LEVEL OF HEAVY METALS AND MINERAL IN TISSUES AND BODY FLUIDS OF AFRICAN GIANT SNAIL (*ARCHACHATINA MARGINATA*)

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ABSTRACT

Minerals and heavy metals contents in tissues and body fluids of African giant land snail (*Archachatina marginata*) from different open markets (Ketu, Mile 12, Ikorodu Garage, and Ogijo) in Ikorodu metropolis were evaluated. Snail tissues and body fluids were harvested having cracked the tail-end of the shell. The snail tissues and body fluids were separated and extracted then digested. Evaluation was done for content of Cu, Cd, Cr Pb, Zn K, Na, Mg, and Ca using Atomic Absorption Spectrophotometer (AAS). The levels of Cu, Cr, Cd, Pb and Zn determined in the body tissues were taken as heavy metals while the levels of K, Na, Mg and Ca analyzed were taken as the mineral contents in the body fluid. The results obtained were compared with both the Federal Environment Protection Agency (FEPA) and the World Health Organisation (WHO) standards for metals in foods. The `value of zinc was highest at Ogijo market (3.301 ppm) and lowest at Ketu (1.904 ppm) market in all the sample due to the bioaccumulation of metals as a result of industrial and commercial activities. The range of Cd, Cr, Cu, Pb and Zn content of snail tissue were 0.001 - 0.003, 0.119 - 0.160, 0.199 - 1.790, 0.000 - 0.007 and 1.904 - 3.30 ppm respectively, similarly Ca, Mg, Na and K of snail fluids were 1823 - 2089, 11.05 - 14.01, 5.02 - 6.05 and 39.07 - 243.9 (mg/kg) respectively. Generally, Cu, Pb, Cd, Zn and Cr accumulated levels were lower than WHO and FEPA), while the mineral content falls within the range.

Key words: Heavy Metals, Snail, Mineral Analysis, AAS

INTRODUCTION

The African giant snails feed in the undomesticated areas, plant waste and decomposed of animals remains. The source of their foods is a likely potential of buildup of pollutants like heavy metals in their tissues, thus it may contribute significantly in the movement of chemicals from foliage or garbage to carnivores. Such movement down the food chains is one of the significant aspects of ecotoxicology [1]. Molluscs amass metals in their tissues in such proportion to the level of ecological contamination and can be used as indicators of aquatic pollution [2]. Snails have high accumulative capacities to many pollutants, particularly heavy metals [3]. Trace metals such as Cu, Zn, Pb, Hg, Al, Cr and Cd are common constituents of aquatic environment, and traces are always found in aquatic organisms [4].

Although, in a natural habitat, metal uptake is an increasing practice that occurs via mixed atmosphere, soil and food exposures [5]. Majority of the ingested metals are metabolically synchronized in the snail body either by cellular segmentation or by complexation to exact metallothioneins [6]. Bioaccumulation in organisms may be linked with considerable connections between these trace metals and macro metallic elements such as K, Ca, Na and Mg. Consequently, inhabitants who eat snails from estuarine or coastal areas from crude oil polluted soils are at risk of trace metal poisoning [7], thus the need for humans to ascertain the sources the snails they eat.

Nutritionally molluscs are highly beneficial and they can also pose a great health challenge to man due to buildup of toxic heavy metals (HMs) such as lead (Pb) and cadmium (Cd). At a low concentration, Pb and Cd are toxic to biological systems. Lead is capable of causing both short and long lasting toxicities. Short toxicity occurs during unintended exposure to high concentrations of soluble Pb compounds. On the other hand, long lasting toxicity can occur through eating of lead-contaminated foods. Lead is known predominantly to decrease intellectual growth in kids and causes cardiovascular diseases in adults and in severe cases, death [8].

MATERIALS AND METHODS

SAMPLING

A hundred (100) Snails samples were bought from four different open markets around Ikorodu metropolis, Lagos State. The snails were separated from the shells and the flesh oven dried at 105 °C to constant weight. The dried samples were grounded using mortar and pestle, digestion was carried out, heavy metals and mineral analysis were determined using Atomic Absorption spectrophotometer

DIGESTION

An amount of 0.2 grams of the sample was weighed into a conical flask with 10 ml of HNO_3 added and gently heated on a hot plate. Heating was then continued until the brown fumes turned to white. The flask was brought down and cooled to room temperature. The mixture was rinsed with 20 ml of deionized water and filtered into a standard 25 ml volumetric flask and made up to mark in readiness for AAS measurement using whatman filter papers [9,10].

