

## Assessment of heavy metals concentrations in tissues of the African Giant Snail (*Archachatina marginata*) in selected major markets in Abeokuta, South West Nigeria

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### ABSTRACT

The study was conducted to determine the heavy metal content of the African Giant Land Snail (*Archachatina marginata*). Thirty-two snail samples were collected from eight selected markets in Abeokuta and analysed for three heavy metals: iron, zinc and manganese. The results showed that the concentration of iron ranged from 56 mg/kg in Elegu market to 91 mg/kg at Lafenwa market. The concentration of zinc ranged from 112 mg/kg at Kuto market to 146 mg/kg at Lafenwa market while the concentration of manganese ranged from 1.35 mg/kg at Omida market to 2.32 mg/kg at Lafenwa market. The highest concentration of the three metals occurred in Lafenwa market and the trend of the heavy metal concentration was of the order Zn > Fe > Mn. The level of contamination found in the snail samples was not hazardous to human health.

Keywords: Heavy metals, Abeokuta, Content, *Archachatina marginata*

### INTRODUCTION

Heavy metals are a serious threat to the stability of the biosphere. Heavy metals are emitted during natural processes as well as during human activities. When in excess, heavy metals may have a toxic effect on the ecosystem. Certain species of animals, classified as bio-accumulators accumulate heavy metals in their tissues at a higher rate than they can excrete and metabolise (Kadria and Hoda, 2013).

Recent studies (Martin *et al.*, 1991; Ezemonye *et al.*, 2013) have emphasized that the atmosphere is a more important transport route for heavy metals than river but very few quantitative comparison are available. More attention has been given to the concentration of some toxic metals in fresh water fish and other aquatic organisms. Interest is mainly directed towards commercial and edible species since high concentration of some

elements can be hazardous to human health (Gbaruko and Friday, 2007; Khalil, 2013).

Pollution of the ecosystem by toxic metals during man's activities poses serious concern because metals are non-degradable and are persistent in the ecosystem. Physical, chemical and biological processes may combine under certain circumstances to concentrate metals rather than dilute them and the societal impact of a contaminated system is substantial (Bislimi *et al.*, 2013).

Zinc is an essential trace metal for human and higher plants. It is an essential component of about a hundred enzymes. Normal zinc level in plants is 25 – 150 mg/kg with concentration above 400 mg/kg being toxic (WHO, 1996; NA, 2002). Human adults contain 1.40g to 2.30g Zn (Peter, 1993) and the recommended safe and adequate dietary intake for adults is around 15 mg/day (WHO, 1996; NA, 2002). Zn deficiency in humans leads to dwarfism,

reduced rate of blood clotting and wound healing, skin abnormalities, failure to eat, sexual immaturity, depression of immuno-competence, and change of taste acuity can also occur. Poisoning due to Zn toxicity from excessive ingestion leads to gastro-intestinal illness and diarrhoea in adult (WHO, 1996, NA, 2002). However toxicity in children results into acute fever, profuse sweating and weakness. Sources of Zn into the environment includes disposal of spent galvanising solutions, leaching of metals from refuse dumps, scrap metal dumps in mechanic villages, and from metallic fabricators etc.

The ability of iron to form complexes and exists in different oxidation states makes it very important in the biological system. The blood pigment haemoglobin contains iron, which is able to become reversibly bonded (by forming coordinate bonds) with oxygen molecules. This allows haemoglobin to transport oxygen to all parts of human body and releases it where it is needed.

The fact that manganese (Mn) was an essential element was first recognised as long as 1863, apparently when Raulin demonstrated that it was needed for the growth of the fungus *Rhizopus (Ascopthora) nigricans*. The role of the metal as a micronutrient in higher plants was first established by McHargue (1923) in his work with oats, soyabean and tomato, and later confirmed by Samuel and Piper (1928). Shortly after, Mn was shown to be essential in mammalian systems also and later it became known that Mn (II) activates enzymes and is involved in the synthesis of glycoproteins and is present in metallo-enzymes such as arginase

and pyruvate carboxylase. Manganese is involved in fatty acid synthesis and bone development (FNB, 2001)

In traditional African medicine, snail meat is used in the preparation of concoctions for the treatment of various health related challenges such as reduction of labour pains, blood loss during delivery, restoration of virility and fertility as well as cure of small pox. Snails serve as a valuable source of nutrition for human beings and animals, (Shotuyo *et al.*, 2008). The non-edible parts, the viscera and the shell, which, represent at least 40% of the snail weight can be recuperated for feeding monogastric animals. The shells are good source of calcium for livestock (Akinnusi, 1998). Snails form the major parts of the diet of some birds.

