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Research Article

Remove Heavy Metals (Cd and Pb) from Irrigation Water in Jordan Valley by Using Duckweeds (*Spirodela polyrhiza*)

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Abstract

The purpose of this study was to investigate the potential of duckweed (*Spirodela polyrhiza*) in heavy metal (Pb and Cd) from water under different pH from (8.0-8.50)

The present study investigates the ability of two genus of duckweed (*Spirodela polyrhiza*) to phytoremediate cadmium and lead from aqueous solution. Duckweed was exposed to 3 different cadmium and lead concentrations, such as, 1.0, 2.5, 5.0 mg/L and the experiment was continued for 10 days. Water samples were collected periodically for estimation of residual cadmium and lead content in aqueous solution. At the end of treatment period plant samples were collected and accumulated cadmium and lead content was measured.

Cadmium and lead toxicity was observed through relative growth factor and changes in chlorophyll content Experimental results showed that *Spirodela polyrhiza* were capable of removing 40-53% and 42-52% cadmium and lead respectively from media depending upon initial cadmium and lead concentrations.

Cadmium and lead accumulation in duckweeds (*Spirodela polyrhiza*) tissues after 10 days of experiment founded 6.7-16.9 mg/L and 7.2 - 17.3 mg/L respectively.

Keywords: Duckweed; *Spirodela polyrhiza*; Cadmium; Lead; Heavy Metals Removal

Introduction

Here is a large group of metallic elements which is present in water in limited amounts, these metals are usually divided in two subclasses; the first includes Fe, Mg, Mn, Co, Zn, Cu which are "essential" for the correct functioning of biochemical processes, Cd, Pb, Hg, Cr, and others belong to a second subclass which is made up of metals without any established biological function and includes the more important contaminants in aquatic environment (Viarego, 1985).

Heavy metal pollution is an important environmental problem in the world. In contrast with most organic materials, metals cannot be transformed by microorganisms and therefore accumulate in water, soil, bottom sediments and living organisms (Miretzky., *et al*. 2004). These pollutants are present in the environment as natural components or as a result of anthropogenic activities (agricultural and industrial activities). Industries such as smelters, metal refineries and mining operations have been indicated as major sources of metal release into the environment (Gardea-Torresdey., *et al.* 1997; Srivastava., *et al.* 2007). Most of the heavy metals are toxic or carcinogenic in nature and pose a threat to human health and the environment (Shakibaie., *et al*. 2008; Vinodhini and Narayanan, 2009). Copper (Cu), nickel (Ni), cadmium (Cd) and zinc (Zn) are considered as toxic since they cause deleterious effect in plants, animals and humans [1-23].

Methodology

Sample collection

Collection duckweeds (*Spirodela polyrhiza*) from lake in farm located in Jordan valley with demand area 25 and farm unit 189, The collected plants were then washed with distilled water to remove any debris if present then let it grow in beaker 1 litter of water in Jordan valley laboratories and collect the sample daily up to 10 days as in table 1.

Preparation of samples

Taken 3x 10 ml from every growth media through the time then filtered (using Whatman 15 filter paper), All samples were immediately analyzed within 1 hr after sample preparation.

Method of analysis

The procedure followed for Pb analysis in samples was performed according to Standard Methods for the examination of water and wastewater, the Reading residual lead and cadmium in samples was by using atomic absorption type PerkinElmer model AA 300, All chemicals used were of analytical grade.

Digestion of tissues

The sample was digested using wet digestion method, one gram of sample taken into Kjeldahl flask having the 500 ml capacity and the sample was digestion in 3:1 ratio of HCl and HNO_3 and leave for

Period time	Growth media 2.5 mg/l		Growth media 1.5 mg/l		Growth media 1.0 mg/l	
	No duckweeds	With duckweeds	No duckweeds	With duckweeds	No duckweeds	With duckweeds
1 day	3 sample	3 sample	3 sample	3 sample	3 sample	3 sample
2 day	3 sample	3 sample	3 sample	3 sample	3 sample	3 sample
4 day	3 sample	3 sample	3 sample	3 sample	3 sample	3 sample
6 day	3 sample	3 sample	3 sample	3 sample	3 sample	3 sample
8 day	3 sample	3 sample	3 sample	3 sample	3 sample	3 sample
10 day	3 sample	3 sample	3 sample	3 sample	3 sample	3 sample

Table 1: Growth medias in the study.

a whole day inside a fume hood. The mixture heated for 40°C for more than half hour, the heat was increased up to 100°C and heating continued till the solution become clear, and the white fumes disappeared indicates the completion of the digestion process.

The digestion solution diluted with distilled water and boiled about 15minutes. The solution was cooled, and filter using Whatman filter paper and filled till the mark of Kjeldahl flask using distilled water. The digested solution transferred into a polyethylene bottle for further analysis of heavy metal concentration using by using atomic absorption type PerkinElmer model AA 300.

Results and Discussion

Period time	Growth Media 5 mg/L /Cd (mg/L)		Growth Media 5 mg/L /Pb (mg/L)	
	No duckweeds	With duckweeds	No duckweeds	With duckweeds
1 day	5.3	4.85	5.2	4.9
2 day	5.1	4.21	5.1	4.52
4 day	5.1	3.84	5.1	4.24
6 day	4.98	3.51	4.95	3.33
8 day	4.94	3.19	4.91	2.91
10 day	4.92	2.94	4.9	2.84

Table 2: Growth media (1) contain 5 mg/L Cd and 5 mg/L Pb.

