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Chromium Accumulation by Eisenia Foetida in Modified Vermicompost Supplemented with Tannery Sludge

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Abstract: *The current study is aimed to analyze the potential of accumulation ofchromium present in tannery sludge by earth worms (Eisenia foetida). Chromium salt is commonly used for tanning of leather and it is present in trivalent and hexavalent form.As earthworms are known to clean up the soil from various pollutants and can accumulate metals from it. Therefore the earthworm provides an easy biological material to explore the potential of accumulation of chromium and limiting its presence in soil. Tannery sludge obtained from Unnao region of Uttar Pradesh was mixed with vermicompost in various concentrations and earthworms were exposed up to 50 days with same mixtures and finally estimated the rate of heavy metal (Cr) accumulation of earth worms' body tissuesusing AAS. The experimental results revealed that earthworms have accumulated 0.131 µg/l at 10% tannery sludge supplement where as 50 % it was 4.919 µg/l.*

1. INTRODUCTION

Environmental pollution from heavy metal contamination has increased to the point that it endangers human life in some areas and the reduction and eventual elimination of pollution in these areas is urgently needed. These unforeseen activities are increasing every passing day due to anthropological activities and urbanization. This continuous interference of human in environment is causing highest degree of pollution including metal toxicity. Metal toxicity especially chromium is one of the major elements causing severe effect on flora and fauna. Metal pollution disturbs soil ecosystem by affecting the structure of soil invertebrate population. Heavy metal toxicity and the danger of its accumulation in the food chain represent one of the major environmental and health problems of our modern society. Toxic metals are important category of pollutants and as such have major detrimental impacts on human health [6].

Earthworms can be exposed by direct dermal contact with heavy metal in soil solution or by ingestion of pore water polluted, food and /or soil particles [10]. In addition, earthworms are able to clean up the soil from various pollutants, and are able to accumulate heavy metal on their bodies from the soil too. The process of vermicomposting is used to treat heavy metal contaminated soil through bioaccumulation and conversion to non-toxic forms.[8] Earthworms have been widely used in the breakdown of a wide range of organic residues including sewage sludge, animal waste, crop residues and industrial refuse in producing vermicompost[5][9]. However the potential of remediation from tannery sludge is yet to be explored.

Vermiremedition is low cost, convenient, technology for combating soil and land pollution. Earthworms in general are tolerant to many chemical, contaminants in soil including heavy metal and organic pollutants and have been reported to bio accumulate some of them in their tissues. Vermicasting of earthworms contain enzyme like amylase, lipase, cellulase and chitinase, which continue to breakdown organic matter in the soil to release the nutrients and make it available to the plant roots even after they have been excreted[11][4].

Earthworms can bio-accumulate high concentrations of metals including heavy metals in their tissue without affecting their physiology [7]. Earthworms ingest metal with soil, change their ionic state in their gut through physiological action and render them in bio-accumulation form for plants when excreted out. Vermicomposting represents an excellent treatment method for contaminated soils, not only for waste reduction but also to recondition the soil. Vermicomposting constitutes a special form of composting in which earthworms metabolize and excrete a mixture of soil and organic matter. In the digestive system of these worms, microorganisms transform organic species (proteins, nucleic acids, fats, carbohydrates, etc.) into more stable products in the process of vermicompost[2].

2. MATERIALS AND METHODS

Earthworms were collected from Biotech Park, Lucknow, Uttar Pradesh for experimental purpose. The test was performed by using a mixture of tannery sludge with

vermicompost in different concentration i.e. 10%, 20%, 30%, 40%, 50% along with control. The different amendments of tannery sludge used were are 10%= 2700 gm vermicompost+300gm tannery sludge, 20%=2400 gm vermicompost+600gm tannery sludge, 30%=2100 gm vermicompost+900gm tannery sludge,40%=1800 gm vermicompost+1200gm tannery sludge, 50%=1500 gm vermicompost+1500gm tannery sludge and finally Control= 3000 gm vermicompost (without tannery sludge). Prior to this supplementation the amended Chromium content in tannery sludge was analyzed (Table-1).

