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Heavy Metals in Slaughtered Cow Meat in Kaduna State, Nigeria

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Abstract

Background: Heavy metals are chemical substances mainly present in water and soil. They exist as natural and or synthetic element in water, soil and industry. This element often finds their way into human through inhalation, contact and ingestion. The exposure to animal could be through eating polluted grass/food, air and or water result in deposition in their organs.

Objective: This study assess find out the level of Lead (Pb) Cadmium (Cd), Chromium (Cr), Copper (Cu), Iron (Fe), Nickel (Ni) and Zinc (Zn) in tripe, Muscle, Liver and intestine of slaughtered cow meats in Kaduna metropolis.

Method: The study was conducted in Tudun-wada central abattoir situated within Kaduna Metropolis. 1g of each sampled tripe, muscle, liver, and intestine were subjected to laboratory for analyses. The samples were analyzed using ALPHA 4 atomic absorption spectrophotometer (Chem-Techn. Analytical).

Conclusion: The findings revealed the range of Pb (0.15-127.9 µg/g), Cu (2-186.5 µg/g), Cd (0.05-0.31 µg/g), and Zn (395.18-619.8 µg/g). The cow meats slaughtered in Tudun Wada abattoir were highly concentrated with heavy metals when compared with World Health Organization (WHO).

Introduction

Nigeria is one of the four leading livestock producers in Sub-Sahara Africa. The population of livestock (ruminant) in Nigeria was estimated to be about 14 million cattle, 13 million sheep and 23 million goats [1]. However, these figures have since increased to 15.2 million cattle, 28 million goats and 23 million sheep livestock plays a very important role in Nigerian agriculture contributing about 12.7% of the total agricultural Gross Domestic Product (GDP) [2]. Most of the ruminant livestock in Nigeria are raised in commercial quantities in the Northern part of the country but the enterprise is not known to be associated with the Southern Nigeria due to the prevalence of hemoparasites like trypanosomiasis, babesiosis, anaplasmosis, erhlichiosis among others.

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Livestock production has been a source of supply of animal protein worldwide. Meat from slaughtered cattle at various abattoirs constitutes the largest source of animal protein for Nigerian populace [3]. Most of the livestock in Nigeria are being raised in commercial quantity in the Northern part of the country, but the enterprise is not known to be associated with the Southern Nigeria due to the prevalence of Trypanosomiasis. These animals are grazed on a free-range system during which they eat grasses in the surroundings and also drink water from any nearby streams and stagnant water, which could have been contaminated with heavy metals. Contamination with heavy metal is a serious threat because of their toxicity, bioaccumulation and biomagnifications in the food chain [4].

Environmental pollution with heavy metals and metalloids is now being considered as a major problem in both developed and developing countries [5]. Heavy metals are important from the viewpoint of their toxicity and essentiality and have been widely studied for their toxic effects and bio-accumulation in food chains [6]. In addition to their essentiality for human nutrition, some micronutrients (e.g. Cu, Cr, and Ni) might be toxic at elevated concentrations [7]. However, other metals such as As, Cd and Pb might also in advertently enter the food chain and pose risks to the human and animals [7]. Heavy metals like Cr, Ni, As, Cd and Pb have been considered as the most toxic elements in the environment by the US Environment Protection Agency (EPA) [8]. Toxic elements can be very harmful even at low concentration when ingested over a long time period. For instance, Cr and Cu are essential but may become toxic at higher levels, while Ni are known to cause a variety of pulmonary adverse health effects, such as lung inflammation, fibrosis, emphysema, and tumors [9]. Lead has been associated with pathological changes in organs and the central nervous system, leading to decrements in Intelligence Quotients (IQ) in children. Cadmium is toxic to the cardiovascular system, kidneys, and bones while inorganic as, a human carcinogen, is the most toxic form of arsenic [10].

