ISSN 2664-4169 (Print) & ISSN 2664-7923 (Online)
South Asian Research Journal of Biology and Applied Biosciences
Abbreviated Key Title: South Asian Res J Bio Appl Biosci

| Volume-7 | Issue-2 | Mar-Apr -2025 | **DOI: https://doi.org/10.36346/sarjbab.2025.v07i02.003**

Original Research Article

Phytoremediation of Cadmium Chloride and Lead Chloride by *Elodea canadensis* and *Myriophyllum verticillatum*

Qassim Ammar Ahmood AL-Janabi[1*], Hasansin Ali Talib AL-Masudi[1], Ahmed Hatem Ali[1]

[1]Environmental Pollution Department, Collage of Environment Science, Al-Qasim Green University, Babylon 51013, Iraq

***Corresponding Author:** Qassim Ammar Ahmood AL-Janabi
Environmental Pollution Department, Collage of Environment Science, Al-Qasim Green University, Babylon 51013, Iraq

Article History
Received: 04.02.2025
Accepted: 12.03.2025
Published: 17.03.2025

Abstract: The purpose of this study was to remove different concentrations of heavy metal salts Cadmium chloride and Lead chloride by some aquatic plants *Elodea Canadensis and Myriophyllum verticillatum* for one month. The results of the study showed that the concentrations of the components in the aquatic plants used in the test increased at the end of the study in a different way than those in the control sample.

Keywords: Heavy Metal, Physiological State, and Response, *Elodea Canadensis* and *Myriophyllum Verticillatum*.

INTRODUCTION

Phytoremediation refers to the technologies that use living plants to clean up soil, air, and water contaminated with hazardous contaminants [1]. It is defined as "the use of green plants and the associated microorganisms, along with proper soil amendments and agronomic techniques to either contain, remove or render toxic environmental contaminants harmless" [2]. Phytoremediation is proposed as a cost-effective plant-based approach of remediation that takes advantage of the ability of plants to concentrate elements and compounds from the environment and to detoxify various compounds [3]. The concentrating effect results from the ability of certain plants called hyper-accumulators to bio-accumulate chemicals, the remediation effect is quite different. Toxic heavy metals cannot be degraded, but organic pollutants can be and are generally the major targets for Phytoremediation. Several field trials confirmed the feasibility of using plants for environmental cleanup [4]. Phytoremediation may be applied to polluted soil or static water environment. Examples where Phytoremediation has been used successfully include the restoration of abandoned metal mine workings, and sites where polychlorinated biphenyls have been dumped during manufacture and mitigation of ongoing coal mine discharges reducing the impact of contaminants in soils, water, or air [5]. Contaminants such as metals, pesticides, solvents, explosives, and crude oil and its derivatives, have been mitigated in Phytoremediation projects worldwide. Many plants such as mustard plants, alpine pennycress, hemp, and pigweed have proven to be successful at hyper-accumulating contaminants at toxic waste sites. Not all plants are able to accumulate heavy metals or organic pollutants due to differences in the physiology of the plant [6]. Even cultivars within the same species have varying abilities to accumulate pollutants, This technology has been increasingly investigated and has been employed at sites with soils contaminated with lead, uranium, and arsenic. While it has the advantage that environmental concerns may be treated in situ, one major disadvantage of Phytoremediation is that it requires a long-term commitment, as the process is dependent on a plant's ability to grow and thrive in an environment that is not ideal for normal plant growth [7].