These mixtures of tannery sludge & vermicompost were kept in clean plastic tubs. Each tub mixed with 3 kg of vermicompost and tannery sludge. Three replications from each concentration and control were used. Ten no. of earthworms (*Eisenia foetida)* weighing approximately 0.16-27gm and length 6cm of each were kept in the all experimental tubs. The moisture content of the mixture was maintained at 70-80 percent throughout the experimental period and plastic tubs were kept in the experimental room at 30-37^{o}C. After 50 days earthworms were collected from all three replicates of each concentration, further they were cleaned, dissected and collected 1gm of body tissue. Further, the body tissues were kept back into 100ml of conical flask. Added 15 ml of digestion mixture in 6:1 (HNO_3:$HClO_4$) (Nitric acid and Perchloric Acid) and heated on the sand bath. Heating was continued till brown fumes convert into white fumes and sample solution remains 0.5-1.0 ml at the bottom of flask. The volume of sample was made to 5ml by adding 1% nitric acid and filtered through Whatmann filter paper and analyzed with the help of Atomic Absorption Spectrophotometer (AA 240FS, Varion) at Department of Environmental Science, BBAU, Lucknow. The data obtained was analyzed by One Way analysis of Variance using SPSS software.

3. RESULTS

The experimental results of heavy metal (Chromium) content accumulated in earthworms after 50 days are summarized in table 2.

It was observed that the bioaccumulation of Chromium in earthworm body tissue varies as per the concentrations. It was found highest in 50% (2.829 µg/l) whereas lowest percentage of bioaccumulation was observed in 20% of tannery sludge (0.148 µg/l) followed by 10% (0.164µg/l), 30% (0.699) and 40% (1.354 µg/l).Earthworms survived well in pure vermicompost (control) as well as in experimental. Therefore, increasing trends of chromium absorption was observed with increased concentration of tannery sludge in vermicompost except 20%.

The statistical analyses revealed that variables show good inter relationship and its values are significant. Detail analysis is in Table-2.

One way analysis of Variance shows that there is a significant difference in the accumulation of Chromium of earthworm at different concentrations of tannery sludge ($F_{5,\ 12}$ = 5.113, P<0.05)

Table 1: Concentration of Chromium in tannery sludge mixture (µg/l)

S.N.	Concentration of tannery sludge in mixture	Chromium in tannery sludge
1	Control	0.285
2	10%	1.967
3	20%	1.989
4	30%	2.032
5	40%	3.255
6	50%	4.321

Table 2: Concentration of Chromium in earthworm body tissue (µg/l) at different concentration

S. No.	Tannery Sludge	R1	R2	R3	Mean
1	10%	0.131	0.150	0.210	0.164
2	20%	0.178	0.118	0.147	0.148
3	30%	0.451	0.912	0.734	0.699
4	40%	1.103	0.894	2.064	1.354
5	50%	1.211	2.358	4.919	2.829
6	Control	0.070	0.074	0.085	0.076

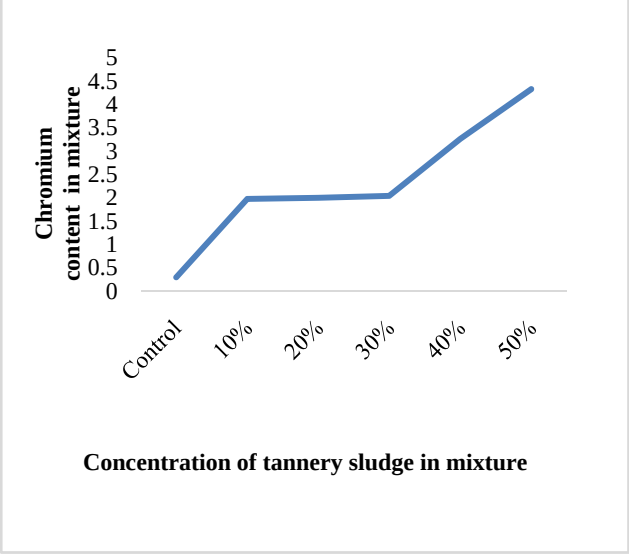

Fig. 1: Concentration of Chromium in tannery sludge mixture (µg/l)