Life-threatening health problems have been known to develop as a result of excessive uptake of dietary heavy metals. This could include depletion of some essential nutrients in the body thereby causing a decrease in immunological defences, intrauterine growth retardation, impaired psycho- social behaviours, disabilities associated with malnutrition and a high prevalence of upper gastrointestinal tract cancer. In the report of the authors assessed the Lead (Pb) burden in the blood of goats reared around a primary lead-zinc smelter and they concluded from the study that goats reared around a primary lead-zinc smelter had higher blood lead levels in a dose-dependent manner. also reported high levels of Lead (Pb) and Cadmium (Cd) in some tissues including blood in sheep and horses, correlating the values with those observed in soil, water, forage and feed in the vicinity of non-ferrous metal smelters and suggested that the disease of sheep and horses in that region was caused by Lead (Pb) poisoning combined with Cadmium (Cd), as a result of heavy metal pollution by industrial activity. Cadmium, lead and chromium are classified as some of the most dangerous heavy metals to health and environment this study investigated heavy metals in slaughtered cow meat in Kaduna metropolis.

Statement of the problem

There has been an increased in illicit the usage of agro-chemical products and indiscriminate disposal of toxic substances on the grazing floors and water bodies where animals graze. ii. Most consumers of meat and meat products are unaware of the presence of heavy metals in meat and its associated health risks [2]. It is against this backdrop that the study sought to assess heavy metals in slaughtered cow meats in Kaduna metropolis, Nigeria.

Research questions

The research questions are as follows:

I. What is the level of Lead (Pb) in tripe, Muscle, Liver and intestine of slaughtered cow meats in Kaduna metropolis?

II. What is the level of Cadmium (Cd) in tripe, Muscle, Liver and intestine of slaughtered cow meats in Kaduna metropolis?

III. What is the level of Zinc (Zn) in tripe, Muscle, Liver and intestine of slaughtered cow meats in Kaduna metropolis?

IV. What is the level of Copper (Cu) in tripe, Muscle, Liver and intestine of slaughtered cow meats in Kaduna metropolis?

V. What is the level of Chromium (Cr) in tripe, Muscle, Liver and intestine of slaughtered cow meats in Kaduna metropolis?

VI. What is the level of Nickel (Ni) in tripe, Muscle, Liver and intestine of slaughtered cow meats in Kaduna metropolis? i

VII. What is the level of Iron (Fe) in tripe, Muscle, Liver and intestine of slaughtered cow meats in Kaduna metropolis?

Aims and objectives of the study

The aim of the study was to assess heavy metals in slaughtered cow meats in Kaduna metropolis, Nigeria, while, the objectives were to:

I. Find out the level of Lead (Pb) in tripe, Muscle, Liver and intestine of slaughtered cow meats in Kaduna metropolis.

II. Identify the level of Cadmium (Cd) in tripe, Muscle, Liver and intestine of slaughtered cow meats in Kaduna metropolis.

III. Examine the level of Zinc (Zn) in tripe, Muscle, Liver and intestine of slaughtered cow meats in Kaduna metropolis.

IV. Find out the level of Copper (Cu) in tripe, Muscle, Liver and intestine of slaughtered cow meats in Kaduna metropolis.

V. Examine the level of Chromium (Cr) in tripe, Muscle, Liver and intestine of slaughtered cow meats in Kaduna metropolis.

VI. Assess the level of Nickel (Ni) in tripe, Muscle, Liver and intestine of slaughtered cow meats in Kaduna metropolis.

VII. Identify the level of Iron (Fe) in tripe, Muscle, Liver and intestine of slaughtered cow meats in Kaduna metropolis?

