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Lead levels in *Chromolaena odorata* (Compositae) along rural and urban roads in Akwa Ibom State, Nigeria

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Abstract: Concentrations of lead(Pb) were determined in leaf samples of *Chromolaena adorata* from a rural road and an urban road in Akwa Ibom State of Nigeria in relation to vehicular traffic density. Mixed results were obtained wich no trend to indict automobile exhaust fumes. Lead was not detected in rain water from these areas and leaf lead levels seemed to relate more to soil lead concentrations. There was no significant difference in mean leaf lead levels between rural and urban leaf samples and between washed and unwashed leaf samples. It was suggested that the lack of concordance between vehicular traffic density and lead levels in leaves along the highways indicates either a low level use of tetraethyl-leaded petrol or, a relatively low vehicular traffic density with lead from exhaust fumes not reaching a threshold to affect levels in plants or be detected in the atmosphere. Implications of concentrations obtained in leaves to consumers when compared with international standards were discussed.

Key words: *Chromolaena odorata*; lead levels; traffic density; Nigeria

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Introduction

Chromolaena odorata (*Eupatorium odoratum*), commonly called "siam weed" was introduced into Nigeria about 30 years ago. It is a strongly scented, diffuse, and rapidly growing herb that can attain a height of 3.0 meters or more. It is locally called "owot owo" because at its debut it was believed to kill human beings even by mere inhalation of its odour. With time, the leaves of this once dreaded plant became a highly appreciated local medicinal bonanza suitable for curing many human ailments such as pains, malaria, abdominal discomforts, skin diseases and blood clotting.

Extracts from this plant are therefore believed to have antibacterial and antifungal properties. This plant also contains oil of medicinal value, and Irobi (Irobi, 1992) has reported the clinical potency of the ethanol extracts of this plant against *Pseudomonas aeruginosa* and *Steptococcus faecalis* at a concentration of 30 mg/L. *Chromolaena odorata* is ubiquitous in Akwa Ibom State, Nigeria and normally grows well in relatively very fertile soils. Thus the plan has come strongly into the support-systems of our people particularly in the areas of health and agriculture.

The trace metal, lead has found many industrial uses, such as in storage batteries, paints, lead filler in joints of PVC pipes, addition to petrol(tetraethyl lead) as a anti-knock additive etc. The wastes generated from these usages are scattered randomly in urban areas in Nigeria and plants may come in contact with them. Numerous reports are available on the toxic nature of lead to man (Nriagu, 1988; Udosen, 1990) and exposure to low levels of lead has been implicated in a number of human metabolic disorders(EPA, 1980; NAS, 1980). Automobile exhaust fumes have been reported to contribute to the levels of this metal in pigeons, tissue concentrations increasing in proportion to traffic density(Antonio-Garcia, 1988). With the importance *Chronolaena odorata* has assumed especially in the local health needs, this study was embarked upon to determine the concentrations of lead in its leaves from a rural and an urban environments. It was also designed to assess the effect of vehicular traffic density on the levels of this metal in the leaves of the plant.

1 Materials and methods

An urban road, the Uyo-Abak road in Uyo municipality and a rural road, Manta-Uruk Uso road in Abak local government area, both in Akwa Ibom state in the southeastern part of Nigeria were chosen. Each sampling site(Fig. 1: A—E) was 2 km apart along each road, with a distance of 100 meters between sampling points per site. The vegetated edge of the roads served as the first sampling point with the two other points per site being 100 meters and 200 meters respectively inward from the first point. Along the rural road the density of vehicles decreases from A to E. A similar assumption holds for the rural road but here the density of vehicles is generally low. Three samples were collected from each of the five sampling sites producing a total of fifteen samples from each road axis so transcended.

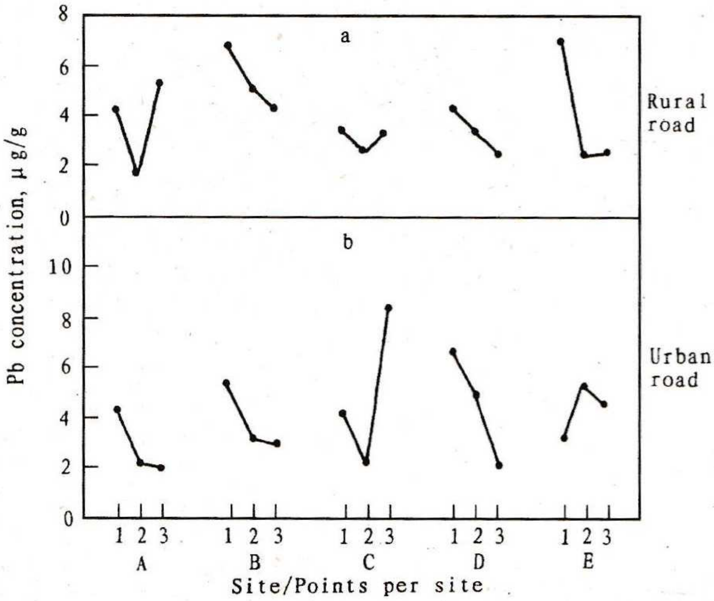

Fig. 1 Variations in leaf lead concentrations of *C. odorata* with distance from the road inward(1—3) per sampling site(A—E)

