ScienSage

Journal of Advanced Scientific Research

Available online through http://www.sciensage.info

ISSN
0976-9595
Short Communication

THE POTENTIALITY OF *AZOLLA MICROPHYLLA* KAULF FOR THE REMOVAL EFFICIENCY OF HEAVY METALS

Anjana V.J., Lekeshmanaswamy M.*

PG and Research Department of Zoology, Kongunadu Arts and Science College, (Autonomous) Coimbatore, India

**Corresponding author: ml_swamy64@yahoo.co.in*

ABSTRACT

Phytoremediation is a technology which utilizes plants to remediate the polluted water by improving the quality of water, with their ability to accumulate the pollutants like heavy metals in their tissues. The present study investigates the removal efficiency of two heavy metals using *Azolla microphylla* Kaulf; a pteridophytic aquatic macrophyte. *Azolla microphylla* was exposed to the prepared solutions of Lead (Pb) and Chromium (Cr) of 2 ppm, 4 ppm, 6ppm, 8 ppm and 10 ppm respectively. Experiments were carried out for a period of 7 days. The experiment showed that the Pteridophytic aquatic macrophyte had maximum removal efficiency in Lead, compared to that of Chromium, thus proving *Azolla microphylla* Kaulf as an excellent phytoremediator.

Keywords: Heavy metal pollution, Phytoremediation, *Azolla microphylla* Kaulf, Removal efficiency.

1. INTRODUCTION

Water is one of the important natural resources. The earth's crust, in fact is formed from seventy-five percent (75%) of water [1]. The anthropogenic activities like mining, agricultural practice using pesticides and chemicals, effluents from industries etc., has contributed to the deterioration of water quality by releasing the toxic products into the water ecosystem [2]. The toxic substances are released into the water bodies directly or indirectly without proper treatments which affects the plants and other living organisms in the water causing a great environmental concern [3, 4]. The toxic substances are usually heavy metals which has a high level of durability and harmfulness to the environment [5].

Phytoremediation is a technology that is widely used in the remediation of polluted environment. This technology uses the intrinsic mechanisms of the plants to accumulate or detoxify the pollutants from soil or aquatic environments. Phytoremediation is a cost effective green technology which is effective in controlling the pollution in the reservoirs and ponds [6]. Some plants has the capacity to absorb the pollutants (heavy metals) which has no importance for their metabolic processes. These hyper accumulating plants are the efficient candidates for phytoremediation. Aquatic macrophytes are potential phytoremediators as they absorb the heavy metals and concentrate them in their tissues [7]. Among the aquatic macrophytes *Azolla*, Lemna minor, Salvinia etc. are mostly used for phytoremediation.

Azolla is a pteridophytic macrophyte which produces maximum biomass in a relatively shorter period of time [8]. The aquatic fern, *Azolla* is usually found in paddy water, streams, and pools in symbiosis with Anabaena azollae alga [9]. *Azolla* is utilized as animal feed, food for humans, water purifier, biofertilizer, hydrogen fuel, biogas, weed and bug controller [10]. Azolla enhances the quality of water by expelling nitrates and phosphorous [11].

The present study involves the use of *Azolla microphylla* Kaulf to study its phytoremediation potential in removing heavy metals.

2. MATERIAL AND METHODS

2.1. Preparation of metal stock solutions

The metal stock solution of Lead and chromium with initial concentration of 1000 ppm were prepared by dissolving an appropriate amount of nitrate salts of these metals *i.e.* $Cr(NO_3)_3$ and $Pb(NO_3)_2$, respectively, in double distilled water [12].

2.2. Preparation of the dilution

To provide the heavy metals solution with concentrations of 2ppm, 4ppm, 6ppm, 8ppm and

10ppm, the stock solution was diluted by using double distilled water [12].

2.3. Plant for the study and authentication

The plant taken for the study was authenticated as *Azolla microphylla* Kaulf by the Botanical Survey of India (BSI), Southern regional centre, TNAU campus, Coimbatore.

