Heavy Metal Content in Wood-Decaying Fungi Collected in Prague and in the National Park Šumava in the Czech Republic

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Received: 10 February 1997/Accepted: 11 June 1997

Accumulation of metals by fungi has been known for a few decades and a number of works describing metal content in fruit bodies collected in different areas have been published (Mejstrik and Lepšová 1993). A key role in metal accumulation by fungi has been attached to cell wall polysaccharides, cysteine-rich proteins and pigments like melanin (Siegel et al. 1990). Some higher fungi are known to have the ability to accumulate toxic elements such as As, Cd or Pb from the environment (Stijve et al. 1990, Vetter 1994, Tyler 1982). Heavy metal content in many terrestrial fungi correlates with metal concentration in the soil in which they grow (Gast et al. 1988). In the case of edible fungi, toxic metals may be incorporated into food chains.

Fungal species growing on wood contain, in general, lower concentrations of heavy metals than fungi growing on soil (Mutsch et al. 1979), probably due to limited contact of mycelia with the soil. Nevertheless, wood-inhabiting fungi growing in polluted areas may contain higher amounts of toxic metals than fungi growing in unpolluted areas, as we demonstrated for beryllium (Gabriel et al. 1995) previously. Wood-decaying fungi take up heavy metals by deposition of particles from the atmosphere and absorption from the substrate. Literature data indicate that heavy metal content decreases from soil through roots to stems (Salt et al. 1995). Earlier experiments (Brunnett and Zadrazil 1981, Gabriel et al. 1996a) confirmed translocation of heavy metals from substrate into the fruiting bodies of lignocellulose decomposing fungi. Atmospheric dry or wet depositions represent another considerable source of metals in plants and plant related parasites or saprophytes (Hovmand et al. 1983).

The purpose of this work was to examine heavy metal content (Al, Cd, Cu, Pb and Zn) in six wood-decaying fungal species collected in polluted and unpolluted areas in the Czech Republic.

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MATERIALS AND METHODS

Fruit bodies of the basidiomycetes Daedalea quercina, Stereum hirsutum, Schizophyllum commune, Ganoderma applanatum, Fomitopsis pinicola and Hirneola auricula-iudae were collected in both the unpolluted (National Park Šumava) and polluted (Prague) areas in the Czech Republic between autumn 1994 and summer 1995. In all sites, fruit bodies of each studied species were collected together and subsequently processed as one sample. The data obtained from each sample thus represent an average for several individuals grown on one site.

Metal content was determined by atomic absorption spectrometry. Dried samples were homogenised, taken up in HNO₃ and after microwave digestion in MDS 2000 (CEM, Matthews, USA) analysed on Spectr AA 300A (Varian, Melbourne, Australia) at wavelengths 396.2 nm (Al), 228.8 nm (Cd), 327.4 nm (Cu), 283.3 nm (Pb), and 213.9 nm (Zn). Deuterium background correction was used for cadmium and lead.

RESULTS AND DISCUSSION

Sample sites in the National Park Šumava (southern Bohemia), area with negligible industrial pollution were designated as unpolluted. The area of Prague was designated as polluted, based on the data on atmospheric deposition; the average concentration of solid particles in atmospheric deposition is 60 µg.m⁻³ and locally exceeds 100 µg.m⁻³ per year in Prague. Emissions of SO₂ and NOₓ were 83.9 tons per year and km² and 75.5 tons per year and km² in 1992, respectively. The same data reported for sulphur and nitrogen oxides in southern Bohemia were 4.4 tons per year and km² and 2.7 tons per year and km² (Bozó et al. 1992).

Wood-decaying fungi do not photosynthesise and therefore they are not particularly sensitive to elevated concentrations of sulphur and nitrogen oxides compared with lichens or mosses and they can grow and fructificate in heavily polluted areas. As they mainly take up heavy metals from the atmosphere, fruit bodies of wood-decaying fungi seem to be useful indicators of atmospheric pollution by heavy metals. The use of these fungi as bioindicators of environmental pollution by heavy metals is limited by nutrient requirements of the studied species. Some wood-decaying fungi grow and fructificate only on particular plant species: e.g. D. quercina prefers oaks (Quercus sp.), H. auricula-iudae prefers elder (Sambucus nigra). This disadvantage may be overcome by collection of several fungal species chosen on the base of their natural distribution.

Fruit bodies of six common species of wood-decaying fungi were collected. Total number of samples from polluted areas was 94 and from unpolluted was 46. Averages and standard deviations of Al, Cd, Cu, Pb and Zn content for all fungal species together are given in the table below. Statistical treatment of the data by