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Phytoremediation of Arsenic using Leaves of *Bambusa vulgaris* (Schrad. ex J.C.Wendl.) Nakai

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Abstract

The present work is aimed to investigate the feasibility of leaf biomass of *Bambusa vulgaris* for removal of Arsenic (As) in contaminated water. Different weight of leaf biomass were treated with As contaminated water sample to observe the biosorption/ adsorption capacity of *Bambusa vulgaris* leaf biomass. Concentration of As was decreased by 55% after treating 8 gm *Bamboo* leaf biomass for 4 hrs. The multivariate ANOVA of the recorded data also indicates that the treatment of Arsenic contaminated water through the bamboo leaves can be applied with promising result. Pearson correlation analysis also shows that all the treatments are positively significant with respect to the mass of the used botanical tool and also with respect to the time. The work demonstrates that *Bambusa vulgaris* leaf biomass can be a suitable botanical tool for phytoremediation of Arsenic contaminated water.

Keywords: *Bambusa*; Arsenic; Biosorption/adsorption; Botanical tool; Phytoremediation

Introduction

Arsenic (As) is a widespread environmental and food chain contaminant and class I, non-threshold carcinogen. Arsenic is listed as the most hazardous substance according to the US agency for toxic substance and disease registry. Arsenic menace is a global concern as it is a potent environmental pollutant as well as it causes enduring health hazards. Arsenic is widely distributed in environment [1]. Groundwater is one of the most important sources of drinking water. Arsenic is highly mobilized element and mainly cycled by ground water in the environment. Contamination of ground water with arsenic has posed major health issues in many parts of the world including Bangladesh, India, China and Taiwan.

Around 10 million people in India are unknowingly consuming high level of arsenic in their water [2]. The current recommended limit of arsenic in drinking-water is 10 μg/litre. A recent survey showed that the groundwater of several parts of eastern Uttar Pradesh and Bihar contain far higher levels of arsenic than is considered safe and permissible for human consumption [3]. Remediation of As-contaminated groundwater is necessary for both human health and agricultural yield.

Phytoremediation of As-contaminated groundwater has been considered a cost-effective and environment-friendly technique and the only economically feasible technology [4]. The term "phytoremediation" consists of the Greek prefix phyto (plant), attached to the Latin root remedium (to correct or remove an evil), as reported by Erakhrumen and Agbontalor [5]. Phytoremediation is an emerging technology that uses selected plants to clean up the contaminated environment from hazardous contaminant to improve the environment quality.

Certain plants have tendency to absorb unusually large amounts of metals are called hyperaccumulators. Certain families viz. Asteraceae, Brassicaceae, Caryophyllaceae, Cyperaceae, Cunouniaceae, Fabaceae, Flacourtiaceae, Lamiaceae, Poaceae, Violaceae and Euphobiaceae have been reported that includes many genera as a hyperaccumulators.

As per records available, no plant of family Poaceae has been investigated to test the potential for accumulation of Arsenic, though it has been used for remediation of lead by Lalhruaitluanga et al. [6]. In light of the above, the present work was take-up with the objective to test the potential of *Bambusa vulgaris* (Schrad. ex J.C.Wendl.) Nakai belonging to family Poaceae.

Material and Method

The experiment is based on the principle of biosorption and phytoremediation. The experiment was designed in such a way that Arsenic solution of 90 ppb concentration was subjected to treatment through the dried leaves of *Bambusa vulgaris*. Bivariate experiment was conducted in which different weight of the botanical tool was subjected for treatment for different time interval; this was done to estimate the most suitable weight and time required for treatment of solution of Arsenic of concentration 90 ppb, using this tool.

The healthy leaves of *Bambusa vulgaris* were collected from the Botanical Research Garden, DDU Gorakhpur University, Gorakhpur, U.P., India. The leaves were washed and dried in an oven at 40°C for 2 hours. Experiment was conducted in cleaned beaker containing 250 ml solution of $Na_2HA_sO_4.7H_2O$ (Dibasic Sodium Arsenate) equivalent to 90 ppb Arsenic. The target concentration of Arsenic was adopted 90 ppb because this is the concentration found in most of the Arsenic contaminated groundwater aquifers. The experiment was conducted as, 250 ml solution of $Na_2HA_sO_4.7H_2O$, containing as equivalent to 90 ppb was subjected to 2 gm, 4 gm, 6 gm and 8 gm of *Bambusa vulgaris* leaves in five replicates. The concentration of Arsenic is detected by Waghtech Digital Arsenator at regular interval of 1 hr, 2hr, 3hr and 4hr respectively. The experiments were conducted at room temperature (25°C).

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The recorded data were subjected to statistical analysis for multivariate ANOVA and the Pearson correlation coefficient, using SPSS 21.