2.4. Scientific classification of *Azolla microphylla* Kaulf[13]

Kingdom-Plantae, Phylum- Pteridophyta, Class-Polypodiopsida, Order - Salviniales, Family - Salviniaceae, Genus- *Azolla*, Species- *A. microphylla* Kaulf

2.5. Experimental design (with days)

Experiments for the metal ions were carried out separately in the greenhouse at an ambient temperature of 23°C- 25° C. Rectangular trays with the dimensions of 42×30×8 cm were used to perform the experiment. The trays were filled with 1 L of each treatment solution in triplicates and distilled water in the absence of the metal was used as the control and pH of the solutions were around 6.5-7.5 throughout the experiment.

Healthy and matured *A. microphylla* plants were selected, rinsed with distilled water and blotted on filter papers to remove adherent water and 10 g of the water fern were laid on the surface of each tray. All the experiments were run for a 7 day period. Distilled water was added based on necessity, to compensate for the water loss through evaporation and transpiration.

2.6. Sample analysis

On the 7th day of the experiment, Water samples were filtered with Whatmann No.1 filter papers and analyzed by Flame Atomic Absorption Spectrometer for Chromium (Cr) and Lead (Pb) to find the removal efficiency (%) of *Azolla microphylla* Kaulf [6].

2.7. Calculation of Removal efficiency (%) [14]

Removal efficiency= (Initial metal concentration−Final metal concentration/Initial metal concentration) ×100

3. RESULTS AND DISCUSSION

The removal efficiency of lead and chromium at various concentrations (2, 4, 6, 8 and 10 ppm) along with the control are depicted in the table below. Distilled water without treatment was taken as the control.

Table 1: Removal efficiency (%) of lead by *Azolla microphylla* Kaulf

Concentration of Heavy metal (ppm)	Contact time (Days)	Biomass of *A. microphylla* (g)	Removal efficiency (%)Mean ± SD
Control	7	10	-
2 ppm	7	10	88.33 ± 2.88
4 ppm	7	10	85.83 ± 2.88
6 ppm	7	10	70.5 ± 1.90
8 ppm	7	10	61.66 ± 0.72
10 ppm	7	10	43.33 ± 1.15

Table 2: Removal efficiency (%) of Chromium by *Azolla microphylla* Kaulf

Concentration of Heavy metal (ppm)	Contact time (Days)	Biomass of *A. microphylla* (g)	Removal efficiency (%) Mean ± SD
0 ppm	7	10	-
2 ppm	7	10	78.33 ± 2.88
4 ppm	7	10	74.83 ± 2.50
6 ppm	7	10	62.08 ± 0.72
8 ppm	7	10	52.08 ± 1.44
10 ppm	7	10	36.66 ± 0.57

3.1. Comparative assessment of removal efficiency of lead and Chromium by *Azolla microphylla*

The removal efficiency was compared between lead and chromium to identify which heavy metal had the maximum removal from the treatment solutions with various diluted concentrations of heavy metals.

The removal efficiency of lead was more in 2 ppm (88.33%). The least removal efficiency was noticed in 10 ppm (43.33%).The removal efficiency of Chromium

was more in 2 ppm (78.33%). The least removal efficiency was noted in 10 ppm (36.66%). The results are in agreement with Hassnea *et al.*, [15] which suggested *Azolla* as a good phytoremediator for lead removal from polluted waters.

