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Comparitive Study of Phytoremediation of Arsenic using Eichhornia Crassipes (Mart.) Solms Roots and Arabidopsis thaliana(L.) Heynh Roots

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ABSTRACT

Phytoremediation involves the use of plants to remove toxic compounds from water. Arsenic is an element of considerable environmental and toxicological interest because of its potential deleterious effects upon human health [14-15]. The present study highlights the scope of biological strategy for As removal through phytoremediation. In this research, a laboratory-constructed experimental set up was employed to characterize for the absorption of arsenic by two plants root which are *Arabidopsis thaliana (* L.) Heynh. *and also Eichhornia crassipes(Mart.) Solms* were taken and experiments were done on them with a control set up of experiment. The result of *Arabidopsis thaliana (* L.) Heynh. Plant root of 40 gm after 6 hours treatment, half of arsenic concentration reduced to its initial concentration. 75 µg was reduced to 40 µg at 6 hour treatment. In case treatment of *Eichhornia crassipes(Mart.) Solms* 40 gm roots after 8 hours the arsenic concentration just reduced to its half and no reduction was observed after 8 hour. So this study reveals that *Arabidopsis thaliana (* L.) Heynh and *Eichhornia crassipes(Mart.) Solms roots* act as As hyperaccumulators, and potentially strong plants for As removal from water system and are highly recommended for using as biological tool for arsenic absorption.

Keywords : Arsenic, Hyperaccumulator, Phytoremediation.

I. INTRODUCTION

Arsenic (As) contamination in water is one of the world's major environmental problems, posing significant risks to human life and ecosystem [1–3].The magnitude of arsenic contamination in groundwater is growing rapidly day by day as it has covered almost 70% countries in its acute severity. Arsenic is toxic, carcinogenic and a potent poison to different organisms [11-12]. Arsenic concentration in water is increasing day by day due to various natural as well as intensified environmentally unsound activities, such as volcanic eruption, dissolution of minerals from sedimentary rocks, dilution of geothermal waters, smelting of ores, disposal of As containing industrial wastes, and others agricultural applications [7-9]. Rural as well as urban areas are dependent on groundwater for drinking water and other domestic uses. The pollution of soil and water with Arsenic (As) is one of the most important environmental problems globally[4-5]. In order to combat arsenic menace, a number of counteractive measures, steps and research

studies have been initiated and put into practice mainly in West Bengal and other states[6]. As the world is under threat and the number of cases and states are increasing in the list of arsenic contamination, it is thus important to work on huge level for its mitigation, the problem resolving issues thus seemed to be partial and inadequate which needs to be strengthened by strategic scientific backing[9-10].

II. MATERIAL AND METHOD

Preparation of Concentrated Solution (A)

To conduct phytoremediation experiment it is necessary to prepare the concentrated solution. For this first 20 ppm concentrated solution is made. Sodium arsenate is used which is an inorganic compound (Na_3AsO_4) with molecular mass 180.033g/mol and density 2.87g/cm3. 20 mg. Na_3AsO_4 is mixed with 1 *l* of water to obtain concentrated solution of 20 ppm. Then 1 ml of this solution is added with 99 ml distilled water and the solution obtained is 20 ppb which is concentrated solution for this experiment. Presence of arsenic in it is above +100 µg analysed through arsenator.

Preparation of Stock solution (B)

4 ml of this solution (A) is dissolved with 796 ml of distilled water to prepare 800 ml sodium arsenate solution with 39 µg/l of As measured by arsenator. Subsequently 750 ml of this stock solution B with 39 µg/l As is distributed into fifteen different conical flasks (5X3), with 50 ml each. Each time while conducting the experiment stock solution was made by adding (2ml, 3ml, 4ml, 5ml) of concentrated solution (A) (In which arsenic range is +100 µg) and each time the made stock solution was analysed by arsenator and reading was noted before the set up of experiments.

Procedure

10, 20, 30, 40 gm of *Arabidopsis thaliana (* L.) Heynh and *Eichhornia crassipes(Mart.) Solms roots* were used for the treatment for a constant duration of 1 Hour, 2 hour, 4 hour, 6 hour and 8 hours simultaneously. In addition to this a control experiment was also set up with the solution of same concentration of Arsenic without any botanical tool to compare the results. Each time while doing phytoremediation of Arsenic by using both plant roots stock solution B was made by using concentrated solution A and reading was observed by digital arsenator.

