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**ACHIEVERS JOURNAL OF SCIENTIFIC RESEARCH***Open Access Publications of Achievers University, Owo*Available Online [www.achieverssciencejournal.org](http://www.achieverssciencejournal.org)**Investigation of Bio-accumulation of Heavy Metals in the Organs (Heart, Lungs, Kidneys and Livers) of Wild and Domestic Animals in Owo Environs.****M.B. Okunade, D.A. Oyegoke, O.D. Owolala, and A. Ademola**

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**Abstract**

Fresh organs (hearts, kidneys, lungs and livers) of three cane-rats i.e grass-cutters (*Thryonomys*) were collected on different days at Bush animals market at Emure-ile, Owo. Also organs of three cows (*Bos taurus*) and three goats (*Capra aegagrus hircus*) were collected at Oja-oba Central Abattoir in Owo. The organs were transported to the laboratory for analysis. A known weight about 10g of each organ was taken, dried in the oven between a temperature of 100 -110°C for about 3-4 hours and weighed intermittently until a constant weight was obtained. Samples were transfer into the muffle furnace for ashing between a temperature of 400-700°C. The period of ashing was between 3-4 hours to ensure total ashing of the samples. The heavy metals Lead (Pb), Cadmium (Cd), Chromium (Cr) and Copper (Cu) were determined by Atomic Absorption Spectrophotometer, model Buck Scientific, 210/211 VGP. The results showed the level of concentrations in all the part of the organs of the respective animals. The overall conclusion of the study recommends that all the organ parts should not be consumed.

**KEYWORDS:** Wild animals, Domestic animal, Organs, Heavy metal.**1.0 INTRODUCTION**

This survey is to investigate the bioaccumulation of heavy metals in both the wild and domestic animals and the effect of these heavy metals on consumption by man. Seiakoto *et al.* (2014) determined the distribution of heavy metal in organs of sheep and goat reared around gold mining

town in Ghana. The group determined heavy metals like mercury (Hg), Zinc (Zn), Copper (Cu), Chromium (Cr), nickel (Ni), Cobalt (Co), Lead (Pb), cadmium (Cd) and Arsenic (As). The group found that the total concentration of zinc and copper were high in the organs followed by Cr, Ni, Co, Pb, Cd, As and Hg.

The liver, kidney and lungs accumulated high level of metals while brain accumulated lowest. The mean Zinc concentration in all organs ranged between  $24.88 \pm 11.22$ mg/kg in goat brain and  $97.0 \pm 19.66$ mg/kg in the liver of goat. Mean copper (Cu) concentration ranged between  $7.96 \pm 1.20$  mg/kg in the small intestine of sheep and  $106.63 \pm 11.24$ mg/kg in the liver of sheep. Cadmium concentration in the liver and kidney in both species were above the set limit (WHO) of 0.05mg/kg (WHO, 1996). Consumption of kidney, liver and lungs of goat and sheep having high concentration of Zinc (Zn), Copper (Cu) and Cadmium (Cd) may lead to bioaccumulation of these heavy metals in humans, causing health hazard of metal toxicity.

Osuola *et al.* (2014) determined the concentration of heavy metals as they affect the liver and kidney in albino rats (*Rattus Norvigus*). The group evaluated the toxicological effect of Cadmium (Cd), Iron (Fe), Manganese (Mn), Lead (Pb) and Zinc (Zn). Cadmium (Cd) was found to be most toxic followed by Zinc, Lead, Iron and Manganese, the least toxic. These heavy metals affected the functioning of both the liver and the kidney of albino rats. Bala *et al.*, (2012) investigated the prevalence of Cadmium in kidney and liver of cattle at the slaughter section of Sokoto Central Abattoir, Sokoto, Nigeria. The group found that Cadmium tested positive in both liver and kidney of all the cattle. Highest concentration of Cadmium ( $0.0243 \pm 0.239$  mg/kg) was found in the liver and the least concentration ( $0.0162 \pm 0.0119$ ) among the age group 0-2 years. The concentration of Cadmium in the kidney was also higher among age group  $\geq 9$  years ( $0.0526 \pm 0.0821$ mg/kg) and the least ( $0.0194 \pm 0.0134$  mg/kg) among the age group 0-2 years and significant difference ( $P < 0.05$ ) in the concentration of cadmium in the kidney and liver samples of different age

groups of the slaughtered cattle. The study confirmed that the level of Cadmium in the kidney and the liver were below WHO (2000) recommendation i.e 1mg/kg in the kidney and 0.5mg/kg in the liver.

