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ANALYSIS OF HEAVY METALS IN AFRICAN GIANT LAND SNAIL *(Archachatina marginata)*: A COMPARISON BETWEEN WILD AND DOMESTICATED SPECIES

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ABSTRACT

This study examined the level of heavy metal in meat, shell and haemolymph of wild and domesticated African Giant Land Snail (Archachatina marginata). A total of fourteen (14) African Giant Land Snail were used for the study, seven (7) of which were purchased from Federal University of Agriculture, Abeokuta's Wildlife domestication unit and the other seven (7) were sourced and handpicked from the institution's premises. Data obtained were subjected to descriptive statistics and least significant difference was done to separate the means. The results showed that in the meat, shell and haemolymph of wild and domesticated African Giant Land Snail, the concentration of Arsenic (As) ranged from 0.002 to 0.003 while chromium (Cr) had mean value of 0.001 to 0.002. Also, Cadmium (Cd) and Lead (Pb) had the mean value of 0.001 to 0.002 respectively. Nickel (Ni) was too low to be detected in all the samples collected. Furthermore, the correlation between the meat, shell and haemolymph from wild and domesticated snail shows that the haemolymph of wild and domesticated snail was significant. The study concluded that the present levels of heavy metal in both wild and domesticated snail samples has no adverse effects since the metals are below WHO recommended levels. It is therefore recommended that proper monitoring of heavy metals in snail on regular basis should be encouraged in order to cater for the safety of the consumer's health.

Keywords: Environmental pollution, Human health, Threat, Concentration

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INTRODUCTION

The giant African land snails (*Archachatina marginata*) are pulmonate, nocturnal, hermaphroditic gastropods of the family Achatinidae. They are indigenous to Africa and are distributed in sub-Saharan Africa, ranging from the Gambia in the West to the Lake Chad region in the East. Nigeria is known to be richly endowed with different species of snails which vary in sizes, colours, adaptability, and performance (Ejidike and Adewuyi, 2018, Ibom, 2009). The land snails are conventional wildlife protein source in Nigeria and some parts of Africa (Fagbuaro *et al.*, 2006). Snail meat is a nutritious food that is high in protein, low in fat and a good source of iron (USDA, 2006). According to Akinnusi (2002) snail meat is high in protein, iron, calcium, and phosphorus, but low in sodium, fat, and cholesterol, and contains almost all the amino acids needed by man. Snail meat is socially well accepted in many parts of Nigeria and it is now becoming a highly valued delicacy in recent times. Snails can accumulate substantial amounts of heavy metals in a polluted environment (Carbone and Faggio, 2019). Environmental pollution has been perceived as an important issue worldwide, disturbing the atmosphere and posing a serious threat to human

well-being (Khan and Ghouri, 2011). They are threat to biotic organisms because of their persistence and harmfulness which makes them a serious contaminant (Adeleken and Abegunde, 2011). Heavy metals are threat to human wellbeing even in low concentration as a result of ineffective excretion mechanism (Ghosh *et al.*, 2012). Prolonged exposure to environmental pollution has been estimated by WHO (2006) as a factor responsible for quarter of diseases affecting humankind nowadays (Kimani, 2007). The major heavy metals of concern are Lead (Pb), Chromium (Cr), Cadmium (Cd), Arsenic (As) and Nickel (Ni), because they are the most toxic and have known serious effects on human health. Heavy metals are toxic in nature and even at relatively lower concentration can cause adverse effects (Santhi *et al.*, 2008). Information about the dietary intake of such heavy metals is important to assess risks to consumers. This study examined the concentration of heavy metal in wild and domesticated giant land snail.

