A closer look at the elemental composition of macrofungi, with a focus on arsenic

Walter Goessler [1,], Simone Braeuer [1] (1) Institut für Chemie, Universität Graz, Graz, Austria, [*]walter.goessler@uni-graz.at.*

Fungi have an important position in ecosystems. Their roles involve rock and mineral transformations, bioweathering, fungal-clay interactions, and metal-fungal interactions formation. Therefore, fungi can also mobilize elements, effectively transform halogens, metals, metalloids, and organometallic compounds by reduction, methylation, and dealkylation. These processes are essential for the environment since transformations of metal(loid)s modify their mobility and toxicity.

Fungal fruit-bodies ("mushrooms") serve as important nutrient source for parasites, wild animals, and humans. They may accumulate remarkable concentrations of (trace) elements – a phenomenon that is still little known outside of the research community. For example, the King Bolete (*Boletus edulis*) is able to accumulate the essential trace element selenium (median 15 mg/kg, max. 74 mg/kg dry mass). At the same time this fungus also accumulates significant amounts mercury (median 2.3 mg/kg, max. 24 mg/kg dry mass) a heavy metal known for its toxic properties. The Fly Agaric (*Amanita muscaria*) is a selective vanadium accumulator. Concentrations of up to 440 mg V/kg dry mass have been determined in our laboratory (compared to on average < 1 mg V/kg dry mass in other species) [1]. The Violet Crown Cup (*Sarcosphaera coronaria*), a mushroom considered edible in previous days, is a known arsenic accumulator. In a recent study, we found up to 9000 mg As/kg dry mass in fruit-body samples of this mushroom species [2]. Such concentrations are hardly ever reported for any natural living organism. The edible ink stain bolete (*Cyanoboletus pulverulentus*) is also capable to accumulate up to 1300 mg As/kg [3].

As not all arsenic compounds have the same toxic properties, we have additionally determined the arsenic speciation in many different mushroom samples [4]. Our studies provide new exiting results with the respect to the arsenic speciation in mushrooms. For example, we discovered two new arsenicals for the first time in a living organism, one of them as the main arsenic compound in a parasitic mushroom.

The presentation covers analytical aspects as well as the results for the total element determinations and the arsenic speciation.

References

[1] S. Braeuer, M. Walenta, L. Steiner, W. Goessler "Determination of the naturally occurring vanadium-complex amavadin in Amanita muscaria with HPLC-ICPMS" J. Anal. At. Spectrom. 36, 954-967, 2021.

[2] S. Braeuer, J. Borovička, J. Kameník, E. Prall, T. Stijve, W. Goessler "Is arsenic responsible for the toxicity of the hyperaccumulating mushroom Sarcosphaera coronaria?" Sci. Total Environ. 736, 139524, 2020.

[3] S. Braeuer, W. Goessler, J. Kameník, T. Konvalinková, A. Žigová, J. Borovička, J. "Arsenic hyperaccumulation and speciation in the edible ink stain bolete (Cyanoboletus pulverulentus)" Food Chem. 242, 225-231, 2018.

[4] S. Braeuer & W. Goessler "Arsenic species in mushrooms, with a focus on analytical methods for their determination - A critical review" Anal. Chim. Acta 1073, 1-21, 2019.