MATERIALS AND METHODS

The experiment was conducted to test two plants, *Myriophyllum verticillatum and Elodea Canadensis*, to remove different concentrations of salts Cadmium chloride and Lead chloride by taking (50 g) of fresh weight of each plant and growing the plants in (10) plastic containers with a capacity of (15) liters. Each container contains (10) liters of water containing three different concentrations (10, 20, 30) mg/liter of salts Cadmium chloride and Lead chloride. After a month,

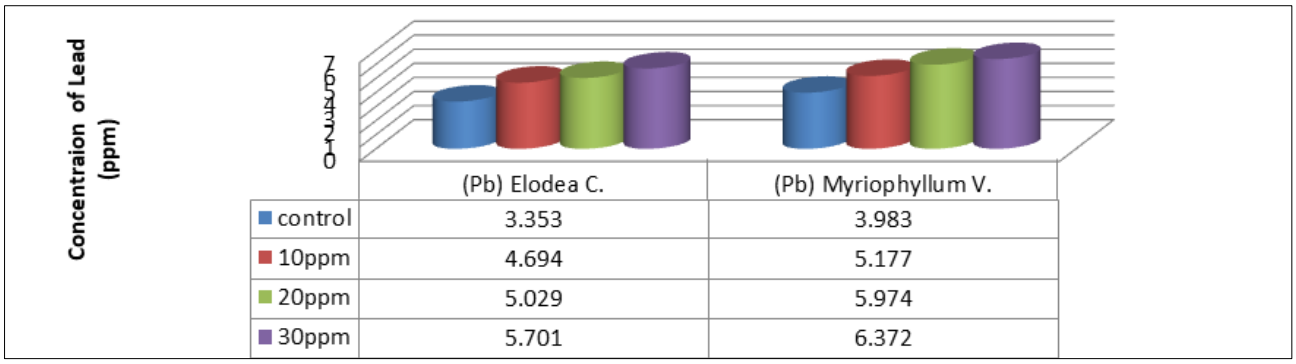
samples of the plants used in the experiment were collected and exposed to different concentrations of element salts to determine the removal percentage [8]. Heavy elements were estimated in water and plant samples using flame atomic spectrometry [9].

RESULTS AND DISCUSSION

The results of the study showed an increase in the concentration of heavy elements in the studied aquatic plants at the end of the experiment, as Figure (1) showed the accumulation of lead in the aquatic plant ***Myriophyllum verticillatum*** *(*5.178, 5.975, 6.373) respectively compared to the control, while the concentration of lead in the plant ***Elodea Canadensis*** (4.694, 5.029, 5.701) respectively compared to the control. The results of the study also showed an increase in the concentration of heavy elements in the studied aquatic plants at the end of the experiment, as Figure (2) showed the accumulation of cadmium in the aquatic plant *Myriophyllum verticillatum* (5.253, 6.207, 6.685) while the concentration of cadmium in the plant *Elodea Canadensis* (5.186, 6.051, 6.915) respectively compared to the control.

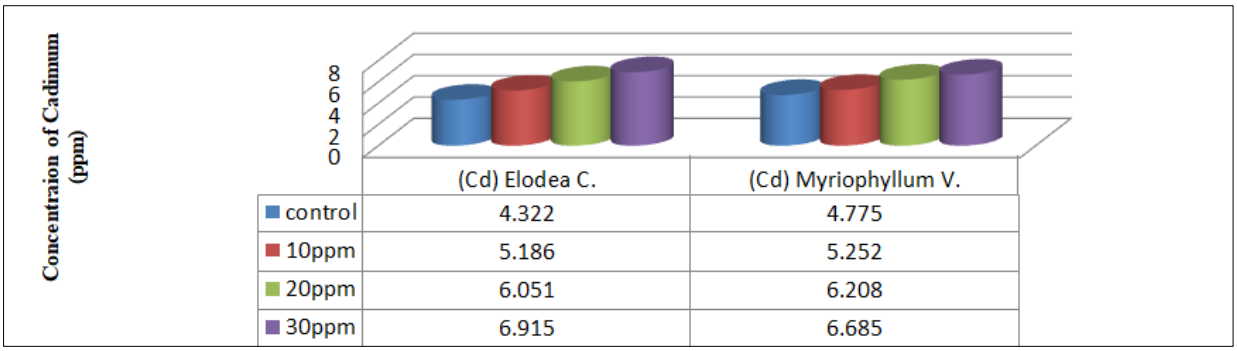
The results of the study showed the percentage of removal of heavy elements in the aqueous solution at the end of the experiment, as Figure (3) showed the percentage of lead removal in the aquatic plant *Myriophyllum verticillatum* (23.076, 9.091, 7.142) respectively compared to the control, while the percentage of lead removal in the plant *Elodea Canadensis* (28.571, 11.764, 6.667) respectively compared to the control. Figure (4) also showed the percentage of cadmium removal in the aquatic plant *Myriophyllum verticillatum* (15.384, 10.782, 6.882) while the percentage of cadmium removal in the plant *Elodea Canadensis* (16.667, 14.285, 12.512) respectively compared to the control.

