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Phytoremediation of arsenic using leaf biomass of *Citrus limon* (L.) Osbeck

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Abstract
Arsenic pollution in ground water and its consequence to human and plant health have been one of the world biggest natural calamity to the mankind. Seven Indian states West Bengal, Jharkhand, Bihar, Uttar Pradesh, Assam, Manipur and Chhattisgarh have so far been shown to have groundwater contaminated with arsenic above the allowable level. The majority of the population in these states is defined to high concentration of arsenic and suffers from diseases related to arsenic: The number of these cases is rising daily. This study has been designed to test the ability of *Citrus limon* leaf biomass for removal of Arsenic contamination. Arsenic solution of known concentration was subjected to treatment by different amount of the botanical i.e. the fruit biomass of *Citrus limon*. Treatment by 50g of the botanical tool for 5 hours. It was found to be sufficient for 1 liter of water containing arsenic up to 70ppb.

Keywords: Arsenic, groundwater, botanical tools, *Citrus limon*, phytoremediation, water contamination

Introduction

Due to the rapid population growth and declining water quality, industrial and rural areas are more dependent on groundwater to supply their water needs. However, the high exploration rate of groundwater and lowering of groundwater table the dependence on groundwater in deep aquifers is increasing [1]. Normally it is trusted that hand pump and bore well water are safe for drinking. The report of occurrence of arsenic in such water lead to deep concern and major threat but still now people are not conscious of arsenic concentration in groundwater and it is deliberated health hazard in coming future. Now a day's arsenic contamination is widely studied in India and neighboring countries because ground water is the primarily source of drinking water and it is highly element like arsenic, which is introduce in the groundwater during weathering of rocks and minerals followed by subsequent leaching and run off and also by anthropogenic source.

Arsenic is an element with the symbol 'As' atomic number 33 and atomic weight 74.92 referred to as metal but is classified chemically as non –metal or metalloid belonging to graph 15.

It is found in rocks in the earth crust. In groundwater inorganic arsenic exists as Arsenate as (V) and Arsenite (III) which is highly toxic [2]. Using this groundwater as drinking, irrigation and in domestic use are the source of exposure, although it is also transferred through fish, meat, poultry and cereals but exposure from these foods is generally much lower compared to groundwater as drinking purpose.

Arsenic elimination filters certified of shortfalls in operating and maintenance of arsenic elimination techniques, delineation of hazard free deeper aquifers as an alternate source of groundwater, developing surface water based water supply schemes in many arsenic affected areas, success stories of community participating in running arsenic sequestration plants etc. are some of the important achievements which is done till now [4, 5]. The problem resolving issues seems to be partial and inadequate which needs to be strengthened by strategic scientific backing.

Many botanical tools have been suggested to be potential accumulator of arsenic by Srivastava and Dwivedi [6]

Srivastava and Dwivedi (2016) [6] and Singh *et al*.; have been also proposed *Bamboosa vulgaris Vetiveria zizanioides*, the plant still seems to be in trial [7]. In light of the above, this study has been designed to test the efficiency of *Citrus limon* leaf biomass for phytoremediation of Arsenic contamination.

Material and methods

In search of the most convenient and suitable botanical tool for eradication of arsenic contamination in water, an experiment was designed with the focus on phytoremediation potential of *Citrus limon* leaf biomass is well known for its medicinal as well as traditional importance; therefore this plant was selected for the experiment.

Arsenic solution of known concentration 70ppb was prepared using inorganic sodium arsenate Na3AsO4 and the solution was subjected to five different treatments. One liter of the solution each, were subjected to treatment by five different weights of *Citrus limon* leaf biomass 10, 20, 30 and 40, 50g. Change in the concentration of Arsenic was recorded after 3, 4 and 5 hours. For comparative study a control was also placed without any tool. The experiment was designed in the multiple of four; to avoid any confusion, the values presented here are arithmetic mean of the three.

The digital arsenator created by Wagtech International was used to estimate the amount of arsenic in the water figure; 1. Detection range of the instrument is between 1 ppb part per billion to 500 ppb.

Fig 1: Wagtech International digital arsenator

Result and discussion

Findings of the experiment have been summarized in the table.1. Graphical represented of the data has been presented in figure 2. The experiment was started with the concentration of 70 ppb of arsenic in the water. Experiment was conducted for five hours, as convincing result was obtained with in this period of time. The experiment in which no botanical tool was utilized, i.e. the control samples show no considerable change in the concentration of arsenic. The table and graph both clearly show that the quantity of arsenic in the solution decreases exponentially as the amount of the botanical tool increases. It appears that the colloidal substance present in the leaf must be separating the arsenic from the solution, may be due to the process of chelation.

Citrus limon used as a botanical tool appears to be a batter plant for phytoremediation of Arsenic, as compared to *Bamboosa vulgaris* Srivastava and Dwivedi 2016 [6] because complete eradication of arsenic was found by the fruit biomass *Citrus limon* 40g as well as the 50g of the botanical tool completely eradicates arsenic from the solution after 5 hours of treatment. As conclusion, the treatment of 50g *Citrus limon* leaf biomass for 5 hours was required for treatment of 1 liter of water containing arsenic concentration up to 70 ppb. The shortcomings recorded in the use of *Citrus limon* leaf biomass as a botanical tool for biosorption of arsenic.

However, this botanical tool can be safely used for treatment of arsenic contamination water on large scale. Additional advantage of this tool is that the taste and odour of the water is not affected. Also, this plant is easily available in tropical countries.

Table 1: Variation in Arsenic concentration in the solution, after treatment with *Citrus limon* leaf biomass

Time Interval	Weight of powdered leaf biomass				
	10g	20g	30g	40g	50g
1hour	70ppb	68ppb	65ppb	60ppb	55ppb
2hour	70ppb	65ppb	63ppb	55ppb	50ppb
3hour	70ppb	60ppb	55ppb	49ppb	40ppb
4hour	68ppb	50ppb	45ppb	40ppb	33ppb
5hour	65ppb	40ppb	35ppb	20ppb	00ppb

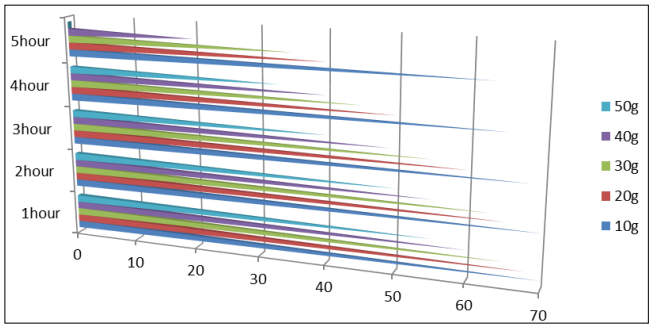

Fig 2: Graphical representation of change in Arsenic concentration with respect to time

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