Available online at www.scholarsresearchlibrary.com

Scholars Research Library

Annals of Biological Research, 2015, 6 (6):48-51
(http://scholarsresearchlibrary.com/archive.html)

ISSN 0976-1233
CODEN (USA): ABRNBW

Lead levels of vegetables planted along river banks in Abeokuta, Ogun State, Nigeria

[*]Lanre-Iyanda Y. A., Taiwo A. G. and Ajayi J. O.

Science Laboratory Technology Department, Moshood Abiola Polytechnic, Abeokuta, Ogun State, Nigeria

---

ABSTRACT

Vegetables contributes essential nutrients to diets especially when in short supply but some planted along river banks may be found to be toxic due to human and industrial pollution of water and soil. This study determines the Lead level of the Control samples, Soil, 'Gbure', (Water leaf, Talinium triangulae) and 'Efo abalaye', (Spinach oleracea) shoot and root grown in Sokori and Lafenwa river banks. Samples were collected randomly, wet digested and lead level determined using Buck Scientific Atomic Absorption Spectrophotometer and the data subjected to statistical analysis using SPSS version 17.0. The moisture content ranged from 52.34±0.05% in Spinach control shoot sample of Lafenwa to 88.06±0.03% in Water leaf root sample of Sokori. The Pb level in soil ranged from 260±3 mg/Kg in Spinach planted soil to 300±4 mg/Kg in Water leaf planted soil; it also ranged from 152±2 mg/Kg in Spinach control shoot sample of Sokori to 402±5 mg/Kg in Spinach total Pb level obtained from Sokori. This shows that the Pb level in both vegetables were above the 5 mg/Kg permissible limit set by FAO and WHO, and also the level is above the critical concentration of Pb in plants (300 mg/Kg). Regular consumption of these vegetables could pose health hazard and risk so vegetables should not be cultivated near river banks and also industrial wastes should be treated before discharge into the environment.

Key words: Vegetables, pollution, lead, waterleaf, spinach and health risk

---

INTRODUCTION

Vegetables constitute essential components of the diet by contributing carbohydrates, proteins, vitamins, other nutrients and minerals which are usually in short supply (Oseni *et al*., 2015). They also act as buffering agents for acidic substances obtained during the digestion process (Sharmar *et al*., 2009). Metals such as lead, mercury, cadmium and copper are cumulative poisons. These metals cause environmental hazards and are reported to be exceptionally toxic (Ellen *et al*., 1990), while trace quantities of Cr, Co, Cu, Mn, and Zn are essential micronutrients for plant and higher animals growth (Oseni *et al*., 2015). Contamination of vegetables with heavy metals due to soil and atmospheric pollutants poses threat to quality, safety and life. However, chronic low level intake of heavy metals have damaging effects on human beings and other animals, since there is no good mechanism for their elimination. Elevated levels of heavy metals in vegetables are reported with such a long term use of treated or untreated wastewater (Sharma *et al*., 2007). Ingestion of contaminated food is one of the main routes through which heavy metals enter the human body (Grasmuck and Scholz, 2005). The excessive content of these metals in food is associated with etiology of a number of diseases, especially with cardiovascular, kidney, nervous system as well as bone disease (WHO, 1992; Steenland and Boffetta, 2000, Tasup, 2003). Due to the population increasing as well as rapid development of agriculture, industry and lack of strict regulation, legislation and control, heavy metals such as

Cu, Zn, Pb, Cd, Cr, As, and Hg are emitted into environment in large quantities through inorganic fertilizer applications, atmospheric decomposition and deposition, sewage sludge, agro-chemicals, livestock manure, solid waste emissions, irrigation water, industrial waste and compost (Zhou *et al*., 2004). Whilst support for increased production and consumption of fresh vegetables is an important goal, growing vegetables have become one of the major concerns for urban agriculture due to heavy metals, other toxic chemical contamination and their bio-accumulation in vegetables. It is a common practice among Nigerians to cultivate vegetables along the banks of rivers passing through cities. However, because of economic considerations, people of idle and low income groups in Lafenwa and Sokori consume significant quantities of vegetable such as African spinach, Water leaf etc. and could therefore be prone to the toxic effects of heavy metals bio-accumulated in these vegetables. This study was conducted to determine the Lead level of some vegetables planted along Sokori and Lafenwa river banks in Abeokuta, Ogun state, Nigeria and provide necessary information of the consequences on human life. The objective is to compare the lead levels of 'Gbure', (Water leaf, *Talinium triangulae*) and 'Efo abalaye', (*Spinach oleracea*) shoot and root planted in Sokori and Lafenwa river banks with the control, soil planted and standard permissible limits.

MATERIALS AND METHODS

Sampling and Pre-treatment

Fresh samples of leaves of Spinach (*Spinacea oleracea*) and Water Leaf (*Talium triangulare*) were randomly collected along the cultivated banks of Ogun river in Lafenwa and Sokori river in Itoku. All samples were collected and stored in a labeled pre-distilled water rinsed polythene bags according to their type and brought to the laboratory for preparation and analysis.

