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Evaluation of Pb, Zn and Cu in Leaves of *Mangifera indica, Parkia biglobosa, Azadirachta indica, Delonix Regia, Schefflera arboricola,* and *Albezia Lebbeck* Trees along Major Road Sides in Makurdi Metropolis, Benue State, Nigeria

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ABSTRACT: High concentration of heavy metals on tree leaves could disrupt mitosis in plant cells, leading to damage during cell division, and thereby reducing the number of stomata. Hence, this study evaluated the concentration of Pb, Zn and Cu in Leaves of *Mangifera indica, Parkia biglobosa, Azadirachta indica, Delonix Regia, Schefflera arboricola, and Albezia. Lebbeck* trees along Major Road Sides in Makurdi Metropolis, Benue State, Nigeria using standard methods. The concentrations of Pb, Zn, and Cu were significantly higher in A. Lebbeck, S. Actinophylla D. Regia than the rest of the plant species. The trend of metal concentration varied followed the order: Pb > Zn > Cu. Mean concentrations of Pb, Zn, and Cu were significantly higher in heavy traffic areas than other sampling areas. The results of the study suggest that the tree leaves samples could potentially serve as bioindicators for Pb, Zn, and Cu in environmental pollution area.

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Keyword: Bioindicator; Heavy metals; Roadside plants; Heavy traffic

Heavy metal pollution in urban environment is a global phenomenon caused due to variety of anthropogenic activities (Deepalakshmi *et al.*, 2014). The most important sources of anthropogenic heavy metals emissions are industrial production, the combustion of fossil fuels in vehicular traffic and energy production, sewage sludge disposal and fertilizer production. Higher levels of lead in roadside environment have been associated with the traffic density (Funmilayo *et al.*, 2019). Vehicular emissions along the busy roadways contain high levels of lead which are present in fuel as anti - knock agents. Along with lead, other heavy metals such as cadmium, copper and zinc are associated with the vehicular activity; since they are included in petrol, engines, tyres, lubricant oils and galvanized parts of the vehicles (Funmilayo *et al.*, 2019). Among heavy metals, lead and cadmium toxicity has become important due to their constant increase in the environment (Naima *et al.*, 2010). The high sensitivity of plants towards some pollutants means that a great variety of plants can be used as bioindicators of heavy metals pollution in soil (Naima *et al.*, 2010). Some plants accumulate heavy metals to concentration that is non – toxic to them or may be toxic to other species (Funmilayo *et al.*,

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2019). (Wenzel and Jockwer, 1999; Wittig, 1993; Markert, 1993; Namiesnik and Wardenski, 2000; Chandhari and Gajghate, 2000), worked on the basic criteria for selection of species as a bioindicator. The major criteria are species should be represented in large numbers all over the monitoring area, have a wide geographical range, be possible to differentiate between airborne and soil-borne heavy metals, be easy to sample and there should be no identification problems. Leaves are the site of major physiological processes and are highly affected by air pollutants (Naveed *et al.,* 2010; Funmilayo *et al.,* 2019). Plant leaves respond to subtle changes in the environment and therefore constitutes an excellent material to assess pollution levels. These changes are extensively used for monitoring pollution levels (Turan *et al.,* 2011; Funmilayo *et al.,* 2019). In the past few decades, leaves of higher plants have been used for biomonitoring heavy metals (Tiwari *et al.,* 2008).

Today, Makurdi, capital of Benue state located between latitude 7˚44'0"N and longitude 8˚32'0"E occupies a land area of about 34,059 square km with an estimated population of about 5,181,642, is considered to be one of the most polluted metropolitan in north central Nigeria especially with its increasing number of automobiles. Therefore, the objective of this paper was evaluate the concentration of Pb, Zn and Cu in Leaves of *Mangifera indica, Parkia biglobosa, Azadirachta indica, Delonix Regia, Schefflera arboricola,* and *Albezia*. Lebbeck trees along Major Road Sides in Makurdi Metropolis, Benue State, Nigeria.