Laboratory treatments of samples were in two sets. One set of leave was oven-dried without washing while the other set was washed before oven-drying. Both samples were oven-dried overnight at a temperature of 105℃ (Ward, 1974; Jones, 1988). The dried samples were then pulverized in an electric blender and 10g of the powder washed in a muffle furnace at 450℃. Further sample treatments followed the methods in Christian(Christian, 1980).

Calibration curves were prepared from lead standards and determinations made with a Solar System A. A. S (UNICAM 919).

Data generated were subjected to analysis of variance with the site mean values tested for significant difference using t-test sensitive to means with equal and unequal variances(Parker, 1979). Coefficients of variation(C. V.) were computed and corrected for bias (Sokal, 1981). Soil and rain water samples from these areas were analysed for lead but the metal was not detected in rainwater.

2 Results

Fig. 1 is a plot of the mean lead concentrations (pooled from washed and unwashed samples) from all sites and points. Figs. 2 and 3 show the comparative levels of led in washed and unwashed samples along a rural road and an urban road respectively. Similarly, Fig. 4 illustrates the comparative levels of lead in washed plant samples from a rural road and an urban road while Fig. 5 shows the comparative levels of the metal levels in unwashed plant samples from a rural road and an urban road.

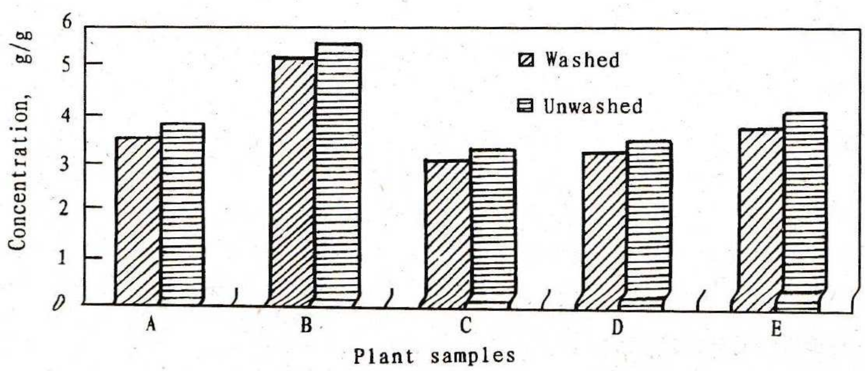

Fig. 2 Comparative levels of lead in washed and unwashed plant samples along a rural road

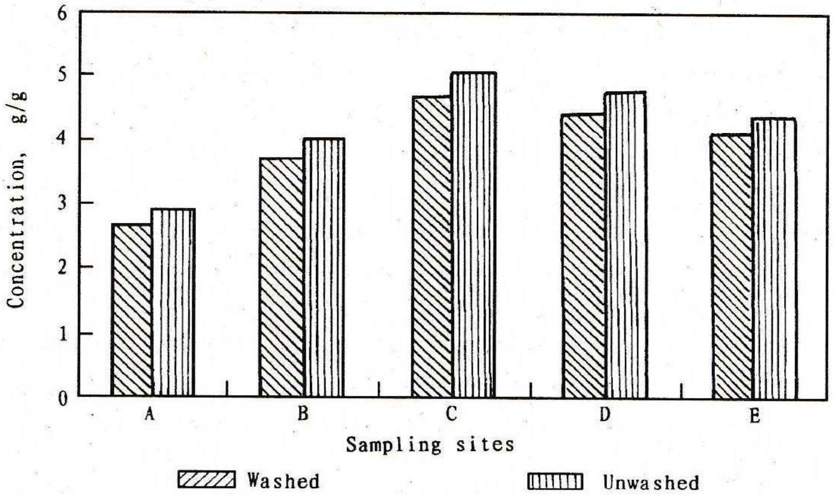

Fig. 3 Comparative levels of lead in washed and unwashed plant samples along an urban road

