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Assessment of Neem Tree (Azadirachta Indica) Leaves for Pollution Status Of maiduguri Environment, Borno State, Nigeria.

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ABSTRACT

Neem tree (*Azadirachta indica*) is a popular tree amongst the populace and has served as medicinal plant. Plants are important bioindicators of heavy metals in Environmental Pollution. This study was aimed at assessing the concentration (µg/g) of Mn, Ni, Co, Cr, Cd, Cu, Fe, Zn and Pb in leaves of Neem tree as indicator of environmental pollution in Maiduguri Metropolitan council, Borno State, Nigeria. Samples (leaves) were collected monthly for three months from three different locations (Bama station, Bulumkutu and Post office areas designated as S1, S2 and S3 respectively) at distances of 50m and 100m each from the main roads, and 250m to serve as control. The samples were collected monthly from the designated and control points for a period of three months from December, 2012 to February, 2013. The concentrations of heavy metals in the samples were determined using Perkin-Elmer Analyst 200 Atomic Absorption Spectroscopy (AAS). The results showed that the concentrations of analysed heavy metals ranged from 0.254±0.063- 1.010 ± 0.104 µg/g Mn; 0.779±0.073-2.452 ± 0.034 µg/g Fe; 0.031± 0.008-0.813± 0.009 µg/g Cu; 0.152±0.012-0.604±0.005 µg/g Zn; 0.002±0.001-0.066 ± 0.033 µg/g Co; whereas, the concentrations of Pb, Ni, Cr and Cd were not detected at certain distances.The concentrations of some of the metals in the three sampling points were lower than that of their corresponding controls. Thus, the Neem tree leaves do not only indicate pollution due to vehicular traffic activities but also other anthropogenic activities.

KEY WORDS: Environment, Heavy Metal,MaiduguriNeem leave, Pollution.

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I. INTRODUCTION

Plants are important indicators of heavy metals Environmental Pollution [1]. Environmental heavy metal pollution is mainly of anthropogenic origin and results from activities such as fossil fuels, vehicular emissions, industrial emissions, landfill leachates, fertilizers, sewage and municipal wastes [2, 3, 4, and 5].Accumulation of heavy metals in plant tissue indicates the very important role of certain plants as Bioindicators of environmental pollution [6]. Determination of chemical composition of plants is one of the most frequently used methods of monitoring environmental pollution. Various plants have been used as bioindicators to assess the impact of a pollution source on the vicinity which is due to high metal accumulation of plants [7]. Uptake of elements into plants can happen via roots from soil and transported to the leaves; also they may be taken up from the air, or by precipitation directly via the leaves [5]. Plants do not provide information on absolute concentration of pollutants in air, however, it indicates, with accuracy, their relative levels [8].Namiesnik and Wardenski [9] 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.

Neem *(Azadirachta indica)* Tree is a hard fast growing evergreen tree with a straight trunk, long spreading branches and moderately thick, rough, longitudinally fissured bark. Matured trees attain a height of 7-15m (23-50feet) [10]. The tree starts producing the yellowish ellipsoidal drupes (fruits) in about four years, and becomes fully productive in ten years and may live for more than 200years. The leaves are compound impair-pinnate, comprising up to 15 leaflets arranged in alternate pairs with terminal leaflets [10]. The leaflets are narrow, lancelet and up to 6cm long. The flowers are abundant with sweet smelling white panicles in the leaf axils. The seed of Neem *(Azadirachta indica)* fruit is yellow when ripe and is about one inch long [10]. Neem flowers mature from May to August[11]. Neem roots have its applications in medicine [12, 13].

The opposite, pinnate leaves are 20–40 centimetres (7.9–16 in) long, with 20 to 31 medium to dark green leaflets about 3–8 centimetres (1.2–3.1 in) long. The terminal leaflet is often missing. The petioles are short. The leaves are also used in Pakistan to give baths to children suffering from skin diseases. The leaves are used in this manner that first they are washed thoroughly. Then 5-10 leaves along with the branch are boiled till the water turns green. The water is then used for varying purposes. Elders find it useful in controlling high blood sugar level and is said to clean up the blood. Neem is also used to give baths to the Muslim dead. Neem leaves are dried in Pakistan and placed in cupboards to prevent insects eating the clothes. Neem leaves are dried and burnt in the tropical regions of Pakistan to keep away mosquitoes. These leaves are also used in many Indian festivals (by making them into garlands).

