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A Study on Heavy Metal Accumulation in *Spinacia Oleracea* L.Grown in Hundri River Bank in Kurnool

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Abstract

Developing countries like India heavy metal accumulation was increased in urban and industrial areas. Contamination of heavy metals represents one of the most pressing threats to water and soil resources, as well as human health. In the present study we estimated heavy metals (Cd, Cr, Pb and As) accumulation quantitatively in Spinacia oleracea grown under hundri sludge as well as control samples. Our study reveals that sludged samples found more heavy metal accumulation than controls. More over heavy metal accumulation was more in Spinacia root tissue than shoot and leaf tissue. Detailed results and discussions were explained below.

Keywords

Heavy metals; Pollution; Hundri River; plant-availability; Phytotoxicity.

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INTRODUCTION:

Vegetables constitute essential diet components by consisting carbohydrates, proteins, vitamins, iron, calcium and other nutrients that are highly beneficial for maintaining health and also preventing diseases. They also contain both essential and toxic elements over a wide range of concentrations. Until recently vegetables did not constitute as major part of the Ethiopian diet. In addition, there is an annual cycle of shortage of grains in some parts of Ethiopia, where families exhaust their grain supply before the next harvest; then they heavily supplement their food intake with leafy vegetables [1, 2].

Leafy vegetables are playing a important role in a human diet, because of their nutritional values. During recent years their consumption is increasing gradually, particularly among the urban community. But the cultivation of leafy vegetables like Spinacia, Amaranthus ect, were cultivated in sludge water instead of rain/cannel water in urban areas. The industrial or municipal water sludge is the major source of heavy metal contamination/pollution. Because heavy metal existence is mainly due to anthropogenic sources such as industrial and agricultural activities [3]. This causes an increase in the concentration of heavy metals content related to soil and water, thus contaminating them. The increased uptake of these metals by plants influence the natural contents of vegetables and thus poses serious health impacts.

Heavy metals are potential environmental contaminants with the capability of causing human health problems such as cancer, mutations, or

miscarriages; if present to excess in the food we take [4]. Plants and vegetables take up heavy metals by absorbing them from contaminated soils and waste water used for irrigating them as well as from deposits on different parts of the plants exposed to the air from polluted environment [5]. The major sources of elements in vegetable crop are their growth media, (soil, air, nutrient solutions) from which these elements are taken up by their roots or foliage. The food chain contamination is the major pathway of heavy metal exposure for humans [6]. Industrial or municipal wastewater irrigation is a common reality in some parts of the cities in Addis Ababa. The vegetable farms located at Kurnool city and surroundings are biggest among the farms that present in the other areas, where a substantial amount of vegetables is being produced. These farms are irrigated with the waste water that obtained from the river of hundri, it was contaminated with industrial and municipal water. Earlier, this river water was pure and utilized for drinking and irrigated purpose. But, with the increase of urban population and industrialization, the water has now become contaminated with various pollutants, among which heavy metals are present. Now the Hundri River is used as open waste disposal site for the city of Kurnool in Andhra Pradesh. Apart from its unfortunate fact, the river is also still used for various purposes including irrigation and animal drink. Furthermore, vegetables consumed in the nearby cities are also produced using polluted waters from the river. [7-9]. Long-term use of industrial or municipal wastewater in irrigation is known to have significant contribution to trace elements such as Cd, Cu, Zn, Cr, Ni, Pb, and Mn in surface soil [10]. Excessive accumulation of trace elements in agricultural soils through wastewater irrigation may not only result in soil contamination but also affect food quality and safety [11, 12]. The present study is therefore proposed with the objective of detection of accumulation of the concentrations of various heavy metals in *Spinacia* irrigated with sewage water and their controls.

METERIALS AND METHODS

Study Site and Sampling

Spinacia plant Samples (Root, shoot and leaf) were collected from wastewater irrigated fields of Hundri river bank and bore well irrigated fields (treated as controls), Kurnool city, Andhra Pradesh, India(photoplate-1). The plant samples were washed with double distilled water to remove dust particles. After washing and cutting, the plant samples were dried in an oven at temperature of 65^0C to remove moisture in them. 1g samples were grounded using mortar and pestle followed by wet digestion with HNO3 and HClO4 in the ratio of 3:1 [13]. The samples were digested on a hot plate at 100°C for 3-4 hours (photo plate-2). Heating was done in such a way that it did not boil the samples and dried up completely to a whitish dry mass. After cooling to room temperature, the residues were extracted in acid water mixture (HCl and distilled water in the ratio of 1:1) and filtered through whatman filter paper No 42. The volume was made up to 50 ml. The filtrate was analyzed for metal content using Atomic Absorption Spectrophotometer (model AA-6300, Shimadzu, Kyoto, Japan).

RESULTS AND DISCUSSION

We estimated accumulated heavy metal (Pb, Ni, Cd, As, Co and Cr) concentrations in both slugged and bore well irrigated spinacia root, shoot and leaf samples results were represented in (Table.1-3). We found all studied heavy metals in both slugged and bore well irrigated Spinacia root, shoot and leaf samples. However slugged Spinacia samples were found high amount of heavy metal concentration than controls (bore well irrigated Spinacia samples. Moreover, among studied heavy metals, lead accumulation was high in root, shoot and leaf samples of both slugged and bore well irrigated Spinacia results were depicted in (figure.1). Based on our results root and leaf samples of *Spinacia* had more contamination of zinc and lead as compared to other metals cadmium, cobalt, aluminum, arsenic and chromium and the order was Zn>Pb>Ni>Co>Cr>Cd>Ag>As. The results were compared according to the safe limits of metals in edible parts of vegetable according to the Indian Standards [14]. Similar results were reported by Singh et al (2010) , Gaeta Tiwari and Chitra Pandae (2013) [15-16] in sludged grown vegetable plants.

Table.1: Different heavy metal concentrations (ppm) in roots of control and sludged grown *Salvodara percica L.*

	Ag	As	Cr	Cd	Co	Ni	Pb	Zn
Control	4	3	5	3	8	24	158	538
Sludged	6	5	6	4	10	28	186	648
Toxic levels	**300**	**2**	**10**	**5**	**5**	**40**	**150**	**400**

Table.2: Different heavy metal concentrations (ppm) in shoot samples of control and sludged grown *Salvodara percica L*.

	Ag	As	Cr	Cd	Co	Ni	Pb	Zn
Control	3	2	4	2	6	16	162	517
Sludged	5	3	4	3	8	18	164	536
Toxic levels	**300**	**2**	**10**	**5**	**5**	**40**	**150**	**400**

Table.3: Different heavy metal concentrations (ppm) in leaf samples of control and sludged grown *Salvodara percica L*.

	Ag	As	Cr	Cd	Co	Ni	Pb	Zn
Control	6	4	6	4	10	32	192	728
Sludged	7	6	8	6	15	34	196	735
Toxic levels	**300**	**2**	**10**	**5**	**5**	**40**	**150**	**400**

CONCLUSIONS

From the above study on accumulation of heavy metals in sludged grown Spinacia, the amounts of Zn, Pb, Ni and Co entering the liquid phase of the sludged soil from this enter into food chain through food and fodder. Finally, our study stated that do not cultivate any leafy vegetables under sludge and drainage water.

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