

Methods to study environmental occurrence, fate and chemico-biological interactions of cyanobacterial toxins

Libor Jaša

Supervisor: RNDr. Pavel Babica, Ph.D.

Cyanobacteria (blue-green algae) are photosynthetic prokaryotic organisms with the ability to synthesize chlorophyll-*a* and produce a wide range of secondary metabolites, including cyanobacterial toxins (cyanotoxins). Most widespread bloom-forming cyanobacteria genus is *Microcystis*, the main producer of the hepatotoxic peptide microcystin¹. It has been estimated that 25-75% cyanobacterial blooms are toxic. Cyanotoxins represent an important group of chemical compounds which are intensively studied with respect to their chemical properties and the presence in the environment, and with regard to their toxicity and ecotoxicity². The toxic cyanobacteria can induce a range of adverse effects, from headaches, dizziness, nausea, diarrhea, skin irritation to the neurotoxic effects or acute/chronic damage to the liver or other organs³.

Microcystins (MCs) are recognized as the most hazardous cyanotoxins with respect to their potential for both acute and chronic effects on wildlife or human health. These substances cause primarily hepatotoxic or hepato-carcinogenic effects in mammals; and World Health Organization (WHO) recommended a guideline value of 1 µg/L for MC-LR in drinking water⁴.

The presentation will primarily focus on sampling and monitoring cyanotoxins in water reservoirs, which serve as a source for drinking water treatments plants (DWTPs), and for evaluation of toxin removal efficiency during the treatment process. POCIS type passive sampler was optimized, evaluated and calibrated and used for monitoring of MCs and comparison with conventional grab sampling. Next studies focused on the development of passive sampler for emerging cyanotoxin cylindrospermopsin, microcystin oxidation with high-valent iron oxidant, determination MCs in invasive bryozoan *Pectinatella magnifica*, isolation and purification of secondary metabolites (microginin and anabaenopeptin) from cyanobacterial water bloom biomass.

1. Fastner J, Erhard M, von Dohren H. Determination of oligopeptide diversity within a natural population of *Microcystis* spp. (Cyanobacteria) by typing single colonies by matrix-assisted laser desorption ionization-time of flight mass spectrometry. *Applied and Environmental Microbiology*. 2001;67(11):5069-5076.
2. Blaha L, Babica P, Marsalek B. Toxins produced in cyanobacterial water blooms - toxicity and risks. *Interdisciplinary toxicology*. 2009;2(2):36-41.
3. Dittmann E, Fewer DP, Neilan BA. Cyanobacterial toxins: biosynthetic routes and evolutionary roots. *Fems Microbiology Reviews*. 2013;37(1):23-43.
4. Svircev Z, Drobac D, Tokodi N, Mijovic B, Codd GA, Meriluoto J. Toxicology of microcystins with reference to cases of human intoxications and epidemiological investigations of exposures to cyanobacteria and cyanotoxins. *Archives of Toxicology*. 2017;91(2):621-650.