Sample Analysis

The fresh samples were rinsed with distilled water to remove air-borne pollutants and adhering soil. The leafy stalks were cut (stem + leaf) and root and then rinsed carefully with distilled water, oven dried to eliminate excess moisture and weighed for fresh weight determination. The samples were then oven dried at 105^{o}C for 48 hours to constant weight. The moisture content was determined using;

$$\%\ \text{Moisture content} = \frac{\text{Fresh weight of. sample} - \text{Dry weight of sample}}{\text{Fresh weight of sample}} \times 100$$

(A.O.A.C.2000)

Atomic Absorption Spectrophotometric Iron Determination

Each oven dried sample was ground in porcelain mortar to a fine powder, the samples were then stored in a clean, dry, stoppered glass container before analysis. About 0.5 g of the grounded vegetable samples were weighed into a 100 mL Erlenmeyer flask, which has been previously washed with acid and distilled water followed by the addition of 4 mL Perchloric acid (60%), 25 mL concentrated Nitric acid and 2 mL concentrated Sulphuric acid in the fume hood. The contents were heated gently at low heat on a hot plate until dense white fume of perchloric acid starts to appear. Finally it was heated for half a minute on the same plate at medium heat. After cooling, the digest was completely filtered and diluted to 100 mL Pyrex volumetric flask with de-ionized water. The lead content of the digest was determined using the AAS (Model VGP 210 Buck Scientific).

The instrument was set up with a previously established optimum setting. Secondary or less sensitive lines were used to reduce necessary dilution as desired. Five standard solutions within the range before and after the test solution were used and the Percentage transmittance and Absorbance re-established each time. Calibration curves were prepared from the coverage of each standard before and after each test. The concentrations of the unknown Lead was read directly or from the plot of Absorbance against concentration in mg/L (ppm) (A.O.A.C. 2000).

Statistical Analysis

Data was processed using statistical package, SPSS Version17.0 to determine mean and standard deviation and also analysis of variance (ANOVA) at $P \leq 0.05$.

RESULT AND DISCUSSION

Table 1: Mean % moisture content of Vegetables in Ogun river bank in Lafenwa

Sample	Shoot	Root
Control (Spinach)	52.34 ± 0.05	85.40 ± 0.03
Spinach	56.39 ± 0.02	60.08 ± 0.02
Control (Waterleaf)	57.93 ± 0.01	86.44 ± 0.01
Water leaf	60.00 ± 0.03	87.29 ± 0.04

Table 2: Mean % moisture content of Vegetables in Sokori river bank in Itoku

Sample	Shoot	Root
Control (Spinach)	57.36 ± 0.02	85.51 ± 0.05
Spinach	58.30 ± 0.01	86.89 ± 0.01
Control (waterleaf)	58.16 ± 0.03	87.69 ± 0.02
Waterleaf	59.99 ± 0.04	88.06 ± 0.03

Table 3: Mean Lead concentration of Vegetables in Ogun river bank in Lanfenwa

Sample	Shoot (ppm)	Root (ppm)	Total (ppm)
Control (Spinach)	200 ± 4	170 ± 4	370 ± 5
Spinach	214 ± 5	180 ± 3	394 ± 2
Control (waterleaf)	190 ± 2	153 ± 4	369 ± 3
Waterleaf	209 ± 3	165 ± 5	374 ± 2
Soil (Spinach)			260 ± 3
Soil (Waterleaf)			280 ± 5

Table 4: Mean Lead concentration of Vegetables in Sokori river bank in Itoku

Sample	Shoot (ppm)	Root(ppm)	Total (ppm)
Control (Spinach)	152 ± 2	198 ± 5	351 ± 3
Spinach	185 ± 3	217 ± 2	402 ± 5
Control(Waterleaf)	229 ± 2	154 ± 3	383 ± 4
Waterleaf	232 ± 5	165 ± 2	397 ± 3
Soil (Spinach)			280 ± 5
Soil (Waterleaf)			300 ± 4

The mean percentage moisture content and Lead concentration found in the vegetable samples from cultivated sites along the Ogun and Sokori rivers at Lafenwa and Itoku respectively are summarized in tables 1, 2 and 3, 4 respectively.

Peri-Urban and Urban rivers of developing countries often receive effluents from industrial or municipal wastewater which are contaminated with heavy metals. Irrigation with water contaminated with heavy metals generally leads to pollution and consequently heavy metal up take by vegetables (Muchuweti *et al*., 2006). The percentage moisture content of the root is higher than the shoot in all the vegetable samples analyzed because it is the transport organ for water, minerals, nutrients etc to other part of the plant. Also Water leaf percentage moisture content is higher than Spinach. The moisture content of food materials is very important because if it is too high moulds and yeasts will be able to grow. Water activity is optimum for microbial growth showing that it may not keep.

