemlock (*Conium maculatum*)

- Contains alkaloid coniine – inhibits nicotinic Ach receptors.
- Coniine irritates GIT, then causes paralysis of motoric centres.
- It is an up-going poisoning – first there is a paralysis of legs, then of a neck, head and finally trunk and chest. Death comes due to the paralysis of respiration muscles and it is in full consciousness.
- Coniine is a volatile substance, so beware of smelling to it, can cause a mild poisoning – headaches, vomiting – even while smelling to it.
- Poisonings are typical in ruminants from hay.
- Treatment is only symptomatic and usually unsuccessful.

Monkshood (*Aconitum napellus*)

- Contains alkaloid aconitine, which is the most potent plant toxic substance in Europe – the lethal dose is 2 mg of aconitine for the an adult man.
- It is very dangerous as it is absorbed via all routes including intact skin.
- It blocks neuronal transmission especially in nervus vagus, inhibits Na channels on synapses and in heart and causes death similar to that in coniine – a respiration paralysis in the full consciousness, or heart failure.
- Treatment is only symptomatic, but rarely successful.

Ragwort (*Senecio* plants)

- Contains pyrrolizidine alkaloids – senecin, senecionin.
- Most common is spring poisoning after chronic or long-term exposure. In spring, the alkaloids are bound in a plant to sugars and other chemicals, so they don't change its taste. Young and inexperienced animals - especially horses - are the main victims. In late summer and autumn, pyrrolizidine alkaloids are released from their bonds and cause a very bitter taste of plants, so there aren't poisonings in this period of year.
- Pyrrolizidine alkaloids create adducts with DNA leading to hepatotoxicity and consequent hepatopathic encephalopathy.
- Signs: weakness, inappetence, jaundice, increased neuronal irritability, blindness, apathy, ataxia, liver failure.
- Prognosis is always poor, because signs are significant at the time when the damage of liver is too massive. Treatment is only symptomatic.
- In the CZ the poisoning of horses is called Žďár disease of horses.

Deadly nightshade, Jimsonweed (thorn apple) and other Solanaceae (*Atropa belladonna*, *Datura stramonium* etc.)

- Contain alkaloids atropine
- Potatoes from Solanaceae contain solanine (lecture on food toxins) and tobacco plant contains nicotine (stimulation of nicotinic Ach receptors).
- Most poisonings by plants containing atropine.
- Some animals are resistant to atropine, they have an enzyme in blood which deactivates it - singing birds, guinea pigs, rabbits.
- Horses are very sensitive to this poisoning.
- Atropine is a parasympatolytic agent (xerostomia, inhibition of peristaltics, mydriasis, hallucinations, seizures, hyperthermia).

- Treatment of the poisoning is usually symptomatic, but the antidote is physostigmine.

Boxwood (*Buxus sempervirens*)

- Contains alkaloids cyclobuxine and buxamine.
- Lethal dose is similar to yew tree, so it is very poisonous.
- Cytotoxic, stimulate apoptosis + inhibit cholinesterases.
- Causes mainly vomiting, diarrhoea, colic, tremors, seizures, exhaustion, pain and vocalisation, death.
- Treatment is only symptomatic.

Common laburnum (golden rain, *Laburnum anagyroides*)

- Contains alkaloid cytisine, which works similarly to nicotine – stimulation of nicotinic receptors.
- Causes mainly vomiting, diarrhoea, colic, tremors, seizures, death.
- Poisonings are mainly from seed ingestion, although whole plant is toxic.
- Treatment is only symptomatic.

Other substances

Frogflower and other Ranunculaceae

- Contain lactone called protoanemonin, which is found in all the Ranunculaceae family
- The alkaloid is highly toxic for water organisms, especially for fish and young frogs.
- It affects mainly kidneys, treatment is symptomatic.
- The poison is one of the few which is destroyed by drying – hay is not toxic.

Sycamore maple tree (*Acer pseudoplatanus*)

- Contains toxic aminoacid hypoglycin A.
- Most of the active substance is found in the seeds (autumn) and seedlings (spring).
- Hypoglycin A inhibits beta oxidation of fatty acids in muscles and leads to so called Atypical myopathy (rhabdomyolysis).
- Signs include apathy, colic pains in belly, sweating, reluctance to move, dark urine, weakness, recumbency, kidney damage, death. Mortality rate is very high.
- Treatment is only symptomatic but rarely successful.