It shows that the aquatic plants under study can either accumulate this element in their tissues, have a unique way of withstanding high concentrations of the element, or absorb high concentrations of the element and transform into dormant vacuoles [10]. Plants' natural balance of heavy elements. This is accomplished by the enzyme phytochelatin synthase, which uses glutathione as a basic material to activate the presence of heavy element ions. [12]. It should be noted that the concentration of heavy metals in the tissues of living things is influenced by a wide range of external factors, such as salinity, pH, the efficiency of complex organic and inorganic molecules, and their impact on the physical and chemical processes that regulate the rate of metabolic processes, such as temperature, oxygen content, and light intensity. Bioaccumulation is also influenced by the element's environmental concentration, environmental properties, organism type, and exposure duration. According to the study's findings, the total concentration of chlorophyll in the aquatic plants under investigation decreased at the conclusion of the experiment. This is because the experimental plants contain these extremely toxic substances, which have the potential to build up in plant tissue [13]. Through blocking the activity of the enzymes that produce it, such as aminolevulinic acid dehydratase and porphobilinogen deaminize, which forms porphyrin, it prevents its creation. Research has shown that the creation of chlorophyll, the process of photosynthesis, and the synthesis of other hues like carotene and efficacy all have an impact on certain heavy metals [14]. Exposed to these elements' enzymatic effects [15]. This could be explained by the fact that when the concentration of heavy metals in plant tissues rises, the amount of chlorophyll in those tissues falls because the enzymes that aid in the synthesis of carotene and chlorophyll are inhibited. Some enzymes that aid in the synthesis of chlorophyll are installed by Nasser [16].



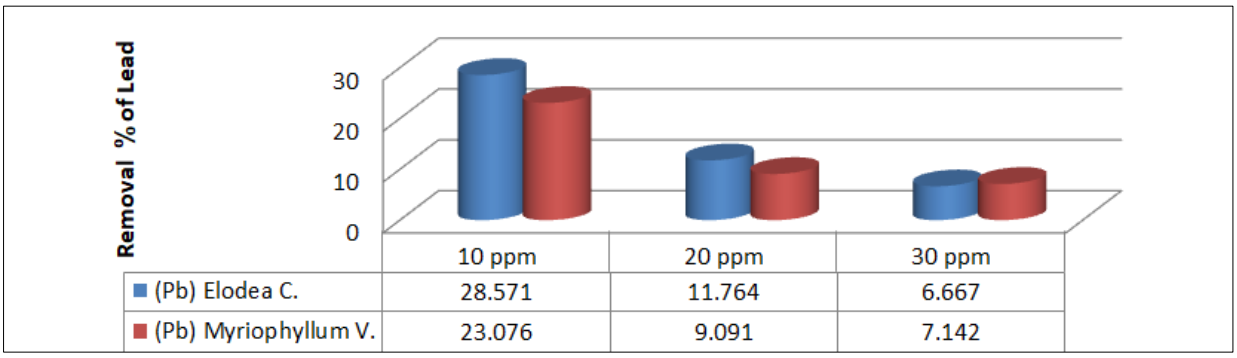
	(Pb) Elodea C.	(Pb) Myriophyllum V.
control	3.353	3.983
10ppm	4.694	5.177
20ppm	5.029	5.974
30ppm	5.701	6.372

Figure 1: Showed the accumulation of Lead in Myriophyllum verticillatum and Elodea Canadensis tissues



