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LEAD CONCENTRATIONS IN FOOD CROPS FOUND ALONG ROADSIDES IN SOME MUNICIPAL ENVIRONMENTS IN NIGERIA

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Summary

Concentrations of lead in cassava, cocoyam, plantain and banana planted along roadsides in Port Harcourt, Rumuokora, Rumuodata, Idama and Bille areas of south-eastern Nigeria were determined. The lead in the crop samples was analyzed using the diphenylthiocabazone colorimetric method and the results showed that lead concentrations from high traffic density areas were higher than those from low traffic density areas. However, a *t*-test showed no significant difference ($P>0.05$) between them. Also, lead concentrations in the crops decreased with increasing distance away from the road junctions. The results further showed significant difference ($P<0.05$) between the lead concentrations in the edible (fleshy) and non-edible (peels) parts of the crops. The observed difference in the lead concentrations are attributed to differences in varieties as well as the length of time the crops stayed in the ground. The results of the study present enough preliminary evidence to discourage farmers from planting crops along road junctions since the lead concentrations in most of the study areas exceeded natural limit.

Introduction

In recent years, increasing attention has been paid to lead contamination from industrial and non-industrial sources.

At present, specific concern is on lead emitted into the environment through the use of lead as an anti-knock compound in gasoline. The combustion of gasoline, globally contributes an estimated 60 per cent of the total lead emissions from human activities (Franz & Hadley 1981; UNEP & WHO, 1988).

The importance of lead and its consequences when released into the environment have been of great concern to man (Singh *et al.*, 1983). Lead is a non-essential element for man and has toxic potential for all biological systems. The biological effects of lead include effects on haem biosynthesis, the nervous system, the kidneys, reproduction, the immune system, and also cardiovascular, hepatic, endocrinal and gastrointestinal effects (WHO, 1987). Reports have it that children show greater susceptibility to lead than adults (UNEP & WHO, 1988). Lead may inhibit plant growth and cause reduction of photosynthesis, water absorption and may lead to copper deficiency (Singh *et al.*, 1983).

Because of the likely biological effects of increased lead intake, the present study investigates the contribution of auto emission to lead concentrations in food crops grown around major traffic junctions in some parts of south-eastern Nigeria.

Experimental

The areas covered by this study are in the same climatic region with Port Harcourt located on latitude 4.51, longitude 7.01 and elevation of 18 m. The agroclimatic data for Port Harcourt environment its, therefore, adopted in this study. It has a total annual rainfall of about 2500 mm, mean monthly temperature of 26.7 °C, relative humidity of 96 per cent and windspeed of 7.9 m/s. There are two periods of heavy rainfall in the year, the first occurring in May (250 mm), June (338 mm), July (325 mm) and the second occurring in September (394 mm), October (271 mm) with a fall considered as "August break" occurring in July (325 m) and August (313 mm). However, there is virtually no month in the year without some rain. The heavy rainfall, long wet season (about 260 days), high relative humidity and moderate wind speed

TABLE 1
Preliminary results of lead concentrations (ppm) in crops found at study areas

Station No.	Location of station	Description of traffic density	Type of crops	Lead concentrations Distance (m) 0	5	10	30
1	Ikwerre/Agip Road junction	High	Cassava tuber	-	15.3	12.4	-
			Cassava Peel	-	7.9	6.1	-
2	Rumuokoro/East-West Road	High	Cocoyam tuber	9.2	7.5	7.0	6.8
			Cocoyam peel	6.9	6.8	6.5	6.2
			Cassava tuber	-	-	6.3	-
			Cassava peel	-	-	5.7	-
3	Rumuodara/East-West Road	High	Cassava tuber	-	6.7	7.9	4.7
			Cassava peel	-	8.3	5.8	6.1
4	Ikwerre Street	Low	Cassava tuber	-	3.5	-	2.3
			Cassava peel	-	10.7	-	6.1
5	Dick Tiger Street	Low	Cassava tuber	5.2	6.7	5.0	-
			Cassava peel	7.5	5.1	3.8	-
6	Anozie Street	Low	Cassava tuber	9.2	7.3	5.6	-
			Cassava peel	7.1	8.9	7.5	-
7	U.S.T. Road E	Low	Plantain tuber	-	4.8	-	-
			Plantain peel	-	6.3	-	-
8	U.S.T. Teaching Farm (Control)	Low (Control)	Banana tuber	-	-	2.5	-
			Banana peel	-	-	1.9	-
			Plantain tuber	-	-	-	1.2
			Plantain peel	-	-	-	1.9
			Cassava tuber	-	-	2.9	-
			Cassava peel	-	-	2.1	-
9	Bille Town (Contol)	Low	Plantain tuber	0.3	-	0.3	-
			Plantain peel	0.8	-	0.6	-
			Cassava tuber	-	-	-	0.5
			Cassava peel	-	-	-	0.2
10	Idama Town (Control)	Low (Control)	Mango	0.7	-	-	-
			Cassava tuber	-	-	-	0.5
			Cassava peel	-	-	-	0.3
			Cassava tuber	-	-	0.6	-
			Cassava peel	-	-	0.4	-
			Cassava tuber	-	0.8	-	-
			Cassava peel	-	0.5	-	-

- Indicates no measurement (i.e. no crop.)

make the growing of the crops possible.