It is therefore imperative to avoid intake of heavy metals as accumulation of chemicals in the body has deleterious effects on human health. One of the major sources of heavy metals in human body is through consumption of food contaminated with chemicals (Killare *et al.*, 2015). Chemical composition of wildlife species utilized for different consumptive purposes should be assessed for heavy metals before use. The main objective of this study is therefore to assess the presence of heavy metals in snails from selected markets in Abeokuta for possible health risk.

## MATERIAL AND METHODS

### Study Area

The study area is Abeokuta metropolis which consists two local government areas (Figure1).

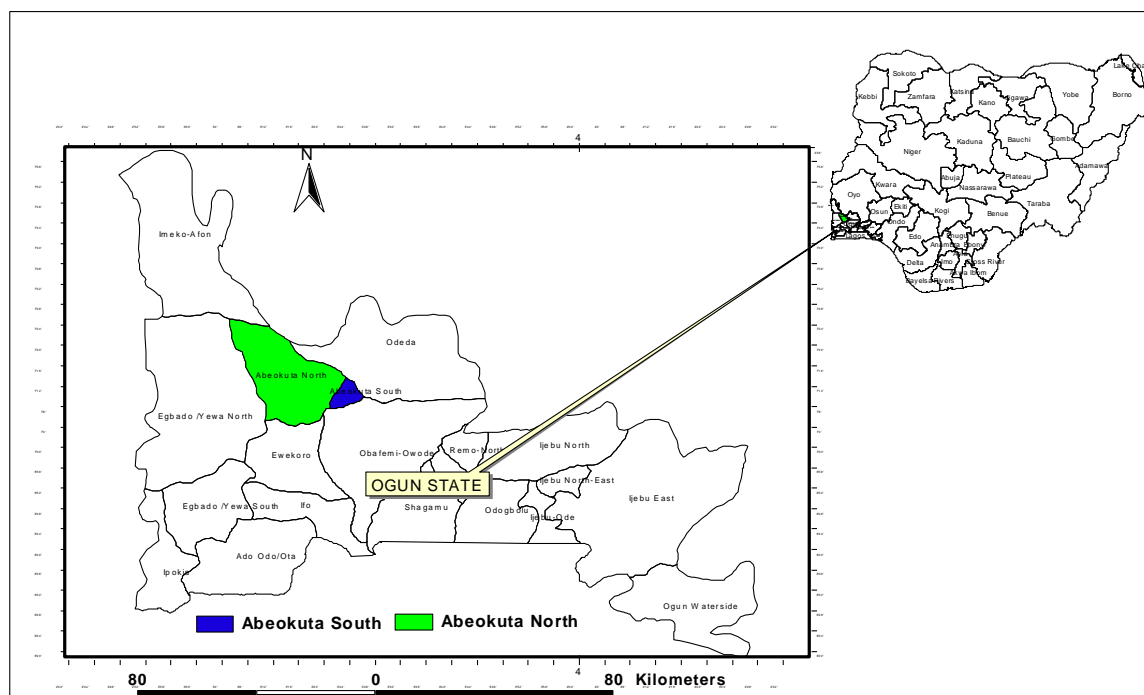


Figure 1: Map of Ogun State showing the study area

### Sampling procedure

The samples, live *Archachatina marginata*, were collected from eight different traditional markets in Abeokuta metropolis. Four samples were collected from each of the eight traditional markets in Abeokuta namely Adatan market, Elegu market, Iberekodo market, Ijaye market, Itoku market, Kuto market, Lafenwa market, and Omida market. A total of thirty-two samples were collected.

### Sample Preparation and Preservation

The snails were removed from the shells and wrapped in polythene bags. The samples were preserved in the refrigerator prior to digestion. Wet digestion using  $H_2SO_4$  and  $HNO_3$  at the ratio of (2:1) was used for the decomposition of the organic matter present in the sample. The glass wares were washed with detergent and rinsed with tap water, followed by distilled water. A quantity (1.5g) of the sample was weighed on the weighing balance and transferred to a pre-cleaned conical flask. A total of 10ml concentrated  $H_2SO_4$  was added by means of a pipette, followed by 5ml of

concentrated  $HNO_3$ . The sample was then heated on the heating mantle until brownish fumes were completely evolved and a clear solution was obtained. The flask with its content was allowed to cool. After cooling, the digested sample was transferred into a volumetric flask, made up to 5ml with distilled water and transferred into a pre-cleaned plastic bottle (Adelaju, 1989).