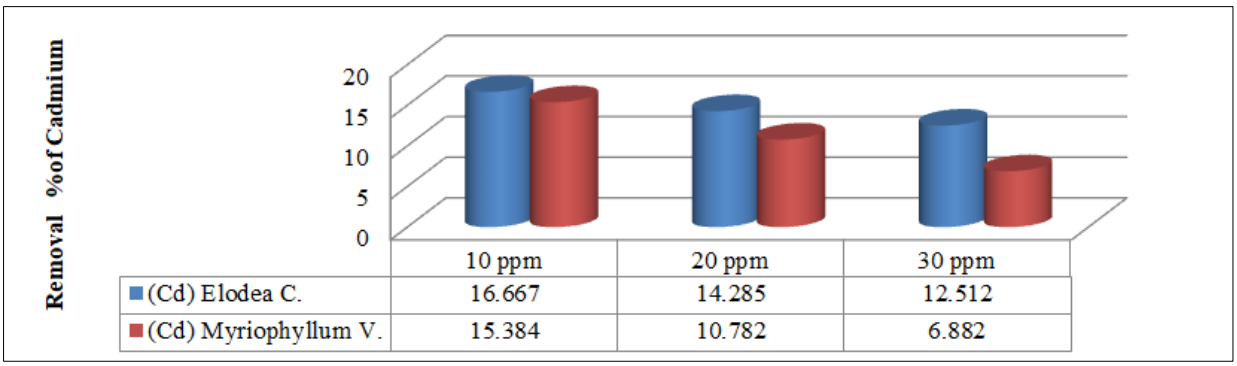
	(Cd) Elodea C.	(Cd) Myriophyllum V.
control	4.322	4.775
10ppm	5.186	5.252
20ppm	6.051	6.208
30ppm	6.915	6.685

Figure 2: Showed the accumulation of Cadmium in Myriophyllum verticillatum and Elodea Canadensis tissues



	10 ppm	20 ppm	30 ppm
(Pb) Elodea C.	28.571	11.764	6.667
(Pb) Myriophyllum V.	23.076	9.091	7.142

Figure 3: Showed the percentage removal of lead by Myriophyllum verticillatum and Elodea Canadensis



	10 ppm	20 ppm	30 ppm
(Cd) Elodea C.	16.667	14.285	12.512
(Cd) Myriophyllum V.	15.384	10.782	6.882

Figure 4: Showed the percentage removal of Cadmium by Myriophyllum verticillatum and Elodea Canadensis tissues

CONCLUSIONS AND RECOMMENDATIONS

Heavy metals negatively affect vital growth processes, and the effects increase as the concentration of the pollutant increases simultaneously. Plants are an effective biological tool in removing pollutants from heavily polluted environments, and the selection of plant species depends on the type of pollutant and its concentration in the environment.

REFERENCES

1. Ahmad, Z. U. (2015). Phytoremediation of heavy metal contaminated soil using Indian mustard and marigold plant. Department of Civil Engineering, *Bangladesh University of Engineering and Technology*, 70.
2. Bhardwaj, R., Gupta, A., & Garg, J. K. (2017). Evaluation of heavy metal contamination using environmetrics and indexing approach for River Yamuna, Delhi stretch, India. *Water Science*, *31*(1), 52-66.
3. Ghosh, A., Dastidar, M. G., & Sreekrishnan, T. R. (2017). Bioremediation of chromium complex dyes and treatment of sludg generated during the process. *International Biodeterioration & Biodegradation*, *119*, 448-60.
4. Qassim, A. A., AL-Janabi, S. K. A., Al- Kalidy, & Zaid, B. H. (2021). Effects of heavy metals on physiological status for Schoenoplectus litoralis & Salvinia natans *L* 1st INTERNATIONAL VIRTUAL CONFERENCE OF ENVIRONMENTAL SCIENCES IOP Conf. Series: *Earth and Environmental Science, 722*, 012012 IOP Publishing doi:10.1088/1755-1315/722/1/012012.

