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Comparative Analysis of Selected Heavy Metals in Water Leaves Grown on Soil in Dumpsites in Amai Community

Etienajirhevwe, Omonigho Frank and Agbini, Oghenenyoreme Anslem

Department of Science Laboratory Technology, Delta State Polytechnic, Otefe, Oghara, Nigeria

Corresponding Author: Etienajirhevwe, Omonigho Frank

ABSTRACT

Four water leaves samples were collected in Otefe-Oghara community (two grown on dumpsite and two from non-dumpsite) and were analysed for the presence of lead, iron and cadmium using atomic absorption spectrophotometer. Results of analysis showed the presence of lead, iron and cadmium in the water leaves from all the sample sites. Lead, iron and cadmium were found in the range of 14.95-16.11mg/kg, 0.50-0.64mg/kg and 27.18-28.42mg/kg respectively for the dumpsite and 0.11-0.17mg/kg, 0.01-0.01mg/kg and 20.6-23.27mg/kg respectively for the non-dumpsite. Amongst the metals, iron was the highest followed by lead while cadmium was the lowest for both dumpsites and non-dumpsites. The leaves at the dumpsites were observed to be contaminated as results of analysis showed that samples at the dumpsites were higher than those of the non-dumpsites, and also above the FAO/WHO standard for vegetables. This therefore calls for regular monitoring. It was therefore recommended that the traditional way of cutting and consuming water leaves anywhere it is grown should be discouraged as the level of contamination cannot be ascertained.

Key words: Dumpsite; heavy metals; non-dumpsite; water leaves,

INTRODUCTION

Environmental pollution by heavy metals at low and/or high concentrations and the long- term cumulative health effects that go with it has become a general health concerns all over the world (Oluyemi *et al.*, 2008). For example, bio-accumulation of lead (Pb) in the human body interferes with proper functioning of the mitochondria thereby impairing respiration as well as resulting in constipation, brain swelling, paralysis and can eventually lead to death (Chang, 1992). The environmental contaminant and/pollution has caused serious problem in recent years facing human since these metals constitute a hazard to organisms and may cause health problems to the consumers (Vasques, *et. al.*, 1993), Municipal solid waste landfills often cause a major environmental problem due to their proximity to inhabited areas. According to Chiemchaisri *et. al.*, (2007)

The increasing load of heavy metals has caused imbalance in aquatic ecosystems and the biota growing under such habitats accumulate huge amount of heavy metals (Zn,Cu,Pb,Cr and Cd) which in turn, are being assimilated and transferred to humans through food chain (Nuzhat *et. al.*, 2013), according to Alloway (1996), toxicity sets in when the heavy metal content in the soil exceeds natural background level. This could result in ecological destruction and deterioration of the quality of the environment, influence quality and produce of crops as well as atmosphere, and health of animal through food chains. Municipal solid waste compositions have had paper, food waste, metal scraps, glass, ceramics, ashes, etc. Decomposition process releases the heavy metal contained in these wastes to

the soil of the waste dumpsite thereby contaminating/polluting the soil (Ukpong *et. al.,* 2013)

The use of dumpsites for farm land is a common practice in urban and sub-urban areas in Nigeria as a result of the fact that decayed and composted wastes enhance soil fertility (Ogunyemi *et. al.,* 2003). These wastes are often known to contain heavy metals in various forms and at different levels. Some metals such as As, Cd, Hg and Pb are particularly hazardous to plants, animals and humans (Alloway and Ayres, 1997).

It is no longer uncommon to see or find huge piles of wastes, old house items, construction waste or used products dumped by the road side, in the forests, or in non-designated dumping sites. This trend is on the rise and is increasingly becoming a problem because it hinders the objective of keeping the environment clean and can have serious impacts on wildlife and habitat. According to environmental protection agencies and departments, this malpractice is termed as illegal dumping. It is considered unlawful on the account of the harms it causes to the environment. What's more, there are officially designated areas with proper integrated waste management systems which should be used for dumping. Therefore, in defying the clearly outlined laws for appropriate dumping by throwing trash just anywhere such as by the roadside or in the forest, it becomes unlawful (USEPA, 2009).