Ajayi *et al.* (2001) worked on the distribution and effect of some heavy metals in the selected organs and tissues of albino-rats not exposed to vehicles exhaust fumes. The group found that heavy metal composition varied with the type of soft tissues and locations. That Zn, Co, Mn, Pb and Fe composition were significantly higher in albino rats exposed to diesel fumes at location called Ijemo compared with albino rats exposed to diesel fumes at another location called Oke-ilewo in Abeokuta, Ogun state because exposure to heavier vehicular fumes at Ijemo location gave higher concentration of heavy metals in Ijemo-location.

Iwegbue (2008) investigate heavy metals composition of liver and kidney of cattles from seven locations in southern Nigeria. He found that the mean and range of Cadmium (Cd) in livers and kidneys to be 0.08 (0.01-0.23)mg/kg and 0.14(0.01-0.46)mg/kg respectively, Cr, 3.62 (0.98-6.33)mg/kg and 32.26(0.10-78.65); Copper (Cu) 1.99(0.11-8.99)mg/kg and 3.27 (0.22-7.49) mg/kg, Iron (Fe) 37.75 (2.64-85.60) mg/kg and 32.26 (0.10-78.65) mg/kg, Nickel (Ni) 0.12 (0.01-0.55) mg/kg and 0.20 (0.02-0.46) mg/kg. the significant difference was observed in the heavy metal levels in the livers and kidneys from different locations and between the heavy metal levels in livers and kidneys from the same location. He concluded that the levels of various heavy metals were generally low and within international safe levels.

Heavy metals pollution is a global problem facing the world at large (Thompson *et al.*, 2019). The aim of this project is to investigate the levels of heavy metals i.e Lead (Pb), Chromium (Cr),

Cadmium (Cd) and Copper (Cu) present in the heart, lungs, kidney and liver of wild and domestic animals and assess their safe levels.

## 2.0 Materials and Methods

### 2.1 Study area

Ondo state is one of the southwestern states. It is the 18<sup>th</sup> largest state in the country. The region is characterized by sedimentary basin. The state economy is dominated by petroleum industry, with cocoa production, asphalt mining and activities utilizing the state's extensive coastline. is a major occupation of the resident of the area. Owo metropolis is in Owo Local Government area of Ondo state. The coordinates which lies at 7 11'N 5 35'E.

### 2.2 Material

Three grass-cutter rats (Cane-rats) dead (fresh) were obtained from bush- animal sale centre on different days along Owo-Akure Expressway, Ondo state. Each carcass was a daily fresh-killed grass-cutter and the organs i.e heart, lungs kidney and livers were removed and transferred into separate sterile polythene containers and labeled accordingly. They were transported to the laboratory for further processing and analysis.

B. Fresh samples of heart, lungs, kidneys and livers were collected from three (3) cows on different days at Oja-Oba Central Abattoir at Owo town. They were stored in

sterile polythene bags, labeled and transported to the laboratory for further processing and analysis.

C. Fresh samples of heart, lungs, kidneys and livers were collected from freshly killed three (3) goats on different days at Goat Abattoir Market at Owo town. They were stored in sterile polythene bags, labeled and transported to the laboratory for further processing and analysis.

**2.3 Sample Treatment:** About five (10) grams each of heart, lungs, kidney and livers from each of the three (3) animals i.e cow and goat (domestic animals) and grass-cutter (Cane rats) (wild animal) were dried in the oven between a temperature of 100-110°C for a period of three (3) hours (Emmanuel *et al.*, 2020; Ogundeleolusola *et al.*, 2019). The drying continued until a constant weight was obtained for each organ. They were then transferred into muffle furnace. The temperature of the furnace was programmed between 500-700°C and the dry-ashing allowed to continue for a period of three-four hours. After ashing, the samples were cooled at room temperature, re-weighed and stored in sterile sample bottles. To each samples, 2.5ml of 6M HNO<sub>3</sub> acid was added to dissolve the content. The filtered and diluted to 25ml with distilled water in a standard flask ready for analysis.