MATERIALS AND METHODS

Study sites: Samples were collected from heavy traffic areas within Makurdi located in Benue State, Nigeria. The sites at which the samples were collected were; Wurukum, High level, North Bank and Welfare Quarters. These sites were roadsides (extreme polluted area), urban (polluted area), suburban (little polluted area) and rural (control site). In line with the criteria given by Wittig, (1993) and Markert, (1993).

Sample collection and Preparations: Samples were collected in duplicate from the following trees (Mangifera indica: commonly known as mango tree, Parkia biglobosa: popularly known as African locust bean tree, Azadirachta indica: commonly known as Neem plants, Delonix Regia: known as Flame-of-the-forest, Schefflera arboricola: commonly called Dwarf Umbrella Tree or Octopus tree, and Albezia. Lebbeck: commonly called woman's tongue tree that were 5 meters closer to the highways and trees that were 30 meters away from the high way were chosen as the control. Leaves harvested were carried in pre cleaned polythene bags. Leaf samples from different sites were washed with distill water to remove dust particles and oven-dried for 24 h, and ground to fine powder. A one (1) gram of the sample was digested with a mixture of 4.0 mL of 65% v/v HNO_3 and 2.0 mL of 35% v/v H_2O_2. After evaporation, 4.0 mL of concentrated HNO_3 and 2.0 mL of concentrated H_2O_2 were added to the residue and heated until a clear digest appeared. The digestion time of 3 h at 130^{o}C was employed. The digest was made up to the 5.0 mL with 1.0 M HNO_3. The concentrations for lead (Pb), Zinc (Zn) and Copper (Cu) were then estimated using Atomic Absorption Spectrophotometer (AAS) PG990.

RESULTS AND DISCUSSION

The results of heavy metal concentrations of tree leaves from five (5) species of tree leaves, as indicators of Lead, Zinc and Copper pollution in Makurdi metropolis are presented in Table 1-3.

Table 1: Mean concentrations of lead in some selected plant species at different study sites

Parameter			Lead		
Species	Wurukum	High level	North Bank	Welfare Quarters	Control
M. Indica	23.22 ±0.04	21.07 ±0.11	22.04 ±0.15	18.11 ±0.23	0.21±0.00
P. Biglobosa	23..59 ±0.31	20.15±0.18	23.22 ±0.21	22.06 ±0.31	0.72±0.11
A. Indica	34.22 ±0.21	27.06 ±0.33	25.11 ±0.23	22.13±0.17	0.22±0.00
D. Regia	37.18 ±0.29	32.11 ±0.15	27.06 ±0.24	23.02 ±0.01	1.53±0.21
S. Actinophylla	41.23 ±0.15	37.22±0.21	30.13 ±0.14	25.11 ±0.18	0.11±0.01
A. Lebbeck	53.12 ±0.11	51.06 ±0.26	37.03 ±0.17	29.04 ±0.11	0.54±0.00

Table 2. Mean concentrations of Zinc in some selected plant species at different study sites

Parameter			**Zinc**		
Species	Wurukum	High level	North Bank	Welfare Quarters	Control
M. indica	21.23 ±0.17	19.55±0.32	17.41±0.33	15.21 ±0.23	0.11±0.00
P. Biglobosa	23.05 ±0.31	20.42 ±0.16	18.22 ±0.11	16.27 ±0.33	0.71±0.02
A. Indica	27.15 ±0.10	27.25 ±0.22	10.00 ±0.31	20.11±0.19	0.01±0.00
D. Regia	28.05 ±0.21	19.48 ±0.18	15.16 ±0.16	22.03 ±0.25	BDL
S. Actinophylla	27.06 ±0.33	24.44 ±0.11	20.19 ±0.17	23.01 ±0.10	BDL
A. Lebbeck	31.41 ±0.26	35.30 ±0.17	27.15 ±0.14	25.12 ±0.30	0.02±0.01

Table 3: Mean concentrations of Copper in some selected plant species at different study sites