The result showed that more lead was in the shoot than the root part of the vegetables except for Control spinach and Spinach in Sokori river bank in Itoku and more in the vegetable parts than the control parts which is expected due to pollution. This is in contrast with the findings of several authors (Schmidst 2003, Das *et al*., 1998, Salim *et al.*, 1993) who reported that heavy metals usually accumulate more in the root than the shoot of plants. However, the higher shoot lead concentration may be attributed to the fact that vegetables absorb heavy metal from the soil as well as from surface atmospheric deposit on exposed parts of the vegetables to polluted air (Buchaver 1973). The results also showed a high level of lead in all the vegetables though no significant variation ($p< 0.05$) between them ranging from 374±2 mg/kg in waterleaf in Ogun river bank to 397±3 mg/kg in waterleaf in Sokori river bank. Also, 394±2 mg/kg in spinach in Ogun river to 402±5 mg/kg in spinach in Sokori river bank. However, Spinach seemed to accumulate more lead than waterleaf having 402±5 mg/kg total lead in the Spinach of Sokori river bank.

The variations in the concentrations of heavy metals in vegetables may be ascribed to the physiochemical nature of the soil and absorption capacity of the metal by each plant, degree of maturity of the plants at the time of harvest and the nature of the plant (Vousta *et al*., 1996). The soil lead level ranging from 260±3 mg/Kg in Spinach planted soil to 300±4 mg/Kg in Water leaf planted soil which is below the 402±5 mg/Kg in Spinach total lead from Sokori shows little pollution from soil source but possible atmospheric source pollution. However, the lead content in both vegetables were above the permissible levels set by FAO and WHO for human consumption (5 mg/kg Pb) and also above the critical concentration of lead in plants, 300 mg/kg (Kabata pendias and Pendias, 1992). This showed that lead was accumulated at a toxic level in both vegetables at various sites. Inspite of the high lead level, however, the plants did not show any physical symptoms of lead toxicity. This means that they are tolerant to high lead concentration and so pose a serious threat to the health of the consumers.

CONCLUSION

This study revealed heavy metal contamination in the shoot and the roots of Spinach and Waterleaf cultivated at the banks of Ogun and Sokori rivers. The sampled vegetables had maximum concentrations higher than WHO/FAO limits allowed for human consumption, indicating a potential risk to every population sub group for carcinogenic and non-carcinogenic effects through long-term dietary intake. Also, these vegetables are accumulators of lead hence, care should be taken to ensure they are not cultivated near banks of polluted rivers.

Recommendation

It is strongly recommended to observe regular monitoring of toxic heavy metals from industrial, anthropogenic effluents in vegetables and in other to prevent excessive build-up in the food chain. Appropriate measures must be in place for companies to always treat their wastes before environmental discharge. Vegetables should not be cultivated in an industrial area to ensure consumer safety.

REFERENCES

[1] A.O.A.C. (**2000**). Official Methods of Analysis of the Association of Official Analytical Chemists, 14th Edition, Washington, DC20044. Buchaver M. J. (**1973**). *Environment Science Technology*, 7:131-135.
[2] Codex Alimentarius Commission, (FAO/WHO) (**2001**). Food additives and contaminants. Joint FAO/WHO Food Standards Programme, ALINORM 01/12A: 1-289
[3] Das P., Samantary S. and Rout G.R. (**1998**). *Environmental Pollution*, 98: 29-36.
[4] Ellen G., J. W. Van loon and K. Tolsina, (**1990**). Heavy Metals in Vegetables grown in the Netherlands and in domestic and imported fruits. Zeits Chift leben smittel untersuchung for schung, 190:34-39.
[5] Grasmuck D. and Scholz R. W. (**2005**). *Risk analysis*, 25 (3): 611-22.
[6] Jarup, L. (**2003**). *Br. Med. Bill*, 68:167-182.
[7] Kabata pendias and Pendias (**1992**). Trace Elements in soils and plants. 2nd Edition CRS press, London.
[8] Muchuweti A., Birkett J. W. and Chinyanga E. (**2006**). *Agric, Ecosystem Environment*, 112 (1): 41-48.
[9] Oseni Olalekan A., Taiwo Abayomi G, Ijaola Taiwo O. and Lanre-Iyanda Yetunde A. (**2015**). *Annals of Biological Research*, 6 (4): 27-32.
[10] Salim R., M. M. Al-subu, and A. Atallah, (**1993**). *Environment international*, vol. 10, pp 393-404.
[11] Schmidgt U. (**2003**). Enhancing Phytoextraction. *J. Environ Qual*., 32:1939-1954.
[12] Sharma R. K., M. Agrawal and F. M. Marshall, (**2007**). *Environ. Safe*., 66:258-266.
[13] Sharma R. K., M. Agrawal and F. M. Marshall, (**2009**). *Food chem. Toxicol*., 47:583-591
[14] Steenland K. and P. Boffetta, (**2000**). *A J. ind. Med.*, 38:295-299.
[15] Vousta D., Grimanis A. and Samara C. (**1996**). *Environ. Pollution*, 94:325-335.
[16] WHO (**1992**). Environmental Health Criteria 134: Cadium World Health Organisation, Geneva.
[17] Zhou L., Wang Y. J., Zhou D.M. and Dong Y. H. (**2004**). *J.Environ. Sci. China*, 16 (3):371-374.