4. DISCUSSION

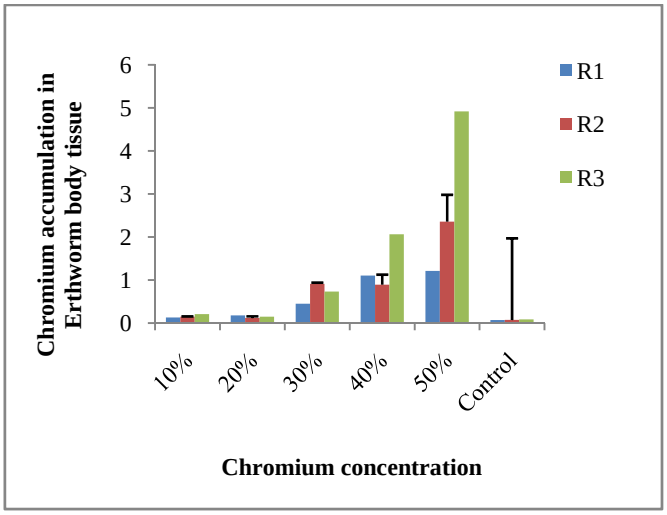

Fig. 2: Chromium accumulation in earthworm body tissue at different concentration

The accumulated Chromium in the body of earthworm shows its ability to digest Chromium. Current study also revealed that the uptake of Chromium by the earthworm is in increasing order as the concentration increases. However in one of the supplements (20%) of tannery sludge higher accumulation of Cr was not observed and its reasons are not known.

These findings were similar to that recorded by [13] [12] who indicated that earthworm activity increases the mobility and bioavailability of heavy metals in soil. Further a similar results obtained by[1] also substantiate the current results. The current study established the fact that earthworms (E*isenia fetida*) are competent enough to accumulate Cr content in their body tissue. Hence soil pollution can be eradicated by using earthworms. The study also reveals that heavy metal toxicity can cause serious damage to the ecosystem can be controlled by using biological organisms and earthworm can be used as a biomarker to access heavy metal pollution.

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REFERENCES

[1] Barrera L., Andres P. (2001). Sewage sludge application on soil: Effect on two earthworm species. *Water,, air and soil pollution.*,129: 319-332

[2] Bianchina J.N. (2009). Development of a flow system for the determination of Cd in fiel alcohol using vermicompost as bio absorbent. *Talanta*, 78:333-336.

[3] Chhotu D. J., Fulekar M. H. (2009). Phytoremediation of heavy metals: Recent techniques. *Afr. J. Biotechnol*., 8(6): 921-928.

[4] Chaoui H.I., Zibilske L.M., Ohno T. (2003). Effects of earthworm casts and compost on soil microbial activity and plant nutrient availability. *Soil BiolBiochem.* 35(2):295-302.

[5] Dominguez J., Edwards C.A. (1997). Effects of stocking rate and moisture content on the growth and maturation of *E.anderi* in pig manure. *Soil Biology and Biochemistry.* 29:743-46.

[6] Duruibe J. O., Ogwuegbu M. O. C., Egwurugwu J. N. (2007). Heavy metal pollution and human biotoxic effects. *International Journal of Physical Sciences*, 2 (5): 112-118.

[7] Ireland M.P. (1983). Heavy metals uptake in earthworms; earthworm ecology. *Environ Pollut*. 19:201-206

[8] Jain K., Singh J. (2004). Modulating of fly ash induced genotoxicity in vicafaba by vermin-composting. *Ecotoxicol. Environ. Safe*. 59 (2):89-94.

[9] Kale R. D. (1998). Earthworms: natures gift for utilization of organic waste. *Earthworm ecology*.CRC Press, Boca Raton FL, 355-77.

[10] Lanno R., Wells J., Conder J., Bradham K., Basta N. (2004). The bioavailability of Chemicals in soil for earthworms.*Ectoxicology and Environmental safety.* 57:39-47.

[11] Sinha RK., Heart S., Agarwal S., Asadi R., Carretero E. (2002). Vermiculture technology for environmental management: study of action of earthworms *Elsinia foetida, Eudriluseuginae* and *Perionyx* excavates on biodegradation of some community wastes in India and Australia. *The Environmentalist. U.K.* 22(2):261-268.

[12] Sizmur T., Hodson M. E. (2009). Do earthworms' impact metal mobility and availability in soil, A review. *Environ. Pollut.* 157(7): 1981-1989.

[13] Wen B., Hu X., Liu Y., Wang W, Feng M., Shan X. (2004). The role of earthworms *(Eisenia fetida)* in influencing bioavailability of heavy metals in soils