Many researchers have worked on neem trees and other medicinal plants.The concentrations of some heavy metals (cobalt, cadmium, lead, nickel and chromium) in the leaves of plants viz: neem (*Azadirachta indica*), kaner (*Nerium oleander* L.), Ashok (*Saraca indica* L.) and imli (*Tamarindus indica*) around the polluted and non polluted sites near Agra region, India was investigated. It was concluded that the presence of these metal ions in plant leaves explain the fact that these plant leaves are good bioindicators and can be used in air pollution monitoring studies in industrial areas [11]. Akan *et al.*[15] studied the concentration Heavy Metals in Leaf, Stem Bark of Neem Tree (Azadirachta indica) and Roadside Dust in Maiduguri Metropolis, Borno State, Nigeria. The highest concentrations of metals were found to be higher at the seven sampling points, while the lowest levels were observed in the street dust samples from the control sites. The concentrations of all the metals in plant samples were significantly highest in the leaves of Azadirachta indica, while the stem bark shows the least values. It was concluded that the traffic situation in the area of study might be regarded as a source of heavy metal content in the roadside dust and plant samples.Ajai *et al*.[16] determined heavy metal profiles in Neem leaves (*Azadirachta indica A)* along some major streets in Minna metropolis, Nigeria. He discovered that that the result from the study indicated that the metal ion concentration in neem leaves along the various route studied were within the permissible level as recommended by WHO for plants to be used as food or for medicinal purposes and therefore will not contribute any toxicity or harmful effect to human health when taken orally or in the form of tea or for medicinal purposes or as part of diet.

In Maiduguri, Nigeria, it is very common to see Neem trees used for shade lining the streets or in most people's back yards. In very dry areas the trees are planted in large tracts of land. Maiduguri is blessed with large population of Neem trees and the people of Maiduguri also use the neem tree as medicine. Maiduguri (Lat. 11°50′N, Long 13°10′E) is located in Borno State, Nigeria. It is underline by the sediments of Lake Chad basin. Temperature ranges between 22 and 28°C, with means of the daily maximum exceeding 40°C before the onset of the rainy season, of March, through May. During the winter (December through February) the temperature falls to 12°C. It has an estimated population of 1,197,497[17].Maiduguri just like any growing City is faced with pollution environmentalchallenges. Thus, determination of levels of heavy metals in plants is one of the most frequently methods used in monitoring environmental pollution.The objectives of the study is to determine the concentrations of heavy metals such as Cu, Co, Mn, Ni, Pb ,As, Cd, Cr and Fe in leaves of Neem tree samples at Post Office, airport junction and Bama Station areasof Maiduguri Metropolis.

II. MATERIALS AND METHODS

2.1 Sample Collection

Samples (leaves) were collected at distances of 50meters and 100meters from roadsides in various locations within Maiduguri, Borno State, Nigeria. Sample collections were carried out according to the methods described by Radojevic and Bashkin[18]: samples (leaves) were collected using knife. Samples were put into a precleaned polyethylene bags and transported to the laboratory. Sampling points were designated as S1, S2 and S3. Point S1 was located at Bama motor park, Point S2 was Bulumkutu and Point S3at Post Office Areas. For each of the sampling points, neem tree samples were also collected at 250meters away from the main road to serve as controls. The samples were collected monthly from the designated and control points for a period of three months from December, 2012 to February, 2013.

2.2 Sample Preparation

Each of the Samples was dried separately in an oven at 105°C for 72 hours until they became brittle and crisp [19]. A portion (1g) of dried, disaggregated and sieved samples were placed separately in 50ml beakers and were digested with 10ml of HNO_3–$HClO_4$–HF(in the ratio of 9:4:1) to near dryness at 80 to 90˚C on hot plate. The digested samples were filtered separately into a 50ml volumetric flask using Whatman No. 42 filter paper and made up to $100cm^3$ mark with deionised water [18].

2.3 Sample Analysis

The digested samples were used to determine the concentration of some heavy metals such as Cu, Co, Mn, Ni, Zn, Cd, Cr, Fe and Pb using Atomic Absorption Spectrophotometer (Analyst 200 Pelkin Elmer).

2.4Data Analysis

Data obtained was statistically analyzed using SPSS 16.0. Analysis of variance (ANOVA) with Turkey post-hoc test was used to determine the level of significance of variations between the samples. Results were considered statistically significant (P<0.05).

III. RESULTS AND DISCUSSION

3.1 Results

Table 1: Heavy metal concentrations (µg/g) in the leaves at vary distances from the main roads in Bama Station area.

DISTANCE	Mn	Ni	Co	Cr	Cd	Cu	Fe	Zn	Pb
50m	0.629^{a} ±0.035	0.017^{a} ±0.003	0.047^{a} ±0.012	0.034^{a} ±0.034	0.017^{a} ±0.007	0.059^{a} ±0.010	0.876^{a} ±0.069	0.197^{a} ±0.008	0.266^{a} ±0.213
100m	0.254^{b} ±0.07	N.D	0.002^{b} ±0.001	N.D	N.D	0.040^{b} ±0.00	0.779^{a} ±0.073	0.604^{b} ±0.005	N.D
Control	0.663^{a} ±0.008	0.079^{b} ±0.021	0.053^{a} ±0.007	0.228^{b} ±0.081	0.029^{a} ±0.019	0.226^{c} ±0.003	1.518^{b} ±0.021	0.248^{c} ±0.001	0.217^{a} ±0.114

The above values are means of replicate values (n=3). Within column, means with different alphabets are statistically different (p<0.05). Control=250m away from each point and N.D= Not Detected.

Table 2: Heavy metal concentrations (µg/g) in the Samples at vary distances from the main roads in Bulumkutu area.

