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Metallic (Zinc) Load of Plants Found Along Ungwan Doasa Stream, Kaduna, Nigeria

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Abstract
The metallic (zinc) load of plants found along Ugwan Dosa stream, Kaduna Nigeria was investigated by using Atomic spectrophotometer (AAS). The plants investigated include Spinach, Mushroom, Potato, mango and cabbage. Results obtained revealed that the highest means concentration of Zinc was 0.91mgl obtained from Spinach in January, 2008 and the lowest mean value of zinc was 0.85mgl obtained from spinach in October 2007. The mean concentration from the two months showed that mushroom recorded the highest value of 0.82 while tomato recorded the least value of 0.20mgl 1. Although these values are below the human means permissible risk (MPR) value and below the Food and Agriculture Organization (FAO) recommended threshold for crops (2.0mgl 1) there is need for proper Channeling and recycling of effluent to avert the danger that might arise from prolonged accumulation.
Keywords: Zinc, Ungwan Dosa Stream, Plants.

Introduction

Nigeria is a developing country where farming in not zoned to a particular area in the cities. Individuals mostly of the low socio-economic status farm on any available land space to augment family income. Increasing population and developmental pressures have led to scarcity of arable lands resulting in the growth or cultivation of crops such as vegetables, fruits and cereals on dump sites and stream or river banks. Partners in Kaduna practice dry season farming along the banks of River Kaduna and its tributaries using the river water for irrigation.

River Kaduna receives about 500,000 cubic metres of untreated effluence per day from various industries through 53 tributaries (Ali, et al. 2005). Ungwan Dosa stream is linked with River Kaduna and also receives effluents from domestic waste Abattoirs, mechanic workshops. Studies have shown that heavy metals from such wastes can accumulate and persist in soils at environmentally harzadous levels (Alloway and Ayres 1994). Most of the crops cultivated in farm plots are vegetables such as *Lycopersicon esculentus, Amaranthus caudatus* and *Daucan carota*. These vegetables or crops end up on the tables of the teaming population of Kaduna thereby presenting them with grave health risk.

In areas where effluents are discharged into river or stream and such water is used for irrigation pollutants are transferred to the soil where they accumulate over time. Plants as essential components of the natural ecosystem and agrosystem represent the first compartment of the terrestrial food chain due to their capacity of toxic metal accumulation when they grow on soils polluted with such metals they present a threat to the living beings which consume them. (Smicval *et al* 2008). Tambarlini *et al* (2002) has associated disease burden with pollution from industrial effluent.

Some heavy metals (trace elements) such as manganese, copper, zinc etc all essential for maintaining the metabolism of plants and animals. At high concentrations these essential elements can had to poisoning (USEPA 2004).

The concentration of life threatening heavy metals such as lead (Pb) zinc (Zn) and mercury (Hg) has been found to be increasing in water, soil and air in several African countries (Carnie 2004). Zinc occurs naturally in air, food water and soil. However human activities are also responsible for most of the zinc contamination of water and soil. McBride (1994) had reported that the primary sources of surface and ground water contamination by zinc are industrial effluent discharge and sewage sludge.

Zinc toxicity affects plant growth by causing malformation of the nucleus and nucleus of meristemtic cells (Bobak, 1985) growth inhibition Sand structure damage (Oanceal *et al*. 2005) and according to Khurana and Chatherjee (2001) reduction in biomas, seed number seed weight and soluble proteins.

Ozoh and Oladimeji (1984) had observed that most work on the effect of effluent on irrigation agriculture have centered on laboratory assessment of individual effluent. since the extensive use of Angwan Dosa stream for irrigation may contaminate the plants particularly vegetables, this study aims at investigating the levels of zinc found in plant samples grown at the banks of the stream.

Materials and Methods

Description of the study area:
Ungwan Dosa stream is located in kaduna North Local Government Area of Kaduna State, Nigeria. Apart from being an outlet of the heavily polluted river Kaduna, it also receives effluent and waste from domestic,

commercial and Agricultural activities. The stream is utilized extensively for irrigation and domestic activities.
Sample collection: The plants were collected in October, 2010 and January, 2011along the bank of the stream. The leaves of the following plants; spinach (*Spinacia oleracea*), mushroom (*Agaricus Sp*), mango (*Magnifera indica*), cabbage (*Brassical oleracia*), potato (*Solanum tuberosum*) and tomato (*Lycopersicon esculentum*) were collected. The leaf samples were placed in a polyethylene bags, labeled and taken to the laboratory.

The samples were rinsed with tap water and then with distilled water to remove any attached soil particles. They were then cut into small portions and oven dried at 70 °C to constant weight. Drying of the collected materials protect the plant material from microbial decomposition and also ensures constant a reference value (Aksoy *et al*, 1999). The dried samples were ground into fine powders using a hammer mill.

Determination of zinc samples

Zinc concentration in the samples were determined using an atomic absorption spectrophotometer (ASS) equipped with hollow cathode lamp. The flame used was Air/acetylene and the current was 7.2 amperes and wavelength of 324nm. The analysis was carried out after the digestion of the plant samples by a tri-acid digestion method as described by AOAC (1990).