SERIAL DILUTION OF STOCK STANDARD

The stock standard was prepared by weighing 1.299 g of $PbNO_3$ salt and dissolving in 1 L of 5% HNO_3 and was serially diluted to concentrations of 5, 10, 15, 20, 25 ppm. The different calibrations levels were used to generate a suitable curve which was used to calibrate the instrument using serial dilution formula; $C_1V_1=C_2V_2$

Where C_1 and C_2 are initial and final concentrations

V_1 and V_2 are initial and final volumes

RESULTS AND DISCUSSIONS

The different markets are represented as shown below:

Table 1: RESULTS FOR HEAVY METALS IN SNAIL TISSUE WITH THE STANDARD ERROR OF MEAN

METAL	A-MILE 12 (ppm)	B- KETU (ppm)	C-IKORODU GARAGE (ppm)	D-OGIJO (ppm)
CADMIUM(Cd)	0.001±0.0006	0.003±0.0006	ND	0.002±0.0006
CHROMIUM(Cr)	0.119±0.0205	0.160±0.0205	ND	ND
COPPER(Cu)	0.199±0.3572	0.583±0.3572	0.406±0.3572	1.790±0.3572
LEAD(Pb)	ND	ND	ND	0.007
ZINC(Zn)	2.042±0.3234	1.904±0.3234	2.110±0.3234	3.301±0.3234

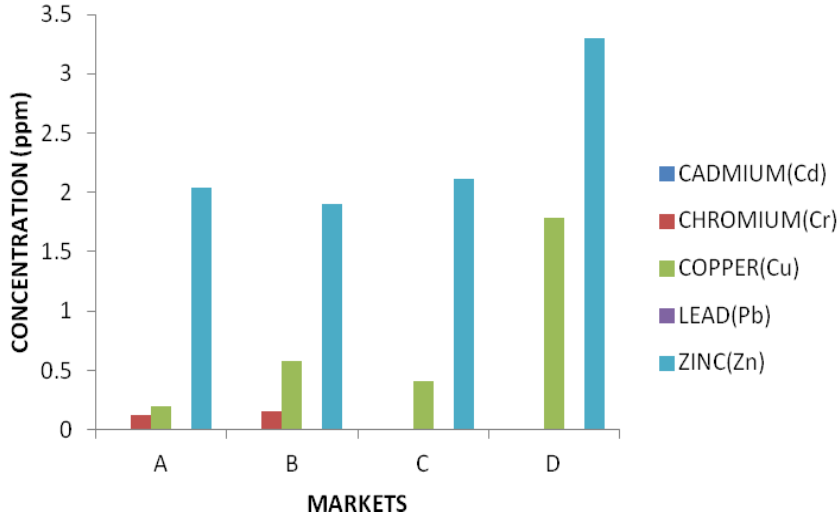


Fig. 1: chart showing heavy metals in snail tissue from four different markets

Table 2: RESULTS FOR HEAVY METALS IN SNAIL FLUID WITH THE STANDARD ERROR OF MEAN

METALS	**A-MILE 12 (ppm)**	**B- KETU (ppm)**	**C-IKORODU GARAGE (ppm)**	**D-OGIJO (ppm)**
CADMIUM(Cd)	ND	ND	ND	ND
CHROMIUM(Cr)	1.362±0.060	ND	1.352±0.060	1.178±0.060
COPPER(Cu)	0.690±0.2954	1.700±0.2954	0.322±0.2954	1.101±0.2954
LEAD(Pb)	0.007	ND	ND	ND
ZINC(Zn)	15.02±2.6767	2.612±2.6767	9.420±2.6767	5.601±2.6767

