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Heavy Metals Levels in Selected Dumpsites in Rivers State and Their Health Implications

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Abstract

This study was conducted to evaluate the levels of heavy metals in selected dump sites in Rivers State and their human health implications. Heavy metals (Mn, Cr, Cd, Pb, Hg) were analysed in the leaf, root and fruit of *Carica papaya* and the soil from three selected dump sites namely; Ikwerre (S.1), Oyigbo (S.2), and Eleme (S.3). A total number of seventy-two (72) samples were collected from all the sampled stations. Samples were analysed following standard methods using Atomic Absorption Spectrophotometer (AAS).The results showed that, the mean concentration(mg/kg) of the heavy metals in all the sampling stations were significantly different ($P<0.05$).S.3 showed the highest levels of metals; Mn(47.15mg/kg), Cd(7.79mg/kg), Pb (6.66mg/kg),Cr(3.57mg/kg) followed by S.1; Mn(38.38mg/kg),Pb (6.50mg/kg), Cr(3.57mg/kg), Cd(0.25mg/kg) and S.2; Mn(32.72mg/kg),Pb (8.20mg/kg),Cr(2.06mg/kg), Cd(0.08mg/kg). Mercury was not found in all the sampled stations. Further calculations, using Biological Accumulation Coefficient (BAC) showed that, Cd in the leaf, from S.1 and S.2, had bio-accumulative potential of >1, while other metals showed no bio-accumulative potentials (<1) in the leaf, root and fruit across the stations. The above results, is an indication that, the selected dump sites showed high levels of heavy metals and bio-accumulative potentials especially Cd. Hence, consumption of *Carica papaya* from this study area should be discouraged.

***Key words**: Heavy metals, Carica papaya, Dump sites, and Bioaccumulation Factor.*

Introduction

The large-scale development in mechanized agriculture and industrialization today, have contributed to an exponential increase in environmental degradation and environmental pollution. Anthropogenic activities have resulted into the release of heavy metals into the environment. The human activities include mining, smelting, domestic waste and various industrials such as primary extraction, processing for industrial and consumption processes are the major sources of soil pollutants (Olatunji and Osinbanjo 2012).

Humans unlimited means to earn living and conquer space, have led to industrialization and civilization, which also contribute to

environmental pollution. Waste generation is increasing every day and in developing countries where stakeholders have failed to give absolute attention and concern to waste management system, it is necessary the levels of pollutants are evaluated and monitored to reduce public health risk. (Edor 2007).

Heavy metals are non-biodegradable elements, and are toxic or poisonous at low concentrations. They are elements with atomic number greater than 20 and have a density higher than water, and have variable oxidation state that, enable them to react at different states. This also makes them unpredictable. (Witck-Krowiak *et. al*., 2011). Several diseases have been traced to long time exposure to heavy metals (Mark, *et al.*, 2011). Therefore, it is, of utmost priorities to give absolute attention to monitoring of the levels heavy metals in the environment

Dump sites are traditional borrow pit or land acquired by government for waste management services. The use of dump site for growing edible crops and medicinal plants is of public health concern, since most plants have bio accumulative potentials to accommodate heavy metals.

According to Odeta (1999), bio-accumulation has been defined as the retention and concentration of substances. Plants are able to retain heavy metals through the process of a well-developed cellular mechanism called phyto-extraction and Phyto stimulation (Ogunyemi *et.al*.,2003).

Materials and Method.

Study Area.

The selected dump sites (sampled stations) in Rivers State, were carefully selected based on their proximity from Port Harcourt metropolis and the socio-economic activities in the area. They are Ikwerre(station1), Eleme(station2) and Oyigbo (station3). These dump sites were characterized by several waste products such as plastic, can, tin, electronic wastes, domestic accessories deposit and plants and small animals etc.

Sample Collection and Transportation.

The leaf, root and fruit of *Carica papaya* and the soil sample were collected from the three sample stations. A total number of seventy-two samples were collected and transported to the laboratory in a clean label bag. Plant samples were collected in the early hours of the day, between 7a- 10am.

Laboratory Analysis.

The samples were digested using heat and a strong acid, from a complex form to a simple form according to Gawen method (1965). Atomic Absorption Spectrophotometer was used to analyse the

Heavy metals (Mn, Cr, Cd, Pb and Hg) concentration (mg/kg) in the samples. The standard wavelength was selected on the Atomic Absorption Spectrophotometer machine and calibrated with a standard concentration to obtain a standard graph of the solution for each metal.

Statistical Analysis and Calculations.

SPSS version 23 was used to measure the analysis of variance for metals concentration.

Biological accumulation Coefficient was calculated for the leaf, root and fruit of *Carica papaya* according to Li *et. al.*, *(*2007).

$$BAC = \frac{concentration\ of\ metal\ in\ organ}{concentration\ of\ metal\ in\ soil.}$$

BAC>1 has no potential health risk,

BAC<1 has a potential health risk.

