Arsenic Metabolism in the Mushroom Agaricus bisporus

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Arsenic is a prevalent existing environmental toxin and also a human carcinogen. Recently, mushrooms were found to have unique properties that allowed them to metabolize arsenic into a completely non-toxic product, namely, arsenobetaine, which was detected in many wild-grown and commercial mushrooms. In this study, a commercial culturable mushroom model, the white button mushroom, Agaricus bisporus, was used to explore the arsenic toxicity, accumulation, and biotransformation under defined conditions in their vegetative and fruiting phases. The mushroom was treated with four different naturally existing toxic arsenic precursors. Each of their toxicities in the vegetative phase has been determined and compared with single-cell fungi, S. cerevisiae (budding yeast). This arsenic accumulation in the vegetative and fruiting phases was also studied, and my results have found that inorganic arsenic, which includes trivalent arsenite and pentavalent arsenate, are well accumulated in mycelium but not fruiting body, while methylated arsenic species are accumulated in fruiting body with higher efficiency. The arsenic speciation analysis was performed in those fruiting bodies using an instrument called HPLC-ICP-MS (High Performance Liquid Chromatography Inductively Coupled Plasma Mass Spectrometer). My results clearly showed that the monomethylated arsenate is the only efficient precursor that can lead to the formation of arsenobetaine. These results not only have established the optimal precursor for arsenobetaine synthesis, but it also confirmed that Agaricus bisporus is a promising model to study arsenobetaine biosynthesis. These preliminary results pave the road towards future application of using this machinery to engineer microbes for arsenic removal from our environments.