Improper Municipal Solid Waste (MSW) disposal and management causes all types of pollution: air, soil, and water. Indiscriminate dumping of wastes contaminates surface and ground water supplies. In urban areas, MSW clogs drains, creating stagnant water for insect breeding and floods during rainy seasons. Uncontrolled burning of MSW and improper incineration contributes significantly to urban air pollution. Greenhouse gases are generated from the decomposition of organic wastes in landfills, and untreated leachate pollutes surrounding soil and water bodies. Health and safety issues also arise from improper MSWM. Insect and rodent vectors are attracted to the waste and can spread diseases such as cholera and dengue fever. Using water polluted by MSW for bathing, food irrigation and drinking water can also expose individuals to disease organisms and other contaminants. The U.S. Public Health Service identified 22 human diseases that are linked to improper MSWM. Waste worker and pickers in developing countries are seldom protected from direct contact and injury, and the co-disposal of hazardous and medical wastes with MSW poses serious health threat. Exhaust fumes from waste collection vehicles, dust stemming from disposal practices and the open burning of waste also contribute to overall health problems. People know that poor sanitation affects their health, especially in developing and low-income countries, where the people are the most willing to pay for environmental improvements (USEPA, 2009)

The aim of this study is to determine the presence of metals in water leaves grown on waste dumpsites and non-dumpsites grown in Amai community.

METHODS

Sampling locations

The study was carried out at a dumpsite along Market road in Amai, Ukwani Local Government Area of Delta State. The dump site is located near the Amai market while the non-dump site is about 1km from the dumpsite.

Sample collection

Water leaves sample was collected at the two sampling points and at two control sites with the aid of a knife. The water leaves were cut and put in black polythene bags, labelled and were transported to the laboratory for chemical analysis.

Sample preparation

The leaves together with the stems were cut into pieces, washed, air dried and

further dried in an oven at a temperature of 80^0C for six hours. About 10g of the dried samples were powdered in a manual blender and the powdered sample was packed in a glass container and were stored in a refrigerator until digestion, extraction and chemical analysis.

Digestion and extraction

Metal concentrations of the samples were determined according to Association of Analytical Chemistry method (AOAC, 1990). 1.0±0.05g dried and ground vegetable samples were placed inside a crucible and ignited at a muffle furnace at A temperature of 500^{o}c for 3 hours. The ignited mass was cooled inside desiccators and were transferred into a 100mL borosil beaker and 10mL concentrated HCl was added and the suspensions were swirled. The suspensions were kept inside a thermostat controlled water bath at a temperature range of 70 - 80^{o}C for 1hour. The supernatants were decanted and kept inside a 100mL volumetric flask. These contain mostly alkaline earth metals. To the residue in the beaker, 10mL each of HCl and $HClO_4$together with few porous beads and were evaporated to dryness using a hot plate. The process was repeated where necessary. The dried residues were dissolved completely by using minimum amount of concentrated hydrochloric acid. The resulting solution was then transferred to the same volumetric flask where previous extracts containing alkaline earth metals were stored. The flasks were then made up to volume using distilled water and were stored at a controlled temperature in a refrigerator pending chemical analysis.

Heavy metals analysis

The various metals were determined using atomic absorption spectrophotometer. The digested and extracted samples were each analysed for iron, lead and cadmium at wavelength of 238,273 and 234nm for lead, iron and cadmium respectively. Standard solutions of the metal ions were also prepared and used to plot calibration curves which were subsequently used for the estimation of the metals present in the water leaves samples.

Statistical analysis

Mean triplicate analysis were carried out and data were compared with FAO / WHO standard.

RESULTS

Table 1: Metal concentration in water leaves from dumpsites and non -dumpsites

METALS	Dumpsite A	Dumpsite B	Non-dumpsite A	Non-Dumpsite B	FAO / WHO
Lead (Pb) (mg/kg)	14.95	16.11	0.17	0.11	0.30
Iron (Fe) (mg/kg)	28.42	27.18	23.27	20.16	0.30
Cadmium (Cd) (mg/kg)	0.50	0.60	0.01	0.01	0.20

DISCUSSION

Table 1 above showed the results of metal concentration in water leaves grown in waste dumpsite soil and non-dumpsite soil in comparison with FAO/WHO standard for metals in vegetables.

Lead concentration in the dumpsite water leaf was found to range from 14.95-16.11mg/kg while that of non-dumpsite range from 0.11-0.17mg/kg. The FAO/ WHO (1999) standard for lead in vegetable is 0.3mg/kg and based on this value, it showed that there is contamination of the leaves grown at the dumpsite which could have occurred as a result of the wastes being dumped at the site.