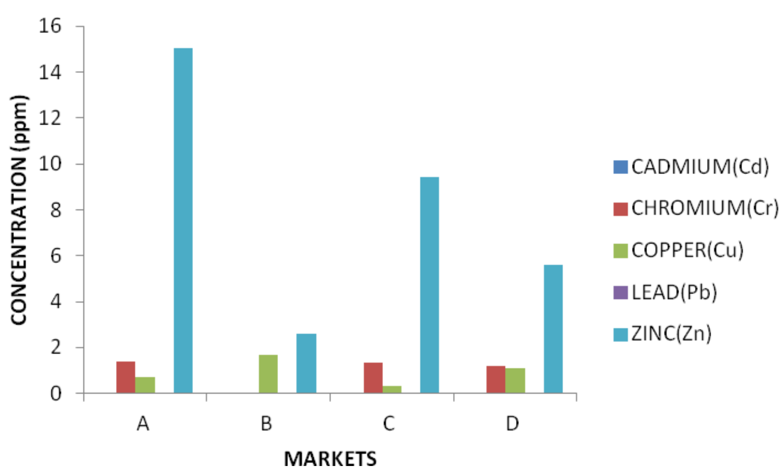
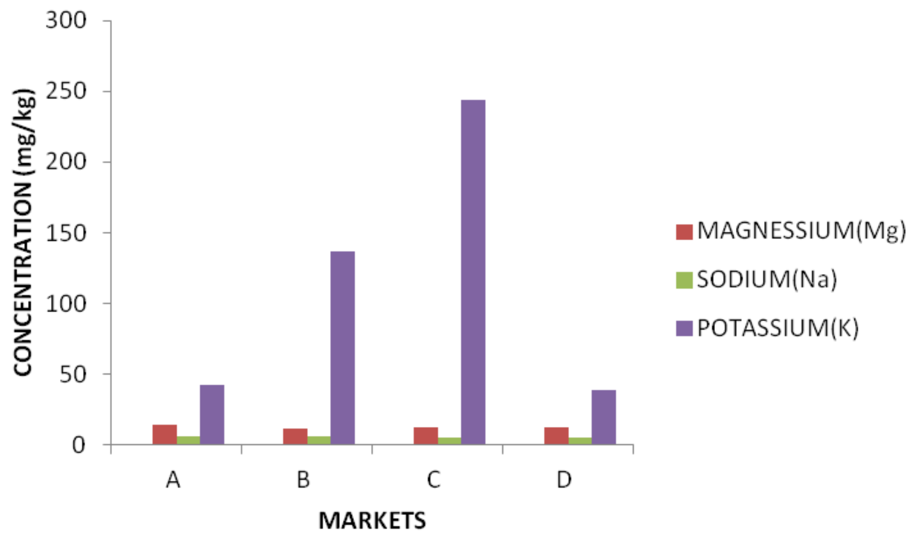


Fig. 2: chart showing heavy metals in snail fluids from four different markets

Table 3: RESULTS FOR MINERAL ANALYSIS OF SNAIL FLUIDS

MINERAL	**A-MILE 12 (mg/kg)**	**B- KETU (mg/kg)**	**C-IKORODU GARAGE (mg/kg)**	**D-OGIJO (mg/kg)**
CALCIUM (Ca)	2089.0±63.5601	1823.5±63.5601	1956.0±63.5601	2089.0±63.5601
MAGNESSIUM(Mg)	14.01±0.6143	11.05±0.6143	12.08±0.6143	12.25±0.6143
SODIUM(Na)	6.03±0.2930	6.05±0.2930	5.02±0.2930	5.03±0.2930
POTASSIUM(K)	42.05±48.4660	136.75±48.4660	243.95±48.4660	39.07±48.4660

(a)



(b)

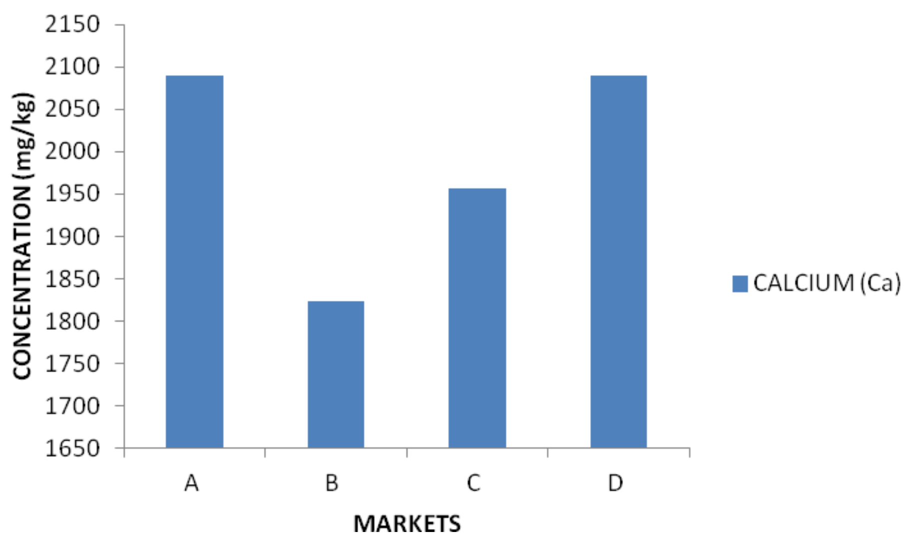


Fig 3: chart showing mineral analysis from the four different markets (a) Mg, Na, K (b) Ca

