

Practice No. 11

Poisonings of honey bees:

Poisons in honey bees cumulate in a venom sack. Honey is absolutely necessary source of nutrition for bees, moreover in winter they can't remove their faeces from hives, so poisons can't be excreted these ways. Almost everything goes to venom, differences in honey quality (means honey produced directly by bees, not mentioning treatment of bees or changes and contamination added later during the processing of honey) are thus quite low.

- Substances toxic to honey bees:
 - a) Some plant toxins:
 - Many plant toxins are safe for honey bees, because bees lack the function which is influenced by toxin, or have specific detoxifying enzymes.
 - Toxic are colchicine (*Colchicum autumnale*) and anemonine (*Ranunculaceae* family plants) - not massive intoxications, appear only in locations where there is huge amount of this plant. Bee is not dying after visiting one flower like this.
 - Probably toxic are oligosacharides in lime tree (*Tilia* sp.) and sunflower. We found a lot of dead bees under these plants. Might be also amplified by other conditions, because so called "summer" honey bees, which live only a few weeks, are during the flowering of these plants at around the end of their life, so are old and thus maybe more susceptible.
 - b) NaCl
 - solution of concentration more than 1 % is toxic to honey bees
 - c) Metals
 - arsenic – released mainly from fossil fuels like coal. With decrease in using coal, the number of such poisonings decreases too.
 - Also lead and copper poisoning in honey bees were described in industrial areas.
 - d) Gases
 - chlorine, fluorine – bees are a sensitive indicator of it
 - e) Hydroxymethylfurfural
 - HMF – its content allows control honey quality easily. It increases if the honey is old, in case it was processed under higher temperatures, or sucrose solution was added to adulterate it
 - produced from sugars during caramelization of sugar
 - inedible for bees – they suffer from hunger and it causes them GIT problems, in higher concentrations the poisoning might be quick.
 - in humans it is classified as a possible carcinogen. Quality limit for HMF – Czech Republic only 20 mg/kg of honey, EU 40 mg/kg of honey. Toxic concentration for honey bees is 200 mg/kg.
 - f) Pesticides
 - nowadays most common source of poisonings in honey bees
 - very dangerous are bipyridil herbicides (desiccants) paraquat and diquat – death comes after longer time, bees bring the contamination to hive where they affect

other bees. After some time they lose the ability to fly, so they walk and “paths” of walking honey bees are seen around hives.

- most dangerous and causing most of the poisonings are insecticides:
 - fipronil from phenylpyrazole group (LD50 = 6 nanograms/bee) - inhibition of GABA = excitation,
 - imidacloprid from group of neonicotinoids (LD50 = 3,9 nanograms/bee) – inhibits nicotinic receptors = paralysis
 - both fipronil and imidacloprid have residual activity (stay in plant tissues but also in contaminated bees for weeks and by contact can still cause poisoning)
 - both of them cause delayed death - death after approx. 4 hours after exposure – affected bees return back to hive and contaminate also other bees

 - organophosphates and carbamates, pyrethroids – quick death
 - bipyridyl herbicides – slow death, residual activity, first sign is inability to fly = walking of bees