Crop samples were collected from three high-traffic density areas, four low-traffic density areas and three control areas. Stations 1 - 8 are in urban areas while stations 9 and 10 are in rural areas. The high and low traffic density areas have minimum daily estimated traffic volumes of 2500 and 5000 respectively while the control stations have an estimated volume of 5.

Estimates of the daily traffic volumes were obtained from independent counts and information from the traffic warden on duty at the time of sampling.

Available food crops at 5 m interval, ranging from zero to 30 m away from the road were collected into polyethylene bags and transported to the laboratory.

The types and varieties of crops found at the study sites were cassava, cocoyam, plantain, banana and mango.

Cassava. Tropical Manihot Selection (TMS) 30572 at Stations 1 and 3. Manihot palmata (Sweet cassava with redish or pinkish peels) at Stations, 2, 5, 9 and 10. Manihot Columbia 276 at Station 4, National roots 8231 at Stations 5 and 8 and TMS 30555 at Station 6.

Cocoyam. *Taro* (Edewachukwu) at Station 2.

Plantain. Obino I Ewai at stations 7 and 8, Bobby Tannap at Station 9.

Banana. Pelipita at Station 8.

Mango. Indial mango (Opioro) at Station 10.

The crop samples were washed and separated into edible (fleshy, usually eaten by man) and non-edible (peels, usually not eaten by man) parts. Each part was dried to a constant weight at 110 °C in an oven. The dried samples were ground and sieved. One gram (1 g) of the sieved crop sample was digested with 10 cm^3 of 50 per cent hydrochloric acid, filtered and made up to 50 cm^3 with deionized water. The digested samples were stored in washed, dried plastic bottles.

Lead was determined in the samples using the diphenylthiocarbazone colorimetric method (Stewart *et al.*, 1974; Thomas & Chamberlin, 1980; APHA-AWWA-WPCF, 1980). This was based on the report (Ideriah, 1995) that there is no significant difference between results obtained from colorimetric and atomic absorption spectroscopic methods.

Results and discussion

The results for lead concentrations in the available crop samples are presented on Table 1. The table also shows the description of the stations and traffic density.

Table 2 shows the variation of lead concentration with crop type and location. Lead concentrations in crops decreased with increasing distance away from the road junctions (Fig. 1, Station 10). It was observed at Station 5 that the edible part of cassava crop had lower lead concentration that the non-edible part at zero (0.0 m) distance. However, at 5.0 m and 10.0 m distances, the reverse was the case. Similar observations were made at other stations as shown in Table 1 and Fig. 1. The students's *t*-test showed significant difference ($P<0.05$) between the lead concentrations in the edible and non-edible parts of the cassava crop. Inquiries from the farmers reveal that the observed differences in parts of the crops were due to differences in type (e.g. agricultural and local) of the crop as well as the time of the year (see ages in Table 2) at which the crop was harvested.

In general, the lead concentrations from high density areas are higher than those from low density areas. It was observed that lead concentration in cassava at Station 6 was higher than that at Station 2 despite the fact that the latter is a higher traffic density station. This is because the crops are of different varieties and were not planted at the same time. It was also observed that cocoyam and cassava found at the same distance from the junction at Station 2 had different

