GLOBAL JOURNAL OF ENVIRONMENTAL SCIENCES, VOL.1, NO. 1 2002:1 -6

CADMIUM, COPPER AND NICKEL LEVELS IN VEGETABLES FROM INDUSTRIAL AND RESIDENTIAL AREAS OF LAGOS CITY, NIGERIA

A. A. YUSUF, T. O. AROWOLO and O. BAMGBOSE

(Received 29 November 2000; Revision accepted 26 June 2001)

ABSTRACT

The levels of cadmium, copper and nickel in five different edible vegetables viz *Talinum triangulare*, *Celosia trigyna, Corchorus olitorus, Venomia amygydalina* and *Telfaria accidentalis*, and the soils on which they were grown from three industrial and three residential areas of Lagos City, in Nigeria, were determined using atomic absorption spectrophotometry. The results obtained for these heavy metals from the industrial areas were higher than those of the residential areas as a result of pollution. Industrial area results for vegetables ranged between 1.13-1.67 □g/g for cadmium; 56.84-25.08 □g/g for copper and 2.06-1.3 3 □g/g for nickel.

There was statistically significant differences ($P<0.05$) between the levels of copper and nickel in all the vegetables studied from industrial and residential areas, while there was no statistically significant difference for cadmium.

The results also show that *Corchorus olitorus* (Bush Okra) has ability to accumulate more copper and nickel than the other vegetable studied but has least ability for cadmium.

Key word: Heavy metals, Vegetables, Industrial area, Pollution.

INTRODUCTION

The impact of industrial development on the environment in the Lagos city cannot be underestimated. Environmental problems encountered ranged from stench and coloration of water bodies to the appearance of surface films..

Heavy metals are of considerable environmental concern due to their toxicity and cumulative behaviour (Omgbu, and kokogbo 1993). Trace quantities of certain heavy elements such as chromium, cobalt, copper, manganese, zinc etc., are essential micronutrients for higher animals and plants growth (Somers 1974).

On the otherhand, they are easily assimilable and accumulate in plants and animal bodies (Numberg, 1984).

In Nigeria automobile exhaust emissions account for major problems of atmospheric pollution in the urban areas (Osibanjo and Ajayi, 1980; Onasanya et. al. 1993).

There have also been reports on contamination of the Nigerian environment by petroleum (Kakulu and Osibanjo, 1988, 1992). Omgbu and Kokogbo (1993) in a recent study showed that the soils of oil producing areas contains relatively high concentration of Zn, Pb, Cu and Hg. The levels reported had an abundance in the order

A. A. YUSUF, Department of Chemical Sciences, UNAAB, University of Agriculture, Abeokuta, Nigeria
T. O. A. AROWOLO, Dept. of Environmental Management and Toxicology, UNAAB, Univ. of Agriculture, Abeokuta, Nigeria
O. BAMGBOSE, Dept. of Environmental Management and Toxicology, UNAAB, Univ. of Agriculture, Abeokuta, Nigeria

Pb>Zn>Hg>Cu for the soil samples. The authors explained that this must have resulted from the discharge of waste effluent of crude oil on soils of Ekpan, Nigeria.

Vegetables absorbe heavy metals from the soil as well as from surface deposits on parts of vegetables exposed to polluted air (Buchaver 1973; Haghiri 1973). Moreover, the presence of heavy metals in fertilizers contribute to additional sources of metal pollution for vegetables.

For cultural reasons and because of economic considerations, the people of Lagos particularly, those belonging to the middle and low income groups, consume significant quantities of vegetables, viz *Corchorus Olitorus* (Bush okra), *Celosia trigyna, Talinum triangulare* (Water leaf) *Telfaria accidentolis* (Fluted pumpkin) and *Venomia amygydalina* (Bitter leaf) Udosen (1994) observed that the trend in metal levels in *Telfaria accidentolis* from soil receiving paint waste was Cr> Zn> Cu> Pb> Cd while the control soil trend was Zn > Cr> Cu > Pb> Cd.

The aim of this research was to investigate the levels of metals of toxicological interest in selected edible vegetables grown in industrial and residential areas in Lagos city of Nigeria.

MATERIALS AND METHODS

Samples of the edible vegetables were randomly collected around farmlands from three industrial areas: Ikeja, Ilupeju and Ogba industrial estates of Lagos. All the samples were then pooled together as industrial area samples. Similarly, the same edible vegetables from three residential area farmlands: Ikoyi, Victoria Island and Victoria garden were randomly collected and then pooled together as residential area samples.

The fresh vegetable samples together with samples of supporting soil were collected from the study areas.

