Metal Contamination In Plants Due To Tannery Effluent

Md. Farhad Ali, Umme Habiba Bodrun Naher, Md. Mahamudul Hasan, Md. Aminul Islam

Abstract: This paper analyzes the determination of heavy metals named Chromium, Lead and Cadmium deposited in soil as well as in the plants and vegetables due to the tanning industries of the area of Hazaribagh, Dhaka. The tanneries discharge untreated tannery effluents which get mixed with the soil, water of rivers and canals in this area. The determination of metals was performed for the soil that was collected from the land adjacent to the canals which bear untreated tannery effluents. The soil is affected with the untreated effluents through the deposition of heavy metals. The metals were furthers deposited into the plants and vegetables grown on that soil. The roots stems and leaves of the plants of Jute (Corchorus capsularis) and Spinach (Basella alba) grown on that soil were analyzed for determining these metals. Extreme amount of chromium was found for plants and again Lead, Cadmium were found in higher amount in these parts of the two plants. These two plants are taken as a popular vegetables extensively. In case of soil, the amount of Chromium, Lead and Cadmium were analyzed as 87 mg/L, 0.131 mg/L and 0.190 mg/L respectively. For the roots, stems and leaves of Jute (Corchorus capsularis), the average values are 115.62 mg/L for Chromium, 11.25 mg/L for Lead and 2.27 mg/L for Cadmium respectively. Again, in case of Spinach (Basella alba), 124.42 mg/L was found for Chromium 7.38 mg/L for lead and 2.97 mg/L for Cadmium as average values for these parts of the two trees. All the observed values of metals of Chromium, Lead and Cadmium are higher than the permissible and specially for Chromium, the amount is extremely higher.

Index Terms: Heavy metals, tannery effluent, contamination, atomic absorption spectrophotometer, Hazaribagh, Jute plants,

1 INTRODUCTION

The Tanning industry is the oldest industries in Bangladesh and about 95% of tanneries of the whole country is situated in Hazaribagh [1]. One of the largest environmental problems is the removal of chromium infected sludge formed as a by product of wastewater treatment [2]. With rain heavy metals of effluents are penetrated into the soil and are eventually translocated into plants and into man through using up of these plants [3]. Heavy metals are the steady metals whose density is larger than 4.5 g/cm^3 [4]. One heavy metal is dumped in the soil, is not disgraced and endured in the surroundings for a long time and bring serious environment contamination [5]. In 90% tanneries worldwide, Chromium compounds are utilized most often as tanning agents [6]. Plants take up heavy metals by taking up the from deposits on the parts of the plants interpretated to the air from infected environment and from impured soils [7]. Lead, Chromium and Cadmium and also other metals are non biodigradable and can undergo-global ecological successions [12]. Heavy metals may be present either as a dump on the exterior of vegetables or may be taken up by the crops roots and pierce into the edible part of plant tissue [8]. Lead is the most significant pollutant of the heavy metals and the inorganic forms are sucked up through intaking by food, water and breathing [9]. Cadmium gathers in the human body influencing adversely numerous organs like liver, kidney, lung, bones, placenta, brain and the central nervous system [10]. Declining in root growth is a well documented consequence owing to heavy metals in trees and crops [11]. In this paper, we want to determine heavy metal contamination of soil and their deposition in the plants due to untreated tannery effluents.

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2 MATERIALS AND METHODS

2.1 Study Area

For the analysis, the soil was collected from the area near the canals of Hazaribagh industrial area through which tannery effluents are discharged.

Figure: *Soil collection from the area near the canal of Hazaribagh industrial area.*

2.2 Sampling

The soil was collected in poly bag and transferred into bowls. Two types of plants named white Jute (Corchorus capsularis) and Spinach (Basella alba) which are used as vegetables and grown on that soil. About one month later, the plants were cut after growing up for sampling. The cleaning of vegetable plant samples was done by shaking and also means of a dry pre-cleaned vinyl brush. The edible parts of vegetable samples were washed with tape water for several times. Then we washed through distilled and de ionized water to remove air bone pollutants. Then the samples were cut into small pieces and meshed it and dried in a hot air oven at 70-80 ^{0}C till the constant weight was achieved.

