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Short Communication

Levels of Heavy Metals (Cr, Pb, Cd) Available for Plants within Abandoned Mechanic Workshops in Umuahia Metropolis

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Abstract

Heavy metals [Pb Cd Cr] levels in plants and soils from abandoned mechanic workshops in Umuahia metropolis were determined using atomic absorption spectrometer (AAS) to estimate the level of pollution. The mechanic workshops were chosen from the four axis of the metropolis and the soils were collected at the root zone of the plants samples. The results show that the concentration of those heavy metals in soils and plants were significantly [p<0.01] higher than the permissible level and correlation analysis showed a strong positive relationships between metal concentration in plants and soil. The result of this work revealed that the consumption of farm products/vegetables grown in the abandoned mechanic workshops poses a significant health hazards to human and therefore calls for government action to control the indiscriminate disposal of waste generated in mechanic workshops.

Keyword: Heavy metals concentration abandoned mechanic workshops, health hazards.

Introduction

Heavy metal pollution of the environment has become a growing ecological crisis and concern and therefore the subject of many research[1,2].

The soil is the primary recipient of these contaminants from where they enter the plants and then, the food chain. The most serious of these contaminants are the non-biodegradable heavy metals, with long biological half lives. They can accumulate over time within the body organs and constitute serious disruption to normal body function[3-5]. Some like Pb, Cd Cr are among the major problems to our environment[6]. The damage associated with these metals is of great concern throughout the world because of their toxic and mutagenic effects even at low concentration[7].

In recent time, the desire for food safety and security has stimulated research on the danger associated with the consumption of food contaminated with heavy metal and toxins.

The high mobility of Cd in soil makes it very available for plants and so the food chain, De Toppi et al 1999, Curtis et al 2002. Cadmium is reported as very dangerous causing kidney damage, cancer, diarrhea, and vomiting[8,9].

Chromium can cause kidney and liver damage, alteration of genetic materials and lung cancer, skin rashes, stomach upset and ulcers, respiratory problems and weakening of the immune system. Lead is very harmful even at very low concentrations damaging the nervous system, bone, liver, pancreases, teeth, gum[10,11].

These heavy metals enter the soil through variety of sources which include urban, industrial aerosols created by combustion of fuels, metal smelting and other industrial activities. Of significant in mechanic workshops are the wastes from overused engine oils, petrol, motor batteries, paints that are indiscriminately disposed therein.

The major concern with the uptake of these contaminants by plants is their presence in plant produce consumed by humans.

This paper investigates the level of heavy metals available to plant produce in mechanic workshops in Umuahia metropolis through the concurrent analysis of heavy metal content of soil and plants from the mechanic workshop and their degree of correlation.

Material and Methods

A total of 12 soil samples and plants were collected, three from each of the four axis of Umuahia metropolis and labeled A-D. Soil and plants were complementarily sampled as the soil samples were collected at the root zone of the plant samples.

The soil samples were collected at 0-20cm depth from three points at interval of 10cm in each mechanic workshop. The soils were place in the labeled plastic bags. They were air-dried, mechanically ground and sieved through 2mm sieve.

To determine the total metal content of the soil, 1.0g of the sieved sample was heated with 20ml conc. HN03 at 30oc to dampness. Then 50ml of 70% HCLO4 acid was introduced into the sample and heated vigorously until a complete digestion was observed. After cooling, the digest was filtered through a whatman filter paper into a 50ml volumetric flask and made up to mark with distilled deionized water.10ml of each digested sample was analyzed for Pb, Cd and Cr using atomic absorption spectrometer (AAS).

The plant samples were washed in distilled water, cut into smaller sizes and air-dried in the laboratory and then at 105oc for 24 hours. Samples from each mechanic workshop were then ground to obtain a homogenized powder which was digested in HNO3: HclO4 ($7:3^v/_v$) .Metals (Pb Cd and Cr) concentrations were measured using AAS.

Result and Discussion

The results of the metal concentrations investigated are shown in tables 1-3. In soil, the concentration of Cr in the 4 mechanic workshops ranged from 18.00-35.50mg/kg with an average of 24.10±0.75mg/kg. The concentration of Pb ranged between 96.50mg/kg and 107.90 mg/kg with an average of 101.32±1.05mg/kg while Cd concentrations ranged between 19.4 -25.60mg/kg with an average of 22.25+ 1.04mg/kg .In this study, Pb had the highest concentration followed by chromium and then cadmium. The values obtained for Pb x Cd were above the permissible level for soils recommended by USEPA. Cr was however below the critical permissible concentration of 40mg/kg for soils. The observed Pb concentration compares favourably with 110 mg/kg reported by Odoemena et al[12] for abandoned waste dump and 268 mg/kg by Mirela et al 2011 for mining area. It is however high than 30.30 mg/kg reported by Kabata Pendius.