Vegetables were washed in fresh running water to eliminate dust, dirt, possible parasites or their eggs and then they were again washed with deionized water (Zurera et. al. 1987)., and oven dried at 90°C for 24hrs before grinding. The wet digestion method was used (AOAC,1990). One gramme of dry matter was weighed into 50ml beakers, followed by addition of 10ml mixture of analytical grade acids Aldrich chemical company: HNO_3: H_2SO_4: $HClO_4$ in the ratio 1:1:1.

The beakers containing the samples were covered with watch glasses and left overnight. The digestion was performed at a temperature of about 96°C until about 4ml was left in the beaker. Then, a further 10ml of the mixture of acids was added. This mixture was allowed to evaporate to a volume of about 4ml. After cooling, the solution was filtered to remove small quantities of waxy solids and made up to a final volume (50cm^3.) with distilled water.

The metal concentrations were determined by atomic absorption spectrometry using a Perkin-Elmer model 4000 Atomic Absorption Spectrophotometer. The method of standard additions was used to eliminate sample – standard matrix differences. Analysis of each sample was carried out six times to get representative results and the data reported in μg/g (dry matter basis). Data were arranged in a facterial design and subjected to analysis of variance using the general linear model procedure of the statistical software Minitab ®Significant differences were determined by Kruskal-Wallis test or by Mann-Whitney U test. (A probability of 0.05 or less was considered significant).

RESULTS AND DISCUSSION

The mean values of cadmium, copper and nickel concentrations in the edible vegetables studied are given in Tables 1,2 and 3 while that of the soil is shown in Table 4. The level of cadmium obtained in all the five vegetables sample (Table

TABLE 1: Cadium concentrations [1](μg/g dry weight) in edible vegetables from industrial and residential areas of Lagos city, Nigeria.

Vegetable	Industrial Area	Residential Area	P[2]
Talinum triangulare (Ta)	1.50±0.09	0.81±0.50	NS
Celosia Trigyna (Ce)	1.61±0.60	1.17±0.59	NS
Corchorus Olitorus (Co)	1.13±0.11	0.69±0.23	NS
Venomia Amygydalina (Ve)	1.55±0.49	0.82±0.07	NS
Telfaria Accidentolis (Te)	1.67±0.36	0.82±0.17	NS

[1]All values are shown as means ± SD.
[2]ANOVA P value.
NS, not significant.

TABLE 2: Copper concentrations [1](μg/g dry weight) in edible vegetable from industrial and residential areas of Lagos city, Nigeria.

Vegetable	Industrial Area	Residential Area	P[2]
Talinum triangulare (Ta)	51.53±7.18	24.41± 3.09	<0.05
Celosia Trigyna (Ce)	25.08±0.89	15.38±4.32	<0.05
Corchorus Olitorus (Co)	56.84±18.59	24.81±4.80	<0.05
Venomia Amygydalina (Ve)	32.54±10.15	17.47±0.98	<0.05
Telfaria Accidentolis (Te)	45.04±3.49	30.31±4.14	<0.05

[1]All values are shown as means ± SD.
[2]ANOVA P value.
NS, not significant

TABLE 3: Mean Nickel Concentrations [1](μg/g dry weight) in edible vegetables from industrial and residential areas of Lagos city, Nigeria

Vegetable	Industrial Area	Residential Area	P[2]
Talinum triangulare (Ta)	1.33±0.31	0.83± 0.27	<0.05
Celosia Trigyna (Ce)	1.66±0.20	1.25±0.22	<0.05
Corchorus Olitorus (Co)	2.06±0.78	0.48±0.18	<0.05
Venomia Amygydalina (Ve)	1.59±0.11	0.81±0.12	<0.05
Telfaria Accidentolis (Te)	1.85±0.26	1.31±0.22	<0.05

[1]All values are shown as means ± SD.
[2]ANOVA P value.
NS, not significant.

1) from industrial area are higher than those obtained from the residential area. However there is no significant differences between the level of cadmium in industrial and residential areas for all the vegetables studied.

TABLE 4: Heavy Metals Concentrations [1](μg/g dry weight) in soil from industrial and residential areas of Lagos city, Nigeria.

Metal	Industrial Area	Residential Area	P[2]
Cadium	13.41±1.87	7.98±1.21	<0.05
Copper	106.14±17.24	63.28±3.27	<0.05
Nickel	24.73±5.18	12.78±2.25	<0.05

[1]All values are shown as means SD.
[2]ANOVA P value.
NS, not significant.

Vegetables from the industrial area have higher levels of copper than those from residential areas (Table 2). In fact, significant differences were found (P<0.05) between the level of copper in all the vegetables from industrial and residential areas. The similar trend have been observed by Adeniyi (1996) in his study on the level of copper in *Talinum triangulare* (water leaf) from dumpsites (fund to be higher) and control sites in Lagos, Nigeria.