Results

The result obtained from the analysis of spinach, mushroom, potato, tomato, mango and cabbage leaves are presented in table 1. The table shows the concentration of zinc for each plant/vegetable obtained in October 2010 and January 2011

In 2010, the highest mean Zn concentration of 0.85mgl^{-1} was obtained from spinach and the lowest value of 0.16mgl^{-1} was obtained from tomato. The mean Zn concentration for plants obtained in Jan. 2011 shows that the highest mean value of 0.91mgl $^{-1}$were obtained from spinach. The highest mean of means of 0.77mgl^{-1} was obtained for mushroom followed by 0.50mgl $^{-1}$ for spinach. The least value of 0.20mgl^{-1} was obtained from tomato.

Fig. 1 shows that spinach had the highest concentration in the dry month of January followed by mushroom while mushroom had the highest concentration than spinach in October.

Discussion

The result of the investigation shows that spinach tends to take up more zinc particularly during the dry season month of January. This was followed by mushroom while tomato tends to take up the least amount of zinc. Akan *et al* (2009) reported heavy metal concentration in leaves of some vegetables found in Chalawa Industrial area of Kano city in Nigeria during the dry season. Zinc concentrations in all the plant samples studied during both the dry and wet seasons were below the maximum permissible risk (MPR) for humans and also below the 0.2mgl-1 FAO recommended threshold for crops. Although zinc is essential to plants and animals and is a constituent of several enzymes and maintains cytoplasmic integrity (Weatherley *et el*, 1980) Venugopa and Lucky (1925) had identified zinc among soon other heavy metals which are potentially toxic.

The results of the investigation reveals that plants tend to accumulate more heavy metals during the dry season than during the raining season. This could be attributed to the fact that irrigation is usually carried out during the dry season with the polluted stream water. It could also be as a result of the less availability of water to dilute the effluent concentration during the dry season unlike in the raining season.

The presence of zinc in plant samples around the Angwan Dosa stream could be attributed to the agricultural practices around where the stream water polluted by agricultural, industrial, mechanic and domestic waste are used for irrigation. Plants get essential elements from the soil through their roots and these elements are utilized in metabolism at various levels and are transported and stored in various parts of the plant. Zinc is mainly a cause of phytotoxicity (Allow and Ayres, 1994) and zinc pollution is significantly associated with lead and copper in some cases as well as cadmium. This could be seen in the work of Ojeka and Achi (2004) who reported high levels of copper, lead and cadmium in vegetables cultivated along the banks of river Kaduna. As Gielderich, (1990) had observed discharge of municipal raw waste or untreated effluent into receiving waters such as streams, rivers or lakes result in frequent dramatic changes in the qualities of the water.

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Table 1: Mean concentration of zinc (Zn) (mg/L) in the leaves of plants found in Ungwan Dosa Stream, Kaduna North in October 2010 and January, 2011.

Source	Type of plant	(WET SEASON) October, 2010			(DRY SEASON) January, 2011				
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Ungwan Dosa Stream Kaduna	Spinach (*Spinacia oleracea*)	0.09	0.08	0.085	0.90	0.92	0.91	0.985	0.50
	Mushroom (*Agaricus sp*)	0.75	0.82	0.78	0.70	0.82	0.76	1.54	0.77
	Potato (*Solanum tubersun*)	0.18	0.20	0.19	0.25	0.28	0.265	0.455	0.23
Totato (*L. esculentum*)		0.15	0.18	0.165	0.20	0.25	0.23	0.39	0.20
Mango (*Mangifera indica*)		0.25	0.30	0.275	0.18	0.20	0.19	0.465	0.23
Cabbage (*Brassical Coleracea*)		0.25	0.20	0.225	0.25	0.30	0.275	0.50	0.25

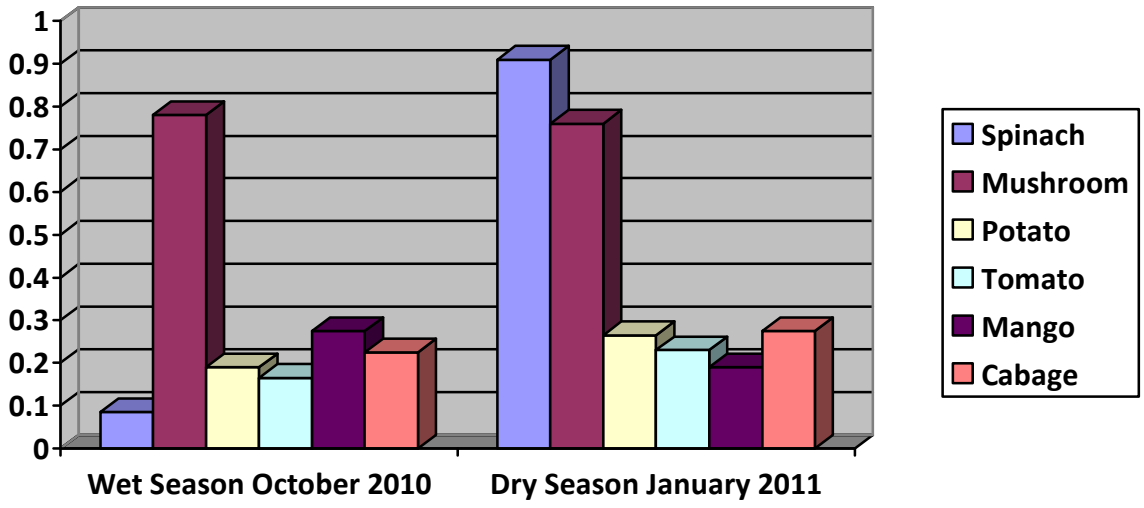

Figure 1
Mean values of the concentrations of Zinc in plants/vegetables in Ungwan Dosa Kaduna, in October 2010 and January 2011.

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