Result

Table 1, shows the least square means value for heavy metals accumulation in the soil in station 1, 2 and 3 respectively. In table 1, there was no significant difference in metal concentrations across the stations at $p > 0.05$ Mn had the highest least square mean value, followed by Pb, Cd and Cr. In station 1, Mn had the highest least square mean value of 47.15mg/kg in station 3, Cr had the highest least square means value of 3.57mg/kg in station3, Cd had the highest least square means value of 7.79mg/kg and Pb had the highest least square means value of 8.20mg/kg in station2. Table 2, 3and 4 below, are biological accumulation coefficient for the leaf, root and fruit of *Carica papaya* for the three sampled stations. The BAC calculated were all less than one, except for Cd in the stations 1 and 2 that were greater than one.

Table1: Mean concentration of metals (mg/kg) in soil, in station 1, station 2 and station 3

Parameter	Station 1	Station 2	Station 3
Mn	38.78	32.72	47.15
Cr	2.06	2.43	3.57
Cd	0.25	0.08	7.79
Pb	6.50	8.20	6.66

Table2: Biological Accumulation Coefficient of leaf in station 1, station 2 and station 3.

PARAMETER	**STATION 1**	**STATION 2**	**STATION 3**
Mn	0.27	0.35	0.23
Cr	0.40	0.20	0.20
Cd	1.62	1.0	0.02
Pb	0.36	0.38	0.38

Table3: Biological Accumulation Coefficient of root in station 1, station 2 and station 3.

PARAMETER	**STATION 1**	**STATION 2**	**STATION 3**
Mn	0.19	0.26	0.11
Cr	0.28	0.10	0.04
Cd	0.41	0.86	0.02
Pb	0.38	0.27	0.22

Table 4: Biological Accumulation Coefficient of fruit in station 1, station 2 and station 3.

PARAMETER	STATION 1	STATION 2	STATION 3
Mn	0.04	0.02	0.05
Cr	0.01	0.10	0.03
Cd	0.35	0.43	0.01
Pb	0.35	0.08	0.12

Discussion

The high amount of metals may be traced to the constituents of the sampled stations which include plastic can, tins, rubbers, metal scraps, electronic wastes, domestic waste and flash flood run-off deposited or concentrated in this dump sites. The levels of heavy metals in the three sampled stations were significant higher than the temporal control at p>0.05. However, there was no significant difference in each metal concentration at p>0.05, across the sampled stations.

The mean levels of Cr, in the sampled stations were lower than the permissible limit 750mg/kg by Visser (1993) and CCME (1994) for residential, domestic garden and agricultural activities. Metal-organic complex decrease metal mobility in soil as reported by (Obasi *et al.*, 2012).

The mean concentrations of Cd, for the three sampled stations were below the permissible concentration of 3.0mg/kg for soil agricultural practice (USEPA 1986, MAFF. 1992). But Cd was more bio-available for plants absorption. This result was reported by Uba *et al*., (2008), Kuo *et al*., (1993), Gupta and Sinha (2006).

Manganese had the highest mean concentration among the studied metals. The total mean concentration of Mn was below the permissible limit of 100-300mg/kg standard by USEPA (1986) for agricultural land in all the three sampled stations. This was similar to the result obtained in Ntigha dump sites in Isiala Ngwa, Nigeria, where high presence of

Manganese was associated with to the precipitation of amorphous hydrous oxides of Manganese during the aging of dump sites (Staelens *et al.*, 2000)

Mean concentration of Lead was found below permissible limit of 30-300mg/kg by USEPA (1986). Similar results were recorded by Uba *et al*., (2008). Nimyel *et al.*, (2015) reported a 23.30±5.70mg/kg for Lead in dump site soil in Kuru Jantar, However, high values ranging from 1340-1693mg/kg had been reported by Aluko *et al*., (2003) in Ibadan, Nigeria and Awokunmi *et al*., (2010) reported values that range from 143.02 -2089.61 and from 95-6726mg/kg from dump sites soils in Nairobi and several dump sites in Nigeria respectively.

Biological accumulation coefficient (BAC) is a standard used to determine high metal accumulation potentials for a plant species which are usually associated with developed cellular mechanisms for heavy metals detoxification and tolerance. (Hall, 2002; Ghosh and Singh, 2005). When the BAC value is > 1, for any metal, this is term to be efficient in accumulating such metal and when plant can accumulate 1000mg/kg or more of the metal, the plant is termed hyper- accumulator. (Baker and Brooks, 1989). In this study, Cd had the highest BAC value but from the results obtained, it is evident that *Carica papaya* had potentials to efficiently accumulate Cd, Pb, Cr and less tolerable to Mn. Similar result was reported by Obasi *et al*., (2012). However, (Shu *et al.*, 2000, Archer and Caldwell 2004) reported high BAC values compared to the results obtained in this study.

Conclusion.

This study has established the levels of heavy metals accumulated in the leaf, root and fruit of *Carica papaya* and the public heath implication associated with human exposure to across the sampled stations. The accumulation of metals across the stations showed that heavy metals are readily available and efficiently absorbed by *Carica papaya.* The biological accumulation coefficient of Cd, found the leaf in stations 1 and station 2 are of significant health risk to consumers on a long-term exposure. Therefore, recycling, re-usage, periodic monitoring and evaluations should be practiced as aspects of waste management system. Medicinal plants found in dump site should be thoroughly and biochemically analysed before usage.

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