The digested samples were determined quantitatively at the Chemistry Department of the Federal University of Agriculture, Abeokuta (FUNAAB) using the Atomic Absorption Spectrometer.

## RESULTS

The mean concentration levels of Mn, Fe and Zn found in the snail samples were 1.78mg/Kg, 71.8mg/Kg and 129.5mg/Kg respectively (Table 1). Manganese concentration was highest in Lafenwa market and lowest in Omida market (Table 1). Kuto and Lanfewa markets had the highest concentration of Fe (table 1), while the lowest was recorded from Elega market. Zinc exhibited the highest value in Lafenwa market and lowest from Kuto market (Table 1).

**Table 2: Concentration of Mn, Zn, and Fe in Snails from selected markets in Abeokuta**

Markets	No.	Mn (mg/kg)	Mean (mg/kg)	Fe (mg/kg)	Mean (mg/kg)	Zn (mg/kg)	Mean (mg/kg)
AD	1	1.74	1.69	59	62	131	134
	2	1.63		62		138	
	3	1.71		66		136	
	4	1.68		61		132	
EL	1	1.81	1.82	55	56	121	123
	2	1.79		57		124	
	3	1.82		59		126	
	4	1.84		54		122	
IB	1	1.85	1.91	62	65	138	141
	2	1.88		66		141	
	3	1.91		64		144	
	4	1.87		68		139	
IJ	1	1.41	1.46	68	72	118	117
	2	1.48		74		114	
	3	1.46		76		117	
	4	1.50		69		121	
IK	1	1.74	1.73	58	62	130	132
	2	1.76		66		134	
	3	1.68		62		137	
	4	1.72		60		128	
KU	1	1.98	1.93	87	91	107	112
	2	1.91		89		114	
	3	1.90		93		144	
	4	1.94		95		139	
LA	1	2.33	2.32	89	91	144	146
	2	2.30		92		147	
	3	2.34		94		149	
	4	2.31		90		143	
OM	1	1.38	1.35	78	75	129	131
	2	1.34		76		131	
	3	1.36		74		133	
	4	1.32		72		130	

AD = Adetan, EL = Elegu, IB = Iberekodo, IJ = Ijaye, IT = Itokun; KU = Kuto, LA = Lafenwa, OM = Omida

## DISCUSSION

Analysis of various specimens of Giant Land Snail (*Archachatina marginata*) collected from selected major markets in Abeokuta metropolis showed various levels of Mn, Fe and Zn.

The average concentration of manganese in the snail samples collected ranged from 1.35 mg/kg (in Omida market) to 2.32mg/kg (in Lafenwa market). The mean concentration was found to be 1.78mg/kg. This values are within the range determined by Balzan, *et al.* (2001) in four species of snail found in the north and the agricultural areas of Italy. The team found out a range of 1.0 – 13.0 mg/kg for *Helix pomatia*, 2.0 – 12.0 mg/kg for *Helix aspersa*, 2.0 – 14.0 mg/kg for *Helix lucorum* and 3.0 – 9.0 mg/kg for *Helix vermiculata*.

The average concentration of iron in the snail samples collected ranged from 56mg/kg (Elega market) to 91mg/kg (Kuto and Lafenwa markets). The difference in values is probably due to collection points feeding the different markets. The mean concentration was found to be 71.80mg/kg which is close to the results of Balzan, *et al.*, (2001) determined in four species of snails with a range of 101 – 125 mg/kg for *Helix pomatia*, 65 – 163 mg/kg for *Helix aspersa*, 210 – 294 mg/kg for *Helix lucorum* and 96 – 202 mg/kg for *Helix vermiculata*.

The average concentration of zinc in the snail samples collected was found to range from 112 mg/kg (Kuto market) and 146 mg/kg (Lafenwa market). The mean value was found to be 129.5mg/kg which is within the range given by Matyas *et al.*, (1993) with mean concentration and standard deviation of zinc in liver of snail as  $157.0 \pm 52.2$  mg/kg.

In general the concentration of the metals was of the order: Zn > Fe > Mn. Also, for all the markets the concentration of the metals was highest for Lafenwa market. This may not be unconnected with the high rate of industrial

and commercial activities associated with the market, which contribute substantially to the release of these metals into the environment.

Furthermore, the levels of the metals in all the cases were below the World Health Organization (WHO, 1996) recommended levels. The implication is that consuming snails from the study area would only be contributing to part of the dietary requirements for these metals, with no fear of adverse effects at the present levels.

The results showed that the snails were contaminated but not yet at the polluted level to warrant abstaining from their consumption. However, there is a need for constant monitoring of snail samples to ensure that it does not exceed the safe level for human consumption.