## 3.0 Results and Discussions

**Table 1:** Level of heavy metals in hearts, lungs, kidneys and livers of grass-cutters sold in Emure (along Owo-Akure expressway), Ondo state, Nigeria

Parameter	Hearts	Lungs	Kidneys	Livers
Cadmium	0.01 ± 0.00	0.01 ± 0.00	0.01 ± 0.01	0.02 ± 0.01
Chromium	0.73 ± 0.21	0.62 ± 0.14	0.27 ± 0.15	0.34 ± 0.03
Copper	0.92 ± 0.05	0.74 ± 0.15	0.62 ± 0.16	1.93 ± 0.84
Lead	4.77 ± 4.75	3.97 ± 4.14	0.43 ± 0.21	0.60 ± 0.01

**Table 2:** Level of heavy metals in hearts, lungs, kidneys and livers of cows from Owo Abattoir market, Ondo state, Nigeria

Parameter	Hearts	Lungs	Kidneys	Livers
Cadmium	0.03 ± 0.02	0.02 ± 0.01	0.03 ± 0.01	0.03 ± 0.01
Chromium	0.49 ± 0.12	0.35 ± 0.15	0.32 ± 0.19	0.49 ± 0.17
Copper	1.62 ± 1.69	2.37 ± 1.2	0.73 ± 0.14	19.96 ± 16.95
Lead	0.67 ± 0.25	0.50 ± 0.2	0.37 ± 0.01	1.00 ± 0.60

**Table 3:** Level of heavy metals in hearts, lungs, kidneys and livers of goats from Owo Abattoir market, Ondo state, Nigeria

Parameter	Hearts	Lungs	Kidneys	Livers
Cadmium	0.01 ± 0.01	0.01 ± 0.00	0.08 ± 0.02	0.04 ± 0.03
Chromium	0.34 ± 0.12	0.36 ± 0.05	0.35 ± 0.06	0.62 ± 0.10
Copper	0.74 ± 0.14	0.80 ± 0.28	0.89 ± 0.30	1.40 ± 7.76
Lead	0.33 ± 0.06	0.51 ± 0.19	0.40 ± 0.10	0.87 ± 0.06

Table 1 represented the concentrations of some selected heavy metals in the hearts, lungs, kidneys and livers of grass-cutter sold in Emure-Owo, while Table 2 and Table 3 represented the concentration of some selected heavy metals in the hearts, lungs, kidneys and livers of cows and goats.

The highest cadmium, (Cd) concentration was observed in the kidney of the goat at 0.08±0.02 mg/kg and the lowest concentration in hearts, lungs, kidneys of grass-cutters, and hearts and lungs of goats at 0.010 mg/kg, far below the permissible limit of 0.500 mg/kg, as recorded by USFDA, 2006 and FAO, 1983. Cadmium exists in low concentrations in all soils. It is spread by air and water (sewage sludge) far over sea and land, but especially in the vicinity of heavy industrial plants and hence absorbed by many plants and sea organisms. The highest level of cadmium detected in the goat could therefore be as a result of goats having more contact with both soil and plants as compared to the other animals. Cadmium is primarily toxic to kidney, especially to proximal tubular cells. Bone demineralization is affected by cadmium toxicity directly by bone damage and indirectly as a result of renal dysfunction (Solidum *et al.*, 2013). Cadmium may

catalyze diabetes-induced effects on kidneys. Kidney damage may further progress to end stage renal disease (ESRD) and death if exposure is high and prolonged. Recent investigations showed that cadmium may also play a role in the development of other cancers, such as testicular cancer, bladder cancer, pancreatic cancer and cancer of the gall bladder (Ilie *et al.*, 2007). The levels of cadmium detected in all meat samples however, pose no toxicological risk to consumers.

Chromium was detected in all the organ samples and varied in the range of 0.27±0.15mg/kg to 0.73±0.21mg/Kg. The highest concentration of Chromium, Cr was found in the heart of grass-cutters, 0.73±0.21mg/kg while the lowest in the kidney of the grass-cutters (0.27±0.15mg/kg). Cr is an essential element helping the body to use sugar, protein and fat, and at the same time carcinogenic above permissible level. Excessive amounts may cause adverse health effects, (Abd EI-Salam *et al.* 2013) and can reduce how effective insulin is at controlling blood sugar and cause irritation itching and flushing (UMMC 2013).The Chromium, Cr level in the organ samples was found to be lower than the permissible level of 1.0 mg/kg (USFDA 2006).