Material and methods

Study area

Kaduna metropolis is located between Lat. 10023' and 10043' N and Long. 7017' and 7037'E. It is characterized by the tropical continental climate with seasonal rainfall patterns, which are characteristically of high intensities. The mean annual rainfall totals are about 1,185mm, the temperature is about 24.50°C with the annual evapotranspiration almost equating

annual rainfall total. River Kaduna is the major river that almost divides the metropolis into two **halves [11].**

Sample collection procedure

Samples of Raw meat (muscle, liver, tripe, and intestine) were collected from Tudun Wada Central Abattoir in Kaduna South LGA of Kaduna State. The quantity of the samples collected per each item was 1g. The samples were cut by the butchers, put into an acid-leached polyethylene bag, and kept into a cold box before transporting to Ahmadu Bello University Central Research Laboratory Zaria on the same day. The sample was centrally collected at Tudun Wada Central abattoir because of its high number of slaughtered animal per day within Kaduna Metropolis. The abattoir record over 300 slaughtered animals per day. This indicated that large number of people within Kaduna Metropolis eats meat slaughtered in Tudun Wada abattoir.

Heavy metal analysis in cow meat

1g of meat sample was weighted into a 125 ml flask that was washed with acid and rinsed with distilled water. Acid digestion with concentrated Per-chloric acid (4 ml), concentratedNitric acid (10 ml) and Sulphuricacid (2 ml) was carried out. The content was thoroughly mixed and digested on BIBBY hot plate and heated gently at low temperature of 550C. Heating was continued until white dense fume observed. The digested sample was analyzed with ALPHA 4 atomic absorption spectrophotometer (Chem-Tech. Analytical) with EPSON LX-300 printer.

Results and discussions

Table 1: Mean concentration (ug/g) of heavy metals in meat samples collected from Central Abattoir in Zango Road, Tudun Wada and Kaduna, Nigeria.

Heavy Metals	Tripe	Muscle	Liver	Intestine	Range	WHO Standard
Pb	127.9	0.72	0.15	108.02	0.15-127.9	0.01
Cd	0.16	0.05	0.31	0.22	0.05-0.31	0.003
Zn	428.31	502.09	619.86	395.18	395.18-619.8	3.0
Cu	4.35	2	186.5	3.70	2-186.5	1-2.0
Cr	15.80	3.81	17.48	13.12	3.81-17.48	0.05
Ni	1.67	0.79	0.65	1.42	0.65-1.67	0.02
Fe	632.6	50.02	241.47	66.69	50.02-632.6	0.3

Source: Field Survey (2021).

The range in concentration of Pb was 0.15 to 127.9 µg/g; with tripe 127.9 µg/g, muscles (0.72 µg/g), liver (0.15 µg/g) and intestine (108.02 µg/g). The WHO standard limit for Pb in these organs is 0.01 µg/g. Based on the analysis carried out all the sampled organs were above the acceptable/standard as set by WHO [12].Thus, High Lead [Pb] concentration in cow meats is associated with cardiovascular, renal, nervous and skeletal-system diseases (World Health Organisation (WHO) [13-16]. In addition, Pb is teratogenic, that is, it is associated with the development of abnormalities in babies when consumed during pregnancy [17].

In the determination of the concentrations of Cd in the analyzed samples, it established the range of 0.05 µg/g to 0.31 µg/g from the all the sample. The concentration of Cd in individual organ established that tripe (0.16 µg/g), muscles (0.05 µ/g), liver (0.31 µg/g) and intestine (0.22 µg/g). The WHO standard limit is 0.003 µg/g. Therefore from the result obtained indicated that all the organs were found to have a high concentration of Cd hence exceeding the upper limit of 0.003µg/g set by WHO [12]. Mean cadmium concentrations in the different meat parts are in the order: kidney> tripe>muscle>intestine>liver. Hence, Islam, Ahmed, Al-Mamun, and Masunaga [10] found that Cadmium is toxic to the cardiovascular system, kidneys, and bones while inorganic as, a human carcinogen, is the most toxic form of arsenic.