5. Kumar, B., Smita, K., & Flores, L. C. (2016). Plant mediated detoxification of mercury and lead. Arabian Journal of Chemistry. 2017; 10:S2335-42.Mahar A, Wang P, Ali A, Awasthi MK, Lahori AH, Wang Q, Li R, Zhang Z. Challenges and opportunities in the phytoremediation of heavy metals contaminated soils: *A review*. *Ecotoxicology and Environmental Safety, 126*, 111-21.
6. Mahar, A., Wang, P., Ali, A., Awasthi, M. K., Lahori, A. H., Wang, Q., Li, R., & Zhang, Z. (2016). Challenges and opportunities in the phytoremediation of heavy metals contaminated soils: A review. *Ecotoxicology and Environmental Safety, 126*, 111-21.
7. Mohammed, E., Al Defferi, Qassim A. AL-Janabi, Sama A. Mustafa & Ali K. AL-Muttarri (2019). PHYTOREMEDIATION OF LEAD AND NICKEL BY *BASSIA SCOPARIA. Plant Archives*, 19(2), 3830-3834 e-ISSN:2581-6063 (online), ISSN:0972-5210.
8. Vijayaraghavan, K., Arockiaraj, J., & Kamala- Kannan, S. (2017). *Portulaca grandiflora* as green roof vegetation: Plant growth and phytoremediation experiments. *International Journal of Phytoremediation, 19*(6), 537-44.
9. Qassim, A. A., & Mohammed, H. Al-Jawasim. (2019). EFFECTS OF HEAVY METALS ON PHYSIOLOGICAL STATUS OF PLANTS. *Plant Archives*, 19(2), 2865-2871 e-ISSN:2581-6063 (online), ISSN:0972-5210.
10. Qassim, A. A., & Mohammed, H. Al-Jawasim. (2019). EFFECTS OF HEAVY METALS ON PHYSIOLOGICAL STATUS OF PLANTS. *Plant Archives*, 19(2), 2865-2871 e-ISSN:2581-6063 (online), ISSN:0972-5210.
11. El-Khatib, A., Hegazy, A., & Abo-El-Kassem, A. M. (2014). Bioaccumulation Potential and Physiological Responses of Aquatic Macrophytes to Pb Pollution. *International Journal of Phytoremediation, 16*(1), 29-45.
12. Bhardwaj, R., Gupta, A., & Garg, J. K. (2017). Evaluation of heavy metal contamination using environmetrics and indexing approach for River Yamuna, Delhi stretch, India. *Water Science, 31*(1), 52-66.
13. Qassim Ammar, A. AL-Janabi., Ziad Bassim, H., & Saad Kadhim AlaAllah Al- Kalidy. (2019). Effect of Heavy Metals on the Protein and Chlorophyll Content of *Phragmitus australis* and *Typha domingensis*, *Indian Journal of* Ecology, 46 Special Issue (8), 65-71.
14. Tauqeer, H. M., Ali, S., Rizwan, M., Ali, Q., Saeed, R., Iftikhar, U., Ahmad, R., Farid, M., & Abbasi, G. H. (2016). Phytoremediation of heavy metals by *Alternanthera bettzickiana*: Growth and physiological response. *Ecotoxicology and Environmental Safety, 126*, 138-46.
15. Suhad AL-Hedny., Qassim, A., Talib, A., & QasimAmma,r A. Al-Janabi. (2018). Using Remote Sensing Derived Indices to Monitor Vegetation Cover Changes of Babylon. *Plant Archives, 18*(2), 2425-2428 e-ISSN:2581-6063 (online), ISSN:0972-5210.
16. Saha, P., Shinde, O., & Sarkar, S. (2017). Phytoremediation of industrial mines wastewater using water hyacinth. *International Journal of Phytoremediation, 19*(1), 87-96.
17. Ghosh, A., Dastidar, M. G., & Sreekrishnan, T. R. (2017). Bioremediation of chromium complex dyes and treatment of sludge generated during the process. *International Biodeterioration & Biodegradation*, *119*, 448-460.