MATERIALS AND METHOD

Study Area

The study was carried out at Federal University of Agriculture, Abeokuta (FUNAAB) which is located next to Ogun-Osun River Basin Development Authority (OORBDA), along Alabata-Abeokuta Road, off Abeokuta-Ibadan Road in the north-eastern end of the city which lies approximately on latitude $7^0$30' N and longitude $3^0$54' E. It lies within the humid lowland rainforest region with two distinctive seasons. The wet season extends from March to October while the dry season extends from November to February. The mean annual rainfall is 1113.1 mm. The rainfall has a characteristic bimodal distribution with peaks in July and September and breaks in August. Generally, the rainfall could be heavy and erosive sometimes accompanied by lightning and thunderstorm at the beginning and the end of rainy season. The mean monthly temperature varies from 22.9^0C in August to 36.32^0C in March. The relative humidity is high ranging from 75.52^0C in February to 88.15^0C in July (Aiboni, 2001). The vegetation of the area comprises of low land forest but become secondary rainforests or forest re-growth because of the increase in land use and exposure. The vegetation has the characteristics of tropical rainforest such as high forest and growth of massive trees and twinning shrubs. The forest is covered with litters of fallen trees by both human and natural activities.

Sample collection

Seven (7) giant land snails were purchased from Federal University of Agriculture, Abeokuta's Wildlife domestication unit and the other seven (7) were sourced and handpicked from the institution's premises. The snails were taken to laboratory for heavy metal analysis.

Haemolymph Collection

Haemolymph was collected with a glass micropipette after puncturing the shell and touching the foot with the point of a micro pipette tip, the snail was forced to retract deeply into its shell and haemolymph was extruded (Sminia and Barendsen 1980). In this way about 300 µL of haemolymph was obtained from each snail.

Shell Collection

The shells were gently cracked with a clean knife to avoid causing damage to the meat, then they were gently peeled away from the tissue. The shells were dried crushed to fine powder and sieved with 2 mm mesh sieve to achieve particle size. Homogeneity was done and the samples was labelled in polythene bags prior to analysis.

Meat Collection

Ten (10) g of meat samples was collected in small dark labelled polythene bags, which was sealed with a rubber band prior to analysis

Haemolymph Digestion

The haemolymph was centrifuged at 15000 rpm for 45 min at 4C° to collect serum, and the haemocyte lysate suspension (HLS) was obtained following the same procedure as described by Gopalakrishnan *et al.*, (2009).

Shell Digestion

The shell was digested with a mixture of HNO_3 and HCl with the addition of H_2O_2, so that approximately 4g of sample is poured with 10 mL HNO_3 (1:1) in a glass partially covered and heated at 95-100°C for 10-15 minutes. To the cooled sample 5 mL of concentrated HNO_3 was added, cover and heat for 30 min at the same

temperature. After cooling, 2 mL of deionized water and 3 mL of 30 % H_2O_2 was added and slight heated. After the sample was cooled 7 mL of 30 % H_2O_2 was added. Then 5 mL of concentrated HCl and 10 mL of deionized water were added, covered, and heated for 15 minutes. After cooling, the sample was transferred to a flask of 50 mL and completed to the volume with deionized water for analysis (AOAC, 1997)

Meat Digestion

This was done by weighing 1.5g of the samples and then transferred into a conical flask. HNO_3-H_2SO_4 wet digestion method was used for decomposition of the organic matter present in the samples. To the sample in the conical flask 5ml of concentrated HNO_3 was added followed by 10ml of concentrated H_2SO_4. This was then placed on the heating mantle at a temperature of 100^{o}C and Nitrogen (IV) oxide fumes was given off. Heating was continued until a clear solution was obtained indicating that digestion is complete. The conical flask was then allowed to cool for some minutes after which the clear solution was transferred into a measuring cylinder and made up to 50ml with distilled water. The digested sample were then transferred into digestion bottles and subsequently labelled.

Data Analysis

Data obtained were subjected to descriptive statistics and means separation was done using least significant difference

RESULTS

Levels of heavy metal concentration in meat domesticated and wild Snails.

The result in Table 1 shows the level of heavy in meat, shell and haemolymph of wild and domesticated snail *(Archachatina marginata)*. In the meat samples, the level Arsenic (As) for both samples was found to be 0.002 and 0.003 mg/l while Chromium (Cr) in both samples was found to be 0.002 mg/l. Cadmium (Cd) and Lead (Pb) in both samples had the mean values of 0.002 and 0.001 mg/l respectively. In the shell, Arsenic (Ar) for both samples was 0.002 and 0.002 mg/l respectively. Chromium (Cr), Cadmium (Cd) and Lead (Pb) in both samples were 0.001 mg/l.