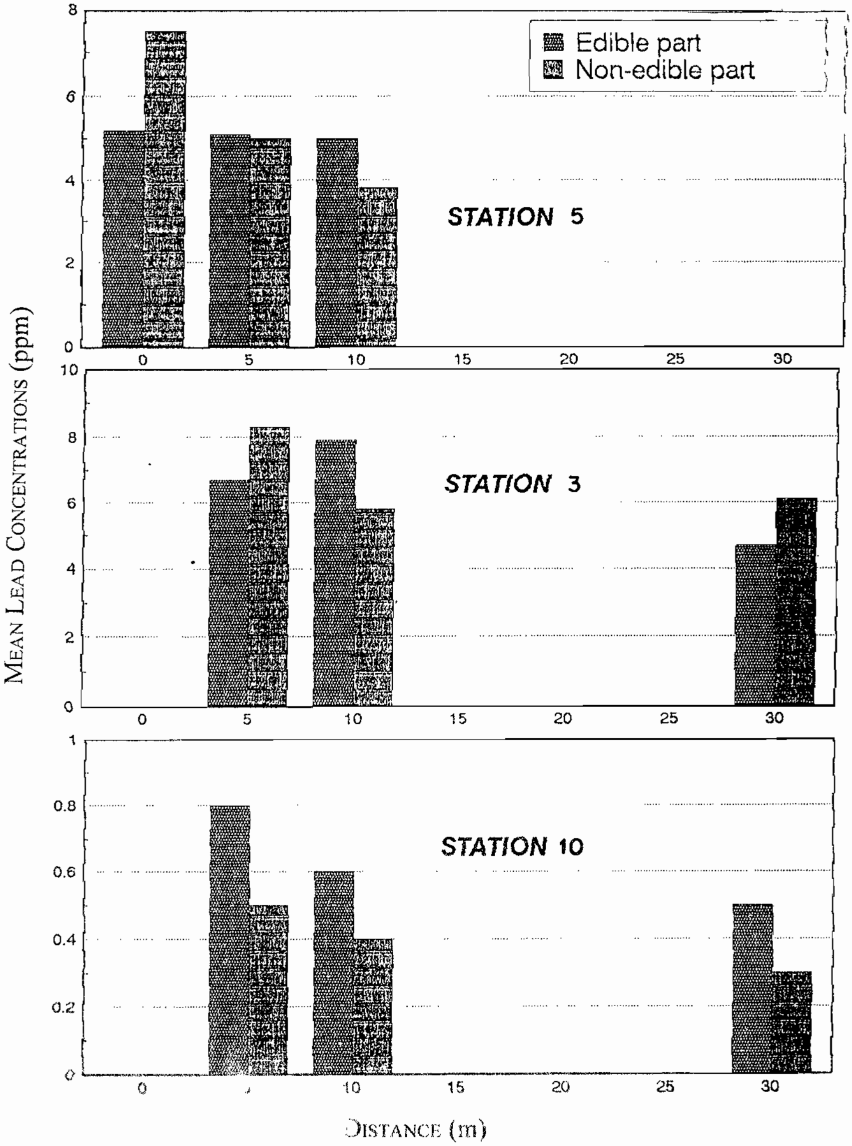
TABLE 2
Variation of lead concentration with crop type and location

Station No.	Name of crops: Scientific	Name of crops: Local	Ages (months)	Mean lead concs (ppm)
1	*Manihot esculenta*	Cassava	10	10.4 ± 0.03
2	*Manihot esculenta*	Cassava	12	6.0 ± 0.00
	Colocasia esculentum	Cocoyam	12	7.1 ± 0.01
3	*Manihot esculenta*	Cassava	11	6.6 ± 0.02
4	*Manihot esculenta*	Cassava	10	5.7 ± 0.05
5	*Manihot esculenta*	Cassava	14	5.6 ± 0.05
6	*Manihot esculenta*	Cassava	10	7.6 ± 0.00
7	*Musa paradisiaca*	Plantain	S 30	5.6 ± 0.03
			B 6	
8	*Manihot esculenta*	Cassava	B 12	2.5 ± 0.00
	Musa sapentum	Banana	S 36	2.2 ± 0.03
			B 7	
	Musa paradisiaca	Plantain	S 36	1.6 ± 0.03
			B 7	
9	*Musa paradisiaca*	Plantain	S 42	0.5 ± 0.00
			B 6	
	Manihot esculenta	Cassava	10	0.4 ± 0.05
10	*Manihot esculenta*	Cassava	12	0.5 ± 0.02
	Mangifera Indica	Mango	T180	
			F 5	0.7 ± 0.00

S = Sucker, B = Bunch, T = Tree, F = Fruit.

lead concentrations of 7.0 ppm and 6.3 ppm respectively. Given that both crops were planted at the same time, the observation shows that different crops have different rate of absorption of lead. The student's *t*-test showed that there was a significant difference ($P<0.05$) in lead concentrations in crops of the test and control stations but no significant difference ($P>0.05$) between high and low density areas. These observations are attributed to differences in the ages, species and varieties of the crops (as specified under materials and methods and Table 2), distances away from the road junctions where the crops were found and different traffic densities of the stations. Although the crop samples were not generally distributed in a manner that could reflect lead concentrations in all the areas studied, the results present enough preliminary evidence to discourage farmers from planting crops like cassava around high traffic road junctions.

In order to determine the level of pollution, the results obtained are compared with plants threshold limited and natural concentrations. The crop lead concentrations are very low compared to the threshold limit of 12-20 ppm (Singh *et al.*, 1983) while those from the test Station 1-7 exceeded the natural limit of 0.05 - 3 ppm (Stewart *et al.*, 1974). This implies that the crops though contaminated, are not toxic. Generally, as shown in Table 2, the cassava crop is more contaminated than the others, and, therefore, requires further investigation.



... lead concentration (ppm) in parts of cassava crop as function of distance.

Although the concentrations of lead in this study do not pose very serious environmental problems, if the crops are left for longer periods, the lead concentrations in them would rise to toxic levels. Since the major sources of lead in humans is the food chain, these observations indicate that farming along major streets and road junctions (high traffic density areas) should be discouraged.

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