2.3 Analytical Procedure

At first 0.5gm of each soil and vegetable samples were taken and digested (Wet acid digestion) with 50ml of the mixture of concentrated HNO_3, H_2SO_4 and $HClO_4$ in ratio of 5:1:1 at 80^{0}C in the hot plate until transparent solution was obtained. The vegetables were filtered through Whitman no. 40 filtered paper and the filtrates were diluted to 50 ml with de ionized water. Then all the samples were stored in separate glass bottle at ambient temperature before analysis. After that the samples were analyzed in the Center for Advanced Research and Sciences (CARS), University of Dhaka for the determination of heavy metals by atomic absorption spectrophotometer.

Figure: *Jute plant (Corchorus capsularis) grown the collected soil*

Figure: Spinach (Basella alba) grown the collected soil

3 Results and Discussion

This analysis has found higher amount of metals name Chromium, Lead and Cadmium for both the soil collected from the adjacent area of pond containing untreated tannery effluents and for the vegetables plants of Jute and Spinach grown on that soil. Vegetables are indispensable elements of diet and are vital part of diet and are taken both cooked and raw types by human [12]. Chromium is one of those heavy metals, the deliberation of which is soundly enlarging because of industrial expansion, especially the growth of metal, chemical and tanning industries [13]. We found very higher amount of Chromium in the trees of Jute and Spinach. Both trivalent and hexa valent Chromium ions are toxic to plant lives [14]. In case of Jute, 176 mg/L Chromium was found in root, 170 mg/L in stems and 0.852 mg/L for leaves. Again 183 mg/L, 190 mg/L and 0.261 mg/L Chromium were measured for the roots, stems and leaves

respectively for the plants of Spinach. Cadmium, an unnecessary heavy metal creates pulmonary emphysem and bone diseases like osteomalacia and osteoporosis [15]. The allowed level of Cadmium in agriculture is around 3 mg/L and is generally lesser than 0.1 mg/L in the soil [16]. This metal has been found in higher amount both in soil and the plants. The amount of Chromium, Lead and Cadmium was found as 87 mg/L, 0.31 mg/L, and 0.190 mg/L respectively in the determination of soil. In the analysis of Jute, the average values of metals for these parts of plants are 115.62 mg/L for Chromium, 11.25 mg/L for Lead and 2.27 mg/L for Cadmium. The average values of Chromium, Lead and Cadmium for Spinach are 124.42 mg/L, 7.38 mg/L and 2.97mg/L respectively.

4 Figures and Tables

The table 1 shows the metal content (Chromium, Lead and Lead) in the soil.

Table 1 *Metal content in soil*

Metal	Chromium	Lead	Cadmium
Analyzed Amounts (mg/L)	87	0.131	0.190

Table 2
Metal content in Roots, Stems and Leaves of plants

Parts of Plants	Jute			Spinach		
	Chromium (mg/L)	Lead (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Lead (mg/L)	Cadmium (mg/L)
Roots	176	15	4.6	183	10	3.5
Stems	170	18.4	2.0	190	12	5.2
Leaves	0.852	0.348	0.212	0.261	0.131	0.212

