


Chapter 4


Hydrophytes as a Source of Bioactives for Heavy Metals Remediation: Phytochemical Potential and Mechanisms in Aquatic Plant-Based Detoxification

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ABSTRACT

*Heavy metal (HM) contamination is one of the major contributors to environmental pollution and the subsequent low quality of life of the affected populace on a global scale. Specifically, the threat of HM in the groundwater poses a heavy risk to human health and disrupts the stability of aquatic ecosystems. Phytoremediation is a less expensive and green technology, and bioremediation, sustainable systems involving the use of plants to mitigate air, water and soil contaminated with toxic pollutants such as hydrocarbons, heavy metals, industrial wastes, and pesticides, have come up as an eco-friendly solution. Plants living in the water, or the hydrophytes, *Pistia stratiotes* (water lettuce) and *Lemna minor* (duckweed), exhibit high levels of tol-*

DOI: 10.4018/979-8-3373-4037-1.ch004

erance and accumulation to the toxic metals. In the current chapter, we discuss the key biomolecules that are found in the various hydrophytes and are involved in the metabolic pathway in capturing or strengthening the eco-friendly phytoremediation approaches, and to come up with a low-cost, nature-based ecosystem cleaning up approach.

INTRODUCTION

Environmental pollution, especially by heavy metals, has become an alarming situation in recent days because of the non-biodegradability, toxicity, and persistence of heavy metals in ecosystems. The occurrence of an outbreak of heavy metals in the waters is a serious ecological and health issue to the population of the world. When at low concentrations, heavy metals like cadmium (Cd), lead (Pb), arsenic (As), mercury (Hg), and chromium (Cr) are profoundly toxic and capable of inflicting significant ecological and health risks in the form of neurotoxicity, organ failure, carcinogenic factors, and loss of biodiversity (Ali et al., 2019; Jaishankar et al., 2014). In contrast with organic pollutants, heavy metals are not degraded and remain in the environment as they get deposited on the sediments or accumulate through the food chain (i.e., aquatic organisms) and are magnified in the food chain (Tchounwou et al., 2012). The general sources of heavy metal contamination are urban runoff effluents, mining, metal plating, battery production, textile industry, tanneries, industrial releases, as well as overuse of agrochemicals (Verma et al., 2020a; Fu & Wang, 2011). In the fresh and salt water environment, the contamination of HM is discovered to be centred around mining, waste release by industries and run off discharge by agriculture, which is a serious human health and environmental risk. The main threat that is associated with the contamination of HM is its toxicity, persistence and accumulation in both terrestrial and aquatic ecosystems. Currently, measures being undertaken in the elimination of HM pollution in waste water are ineffective, expensive, tedious and most times the elimination is equally hazardous to the surroundings as the contamination itself. The traditional S4 technology to eliminate the heavy metals like chemical S4, reverse osmosis, Ion exchange and electrical S4 treatment tends to be very ineffective, costly and produce secondary waste, hence not applicable in large-scale treatment (Fu & Wang, 2011; Barakat, 2011).

Phytoremediation is a sustainable, cheap, environmentally-friendly methodology of removing, stabilizing or detoxifying pollutants observed in the environment through the aid of plants, as well as heavy metals (Tangahu et al., 2011). In this plan, there is the use of hydrophytes; aquatic plants that are specifically suited to grow in or on water, which play an imperative role in the cleansing of used-up water resources. These plants are either submerged, emergent or floating and have unique

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