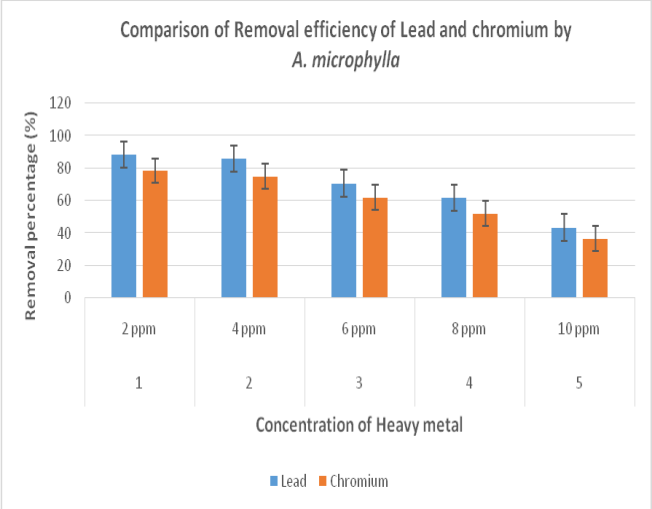

Fig.1: Comparison of Removal efficiency of Lead and chromium by *A. microphylla*

Nuzhat *et al.*, [16] have revealed that the free floating macrophytes plays a major role in removing heavy metals from water which supports the use of *Azolla* in phytoremediation process. Similar results were obtained from the results of Mandakini *et al.*, [6] which suggests the use of free floating aquatic macrophyte in the removal of heavy metals by phytoremediation process. This study also reveals that compared to Chromium (Cr), Lead (Pb) showed greater removal efficiency by *Azolla microphylla* Kaulf, proving the potentiality of the aquatic macrophyte, *Azolla microphylla* in heavy metal removal. But the difference in removal efficiency is small. The study also showed that the heavy metals used in the treatments however did not affect the growth rate of the *Azolla*. This may be because the number of days and concentration of the chemicals in the treatment is small. The small concentrations of the heavy metals might have been used by *Azolla microphylla* Kaulf for its growth.

Mant *et al.*, [17] reported that higher removal rate of metals by free floating macrophytes is due to their efficient growth and high biomass accumulation in nutrient and metals contaminated environment. Arora *et al.*, [18] reported that, *Azolla* have been shown to absorb Cr, Pb, Cd, Zn and other heavy metals and showed tolerance when present in low concentrations.

4. ACKNOWLEDGEMENT

We acknowledge with due regards the funding agencies like FIST, CPE and CE for providing funds to enhance the research facilities in Kongunadu Arts and Science College which were used effectively during the research and was very helpful in bringing out this publication.

5. REFERENCES

1. Noreena U, Ahmeda Z, Khalidb A, Seerafinoc AD, Habibad U, Alid F, Hussainsd M. *Environmental Technology &Innovation*, 2019; **16**:100470.
2. Chen H, Teng Y, Yue W, Song L. *Environmental Monitoring and assessment*, 2013; 185(11).
3. Colic M, Hogan J, Lechter A. *Pro Water Environ. Fed*, 2010; 2193-2202.
4. HussainM, Muhammad S, Malik RN, Khan MU, Farooq U. *Environ. Contam. Toxicol*, 2014:**230:**111-132.
5. Bennicelli R, Stepniewska Z, Banach AM, Szajnocha. Chemosphere, 2004; **55(1):**141-146.
6. Mandakini LLU, Bandara NJGJ, Gunawardana D. *Journal of Tropical Forestry and Environment*, 2016; **6:**36-49.
7. Salt DE, Blaylock M, Kumar NPBA, Dushenkove V, Ensley BD, Chet I, Raskin I. *Biotechnology*,1995; 13.
8. Brouwer P, Brautigam A, Buijs VA, Tazelaar AO, van der Werf A, Schluter U. *Front Plant Sci*, 2017; 8:442.
9. Subba Rao NS. *Biofertilizers in Agriculture*, 2nd ed. 1988.
10. Gomes MP, de Brito JC, Carneiro MM, da Cunha MR, Garcia QS, Figueredo CC. *Environ Pollut,* 2018; **232:**293-299.
11. Liu J, Xu H, Jiang Y, Zhang K, Hu Y, Zeng Z. *Sci Rep,* 2017; **7**:40635.
12. Naghipour D, Ashrafi SD, Gholamzadeh M, Taghavi K, Joubani MN. *Data in brief*, 2018;
13. Zimmerman WJ, Lumpkin TA, Watanabe I. *Euphytica*, 1989; **43**:223-232.
14. Bakar AFA, Yusoff I, Fatt NT, Othman F, Ashraf MA. *BioMed Research International,* 2013; 890803.
15. Hassnaa AM, Fatma AAE, Gomaa N, *Current science international*, 2016; **5:**26-35.
16. Nuzhat S, Ashok KP, Azra NK, Basharat M. 2015; **1(1):**8-12.
17. Mant C, Costa S, Williams JB, Tambourgi EB. *Bioresource Technology*, 2006; **97(15):**1767-1772.
18. Arora A, Sood A, Singh PK. *J.Plant physi*. 2004; **9:**302-304.