Copper was also detected in all the organ samples and varied in the range of  $0.62 \pm 0.16$  mg/kg to  $19.96 \pm 0.16.95$  mg/kg. The highest concentration of Copper, Cu was found in the liver of cows  $19.96 \pm 0.16.95$  mg/kg while the lowest in the kidney of the grass-cutter  $0.62 \pm 0.16$  mg/kg. The Copper concentration in the organs of the grass-cutter and cow were lower than the 30 mg/kg recommended by WHO (1989) and FAO (1989).

According to Ogwok *et al.* 2014, 100 mg/kg is the lethal dose of Copper in the body. Furthermore, the authors also reported that Copper level in the range of 100-300 mg/kg do not pose health risk. The concentration of Copper in this study is lower compared to previous works. Like other essential heavy metals, Copper is vital in the human body due to their role in physiology, growth and post-natal development.

Lead is a toxic metal that has no known vital or beneficial effect on organisms and its accumulation over time in the bodies of animals and humans can cause serious ailments (Binkowski, 2012). The highest concentration of lead was  $4.77 \pm 0.4.75$  mg/kg and the lowest at  $0.33 \pm 0.06$  mg/kg, all above the tolerable limit of 0.5mg/kg (FAO, 1989). Its highest concentration was recorded in the heart of grass-cutter  $4.77 \pm 0.4.75$  mg/kg and the lowest in that of the heart of goat  $0.33 \pm 0.06$  mg/kg. Pb may enter the atmosphere during mining, smelting, refining, manufacturing processes and by the use of lead containing products (Abd El-Salam *et al.*, 2013). The source of Pb contamination of livestock come from the air, water they drink and food they eat. All the organs analysed contain lead in high doses (above the tolerable limit. Higher levels of lead in grass-cutter could be as a result of the areas in which grass-cutter has scavenge for foods (Harlia and Balia, 2010).

#### 4.0 Conclusions

The results of the investigation confirmed the presence of heavy metals namely, Cd, Cr, Cu and Pb in all the organ samples analyzed but at varying concentration. Among all the heavy metals, the presence of copper (Cu) was prevalent in all the organs, heart, lungs, kidney and liver of both the grass-cutters, cows and goats. According to WHO/FAO 1989, the permissible level of Copper in humans is 30mg/kg. All organs of the three animals studied were lower than the permissible level recommended by WHO/FAO, 1989. Therefore, the consumption of organs of all the animals, both domestic and wild animals' investigation still not recommended for consumption because of subsequent bioaccumulation in humans.

Lead (Pb) was another heavy metal studied. Nearly all organs of cows, goats and grass-cutters bio-accumulated this toxic metal. The permissible level of lead (Pb) in human according to FAO, 1989 was 0.5mg/kg. Appreciable concentrations of lead (Pb) were present in all the organs of the three animals. All the organs were not recommended for consumption because of the high concentrations of lead in them.

Cadmium Cd was another heavy metal investigated, it is very toxic. WHO/FAO, (1989) recommended the permissible level of cadmium in humans to be 0.5mg/kg. The concentrations of cadmium in all the organs of the three animals were low, far below the permissible concentration in humans. Even though the cadmium concentrations were low but because it is a toxic metal, the organs were not suitable for consumption.

Chromium, Cr was detected in all the organs of the cows, goats and the grass-cutters though at low concentrations, between  $0.27 \pm 0.15$  –  $0.73 \pm 0.21$  mg/kg. The recommended level of chromium in humans was 1.0mg/kg, according to WHO/FAO,

1989. Because it could bio-accumulate in humans and because it is toxic, it is therefore not good for consumption.

Africans (South of Sahara), most especially Nigerians, are fond of consuming organs of both domestic and wild animals. This short term study confirmed the presence of heavy metals in all the organs investigated i.e the hearts, lungs, kidneys and livers and the consumption of these organs MUST STOP IMMEDIATELY.

### Recommendation

This investigation revealed the presence of Lead, Chromium, Cadmium and Copper in all the organs of the grass-cutters (cane-rats), cows and goats. Because they are present at various concentrations, it is therefore strongly recommended that all organs in both domestic and wild animals must not be consumed. These heavy metals can bio-accumulate in humans over a long period. Nigerians treat organs of bush and domestic animals as “delicacies”. Both the state and Federal Governments through their Ministries of Health must come up with laws, banning consumption of organs of all animals, either domestic or wild animals. The organs are not safe for consumption.

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