DISTANCE	Mn	Ni	Co	Cr	Cd	Cu	Fe	Zn	Pb
50m	0.601^{a} ±0.059	0.028^{a} ±0.014	0.048^{a} ±0.003	N.D	0.021^{a} ±0.007	0.107^{a} ±0.001	1.097^{a} ±0.007	0.162^{a} ±0.009	0.075^{a} ±0.052
100m	0.380^{b} ±0.023	0.092^{ab} ±0.037	0.025^{a} ±0.016	N.D	0.018^{a} ±0.009	0.047^{b} ±0.001	0.937^{b} ±0.021	0.412^{b} ±0.006	0.189^{a} ±0.088
Control	0.833^{c} ±0.074	0.118^{b} ±0.002	0.066^{a} ±0.033	0.205 ±0.031	0.003^{b} ±0.003	0.813^{c} ±0.009	1.662^{c} ±0.131	0.317^{c} ±0.008	0.161^{a} ±0.043

The above values are means of replicate values (n=3). Within column, means with different alphabets are statistically different (p<0.05). Control=250m away from each point and N.D= Not Detected.

Table 3: Heavy metal concentrations (µg/g) in the Samples at vary distances from the main roads in Post office areas

DISTANCE	Mn	Ni	Co	Cr	Cd	Cu	Fe	Zn	Pb
50m	0.715^{a} ±0.099	N.D	0.013^{a} ±0.001	0.033^{a} ±0.008	0.009^{a} ±0.003	0.038^{a} ±0.001	1.262^{a} ±0.001	0.355^{a} ±0.013	0.056^{a} ±0.032
100m	0.445^{b} ±0.057	N.D	0.019^{b} ±0.011	N.D	0.009^{a} ±0.005	0.119^{b} ±0.002	1.016^{b} ±0.044	0.503^{b} ±0.013	0.044^{a} ±0.012
Control	1.010^{c} ±0.104	N.D	0.005^{a} ±0.005	0.042^{a} ±0.042	N.D	0.031^{a} ±0.008	2.452^{c} ±0.034	0.152^{c} ±0.012	0.194^{a} ±0.137

The above values are means of replicate values (n=3). Within column, means with different alphabets are statistically different (p<0.05). Control=250m away from each point and N.D= Not Detected.

3.2 Discussion

Table 1 showed the heavy metal concentrations (µg/g) in the Samples at vary distances from the main roads in Bama Station area; table 2 showed heavy metal concentrations (µg/g) in the Samples at vary distances from the main roads in Bulumkutu area and table 3 shown heavy metal concentrations (µg/g) in the Samples at vary distances from the main roads in Post office area in Maiduguri metropolis The samples contained variable levels of the heavy metals. Generally, the concentrations of the metals was in the order of Fe>Mn>Zn>Cu>Pb>Co>Ni>Cr>Cd for the leave samples.

Many researchers have notified that heavy metals contents were higher in plants samples collected near a main road. This is in line with the present study in which the level of some of the heavy metals analyzed decrease with increase in distances from the main roads. Some reports have shown that traffic activities enrich the roadside soil metals content [20]. However, Oliva and Espinosa [21] concluded that the enrichment of some metals in road soil was attributed to the natural sources. The results also showed that the level of some of the heavy metals analyzed were higher at 100m and at the controls when compared with their corresponding 50m.This is in support of the work of Aslan*et al.* [22], in which the concentrations of selenium in lichen increase with increase in distance. It was concluded that the higher selenium content of the lichen was due to the geographical area. Analysis of Variance (ANOVA) also confirmed significant differences ($p<0.05$) between the levels of heavy metals in leaves from different distances within the same locations with the exception ofManganese in Bama, Nickel in Bulumkutu, Cobalt from the three locations, chromium in Post Office, Cadmium from the three locations, Copper in Post office, Iron in Bama station and Lead from the three locations which shown no significant differences.Therefore, the higher concentration of the heavy metals at 100m and at the control points might not only due to traffic pollution but also due to geographical status or leaching and runoff.

IV. CONCLUSION

The following conclusions were made from the results and the discussion:

[1]. The samples contained variable levels of the heavy metals.
[2]. Generally, the concentrations of the metals was in the order of Fe>Mn>Zn>Cu>Pb>Co>Ni>Cr>Cd for the leave samples.
[3] Analysis of Variance (ANOVA) also confirmed significant differences ($p<0.05$) between the levels of heavy metals in leaves from different distances within the same locations with the exception of Manganese, Nickel, Cobalt, Chromium, Cadmium, Copper, Iron and lead which shown no significant differences.
[4]. The Results also showed that the level of some of the heavy metals analyzed was higher at 100m and at the controls when compared with 50m.
[5]. This can give a support to conclude that traffic activities can partly contribute to heavy metals pollution in these areas and actually, the main contributors of heavy metals accumulation in this area might due to mobility of the metals through leaching and runoff.
[6]. It is therefore recommended that indiscriminate dumping of wastes should be avoided. Also, regular monitoring of heavy metal concentration in the environment, most importantly dumpsites is necessary and finally, further studies should be conducted using neem tree leaves to assess the levels of other Environmental Pollutants like Arsenic.

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