## REFERENCES

- Adeloju, B. S. 1989. Comparison of some wet-digestion and Ashing methods for voltametric trace element analysis. *Analyst* 114, pp. 455-461
- Akinnusi, O. 1998. Introduction to snail farming. Real Solution Computer, Quarry Road Abeokuta. Pp. 1-7.
- Balzan, M.C., Buosa,D., Ceocuto,M. de Poli, Giaccone, V., Moschini, G., Novelli, E. 2001. Investigation on Micronutrient Elements Composition of Terrestrial Snails belonging to the Genus *Helix*. LNL Annual Report. 2pp. [Citadudosa]
- Bislimi,K. Behluli, A.,Halili,J.,Mazreku,I., Osman, F. and Halili, F. 2013. Comparative analysis of some biochemical parameters in Heomolymph of Garden snail (*Helix pomatia* L.) of the Kostriot and Ferizaj Regions, Kosovo. *International Journal of Engineering and Applied Sciences*. 4 (6), pp. 11 – 18.

Ezemonye, L., Enobakhare, V. and Ilechie, J. 2006. Bioaccumulation of heavy metals (Cu, Zn, Fe) in Freshwater snails (*Pila ovate* Oliver 1804). *Journal of Aquatic Sciences* 21 (1), pp. 23-28.

Food and Nutrition Board, Institute of Medicine. 2001. Dietary reference intakes for vitamin A, vitamin K, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium and zinc. Washington, DC. National Academy Press, pp. 394-419.

Gbaruko, B. C., Friday, O. U. 2007. Bioaccumulation of heavy metals in some fauna and flora. *International Journal Environ. Sci. Tech.*, 4 (2), pp. 197 – 202.

Kadria, M. A. and Hoda A. T. 2013. Freshwater snails as bio-indicator for some heavy metals in the aquatic environment. *African Journal of Ecology*. 51 (2), pp 193-198.

Khalil, A. M. 2013. The effects of soil heavy metals pollution and seasonal variation on gametogenesis and energy reserves of the land snail *Eobania vermiculata*. *Journal of Biology and Earth Sciences* 3(2), pp. 206 - 213.

Khillare, K, Khillare, Y.K and Wagh, U. 2015. Bioaccumulation of heavy metals in freshwater fishes from Aurangabad District, Maharashtra, India. *World Journal of Pharmacy and Pharmaceutical Sciences*. 4 (9), pp. 511-520.

Matayas P., Katalin V. and Jones S. 1993. Cadmium uptake and deposition in different organs of *Lymnaea castragnalis* and the effect of cadmium on the natural zinc level. *Environmental contamination and Toxicology* 24, pp. 28 -32.

Martin S. H., Gordon, R. M. and Fitzwater S. E. 1991. Iron Limitation? The case for Iron Limnol. *Oceanogr.*, 36 (8): 1793 -1802

McHargue J. S. 1923. The effect of different concentrations of manganese sulphate on the growth of plants in acid neutral soils and necessity of manganese as a plant nutrient. *Jour. Agric. Research*, 24, pp. 781-94

NA 2002. Dietary reference Intakes (DRIs). Recommended Intakes for Individuals, elements. National Academics. (online) [www.nationalacademies.org](http://www.nationalacademies.org). Retrieved 11/04/16.

Peter O'Neils 1993. *Environmental Chemistry*, Chapman Publishers, London 828pp.

Samuel F and Piper C.S. 1982 'Grey-Speck (manganese deficiency) disease of Oats'. *Journal of the Department of Agriculture South Australia*, 31, pp. 696-705

Shotuyo, A. L. A.; Akintunde, O. A. and Oladoyinbo, E. O. 2008. Effect of Calcium and Phosphorous in the diet of high Forest African Giant Land Snail (*Archachatina marginata* (Swaison)). *Integrated Journal of Sciences and Engineering*. 7 (1) pp. 31 – 38.

Shotuyo, A.L.A., Bamgbose, O., Oduntan, O.O. and Ogunsola, O.S. 2013. Levels of heavy metals in Giant African Land Snail (*Archachatina marginata*). Proceedings of the 2<sup>nd</sup> International Conference/Workshop on Giant African Land Snail (NetGALS) 2-5 June, 2013. Abiona, J.A. and Osunsina, I.O (Eds) pp. 91-96.

World Health Organization (WHO) 1996. Trace Elements in Human Nutrition and Health. Technical report of the joint WHO/FAO/IAEA Expert Consultation, Geneva.