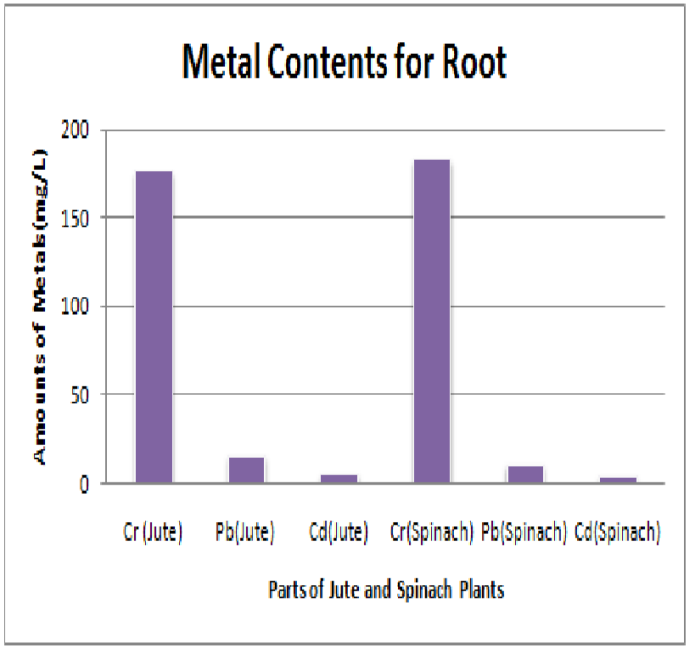

Fig 1*. Metal content for roots of Jute and Spinach plants*

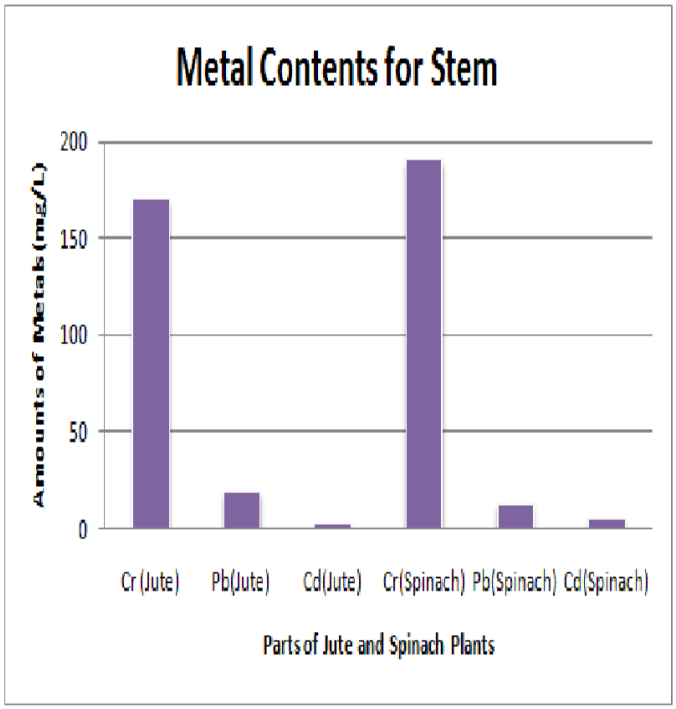

Fig 2. *Metal content for Stems of Jute and Spinach plants*

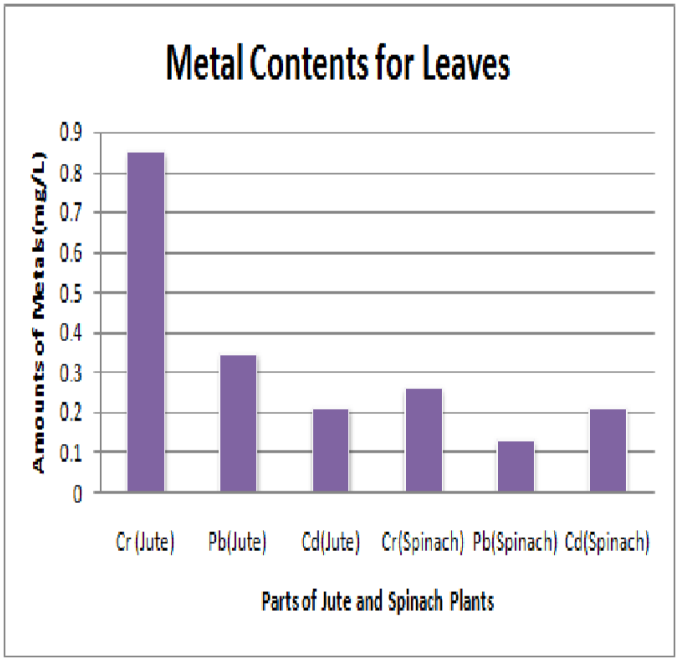

Fig 3. *Metal content for Leaves of Jute and Spinach plants*

5 Conclusion

This study has found higher amount of metal content in the soil of the area due to the untreated effluents discharged by the tanneries of Hazaribagh. Again, the deposition of these metals into the plants and vegetables can bring about a lot of devastative effects on the lives after taking these as edible vegetables. For this greatest problem of metal contamination due to tannery effluents, the establishment of treatment plants is the only solution. This must be established for saving of a lives and also the whole environment as soon as possible in this area as it covers the whole tannery industries of the whole country.

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