The concentrations of Pb, Cd and Cr in plant samples were of similar trend to soil heavy metal concentrations. Pb level is highest ranging from 25.85 mg/kg to 38.83 mg/kg with a mean concentration of 30.82±1.22 mg/kg. Cd concentrations were between 4.65 mg/kg and 6.65mg/kg with an average value of 5.86 mg/kg. Cr concentrations varied between 8.76 mg/kg and 9.90 mg/kg with a mean value of 9.88mg/kg. In all locations the value of Pb, Cd and Cr obtained were above the critical value for plants according to EC regulations No. 1881/2006.

These toxic elements Pb, Cd and Cr in the plants were examined for dependency upon their values in the soil. Significant and positive correlation was observed between their concentrations in soil and plants in all the workshops. This result shows that the soil metal concentrations influence the uptake of the metals by the plants. This findings agree with the work of Kanchenko et al[13] and Mirela et al.

This high concentration of metals in soil and plants is the result of different activities in the mechanic workshops such as disposal of lead acid batteries, waste motor oils, grease and paints which contain these metals. The disturbing aspect of these pollutants is not only that they render the soils dangerous for farming, but, also give the soil a false and misleading appearance of being highly fertile full of manure which attracts framers.

The high level of these toxic metals in plants grown in the mechanic workshops suggests that the metal accumulation in vegetables and farm products grown there represents a potential risk for public health. Their consumption will among other hazard cause damage to the nervous system and problem in the synthesis of hemoglobin[11].

Conclusion

The result of this work highlights the urgent need for government to take a serious look at the activities in the mechanic workshop and control the indiscriminate disposal of wastes generated there. Public enlightenment on dangers of farming in these places should also be considered.

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Table 1
Concentration of (Cr) in soil and plant samples in /mg/kg/from locations

Soil			Plant	Mean
Location (A)	**(Cr)**	**Mean**		
A	18.08-18.50	18.25±0.45	8.20-8.70	8.45±0.12
B	18.25-18.75	18.50±0.75	9.83-10.13	9.98±1.01
C	30.70-35.50	34.85±1.25	8.10-8.60	8.35±0.42
D	25.60-26.60	26.80±0.11	9.33-9.63	9.48±0.24

Table 2
Concentration of (Pb) in soil and plant samples in /mg/kg/

Soil			**Plant**	**Mean**
Location (B)	**Ph mg/kg**	**Mean**		
A	102.00-102.50	102.25±2.05	28.25-28.75	28.50±0.01
B	107.50-107.90	107.70±1.15	30.75-30.25	31.00±0.25
C	99.50-99.95	99.75±0.15	25.85-26.25	26.05±0.10
D	95.05-98.85	97.75±0.25	30.50-38.00	37.75±1.11

Table 3
Conc. Of cadmium in soil and plants sample in /mg/kg/

	Soil		**Plant**	**Mean**
Location (c)	**cd.mg/kg**	**Mean**		
A	19.40-20.00	19.70±0.06	5.70-6.00	5.85±0.02
B	21.60-22.00	20.80±0.25	5.00-5.50	5.25±0.10
C	23.50-24.00	23.75±0.03	4.6-5.00	4.80±0.01
D	24.60-25.60	24.80±0.06	6.25-7.00	6.63±0.05

Table 4
Correlation coefficients between (Cr) concentration in soil and plants

	A (Cr)	**B(Cr)**	**C(Cr)**	**D(Cr)**
A (Cr)	1.000^{xx}	0.945^{xx}	1.000^{xx}	1.000^{xx}
B(Cr)		1.000	1.000	1.000^{xx}
C(Cr)			1.000^{xx}	0.866
D(Cr)			1.000^{xx}	1.000^{xx}

xx correlation is significant at P<0.01)

Table 5
Correlation coefficient between lead concentrations in soil and plant

	A (Pb)	**B(Pb)**	**C(Pb)**	**D(Pb)**
A (Pb)	1.000	0.805	1.000^{xx}	1.000^{xx}
B(Pb)		1.000^{xx}	1.000	1.000^{xx}
C(Pb)			1.000^{xx}	0.866
D(Pb)			1.000^{xx}	1.000^{xx}

Correlation is significant at the P<0.01)

`Table 6
Correlation coefficient between cadmium concentration in soil and plant

	A (Cd)	**B(Cd)**	**C(Cd)**	**D(Cd)**
A (Cd)	1.000	0.866^{xx}	1.000^{xx}	1.000^{xx}
B(Cd)		1.000^{xx}	0.866	1.000^{xx}
C(Cd)			1.000^{xx}	0.060
D(Cd)			1.000^{xx}	1.000^{xx}

xx correlation is significant at P<0.01)

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