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A Potential Method for Remediation of Cadmium Pollution in Aquatic Medium by Hydrophyte, *Ceratophyllum demersum* L.

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Introduction: With increasing of population and the valuable water resource pollutions, a demand has been felt for new and inexpensive methods in order to remediation and improving of water quality. Cadmium is a trace element. In low concentration, this heavy metal is harmful to life, and considered as a dangerous pollutant. Cadmium leads to pollution and reduction of water quality; sometimes even toxicity through contaminated sources such as wastewater (Agricultural, municipal and industrial). Phytoremediation with aquatic macrophytes is an effective and inexpensive method for improving water quality and wastewater. The aim of this study was to investigatethe cadmium phytoremediation by *Ceratophyllumdemersum* L. as a potential method for remediation of cadmium pollution in aquatic medium.

Materials and Methods: In this study, the remediation of cadmium pollution in aquatic medium monitored, within 14 days cultivation of coontail (*Ceratophyllumdemersum* L.). At first, for estimating the level of local wastewater cadmium pollutions, five-month cadmium concentration measurement of steel industrial wastewater and urban wastewater set. Then, plants collected from the irrigation channels of ShahidChamran University of Ahvaz. After finding the best pH of nutrient solution for *Ceratophyllumdemersum* L. growth by cultivating the plants in 2 liters pots filled by the solutions withthree different pH(5.5, 7 and 9.5) within three weeks; 12 grams of plants cultivated in 2 liters of Hoagland nutrient solution contaminated by cadmium(pH = 7). The initial contamination levels were setasfive different concentrations of cadmium (0, 1, 2, 4, and 6 mg l^{-1}) with three replications. The cadmium concentrations of the pots were measured every day and on the last day of cultivation, plants wet weight, plants dry weight and Cd concentration in plants weremeasured. Then,biomass production, Cd bioconcentration factor (BCF), Cd uptake index, and Cd uptake percentage of plants were calculated. Standard deviations calculationand correlation and regression analysis were performed using Microsoft Office Excel2007 and SPSS 16. One-way ANOVA performed to identify significant differences in metal concentrations in the different treatments. Differences considered significant atp < 0.05.

Results and Discussion: Among three pH (5.5, 7 and 9.5) for plants cultivation, *C. demersum* L.grewbetter in pH = 7. In fact, the average amount of produced biomasses were 46.6 g (pH = 5.5), 79.6 g (pH = 7) and 68.4 g (pH = 9.5). Therefore, to investigate the Cd remediation, the pH of nutrient solution set equal to 7. The final Cd concentrations in nutrient solution for initial Cd concentrations of 1, 2, 4 and 6 mg l^{-1} were 0.30, 0.36, 2.76 and 3.85 mg l^{-11}respectively. Moreover, the Cd uptake percentage after 14days cultivation of *C. demersum* L.in nutrient solution for initial Cd concentrations of 1, 2, 4 and 6 mg l^{-1} were 70.00, 82.01, 31.00 and 35.83 %respectively. Cd uptake percentage of plants for initial concentrations of 4 and 6 mg l^{-1}weresignificantly lesser than those of 1and 2 mg l^{-1}.The decreased uptake efficiency percentage maybe caused by the effect of Cd toxicity on plant cell membrane permeability and efficiency.The average of BCF in plants for initial Cd concentrations of 1, 2, 4 and 6 mg l^{-1} were 384.4, 707.9, 66.5 and 75.0respectively. High reduction ofBCF amounts with increasing the initial concentration of 2to 4 and 6mg l^{-1}, maybe caused by cadmium physiological adverse effects on plants. The averages of uptake index in plants were 1.26, 2.95, 2.24 and 3.92 mg for initial Cd concentrations of 1, 2, 4 and 6 mg l^{-1}respectively. The results showed a reduction between 2 and 4 mg l^{-1}concentrations that probablycaused by Cd toxicity disruption on plants uptake mechanism and growth. Moreover, the increase of plants uptake index in initial concentration of 6 mg l^{-1} could be explain by partial losing of the selective permeability of the plants cell membrane. The maximum (3.60 g/day) and minimum (1.62 g/day) of biomass production related to pollutant concentrations of 0 and 6 mg l^{-1} respectively, and it shows a greatefect of the Cd on *C. demersum* L.growth.

Conclusion: The plant accumulated cadmium efficiently, and the remediation efficiency was near to 82%. However, the pollutant removal was not complete in a short time.In total, phytoremediation of cadmium and other pollutants from wastewater or other aqueoussolutions by *Ceratophyllumdemersum*, as a native aquatic

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plant of most of Iran’s rivers, could be anefficient and appropriatemethod.

Keywords: Aquatic macrophyte, Cadmium, *Ceratophyllum demersum* L., Heavy metals, Wastewater phytoremediation