Result and Discussion

The findings are summarized in following Table 1 and the variables are graphically represented in Figure 1. The experiment was conducted in the replicate of three but for the ease of understanding the value of arithmetic mean has been used in the literature. The obtained values were subjected to multivariate ANOVA. The concentration of arsenic significantly decreased by increasing weight of Bamboo leaf biomass. Initially the decrease in concentration of As was slow but it enhanced greatly with increase in weight of leaf biomass with time. Maximum decrease in as concentration (50 ppb) is observed on treatment of 8 gm Bamboo leaf biomass for 4 hrs. The total reduction in Arsenic concentration was 55%.

The intercept of Pillai's trace (0.999) and Wilk's lambda (0.001) in the multivariate ANOVA of the recorded data also indicates that the treatment of Arsenic contaminated water through the bamboo leaves can be applied with promising result. Pearson correlation analysis also shows that all the treatments are positively significant with respect to the mass of the used botanical tool and also with respect to the time (Figure 1).

Time	Weight of Bamboosa Leaves			
	2 gm	4 gm	6 gm	8 gm
1 hour	90 ppb	86 ppb	77 ppb	62 ppb
2 hour	90 ppb	84 ppb	72 ppb	59 ppb
3 hour	88 ppb	81 ppb	70 ppb	54 ppb
4 hour	88 ppb	80 ppb	67 ppb	50 ppb

Table 1: Change in arsenic concentration in the solution, after treatment.

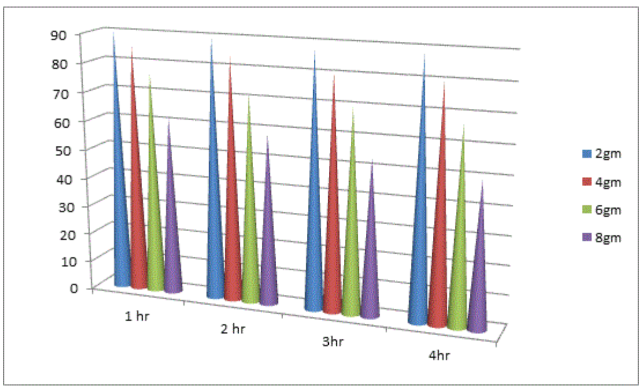

Figure 1: Graphical representation of change in As concentration in the solution.

Thus, the experiment shows that leaf biomass of Bamboo in higher quantity adsorb As rapidly and it can be utilized as cost effective alternative for remediation of Arsenic contaminated water [7]. The arsenic adsorption capacities depend upon the characteristics of adsorbent, concentration of arsenic, pH, temperature, and treatment time. According to Srivastava and Dwivedi [8] Natural botanical tools can be good adsorbents for arsenic.

The large scale use of dry botanical tools as substrates for the removal of heavy metals such as arsenic from groundwater should be strongly recommended due to their cost effectiveness, local availability and feasibility [9,10].

References

1. Yoshida T, Yamauchi H, Fan Sun G (2004) Chronic health effects in people exposed to arsenic via the drinking water: dose–response relationships in review. Toxicol Appl Pharmacol 198: 243–252.
2. Chiban M, Zerbet M, Carja G (2012) Application of low-cost adsorbents for arsenic removal: A review. Journal of Environmental Chemistry and Ecotoxicology 4: 91-102.
3. Nickson R, McArthur J, Burgess W, Ahmed KM, Ravenscroft P, et al. (1998) Arsenic poisoning in Bangladesh groundwater. Nature 395: 338–338.
4. USEPA (U.S. Environmental Protection Agency) (2000) Introduction to Phytoremediation. National Risk Management Research Laboratory, EPA/600/R-99/107, 2000.
5. Erakhrumen A, Agbontalor A (2007) Review Phytoremediation: an environmentally sound technology for pollution prevention, control and remediation in developing countries. Educational Research and Review 2: 151–156.
6. Lalhruaitluanga H, Jayaram K, Prasad MNV, Kumar KK (2010) Lead(II) adsorption from aqueous solutions by raw and activated charcoals of Melocanna baccifera Roxburgh (bamboo)—a comparative study. J Hazard Mater 175: 311–318.
7. Dwivedi AK, Srivastava S, Dwivedi S, Tripathi V (2015) Natural Bio-Remediation of Arsenic Contamination: A Short Review. Hydrol Current Res 6: 186.
8. Srivastava S, Dwivedi AK (2015) Biological Wastes the Tool for Biosorption of Arsenic. J Bioremed Biodeg 7: 323.
9. Dwivedi AK (2012) Groundwater and Arsenic: A Mini-review.
10. Dwivedi AK (2013) Arsenic in Groundwater: An Issue Beyond Boundary.