Corchorus olitorus contained the highest amount of copper (56.84±18.59 μg/g) in all vegetables studied while the *Celosia trigyna* contained the least (25.08±0.89 μg/g).

The concentrations of Nickel (Table 3) in vegetables from industrial area were higher than those from the residential area. A stastically significant differences (P<0.05) was found between the industrial and residential areas and vegetables sampled. Table 3 indicates that *Corchorus olitorus* had the ability to accumulate more nickel than other vegetable studied.

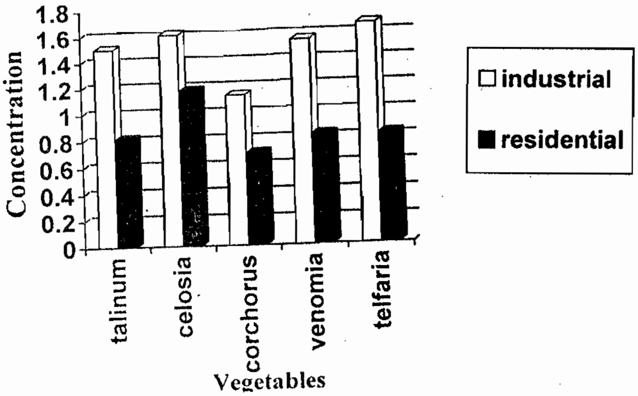

Figure 1. Mean cadmium concentrations (ug/g dry weight) of vegetables from industrial and residential areas

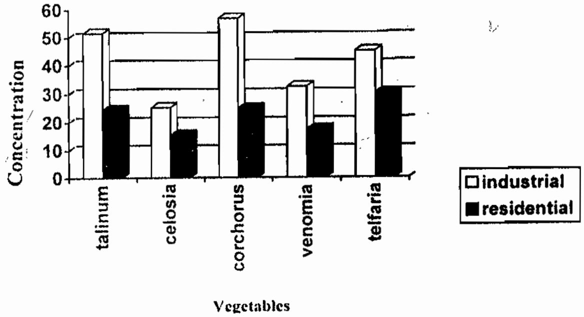

Figure 2. Mean copper concentrations (ug/g dry weight) of vegetables from industrial and residential areas.

Results in Table 4 indicates a high degree of contamination in soils of industrial areas, when compared to soil samples from residential area. Copper is found in higher concentration in both industrial and residential area soils, followed by Nickel and Cadmium. This indicate that industrial activities such as paint, battery, textile, mill, and chemical industries (fund in studied areas) contaminates or introduces heavy metals into the soil. This finding coroborates the finding of Srikanth and Reddy (1991), who showed that sludge and industrial polluted soil have more Cadmium and Lead than soil free from sludge and industrial pollution from Hyderabad, India. In Nigeria, Ndiokwere and Ezihe (1990) reported the amount of copper in soils of Aladja and Warri as ranging between 24.8-31.4 µg/g dry weight. Omgbu and Kokogho (1993) obtained a range of 3.47-6.50 µg/g for copper in soil from Ekpan, Nigeria. The value of copper obtained (63.28 g/g for residential area and 106.14µg/g for industrial area) in this work are generally higher than the examples cited above. This shows that industrial activities of the studied areas introduces more Copper into the soil than that of petroleum refining and steel industries (Aladja, Warri, and Ekpan).

..The level of trace metals in vegetables studied were generally lower than the amount present in the respective soils. That is, only limited quantities of metals were absorbed to the aerial parts of the vegetables. This findings may be attributed to the root which seems to be a barrier to the translocation of metals(Davics and White , 1981) .

CONCLUSION

From this work , it is fund that industrial activities such as paint , battary , textile mill and chemical industries increases the level of cadmium, copper and nickel intake of vegetables studied.

However, the results of this study indicate that the daily intake of cadmium and copper through edible vegetables from industrial area may not constitute a health hazard for consumers because the values are far below the recommended daily intake of these metals (chromium, 50-200 g/day and copper 2000-3000 g/day) (Orten and Neuhaus 1984).

All these metals have toxic potential but the detrimental impacts become apprent only after decades of exposure. Monitoring of heavy metals in plant tissues is essential in order to prevent excessive build up of these metals in the human food chain. Appropriate measures should be put in place by the companies to always treat their waste effluents before discharging them into the immediate environment as it will control the levels of heavy metals in the soil. Nevertheless, planting of vegetables in an industrial area should be discouraged to avoid health hazard for consumers.