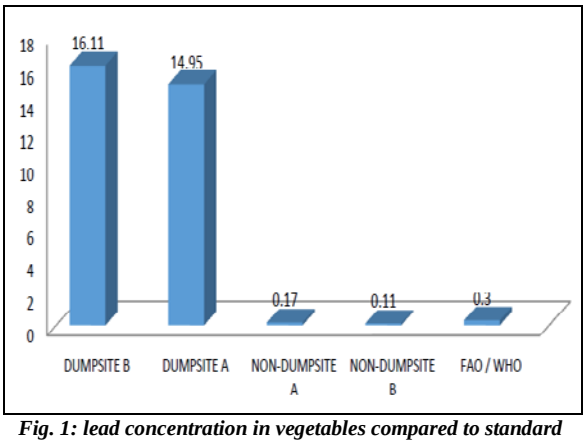

Fig. 1: lead concentration in vegetables compared to standard

It is worthy to state that consuming water leaves grown at dumpsite may constitute severe health hazard and the site may therefore not be categorized as non-hazardous. The traditional practice of harvesting vegetables from dumpsite for human consumption is not safe in the modern times experiencing the detrimental levels of toxic pollutants in almost all environmental media.

Cadmium concentration in the water leaves grown on dumpsites ranged from 0.5-0.64mg/kg and non-dumpsite was 0.01-0.01mg/kg. Comparison of the results for the two sites with FAO/WHO limit found the dumpsites water leaves to be polluted/ contaminated with cadmium. This showed that the dumpsite has great effects on the soil which in turn can also affect the water leaves grown on it.

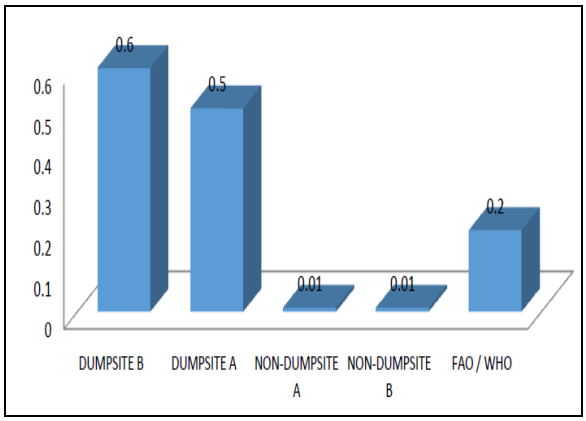

Fig. 2: cadmium concentration in vegetables compared to standard

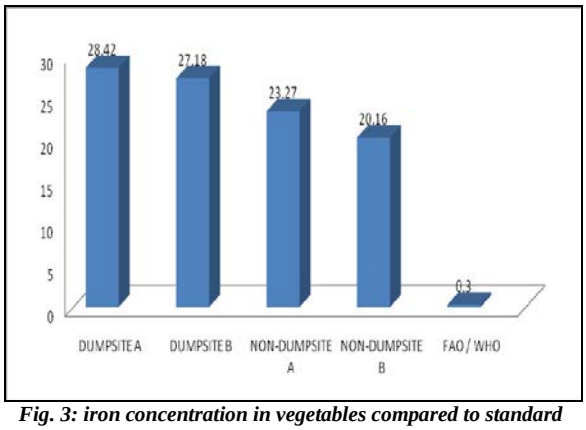

Fig. 3: iron concentration in vegetables compared to standard

Iron concentration in the water leaves ranged from 27.18-28.42mg/kg and 20.16- 23.27mg/kg for the dumpsites and no-dumpsite respectively. Both sites were found to be higher than the FAO/WHO standard limit of 0.3mg/kg for vegetable which showed that the dumpsites and non - dumpsites are contaminated with iron.

Theoretically, it should be expected that the concentration of metals in water leaves be higher at the dumpsite. The high level of metals might be a reflection of severe pollution of soil from the release or emission of pollutants which are consequently taken up by the plants growing on the soil (AL-Rashdi and Sulaiman, 2013). Kailas (2013) also noted high levels of heavy metals for various leafy vegetables grown in industrial areas of Nashik city, India compared with those from non-industrial areas.

Also, since the indiscriminate burning of solid wastes is a common practice, toxic elements may be release into the soil and consequently taken up by plants. This may be the cause of such high level of lead and other metals detected at the dumpsites

CONCLUSION AND RECOMMENDATION

The water leaves from the two dumpsites were found to be contaminated/polluted with lead, iron and cadmium as values obtained were higher than those of the non-dumpsite and FAO/ WHO standard limits for metals in vegetables. The contamination of the leaves could be due to the impact of the wastes on the dumpsites which has contaminated the leaves through the soil on which they are grown. The level of contamination follows the order: Fe>Pb>Cd. It is therefore recommended that it is not safe to purchase water leaves from the market since the sources where they are harvested may be questionable; the traditional ways of cutting water leaves anywhere it grown should be discouraged as the level of any form of contamination cannot be ascertain and farmers should be discouraged in planting water leaves in dumpsite.

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