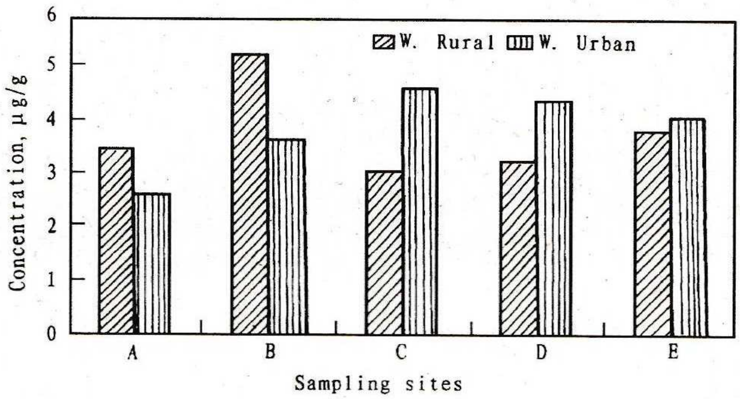

Fig. 4 Comparative levels of lead (μg/g) in washed samples along rural and urban roads

From Fig. 1 three trends are discernible: (1) a decrease in lead concentration from the road inward at sites B and D along the rural road, and sites A, B and D along the urban road; (2) different degrees of clustering of concentrations at sites A and C along the rural road, and site E along the urban road; (3) scattering of concentrations at site E along the rural road and site C along the urban road. The road edge points at sampling sites B and E of the rural road, and the innermost point of site C of the urban road had relatively higher mean values of 6.9, 7.0 and 8.4 μg/g lead respectively. The lowest mean value of 1.65 μg/g lead came from point 2 site A of the rural road.

Figs. 2 and 3 show that all washed samples from rural and urban roads contain comparatively lower lead levels than the unwashed samples. Fig. 4 shows that sites A and B contain higher lead values in washed rural samples than in washed urban samples while sites C, D and E reveal the reverse trend in Fig. 5. Analysis of variance of the fifteen leaf samples determinations (pooled from washed and

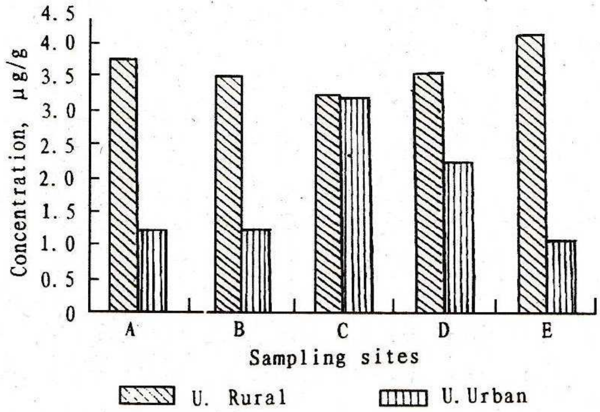

Fig. 5 Comparative levels of lead (μg/g) in unwashed samples along rural and urban roads

unwashed sample) per road showed no significant difference between sampling sites($F = 1.425$; df 4,8) and points per site regarded as replicates ($F = 3.539$; df 2,8; $P > 0.05$) in each case for rural samples. Urban samples analysis produced similar results for sites($F = 0.431$; df 4,8) and points($F = 0.353$; df 2,8; $P > 0.05$). Moreover, no significant difference were obtained between washed and unwashed leaf lead levels from both the rural and urban samples ($P > 0.05$) in each case(Table 1). A higher percentage variation in concentrations occurred in washed sample determinations from both rural and urban road leaves(Table 1).

Table 1 Mean concentrations(μg/g) ± *S.D.* of lead in washed and unwashed leaf samples of *Chromolaena odorate* along a rural road and an urban road

	Rural road						Urban road					
Treatment	A	B	C	D	E	C.V.	A	B	C	D	E	C.V.
Washed	3.50	5.30	3.10	3.30	3.87	42.09	2.67	3.70	4.70	4.43	4.13	47.43
S.D.	1.80	1.28	0.52	0.80	2.63		1.33	1.30	3.21	2.21	1.05	
Unwashed	3.83	5.60	3.30	3.57	4.17	39.33	2.93	4.03	5.07	4.77	4.40	44.00
S.D.	1.82	1.38	0.52	0.85	2.54		1.27	1.27	3.25	2.29	1.10	

A comparison of the overall mean values from rural and urban road leaf samples with the respective soil lead value(Table 2a) showed significant differences between soil lead values and leaf lead levels($P < 0.01$ and 0.001, respectively) with soil levels being higher than leaf levels. In Table 2b a comparison of the soil lead levels with the respective rural and urban leaf levels per site showed some site leaf concentrations not different from the soil value, while others were different at different probability levels. Coefficient of variation was higher from urban leaf concentrations than rural leaf lead concentrations. There was no significant difference in the overall mean leaf lead levels between the rural samples(3.96 μg/g) and urban leaf lead level (4.08 μg/g; $t = 0.086$; $P > 0.05$).

