

# Chapter 11

## Fungi–Mediated Detoxification of Heavy Metals

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### ABSTRACT

*Heavy metal pollution is one of the major environmental problems today. Therefore, the elimination of heavy metal ions from wastewater is important to protect public health. The use of biological material in the removal and recovery of toxic metals from industrial wastes has gained important credibility during recent years. Several microorganisms including bacteria, algae, yeast, and fungi have been reported to effectively accumulate or adsorb heavy metals through biosorption. Fungal biomaterial has been proved to be efficient as a biosorbent. High percentage of the cell wall material and availability of fungal biomass as a by-product of various antibiotic and food industries makes it an obvious choice. Thus, the chapter deals with detoxification of heavy metals from contaminated sources using biomaterials with special reference to fungi.*

### INTRODUCTION

Rapid improvement in industrialization has made human life comfortable, but it has also brought along with it a disruption of environmental balance. Heavy metals produced as a byproduct of many such industrial processes is toxic, and its accumulation in the environment can lead to severe health hazards in human beings. It can also harm the eco-system by accumulating in the food chain. Environmental heavy metal pollution can be primarily associated with the following causes:

- Seepage and overburdens generated from mines- associated with mining operations
- Effluents produced from electroplating plants
- Effluents produced from Coal-based power plants
- Byproducts produced from nuclear reactors

DOI: 10.4018/978-1-7998-4888-2.ch011

Heavy metals due to their non-biodegradable nature pose severe threat to the environment as it cannot be removed from the system once it enters; these metals may also seep in to the soil contaminating the ground water sources. Hence, removal or de-toxification of the accumulated heavy metal from the environment is a major challenge for the environmental scientists.

Several techniques are available for treatment of the effluents which are physiochemical in nature. However, the major drawbacks of these processes are their high operational cost, high energy consumption and lack of efficiency with respect to complete removal of the metal concerned. The problems mentioned for the physico-chemical methods could be reduced with the use of biological organisms.

Out of the several biological methods known for removal of metals from aqueous solution bioaccumulation and biosorption have been proved to be effective (Volesky and Holan, 1995). However, biosorption using dead biomass have been preferred over bioaccumulation. Biosorption has a few advantages over active cellular accumulation like: absence of toxicity limits, possibility to regenerate and recycle of biomass, easy absorbance and recovery of the sorbed biomaterial.

Several biological substances are being used for the process of biosorption. Among the known biological materials, microbes have gained importance because they are ubiquitous in nature and can be grown and manipulated easily. A number of microbial organisms have been used as a biosorbent.

Fungi pose a suitable material for biosorption among the microbes, as it is a common product of industrial processes like food, brewing and distillation; biomass content of fungal cells are high, it is comparatively easier to handle and can regenerate within a short span. Thus fungi can serve as an effective biomaterial for heavy metal removal from aqueous solution.

## **HEAVY METAL POLLUTION**

**Heavy metals** occur naturally in the environment like many other metallic elements and have an atomic weight higher than the molecular weight of water. They occur in the earth crust naturally and do not interact with the normal biotic system. However, they may get introduced in to the environment via (1) natural phenomenon like volcanic eruptions, forest fire, deep sea vents etc. and (2) anthropogenic events like mining, industrial effluents, smelters etc. In recent times magnified exposure of the heavy metals are happening in the regular life of the biotic elements through anthropogenic activities involving their indiscriminate use in industrial, domestic, agricultural, medical and technological sectors.

Heavy metals may have some biological roles and are known as **essential metals** (zinc, nickel, copper). These metals are required in very low concentration and can be detrimental to life forms in a slightly higher concentration. The other heavy metals like lead, cadmium, mercury etc. are not known to have any role related to biological organism and are known as **non-essential metals**.

The heavy metals are systemic toxicants and cause various adverse health issues in human and animals. The adversity however is dependent on the chemical nature, time of exposure and dose of the metal concerned. It has also been reported that co-exposure to metal/metalloid mixture cause more severe effects on human health (Wang et. al., 2008).

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