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Original Research Article

Survey of Some Heavy Metals in Tissues and Organs of Goats Slaughtered At Sokoto and Gusau Modern Abattoirs

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Abstract: Contamination of environment with heavy metals as a result of human activities and natural causes has become a global problem, as these metals find its way into the food chain which may causes a serious health problem to both animals and human. The main objectives of this research is to determine the concentrations of lead (Pb), cadmium (Cd), and chromium (Cr) in kidney, liver, muscle, hide, and blood of goats slaughtered at Sokoto and Gusau modern abattoirs. The concentrations of lead (Pb), cadmium (Cd), and chromium (Cr) in tissues and organs of goats slaughtered at Sokoto and Gusau modern abattoirs were determined using Atomic Absorption Spectrophotometer. A total of one hundred and twenty samples were collected from slaughtered goats at Sokoto and Gusau modern abattoir for analysis. All the samples were positive for Lead, cadmium, and chromium. At Sokoto Modern Abattoir, the overall mean concentrations of lead, cadmium and chromium in slaughtered goats were ranging from 0.13 to 0.38 mg/kg, 0.04 mg/kg to 0.24 mg/kg and 0.06 mg/kg to 0.10 mg/kg respectively. While at Gusau modern abattoir, the overall mean lead, cadmium and chromium concentration were ranging from 0.05 to 0.50, 0.05 mg/kg to 0.24 mg/kg and 0.15 mg/kg to 0.29 mg/kg respectively. There was significant difference in the concentration of lead, cadmium, and chromium, in kidney, liver, muscle, skin and blood of slaughtered goats ($P< 0.05$). The mean Pb, Cd, and Cr concentrations in all tissues and organs collected from slaughtered goats at both Sokoto and Gusau modern Abattoirs were within the permissible concentration recommended by FAO/WHO and USDA, for animal and human consumption.

Keywords: Heavy Metals Tissues and Organs Sokoto Gusau.

INTRODUCTION

Proteins of animal origin contain a wide range of nutrient that are needed for proper tissue formation, growth and repair. In Nigeria domestic and wild animals are use as source of animal protein. The habitat of these animals are continually been polluted with heavy metals as a result of human activities and natural disasters. (Kamal and Kumal, 1998; Dioka *et al*., 2004), grazing of animals in such environment may expose them to heavy metals and other toxic substances (Nwude *et al*., 2010). Survey of heavy metals residues in raw meat is necessary to ascertain whether their concentrations are within the permissible level recommended by Food and Agricultural Organization (FAO) and World Health Organization (WHO) 2017, and USDA 2006 for human consumption or not (FAO/WHO2017; USDA, 2006). All heavy metals are toxic at certain concentration, and they may pose some serious health problems to both animals and human. Some toxic heavy metals such as lead, cadmium, mercury, and arsenic has no any role to play in the development of animals or human body, but rather causes health problems to them (Khalafalla *et al*., 2015).

Therefore, this study aims at establishing the present of Lead, cadmium and chromium in kidney,

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liver, muscle, hide and blood of slaughtered goats at Sokoto and Gusau modern abattoirs, and also to evaluate the concentrations of these metals in selected organs and tissues in order to ascertain whether the concentrations of these metals are within the permissible concentration recommended by Food and Agricultural Organization (FAO) and World Health Organization (WHO)(2017), and USDA(2006) for human consumption or not.

MATERIALS AND METHODS

Study areas

Sokoto Modern abattoir is located in Sokoto North Local Government Area of Sokoto State. The State is located in North West agro-ecological zone of Nigeria, its longitudes is between 4^o8'E and 6^o54' E and its latitudes between 12^o N and 13^o58'N. In the North, the shares international boundary with Niger Republic, to the west Kebbi State and to the east Zamfara State. The State has a total land mass area of 32,000 square Kilometres with an estimated human population of 3,696,999 (NPC, 2006). In Nigeria, the State ranks second in livestock population (MOCIT, 2002; Mamman, 2005).

Gusau Modern abattoir is located in Gusau, which is the State capital of Zamfara State. The State is located at the North West agro-ecological zone of Nigeria. The State lies between Latitude 11º 10' N and Longitude 6º 15' E, covering a land mass area of 39,762 km^2 with an estimated human population of 3,582,912 (NPC, 2006; UNEP/OCHA, 2010). It shares bondaries with Kebbi, Kaduna, Sokoto, Niger and Katsina states. It also shares an international boundary with Niger Republic to the north (UNEP/OCHA, 2010).

Study Design

The study was a cross- sectional type and abattoir based, and it was carried out at Sokoto, and Gusau Modern abattoirs.

Sampling method

Samples were collected using simple random sampling method on a weekly basis. Samples were collected from Sokoto and Gusau Modern abattoirs at the same period of the year**.**

Samples types

The samples consist of kidney, liver, muscle, skin, and blood from randomly selected slaughtered goats at both Sokoto and Gusau modern abattoirs.

