Paper Number: 3053

Metal accumulation in Australian fungi: Uptake, Toxicity and Risk

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The ability of fungi to accumulate metals such as arsenic, cadmium, chromium, mercury and gold has promoted the use of various genera for metalliferous ore prospecting, and environmental contamination detection. The use of fungi is broad: cultivated as a food source, grown in specific media to provide enriched foods, and as a nutraceutical and in traditional medicines. The heterotrophic nature of the fungi makes them ideally suited to characterising the soil chemistry in which they grow. This property is relevant to disturbed landscapes and is specifically relevant to the Goldfields region of Victoria, Australia, where more than 150 years of gold mining has significantly impacted the landscape.

Fungi are capable of significant metal uptake and transfer to the fruiting body. Whilst the fruiting body of fungi may be small, an entire organism, including the mycelium and rhizomorphs, may extend underground over an area of many hundreds of square metres. This characteristic makes fungi ideal as a sampling media for soil contamination.

Significant, but non-Australian based, fungi research has focused on edible species, motivated by growing public concerns of high concentrations of toxic trace elements in available fungi. Given the potential health risks of species misidentification, Australia has a tradition of discouraging field collection of fungi. However the expanding multicultural base of the population has led to an increasing prevalence of field collection over time. The proximity of mining-affected landscapes to urban expansion has also resulted in greater and growing exposure of populations to the availability of mushrooms, as free produce, with the inherent risks to health. Further, the use of fungi as a preferred sampling medium to identify and characterise contaminated sites has not been explored in the Australian context.

We present chemical analysis of Australian fungi and the surrounding soil and explore the potential for this analysis to contribute to environmental assessment of contaminated sites. We also explore the human health context for fungi foragers by providing a baseline for metal toxicity data for field-gathered fungi in the Goldfields region. Our results indicate the relationship between metal uptake in edible species, the maturity of the fungi and with the level of contamination in the soils. We explore the health implications and make recommendations for fungi foragers in landscapes that have been disturbed by mining. We further postulate on the significance of fungi as an indicator of contamination.

Figure 1: Lactarius deliciosus (Saffron Milk Cap) an introduced and commonly foraged species in Australia.