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Mercury Bioaccumulation in wild fungi from Almaden mining district (Spain)

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Almadén (South Central Spain) is the world's largest mercury mining district, having produced almost one third of total mercury used by mankind, during a time span from prehistoric times to the year 2000 approximately, when the mines and metallurgic activity ceased definitively. Mercury pollution in the area affects all the abiotic and biotic environmental compartments, including soils and plants living on them (Millán et al., 2006; Molina et al., 2006). Edible and non-edible mushrooms are organisms living in a direct relationship to soil substrate, and due to this, they are able to incorporate and accumulate toxic soils components, such as heavy metals (Campos et al., 2009), in most cases with higher concentrations in their mycelium than in the substrate where they live. Uptake patterns depend on heavy metal concentration on soil, speciation and bioavailability, but also on mushroom species considered.

The survey was carried out in the mercury mining district during fall 2008 and spring 2009 and focus on soils and fungi from the main hotspots of the district. Fungi sampling were focused on calps and stalks, while soil was collected simultaneously in the same area/site on which each fungus sample grows. Mushroom was frozen after collection, freeze-dried, crushed and homogenised until total mercury determination. Analysis of biological and geological samples was carried out using an atomic absorption spectrometer AMA254. This equipment accomplishes EPA-method 7473, with a detection limit of 1 $ng \cdot g^{-1}$ for biological samples.

Samples of edible (*Agaricus sp.*, *Pleurotus eryngii, Russula delica, Lactarius deliciosus* and *Boletus edulis*) and non-edible *(Lepista nuda, Lepista leonida, Lactario torminosus, Lactarius vellereus, Russula olivacea, Cliptocybe nebularis* and *Lycoperdum velatum)* fungi species were considered on this study. Mercury contents in soils and fungi show similar range (0.49 – 42.06 $\mu g \cdot g^{-1}$ / 0.28 – 51.28 $\mu g \cdot g^{-1}$ respectively), with a bioconcentration factor (BF=Hg_{fungi}/Hg_{soil}) close to 1 in average (1.33). But this uptake pattern shows differences depending on each mushroom species considered. Maximum BF on mushroom was found on *Lactarius vellereus* (4.21) and *Pleurotus eryngii* (3.83) and minimum on *Rusula delica* (0.09). A remarkable fact is that an edible species (*Pleurotus eryngii*) has high mercury concentration and capacity to bioaccumulate mercury from the soil.

Mushrooms that develop its life underground (*Tuber nigrum*) shows lower mercury levels than other mushrooms growing on soil surface in the same areas, probably due to environmental factors and not only because of soil condition.

A correlation between mercury in mushrooms and soil was found. In a polynomic adjustment it can be seen that 40% of samples have a perfect adjustment (R^2=0.675) to the model proposed implying mushrooms possibilities to be used as a bioindicator.

References

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