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Bioaccumulation and phytoremediation of some heavy metals (Mn, Cu, Zn and Pb) by bladderwort and duckweed

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Abstract. *Azeez NM. 2021. Bioaccumulation and phytoremediation of some heavy metals (Mn, Cu, Zn and Pb) by bladderwort and duckweed. Biodiversitas 22: 3093-3098.* This paper discussed the changes in some heavy metals (Mn, Cu, Zn, and Pb) in *Utricularia vulgaris* L. (Bladderwort) and *Lemna minor* L. (Duckweed) in the sewage treatment unit at the University of Basrah Campus, Iraq. For all examined heavy metals, the better accumulator was *U. vulgaris* than *L. minor*. This study proved that both plants significantly reduced the concentrations of heavy metals in wastewater. The efficiency of removing heavy metals was more than 68%. For both species, the bioconcentration factor (BCF) values of the tested metals were <1, and the BCFvalues decreased in the following order in both species: Pb>Mn>Cu>Zn. Reduction rates of pH, TSS, TDS, and conductivity were significant at the end of the experiment. The results showed that the tested macrophytes exhibit a good characteristic as bioaccumulators and could be effectively used in phytoremediation techniques.

Keywords: Accumulation, bioconcentration factor, *Lemna minor*, metals contamination, *Utricularia vulgaris*

INTRODUCTION

Heavy metals are typical components of Earth's crust, but certain heavy metals' concentrations reached toxic levels because of anthropogenic activities' consequences in many ecosystems. In recent years, pollution of the environment with heavy metals has become a significant global problem of modern society with characteristic cumulative effects (Tchounwou et al. 2012; Nouri and Haddioui 2016). Almost every human activity result in the production of waste. In water use, this is more so, as nearly 80% of water ends up as wastewater (Emenike et al. 2015). The management of this wastewater can, if not well handled, be a problem. One way to reaching environmental sustainability is via effective wastewater treatment. The treatment of wastewater is a critical community practice for both environmental and public health reasons. Heavy metals in wastewater testing are carried out to determine their consistency, potential changes, make adjustments to the measures if required, and assess drainage systems' functionality.

Exposure of aquatic plants to toxic levels of heavy metals starts a broad spectrum of physiological and metabolic changes (Jaishankar et al. 2014; Ashfaque et al. 2016; Sarma and Prakash 2020), which include the following: decreasing in plant's growth, changing in cell metabolism, damage of cell membranes, proteins changing and inhibition of photosynthesis, which leads to senescence and, in the end, to plants death (Paunov et al. 2018; Varma 2021). Some aquatic plants have a good ability to tolerate increased levels of heavy metals and accumulate them up to unusually high concentrations, causing accumulative effects (Pant and Tripathi 2014; Solomon et al. 2015; Al-Abbawy et al. 2021). Plants growing in polluted environments are often under stress because of bioaccumulation through direct uptake by root, stem, or sprouts (Babović et al. 2010).

Current technologies available for mitigation of pollution are costly, and in most cases, they represent a cost for industry (Rai 2009). Aquatic plants are used as bioindicators of water quality and phytosanitary of water pools more often (Ceschin et al. 2010; 2012). Various studies (Azeez and Sabbar 2012; Taha et al. 2019; Ali et al. 2020) showed that aquatic macrophytes concentrate certain metals to various degrees; hence, critical levels could vary among species. Phytoremediation is a relatively new approach to the cost-effective treatment of wastewater, groundwater, and soils contaminated by organic, heavy metals, and radionuclides (Singh et al. 2017; Prieto 2018).

Phytoremediation has been described as an advanced bioremediation method that uses flowering plants and associated microbes to extract, pass, stabilize, metabolize, degrade, or volatilize pollutants in soil and water for environmental cleanup (Carvalho and Martin 2001; Mahmoud and Hamza 2017). Plants used in phytoremediation should be ideal for the setting and can withstand stress induced by pollutants (Njoku et al. 2009). Phytoremediation is a non-destructive and cost-effective technology that uses plants to extract toxins from soil and water.

Babović et al. (2010) and Tanwir et al. (2020) found that some macrophytes, including *Typha latifolia, Phragmites australis, Ceratophyllum demersum, and Salvinia natans*, are good indicators of some heavy metal contamination and may have remedial properties.