III. RESULT AND DISCUSSION

Findings of both the experiments have been summarized in the table 1.1 and table 1.2. Data represents the mean of three replicates with standard deviation. Comparison of both the plant roots of absorption rate of arsenic in graphical representation is given in table 2.1 and table 2.2. In experiment no 1 in which *Eichhornia crassipes(Mart.) Solms roots* were used as biological tool for mitigation process the initial concentration of arsenic in the water sample was 68 µg/l and it was subjected to 4 treatments using the roots of the plant such as 10 gm, 20 gm, 30 gm and 40 gm in four different experimental set up simultaneously. A fifth set up was also installed without any biological tool and it was the controlled set up. The change in arsenic concentration in the solution due to the treatments was recorded at different intervals such as after 1 hour, 2 hour, 4 hour, 6 hour and 8 hour. The results indicate that maximum absorption of arsenic from the solution was recorded in the case of treatment by 40 gm roots after 8 hours when the arsenic concentration reduced to just half of its initial concentration. There was no significant change in arsenic concentration after 8 hours. 30 gm

roots showed significant reduction in arsenic in 4 hour and it just remained constant in 6 hour and showed minute reduction in 8 hour. In the case of control the arsenic reduced from 68 µg to 50 µg in the solution which is comparatively much less as compared to 30 gm and 40 gm roots treatments. At the same time the use of 10 gm and 20 gm roots treatments also shows non-significant results, which is much closer to the controlled treatments.

Experiment 2

Change in arsenic concentration in the water sample using roots of ***Arabidopsis thaliana (*** **L.) Heynh.** as a botanical tool has been expressed in table no1.2. The initial concentration of arsenic in the water sample was 75 µg /l and it was subjected to 4 treatments using the roots of ***Arabidopsis thaliana (*** **L.) Heynh.** such as 10 gm, 20 gm, 30 gm and 40 gm in four different experimental set up simultaneously. A fifth set up was also installed without any biological tool and it was the controlled set up.

The change in arsenic concentration in the solution due to the treatments was recorded at different intervals such as after 1 hour, 2 hour, 4 hour, 6 hour and 8 hour. The results indicate that maximum absorption of arsenic from the solution was recorded in the case of treatment by 40 gm roots after 6 hours when half of arsenic concentration reduced to its initial concentration. Initially it was 75 µg and reduced to 40 µg at 6 hour treatment. The arsenic range was just constant at 8 hours treatment. 30 gm roots showed significant reduction in arsenic at 8 hour treatment . In the case of control the arsenic reduced from 75µg to 73µg in the solution which is comparatively much less as compared to 30 gm and 40 gm roots treatments. At the same time the use of 10 gm and 20 gm roots treatments also showed reduction , which is much closer to the controlled treatments.

TABLE 1.1 Phytoremidiation of Arsenic using Eichhornia crassipes (Mart.) Solms Root

Weight of the roots	**Concentration Of Arsenic (µg) after Treatment**					
Weight of *Eichhornia crassipes (Mart.) Solms* Root	**0 Hour**	**1 Hour**	**2 Hour**	**4 Hour**	**6 Hour**	**8 Hour**
control	68	68 ± 1.75	55 ± 3.00	50 ± 2.50	50 ± 2.00	50±1.75
10 gm	68	60 ±1.85	55 ±3.20	45 ± 2.25	43 ± 1.75	43 ±1.25
20 gm	68	60 ±1.85	55 ±3.20	45 ± 2.25	43 ± 1.75	43 ±1.25
30 gm	68	60 ± 1.89	54 ± 2.50	40 ± 2.00	40 ± 1.69	38 ±1.00
40 gm	68	55 ± 2.00	40 ± 2.25	35 ±1.75	33 ±2.00	30 ±0.50

Data represents the mean of three replicates with Standard deviation

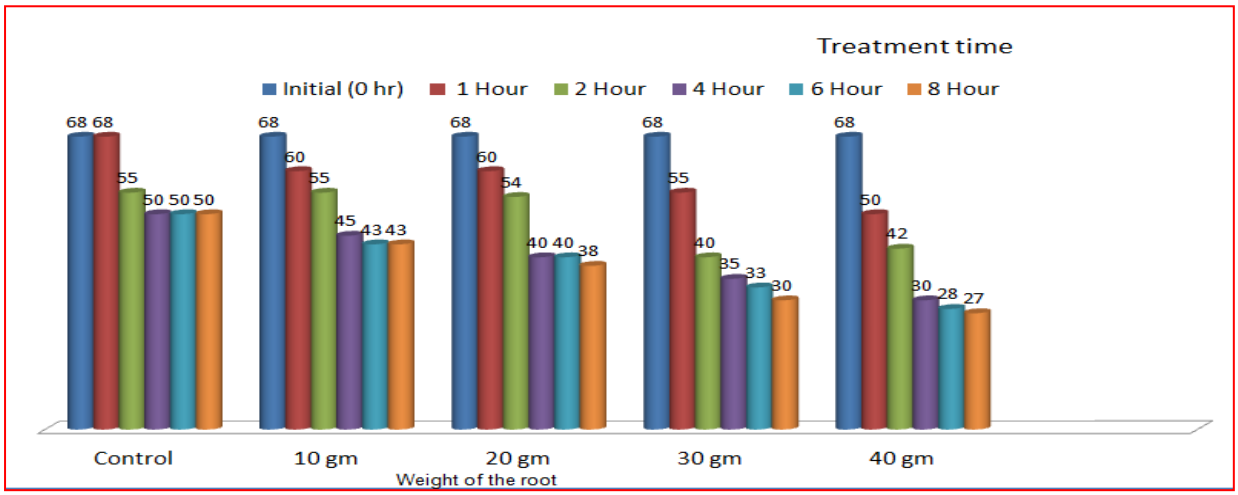
TABLE 1.2.