Samples collection and preservation

In each of the Abattoir (Sokoto, and Gusau Modern abattoirs); samples were collected from randomly selected slaughtered goats; samples collected consist of a whole kidney (either right or left), about 100 g of any part of the muscle, about 100 g of any part of singe or un-singe skin, and about 100 ml of blood from slaughtered goats. Each sample was packed in a sterile polythene bags and properly labeled with permanent marker. The samples were transported to Veterinary Public Health and Preventive Medicine laboratory of Faculty of Veterinary Medicine, Usmanu Danfodiyo University Sokoto, where it was frozen and stored in freezer.

Processing of samples

All the frozen samples were packed and transported in a cold chain to National Research Institute for Chemical Technology Zaria, Kaduna State Nigeria, for further processing and analysis.

Digestion of samples

Liver, kidney, muscle, skin, and blood samples were dried at 45^0 C using oven, after drying, individual sample was crushed into fine powder using mortar and pestle, and 1.0g of the fine powder sample was weigh out into porcelain crucible. The crucible plus the fine powdered sample was ignited in a muffle furnace at 500^0 C for eight hours. The Samples were then removed from the furnace and placed in a desiccator to cool and it is weighed again. The difference between the weight of the crucible plus ash and the weight of the crucible alone was used to calculate the percentage ash content of the sample. 5 cm^3 of 1M trioxonitrate (v) acid (HNO_3) solution was added to the left-over ash and it was evaporated to dryness using a hot plate, after which it was returned to the furnace and heated again at 400^0 C for 15-20 minutes depending on the sample type, until perfectly grayish-white ash was obtained. The samples were allowed to cool in desiccators followed by the addition of 15 cm^3 of 1M hydrochloric acid (HCl) to dissolve the ash and the solution was filtered into 100 cm^3 volumetric flasks. The volume was made to the mark 100cm^3 of the flask with distilled water

Spectrophotometry Techniques for Heavy Metals Detection

In the prepared samples, Cadmium (Cd), lead (Pb), and chromium (Cr) residues were determined under specified condition according to the manufacturer Instruction (AA-6800, Shimadzu Atomic Absorption Spectrophotometer) (Szkoda and Zmudzki 2005).

STATISTICAL ANALYSIS

Data from the study were presented in tables. One-way analysis of variance (ANOVA) was used to establish significant differences between mean concentration of Pb, Cd and Cr present in the kidney, liver, muscle, hide and blood at 95% confidence limits using Graphpad Instat 3.10, 32-bit software for windows7.

RESULTS

The prevalence rates of Pb, Cd and Cr in goat's slaughtered goats at both Sokoto and Gusau Modern Abattoirs were 100% each, At Sokoto Modern Abattoir, the overall mean concentrations of lead, cadmium and chromium were ranging from 0.13 to 0.38 mg/kg, 0.04 mg/kg to 0.24 mg/kg and 0.06 mg/kg to 0.10 mg/kg respectively (table1).

Table-1: Mean and Standard Error of Mean Concentration (mg/kg) of Lead, Cadmium, and Chromium (mg/kg) in Kidney, Liver, Muscle, Skin and Blood of Goats Slaughtered at Sokoto Modern Abattoir

Metal	Mean ± Standard Error of Mean (SE) (mg/kg)				
	Kidney	liver	muscle	Skin	blood
Lead	0.33±0.08	0.38±0.08	0.13±0.03	0.19±0.04	0.32±0.06
Cadmium	0.24±0.09	0.12±0.05	0.05±0.01	0.04±0.01	0.04±0.01
Chromium	0.09±0.02	0.09±0.02	0.07±0.01	0.06±0.01	0.10±0.03

Table-2: Mean Concentration (mg/kg) of Lead, Cadmium, and Chromium against International Standard in selected Organs and Tissues of Goats Slaughtered at Sokoto Modern Abattoir

Tissue/organs Type	Heavy metal(mg/kg)					
	Pb	FAO/WHO	Cd	FAO/WHO	Cr	FAO/WHO
Kidney	0.33	0.5	0.24	1.0	0.09	1.0
Liver	0.38	0.5	0.12	0.5	0.09	1.0
Muscle	0.13	0.1	0.05	0.05	0.07	1.0
Skin	0.19	0.5	0.04	0.5	0.06	1.0
Blood	0.32	0.5	0.04	0.5	0.10	1.0

At Gusau modern abattoir, the overall mean concentration of lead, cadmium and chromium were ranging from 0.05 to 0.50, 0.05 mg/kg to 0.24 mg/kg and 0.15 mg/kg to 0.29 mg/kg respectively as shown in table 3.