DISCUSSION

From the results obtained it was observed that the concentrations of cadmium, chromium, copper, lead and zinc in the *Achachatina marginata* tissue in Mile 12 market were 0.001, 0.119, 0.199, ND and 2.042 (mg/g), respectively. This slightly high valuse can be attributed to industrial influence in that area this was supported by Adedeji *et al*. (2011) [11] *who investigated heavy metals content in snails form Alaro River within Oluyole industrial area in Ibadan, Nigeria*. From our findings we observed that the concentrations (mg/g) of heavy metals in body fluid were as follows; cadmium - ND, chromium – 1.362, copper – 0.690, lead – 0.007 and zinc- 15.02. The result indicates zinc concentration to be highest in both tissue and fluid which was supported by Agusa *et al.* (2005) [12].

The concentrations (mg/g) of the metals in the tissue of snail in ketu market were found to be as follows: Cd=0.003 Cr=0.160, Cu=0.583 ,Pb= ND and Zn=1.904 Chukwujindu *et al* (2008) [13] is in accord with our findings, while in the fluid, the concentrations obtained were Cd = ND, Cr=ND, Cu= 1.700 and Zn= 2.612 The result of analysis indicates higher concentrations of Zinc metals in the tissues and body fluid. This may be due to adsorption of the metals in the fluid; it also implies that the heavy metals in these organisms were gradually leached from the soft tissue to the fluid with time. In Ikorodu garage market the concentrations in the tissues were as follows Cd= ND, Cr =ND, Cu=0.406, Pb= ND, and Zn=2.110 Sivaperumal *et al.* (2007) [14] was in line with our submission . We observed that the value for the body fluid were Cd=ND, Cr=1.352, Cu==0.322, Pb=ND, and Zn=9.420. However at Ogijo, the values of heavy metals in the tissue were as follows Cd=0.002 Cr=ND, Cu=1.790 ,Pb=0.007 and Zn=3.301 and in the body fluid it ranges from Cd=ND Cr=1.178, Cu=1.101,Pb= ND and Zn= 5.601, this is in conformity with Lin (2006) [9] that Zn are capable of bio-acuminating up to ten times higher in freshwater snail than in sediments of soil. The concentration of zinc in the fluid of the snail was high than the other parts which tallies with the work of Yap and Cheng (2016) [10]. Generally, the concentrations of these heavy metals in the snails are low but continuous bioaccumulation may lead to health threat The results obtained for the mineral contents were Ca=2089.0, Mg=14.01, Na =6.03, K=42.05 mg/kg in Mile 12 which correspond with the findings Emelue and Dododawa (2017) [15]. From the results gathered in Ketu we recorded the highest value in Ca=1823.5 mg/kg and the least value been Na=6.05 mg/kg. The trend also continue in Ikorodu with Ca having 1956.0 mg/kg K having 136.75 mg/kg and Na having the least value of 5.02 mg/kg. Similar pattern was also observed in Ogijo which also having the least value of 5.03 mg/kg, K having 39.07 mg/kg and the highest been Ca which was 2089.0 mg/kg this may be due to proxity to farm lands and poultry farms in the area sampled. This coincides with both the submissions of Fagbuaro *et al.* and Ozogal *et al.* [16,17].

Some of the heavy metals were higher than the maximum permissible limit set by local and international safety agencies this may be due to the closeness to industrial and commercial activities. International safety agency such as World health organisation WHO and Federal environmental protection agency F.E.P.A [18]. set a maximum permissible limit for all heavy metals intake, but our results showed that some were above and below the standards as shown earlier.

CONCLUSION

It can be concluded that due to accelerated growth in commercial and industrial activities, coupled with high rate of application of fertilizers and herbicides on farmlands within the areas sampled, this may have been responsible for the high level of heavy metals and mineral contents in the snail samples.

The snail, *Archachatina marginata*, tissue is a good source of Ca, Mg, Na, and K and can play a significant role in blood clotting in human body. Also the high concentration of Ca in the snail is beneficial to human in the development of bones, teeth and the clotting of blood.

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