Furthermore, in haemolymph, Arsenic (As) for both samples was 0.003 mg/l. Chromium (Cr) in both samples was 0.001 and 0.002 mg/l respectively. Also, Cadmium (Cd) in both samples was 0.002 mg/l respectively and Lead (Pb) in both samples was 0.001 mg/l respectively while the level of Nickel (Ni) was too low to be detected.

Table 1: Level of heavy metal concentration in wild and domesticated Snail

Snail Part	Source	Mean ± sdv				
		As	Cr	Cd	Pb	Ni
Meat	Domesticated	0.002 ± 0.003	0.002 ± 0.001	0.002 ± 0.001	0.002 ± 0.001	0.000
	Wild	0.003 ± 0.002	0.002 ± 0.001	0.001 ± 0.001	0.001 ± 0.001	0.000
Shell	Domesticated	0.002 ± 0.003	0.001 ± 0.001	0.001 ± 0.001	0.001 ± 0.001	0.000
	Wild	0.002 ± 0.001	0.001 ± 0.001	0.001 ± 0.001	0.001 ± 0.001	0.000
Haemolymph	Domesticated	0.003 ± 0.002	0.001 ± 0.001	0.002 ± 0.001	0.001 ± 0.001	0.000
	Wild	0.003 ± 0.002	0.002 ± 0.001	0.002 ± 0.001	0.001 ± 0.001	0.000

Correlation between the meat, shell and haemolymph of wild and domesticated snail

The result in Table 2 shows the correlation between the meat, shell and haemolymph from both wild and domesticated snail. The result shows that the haemolymph of wild and domesticated snail was found to be significant.

Table 2: Correlation for meat samples of wild and domesticated snail

Snail part		Wild	Domesticated
Meat	Wild	1	0.07538
	Domesticated	0.07538	1
Shell	Wild	1	0.15058
	Domesticated	0.15058	1
Haemolymph	Wild	1	0.38739**
	Domesticated	0.38739**	1

DISCUSSION

The result from the findings revealed that the mean concentration (mg/l) of heavy metals in domesticated snail sample ranged from 0.001 to 0.003mg/l in meat, shell and haemolymph. Cadmium (Cd) and Lead (Pb) were found in both domesticated and wild meat samples with the mean value of 0.002 and 0.001 mg/l respectively. The mean value is lower than the findings of Mariam *et al*., (2004) who reported Cadmium (Cd) concentrations of 0.33, 0.37 and 0.31mg/kg in lean meat of beef, mutton and poultry respectively. Chromium (Cr) was found to have the same mean value of 0.002 mg/l in both samples. Arsenic (As) had a mean value of 0.002 mg/l in domesticated meat sample which is slightly lower than the wild sample with the mean value of 0.003 mg/l while Nickel (Ni) was not detected in both samples.

Arsenic (As) was found to have the highest concentration in the shells of both the domesticated and wild samples with the mean values of 0.002 and 0.002 mg/l respectively while Chromium (Cr), Cadmium (Cd) and Lead (Pb) all had the same mean value of 0.001 mg/l in both domesticated and wild samples. This is in line with the study of Nwoko *et al*., (2014) who reported the concentration of Cr in shell and tissue of snail to be 1.00 mg/kg and 1.00 mg/kg respectively.

Furthermore, in the haemolymph, Chromium (Cr) was found in both domesticated and wild samples of the haemolymph with the mean values of 0.001±0.001 and 0.002±0.001mg/l while Arsenic (As), Cadmium (Cd) and Lead (Pb) all had same mean values for both samples with 0.003±0.002, 0.002±0.001, and 0.001±0.001mg/l. This corroborates with the study of Ebabhamiegbebho *et al.*, (2018) who stated that the concentrations of Pb, Cr and Ni in raw snail sample did not exceed the World Health Organization (WHO) Standard values of 1.0, 1.0 and 0.05 mg/kg.

CONCLUSION

It can be concluded that there are presences of heavy metals in both wild and domesticated snail samples although the levels were below the World Health Organization (WHO, 1996) recommended levels. Also, snail consumption only contributes to part of the dietary requirements for these metals with no fear of adverse effects at the present levels. It is therefore recommended that proper monitoring of heavy in snail on regular basis should be encouraged in order to cater for the safety of the consumer health.

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