Period time	Growth Media 2.5 mg/L /Cd (mg/L)		Growth Media 2.5 mg/L /Pb (mg/L)	
	No duckweeds	With duckweeds	No duckweeds	With duckweeds
1 day	2.53	2.42	2.5	2.35
2 day	2.5	2.34	2.44	2.31
4 day	2.47	2.02	2.42	2.2
6 day	2.44	1.82	2.4	1.62
8 day	2.4	1.5	2.39	1.45
10 day	2.39	1.37	2.39	1.33

Table 3: Growth media (2) contain 2.5 mg/L Cd and 2.5 mg/L Pb.

Period time	Growth Media 2.5 ppm/Cd (ppm)		Growth Media 2.5 ppm /Pb (ppm)	
	No duckweeds	With duckweeds	No duckweeds	With duckweeds
1 day	1.08	0.98	1.02	0.97
2 day	1.05	0.91	1.01	0.9
4 day	1.01	0.8	0.97	0.81
6 day	0.99	0.62	0.95	0.66
8 day	0.98	0.51	0.95	0.55
10 day	0.96	0.45	0.91	0.43

Table 4: Growth media (3) contain1.0 ppm Cd and 1.0 pppm Pb.

Period time	Unit	Growth media blank	Growth media (1) 1.0 mg/L	Growth media (2) 2.5 mg/L	Growth media (3) 5 mg/L
10 day	mg/L	0.03	6.7	11.4	16.9

Table 5: Accumulation of Cd in duckweed (*Spirodela polyrhiza*) tissues.

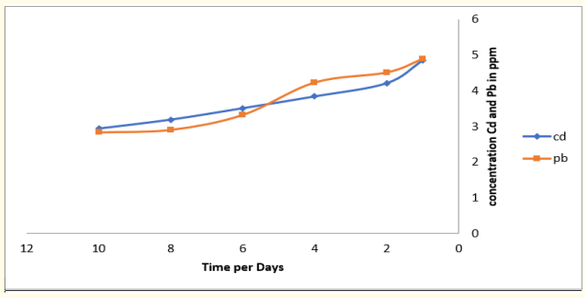

Figure 1: Removal of Cd and Pb in Growth Media (5 mg/L).

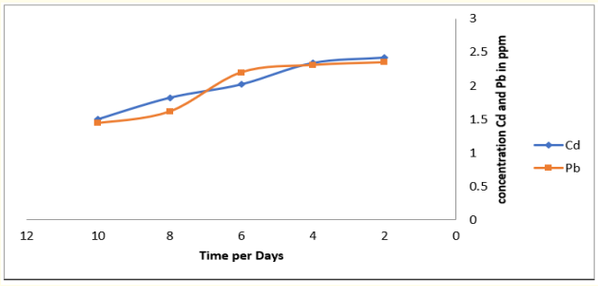

Figure 2: Removal of Cd and Pb in Growth Media (2.5 mg/L).

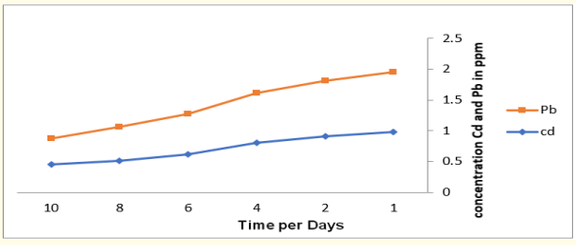

Figure 3: Removal of Cd and Pb in Growth Media (1.00 mg/L).

Percentage removal of metals

- The removal percentage of Pb and Cd from growth media (3) which contain 1.0 mg/l was 53% for both. show (Figure 3).
- The removal percentage of Pb and Cd from growth media (2) which contain 2.5 mg/l was 44.0% and 43.0 respectively. show (Figure 2).
- The removal percentage of Pb and Cd from growth media (1) which contain 5.0 mg/l was 42.0% and 40.0% respectively. show (Figure 1).

The concentration of lead in this tissues increase from 0.02 ppm to 17.30 after 10 days, the concentration of lead in this tissues increase from 0.03 ppm to 16.9 after 10 days.

Conclusion

The study shows decreasing in the level of residual toxic elements, lead and cadmium in prepared growth media which covered by duckweeds plant (*Spirodela polyrhiza*), the reading these elements was by using atomic absorption instrument type PerkinElmer model AA 300.

The higher concentration of lead and cadmium in irrigation water is became toxicity for most of plant and human health.

In this study we covered irrigation water by using duckweeds plant (*Spirodela polyrhiz*a) to remove or decrease the concentration of lead and cadmium metals from irrigation water by preparation three growth media, growth media (1) contain 5.0 ppm of lead and cadmium, growth media (2) contain 2.50 ppm of lead and cadmium and growth media (3) contain 5.0 ppm of lead and cadmium, we let to duckweeds (*Spirodela polyrhiza*) to grow in this medias for 10 days, after this time we analysis the residual of lead and cadmium in the growth medias, we found the absorption lead and cadmium percent by duckweeds (*Spirodela polyrhiza*) plant.

Firstly, growth media (1) absorbed 42.0% and 40.0% of lead and cadmium respectively. secondly, growth media (2) absorbed 44.0% and 43.0% of lead and cadmium respectively. Thirdly, growth media (3) absorbed 43.0% and 43.0% of lead and cadmium respectively.

All absorbed heavy metals from growth medias are accumulated in duckweeds (*Spirodela polyrhiza*) tissues, so we find the concentration of lead in this tissues increased from 0.02 ppm to 17.30 after 10 days, while the concentration of cadmium in this tissues increased from 0.03 ppm to 16.9 after 10 days.

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