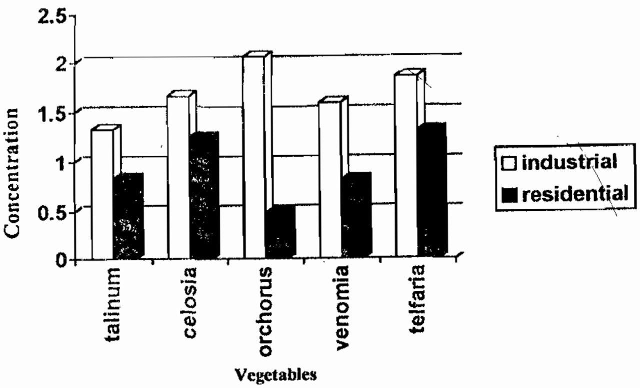

Figure 3. Mean nickel concentrations (ug/g dry weight) of vegetables from industrial and residential areas.

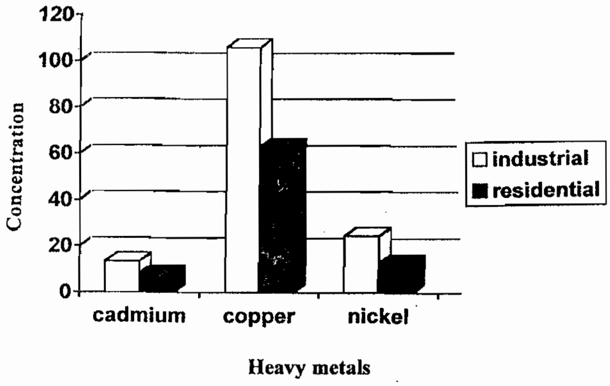

Figure 4. Mean concentrations of heavy metals (ug/g dry weight) of soils from industrial and residential areas.

REFERENCES

Adeniyi A.A. ; 1996. Determination of cadmium, copper, iron, Lead, manganese and zinc in water leaf

(Talinumtriangulare) in Dumpsites,Environ. Int. 22 (2) 259- 262

AOAC (Association of official Analytical chemists); 1990 . Official methods of Analysis of the Association of Official Analytical chemists, 15th ed . Arlington, VA.

Buchaver, M.J.; 1973 . Contamination of soil and vegetation near zinc smelter by zinc, cadmium, copper and lead. Environ. Sci. Technol. 7: 131-135

Davies BE ,White H .M ; 1981 .Trace element in vegetables grown on soils contaminated by base metal mining.J Plant Nutr 3:387- 396.

Haghiri, F.; 1973. Cadmium uptake by plants. J. Environ. Qual 2: 93-96.

Kakulu, S.E. and O. Osibanjo; 1988. Trace heavy metal pollutional studies in sediments of the Niger delta area of Nigeria. J. Chem. Soc. Nigeria, 13: 9 - 15.

Kakulu, S.E and O. Osibanjo; 1992. Pollution studies of Nigerian rivers; Trace metal levels of surface waters in the Niger Delta area. Int. J. Environ Stud. 41: 287.

Ndiokwere C.L and Ezihe C.A; 1990. The Occurrence of heavy metals in the vicinity of industrial complexes in Nigeria, Environment internation,vol.16,p. 295.

Numberg, H.W; 1984. The Voltametric approach in trace metal chemistry of natural waters and atmosphere precipitation: Analyt. Chim. Acta 164; 1-21.

Ogunsola, O.J.; Oluwole, A.I.; Osubigo, O.I.; Durosinmi,;M.A; Fatusi, A.O.; Ruck, W; Environmental impact of vehicular traffic in Nigeria; health aspects. Sci. Total Environ.; 146/147; 111-116.

Omgbu, J.A; and Kokogbo, M.A; 1993. Determination of Zn, Pb, Cn and Hg in Soils of Ekpan, Nigeria. Environ. Int. 19; 611-612.

Orten, J.M. and Neuhaus, O.W; 1984. Human Biochemistry, pp. 743-750, Ed.Panamericana, Buenos Aires.

Osibanjo, O. and Ajayi, S.O; 1980. Trace metal levels in tree barks as indicator of atmosphere pollution.Environ. Int. 4(3); 239-244.

Rodriguez-Flores, N. and Rodriguez-Castellon E; 1982. Lead and Cadmium levels in soil and plants near highways and their correlation with traffic density; Environ. Pollut. 4: 281-290.

Srikanth R. and Raja Papi Reddy S; 1991. Lead, Cadmium and chromium Level in Vegetable Grown in Urban sewage sludge-Hyderabad , India,Food chemical 40 (1991) 229-234.

Somers, E; 1974. the toxic potential of trace metals in foods. A review. J. Food Sci. 39: 215-217.

Udosen, E. D ;1994. Level of Toxic metals in Telfairia occiddentalis from A Paint Industry Enviroment. J. Appl. Chem. Of Agric. Res.Vol 1, NRI 35- 42.

Zurera, G.; Estrada, B.; Rineon, F.; Pozo, R; 1987. "Lead and Cadmium contamination levels in edible, vegetables"; Bull Environ. Contam. Toxicol 38: 805-812.