Table 2 Comparison of mean soil lead concentrations with (a) overal mean leaf lead levels in *Chromolaena odorata* and (b) mean leaf lead levels from sites in rural and urban roads

(a)

Area	Soil lead levels, μg/g ± *S.D.*	Leaf lead levels, μg/g dry weight ± *S.D.*
Rural	5.80 ± 0.41	3.96** ± 1.58
Urban	6.60 ± 0.06	4.08*** ± 1.85

(b)

	Site					
Area	A	B	C	D	E	C.V.
Rural	3.67 n.s.	5.45 n.s.	3.20**	3.43***	4.02 n.s.	40.59
S.D.	1.63	1.20	0.48	0.75	2.32	
Urban	2.80**	3.87**	4.88 n.s.	4.60 n.s.	4.27*	46.09
S.D.	1.17	1.16	2.89	2.02	0.97	

*, **, *** significantly different from soil concentrations at $P = 0.02$, 0.01 and 0.001 respectively using t-test. n.s. is not significant.

3 Discussion

Lead is reported to accumulate in plants growing alongside highways in proportion to traffic density (Smith, 1976). The occurrence of mixed results in this study indicates a lack of correspondence between vehicular traffic density and lead concentrations in the leaves of *Chromolaena odorata*. This is corroborated by the absence of lead in rain water from the areas studied. Atmospheric lead would certainly fall out and be detected in rain water (Murozumi, 1969).

Lead concentrations in *C. odorata* in this study relate more to soil lead levels. For example, the three highest leaf concentrations from this study which did not differ significantly from soil levels occurred at points close to automobile mechanic workshops, both from the rural and urban roads. Udosen (Udosen, 1994) reported that lead levels in *Telfairia occidentalis* (Fluted pumpkin) leaves grown in background (control) soil were higher than in leaves grown in soil receiving paint industry wastes. Two suggestions were given to explain the seeming anomaly. In the first instance, this was attributed to the possibility of aerial contamination by lead-laden dust since the background soil was close to a highway. This is at variance with our findings in our present study. The second reason was that the background soil might have served as a dump site later reclaimed for cultivation. This possibility is close to our findings in this study.

In this study the lack of concordance between vehicular traffic density and lead levels in leaves along the highways indicates either a minimal use of tetraethyl-leaded petrol, or relatively low vehicular traffic density with lead from exhaust fumes not reaching a threshold to affect levels in plants or be detected in the atmosphere. The non occurrence of, or low atmospheric contamination with lead is reflected also in the lack of significant differences between mean concentrations of lead in washed and unwashed lead samples. The size of lead particles in the atmosphere is said to correlate with the rate of absorption by tissue (Antonio-Carcia, 1988). Whether this relationship is applicable to plant tissue is not clear. However, since atmospheric lead levels in the present study areas were below detection limit, linking the non-significant differences between washed and unwashed mean leaf lead levels to particle size of lead in the atmosphere is not possible.

The non-indictment of automobile exhaust fumes in leaf lead levels of *Chromolaena odorata* in this study is further supported by the lack of significant difference between the overal mean lead levels in leaves from both the rural and urban area. Moreover, the three trends evident in the distribution of lead concentrations in the leaves of this plant species occurred in both the rural and urban areas.

In the areas of this study, the leaves of *Chromolaena odorata* are usually used in the fresh state and according to Bohn *et al*. (Bohn, 1979), and Greenland and Hayes (Greenland, 1981) a concentration range of 0.1—10 ppm lead in plants is generally regarded to be toxic. Based on the above information, consumers of this plant in whatever form are at risk of lead poisoning considering the concentrations obtained in this study. Moreover, lead levels above 0.8 ppm are reported to be associated with brain damage in children (Simmons, 1974). These assertions notwithstanding, the toxicity risk of the concentrations obtained in this study to consumers cannot be stated with certainty until blood lead levels in consumers of *Chromolaena odorata* leaves in these areas are determined.

4 Conclusion

This study has revealed no consistent trend in the distribution of leaf lead concentration in *Chromolaena odorata* along the road transects to implicate automobile exhaust fumes. Since the three trends observed occurred both in the rural and urban leaf samples, concentrations in leaves appear to be related to soil lead concentrations. Implications of the consumption of the leaf with the lead levels obtained in this study are mixed following the wide range tolerance given. Therefore, until blood lead levels in consumers are determined, the toxicity risk of the concentrations obtained in this study to consumers cannot be stated with certainty.

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