Table-3: Mean and Standard Error of Mean Concentration (mg/kg) of Lead, Cadmium, and Chromium (mg/kg) in Kidney, Liver, Muscle, Skin and Blood of Goats Slaughtered at Gusau Modern Abattoir

Metal	Mean ± Standard Error of Mean (SE) (mg/kg)				
	Kidney	liver	muscle	Skin	blood
Lead	0.31±0.12	0.50±0.22	0.05±0.01	0.19±0.05	0.24±0.05
Cadmium	0.24±0.06	0.16±0.05	0.05±0.02	0.06±0.02	0.09±0.03
Chromium	0.27±0.06	0.41±0.09	0.18±0.08	0.15±0.07	0.29±0.10

Table-4: Mean Concentration (mg/kg) of Lead, Cadmium, and Chromium against International Standard in selected Organs and Tissues of Goats Slaughtered at Gusau Modern Abattoir

Tissue/organs Type	Heavy metal(mg/kg)					
	Pb	FAO/WHO	Cd	FAO/WHO	Cr	FAO/WHO
Kidney	0.31	0.5	0.24	1.0	0.27	1.0
Liver	0.50	0.5	0.16	0.5	0.41	1.0
Muscle	0.05	0.1	0.05	0.05	0.18	1.0
Skin	0.19	0.5	0.06	0.5	0.15	1.0
Blood	0.24	0.5	0.09	0.5	0.29	1.0

DISCUSSION

The prevalence rate obtained from this study was in agreement with the findings of Adetunji *et al*., 2014 who reported 100% prevalence of Pb in muscle and edible tissue of cattle slaughtered at slaughter slab in Ibadan.

The mean lead concentration was generally high in liver of slaughtered goats at Sokoto and Gusau modern abattoirs than other tissues and organs, this may be as a result of liver been an organ of detoxification of toxic substances, and as a result of this, more of the lead from blood and other tissue may be mobilized and taken to the liver through circulation for detoxification to take place. It may also be as a result of excretion of lead to the bile which later will re-absorbed into the liver (enterohepatic biliary cycles), in the process liver may tend to contain high concentration of lead (Sycracuse 1990; Sedki *et al*., 2002). This finding was contrarily to the findings of Adetunji *et al*., 2014 who's found the concentration of lead to be high in kidney than any tissues and organs.

Generally, the concentration of cadmium was found to be high in kidney compared to any tissues or organs. this may be as a result of metallothionein which is a protein found in the liver that usually remove

cadmium from hepatocytes forming a cadmium-metallothionein complex which is then released into the blood stream and filtered by kidney glomeruli, which can be reabsorb into the kidney and may result in high concentration of cadmium in the kidney than other tissues and organs (Squibb and Fowler1984; Roman *et al*.,2002), this findings was contrarily to the findings of Adetunji *et al*., 2014 who observes higher concentration of cadmium in liver than other tissues and organs.

Generally, the mean chromium concentration in the blood of slaughtered goats at both Sokoto and Gusau modern abattoirs were higher compared to the mean concentrations of chromium in kidney, liver, muscle, and hide. The result from this study was contrarily to the findings of Akan *et al*., (2010), who reported high concentration of chromium in liver than other tissues and organs of cattle, goats and sheep. High concentration of chromium in the blood observed from this study may be as a result of recent exposure of the animal to the metal in the environment either through air, feed or water.

The mean Pb concentration in kidney, muscle and blood of slaughtered goats at Sokoto modern abattoir were higher compared to goat's slaughter at Gusau modern abattoir. While the mean Pb concentration in liver and skin of slaughtered goats at Gusau modern abattoir were high compared to those slaughtered at Sokoto modern abattoir, these may be due to different level of exposure and also time at which these animals were exposed since they are not subjected to the same environment and the time at which they were exposed.

The mean Cd concentration in liver, skin and blood of slaughtered goats at Gusau modern abattoir were high compared to those slaughtered at Sokoto modern abattoir.

The mean Cr concentration in kidney, liver, muscle, and skin of slaughtered goats at Sokoto modern abattoir were high compared to those goats slaughtered at Gusau modern abattoir, while the concentration of Cr in blood of slaughtered goats at Gusau modern abattoir were high compared those goats slaughtered at Sokoto modern abattoir.

The mean concentrations of Pb, Cd, and Cr in all tissues and organs collected from both Sokoto and Gusau modern Abattoirs were within the permissible concentration recommended by FAO/WHO (2017), and USDA, (2006) as shown in table 2 and table 4.

CONCLUSIONS

The results of this study showed that goats slaughtered at both Sokoto and Gusau Modern abattoirs were exposed to Pb, Cd, and Cr Liver samples contained high concentrations of Pb than kidney, muscle, hide and blood samples. Also, the concentration of Cd in kidney samples was high compared to liver, muscle, hide and blood.

Tissues and organs obtained from slaughtered goats at both Sokoto and Gusau modern abattoirs were safe for human consumption.

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