The concentrations of Zn in the analyzed samples revealed the range of 395.18 to 619.8 µg/g. The concentrations of Zn in individual organ indicates concentrations of 428.31 µg/g in tripe, 502.09 µg/g in muscles, 619.86 µg/g in liver and 95.18 µg/g in intestine. The WHO standard limit is 3µg/g. Therefore, based on the result presented all the organs had higher concentrations of Zinc when compared with WHO [12] standard. It is pertinent to note that Zinc is an example of a heavy metal essential for normal functioning of cells including protein and carbohydrate metabolism, cell growth, and cell division. However, while humans can handle proportionally large concentrations of zinc, overconsumption of zinc can cause stomach cramps, skin irritations, vomiting, nausea, and anemia. Very high exposure to zinc can damage the pancreas, disturb protein metabolism, and cause arteriosclerosis [18].

The result presented for Cu revealed the mean concentrations as within the range of 2 to 186.5 µg/g in the samples. The concentrations of Cu in individual organ show as follows tripe 4.35 µg/g, muscles 2 µg/g, liver 186.5 µg/g and intestine 3.70 µg/g. The WHO standard limit is 1-2 µg/g. Therefore, all the organs except muscles had high concentrations of Cu when compared with standard limit set by WHO. Mean concentrations of Cu in the different parts of meat follow the order liver > kidney > intestine > tripe > muscle. The high values observed in liver and lowest value in muscle agreed with reports.

The mean chromium concentrations in the meat parts are in the following order: muscle > intestine >tripe > liver. The values in this study are much higher than those reported in cattle from various countries. The mean concentration recorded from the sampled organs for chromium was muscles 3.81 µg/g, intestine 13.12 µg/g tripe 15.80 µg/g, and liver 17.48 µg/g. The WHO set limit is 0.05 µg/g. from the result it established that all the organs have high concentration of Chromium.

The results for Ni show the mean concentration range of 0.65 to 1.67 µg/g. The concentrations is as follows are tripe 1.67 µg/g, muscles 0.79 µg/g, liver 0.65 µg/g and intestine 1.42 µg/g. The WHO standard limit is 0.02 µg/g, hence establishing that all the organs were at the upper limit of WHO. The trend of mean nickel concentrations were liver> muscle >intestine >tripe. It is an important cofactor for various enzymes and acts to accelerate normal chemical reactions occurring in the body. However, the ingestion of high levels of nickel may aggravate vesicular hand eczema and possibly eczema arising on other parts of the body, even in the absence of skin contact with nickel.9 Very high concentrations of nickel can induce teratogenic or genotoxic effects [12].

The concentrations of Fe is in the following sampled organs tripe (632.6 µg/g), muscles (50.02 µg/g), liver (241.47 µg/g) and intestine (66.69 µg/g); and the range is 50.02 to 632.60 µg/g while the WHO [12] standard limit is 0.3 µg/g. Base on the results all the sampled organs had a high concentration of Fe. The trend of mean iron concentration in the meat part studied range from muscle>intestine > liver > tripe. The mean concentrations of Fe in the various meat parts were higher than re-

ported values elsewhere. Hence, high iron intakes or high body iron burden may increase the risk of colorectal cancer, Cardiovascular Disease (CVD), infection, neurodegenerative disorders and inflammatory conditions [19-21].

Conclusion and recommendations

The study identified that there are high concentration of heavy metals above WHO standards in all the samples and examinations conducted on the sampled samples examined in the Central Abbatoir, Zango Road, Tudun Wada, Kaduna, Nigeria. The high concentration of Cadmium (Cd), Chromium (Cr), Copper (Cu), Iron (Fe), Nickel (Ni), Lead (Pb) and Zinc (Zn) is indicative of high level of environmental pollution and therefore underlies that animal offal could be a biomarker of environmental pollution considering that cow meats are exposed to heavy metals through several environmental sources. Overall, the consumption of cow meats in Kaduna metropolis could cause deleterious effects during a lifetime in humans especially for children and women of child bearing age. The study recommended that Kaduna state should employ public health officers to regularly monitor the contamination levels of toxic heavy metals in cow meats in-take.

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