Parameter	**Copper**				
Species	Wurukum	High level	North Bank	Welfare Quarters	Control
M. indica	16.55 ±0.03	10.12 ±0.22	7.05 ±0.21	8.24 ±0.16	BDL
P. Biglobosa	16.75 ±0.25	13.32 ±0.17	7.55 ±0.11	6.16 ±0.21	0.11±0.02
A. Indica	17.17 ±0.29	15.66 ±0.37	8.17 ±0.21	9.31±0.26	0.02±0.00
D. Regia	20.11 ±0.20	17.14 ±0.16	10.55 ±0.37	10.18 ±0.33	0.12±0.10
S. Actinophylla	22.25 ±0.18	19.11 ±0.23	12.11 ±0.32	13.23 ±0.11	BDL
A. Lebbeck	25.17 ±0.11	21.34 ±0.36	15.10 ±0.10	13.55±0.22	BDL

BDL – Below Detection Limit

The extractable heavy metal concentrations in all the plant species (*M. Indica, P. Biglobosa, A., Indica, D. Regia, S. Actinophylla, A. Lebbeck)*, accumulated varying degrees of Pb, Zn and Cu from the various sites in Makurdi metropolis, Benue State. This might be attributed to the geological status of the area under investigation, the ability of plants and their specific parts to accumulate metals and as well as the air pollution (Oklo and Asemave, 2012). Heavy metal concentration appears to be the highest in Wurukum, a very high traffic density area as contained in Table 1 – 3. However, due to differences in human activities (traffic density, leave characteristic) on the environment, nature of metal and geological factor, heavy metals contents of the tree leaves are expected to vary in concentrations across the metropolis (Lawal *et al.*, 2011; Oklo and Asemave, 2012). Mean concentration of heavy metals in the areas followed the trend: Wurukum > High level > North Bank > Welfare Quarters > Control as seen in Table 1.0 – 3.0. The highest metal concentration was found in the *A. Lebbeck,* while the least was in *M. Indica.* The various heavy metals accumulation in different plant parts is dependent on the amount of metals present in the ecosystem, and the metal accumulation levels differ within and between species of plants (Ikechukwu and Percy, 2015). *A. Lebbeck* was observed to be the most tolerant specie having the highest capacity to accumulate metals which could be due to its morphological characteristics (Funmilayo *et al.*,.2019). The concentration of Metals in plants increase with increase in traffic density (Deepalakshmi *et al.*, 2014). The highest mean concentration of 53.12 µg/g recorded was from lead at Wurukum. The higher concentration of lead observed could be as a result of the traffic density of wurukum, located at the center of Markurdi with huge vehicular activities as shown by Joseph *et al.,* (2013). There are reports of direct relationship between levels of lead in plants and traffic density (Atayese *et al.*, 2009; Naveed *et al.,* 2010; Turan *et al.*, 2011; Shafiq, 2012; and Verma *et al.,* 2013). Sahar and El – Khawas, (2011) showed that Mangifera indica accumulate higher levels of lead. The highest zinc concentration 35.30µg/g was detected at high level. This could be as a result of emission and tyre wear from motor vehicle, pointers as a source of the environmental zinc contamination. Zinc promotes growth and development in the human body but its excessiveness may be an indication of metal poisoning and growth impedance (Singh and Taneja, 2010; Ikechukwu and Percy, 2015). The highest Cu concentration of 25.17 µg/g was detected at Wurukum, while the lowest concentration of 6.16 µg/g was observed at Welfare Quarters area. The observed concentration of Cu might be due to corrosion of metallic parts of cars derived from engine wear, thrust bearing, brushing, and bearing metals (Joseph *et al.*, 2013). This high concentration may be toxic to both humans and animals when its concentration exceeds the safe limits, and its concentration in some human tissues such as thyroid can be changed depending on the tissue state (Joseph et *al.*, 2013).

Results however obtained from the selected tree plants fulfill the criteria of bioindicators and can be used as bioindicators of traffic related pollution areas.

Conclusion: Studies show the distribution of heavy metals within the metropolis which is particularly attributed to commercial activities. The study also reveals the ability of the plants used as bio indicator for heavy metals pollution in the environment and their various tolerance levels. However, from the results obtained, there is an observable increase danger of environmental pollution especially with the continuous rise in the commercial activities. This could result to an increase health risk effect of inhabitants along these areas in the long run.

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