Phytoremediation of Arsenic using *Arabidopsis thaliana (*L.) Heynh. Root	
Weight of root	Concentration of Arsenic (µg) after Treatment

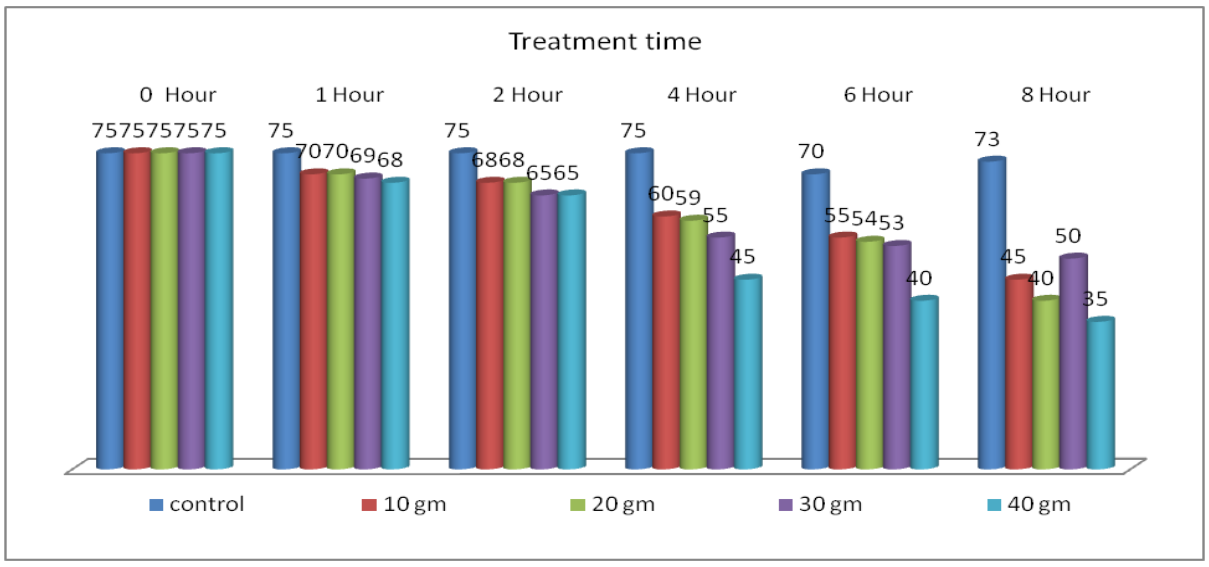
Weight of *Arabidopsis thaliana* (L.) Heynh. Root	0 Hour	1 Hour	2 Hour	4 Hour	6 Hour	8 Hour
Control	75	75±0.22	75±0.22	75±0.22	74±1.20	73±1.27
10 gm	75	70±1.22	68±1.85	60±1.89	55±1.25	55±2.00
20 gm	75	70±1.22	68±1.85	59±1.75	54±1.22	54±2.15
30 gm	75	69±1.35	65±2.00	55±1.00	53±1.43	50±2.43
40 gm	75	68±1.45	65±2.00	45±0.45	40±1.00	40±2.45

Data represents the mean of three replicates with Standard deviation

COMPARISON BASED ON GRAPHICAL REPRESETION



Eichhornia crassipes (Mart.) Solms Root



*Arabidopsis thaliana (*L.) Heynh. Root

IV. RECOMMENDATION AND CONCLUSION

In the case of treatment of ***Eichhornia crassipes (Mart.) Solms*** roots the treatment of 40 gm roots for 8 hours is recommended and in the case of treatment of ***Arabidopsis thaliana (*** **L.) Heynh. Root** the treatment of 40 gm roots for 6 hours is recommended. After 8 hours there is no significant change in arsenic concentration is observed and it almost remain constant when left for one day in experimental set up.

Both ***Eichhornia crassipes (Mart.) Solms*** and ***Arabidopsis thaliana (*** **L.) Heynh. Roots** are arsenic hypoaccumulators and showed good result in arsenic absorption and are used as biological tool for phytoremediation of arsenic.

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