



Prevalence of toxic heavy metals in different meat parts of sheep raised in parts of Jigawa state

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Short Communication

Abstract

The study was carried out to determine the prevalence of toxic heavy metals of public health concern in different meat parts of sheep raised in parts of Jigawa State. The experiment was laid out in a Completely Randomized Design. Six 3-year old rams purchased from Laya and Abdallawa villages in Gwaram and Kafin Hausa Local Government Areas (LGAs) respectively were used to determine the prevalence of toxic heavy metals (Cd, Cr and Pb) in different meat parts (Muscle, liver and kidney). The rams were slaughtered and samples of the carcass, liver and kidney were collected and used for the determination of toxic heavy metals at the Centre for Biotechnology Research Laboratory, Bayero University Kano using Atomic Absorption Spectrophotometer. The results were subjected to T- test using SPSS software version 25. The results showed that all the heavy metals were present in the study area with the exception of Cr which was not found in muscle from Kafin Hausa. In Muscle and liver, Pb had the highest mean value of 0.109mg/kg and 0.205mg/kg, respectively. However, for kidney, Cr and Pd had the highest mean value of 0.248mg/kg and 0.238mg/kg respectively. It was concluded that mining, flooding and intense use of agro-chemicals in the two study locations might have resulted in the contamination of the meat. Massive public health awareness on the need to reduce illegal mining activities near grazing areas is recommended.

Keywords: Food safety, Heavy metals, Muscle, Liver, Kidney

Introduction

Meat contributes greatly in complementing the diet of humans by providing the essential nutrients for growth and development (Makanjuola, 2016). It is the fourth most commonly consumed food group by households and excellent in providing essential amino acids in adequate amounts and proper proportions (Olamide and Carlos, 2017). Heavy metals are group of chemical elements having density of 5 g/cm³ and atomic weight of 63.5 to 200.5 g (Bilal, 2010). They enter the environment through anthropogenic activities like mining, industrial effluents and use of agrochemicals (Tchounwou *et al.*, 2012). Different meat products are developed over time and are becoming widely acceptable but the products are now at risk of heavy metal contamination from natural and anthropogenic sources that include mining

and metallurgy, foundries, burning fossil fuel, vehicular emissions, volcanic eruptions, metal corrosion and sediment re-suspension, soil erosion and geological weathering (Tchounwou *et al.*, 2012). In the study area, contaminations are mainly from mining and seasonal flooding. Exposure to lower doses over long periods results in to bioaccumulation of toxic heavy metals and pathologic conditions (Adesakin, 2009). The bioaccumulation of cadmium, chromium and lead causes kidney failure, skin and lungs cancer and neurological abnormalities in children (ATSDR, 2007). Heavy metals disrupt the activities of respiratory, nervous, digestive and reproductive systems of the body of humans (Tchounwou *et al.*, 2012). Prevalence of toxic heavy metals in meat and milk products has raised concern for food safety in recent years (Orisakwe *et al.*, 2005). The

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objective of the research was to examine the prevalence of some heavy metals of public health concern in different meat parts from sheep raised in parts of Jigawa State.

Materials and Methods

Study Area

The study was conducted in Laya Gwaram and Abdallawa Kafin hausa Local Government Areas of Jigawa State, Nigeria. Gwaram is located on latitude 11° 4' 0" North and longitude 9° 58' 0" East (Vihi *et al.*, 2019). While Kafin Hausa is a local government area of Jigawa state located on latitude 12° 68'N and longitude 10° 26'E (Ahmed and Zakariya, 2017).

Sample Collection

Samples of raw meat and offals (muscle, liver and kidney) from Gwaram and Kafin Hausa Local Government Areas of Jigawa State were collected. Samples were

collected in a cold box, digested and analyzed for the presence of heavy metals.

Statistical Analysis

The experiment was laid out in a Completely Randomized Design, with location (Gwaram and Kafin Hausa) as the fixed factor. Statistical analysis was done using T- test at 5% level of significance.

Results

The effect of location on the concentration of toxic heavy metals in muscle from Gwaram and Kafin Hausa Local Government Areas is presented in Figure 1. The results showed that, mean concentration of cadmium from Kafin Hausa was slightly higher than Gwaram. Concentration of chromium was not found in muscle from Kafin Hausa and lead from Gwaram was higher than that of Kafin Hausa.

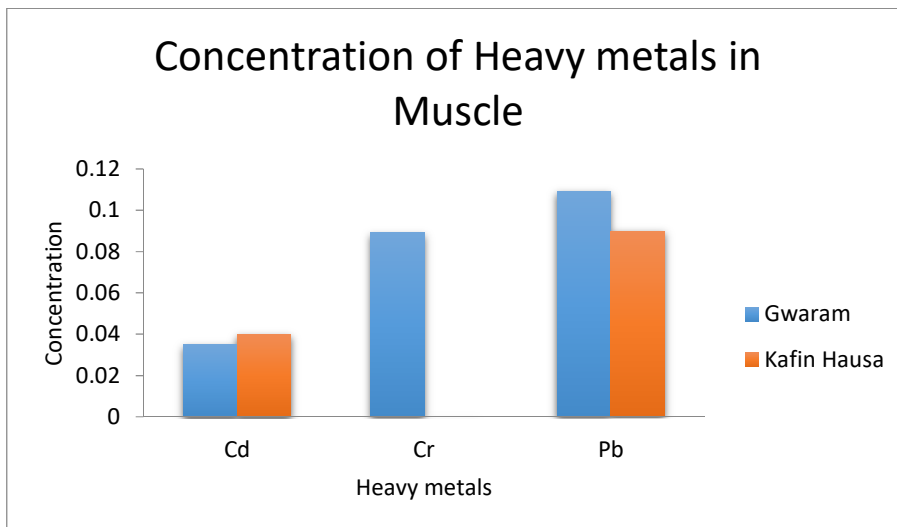


Figure 1: The effect of Location on the Concentration of Toxic Heavy Metals in Muscle from Gwaram and Kafin Hausa Local Government Areas (mg/kg).

The effect of location on the concentration of toxic heavy metals in liver from Gwaram and Kafin Hausa Local Government Areas is presented in Figure 2. The concentration of cadmium and chromium from Kafin

Hausa was slightly higher than values obtained from Gwaram. Lead concentration from Gwaram was higher than that of Kafin Hausa.

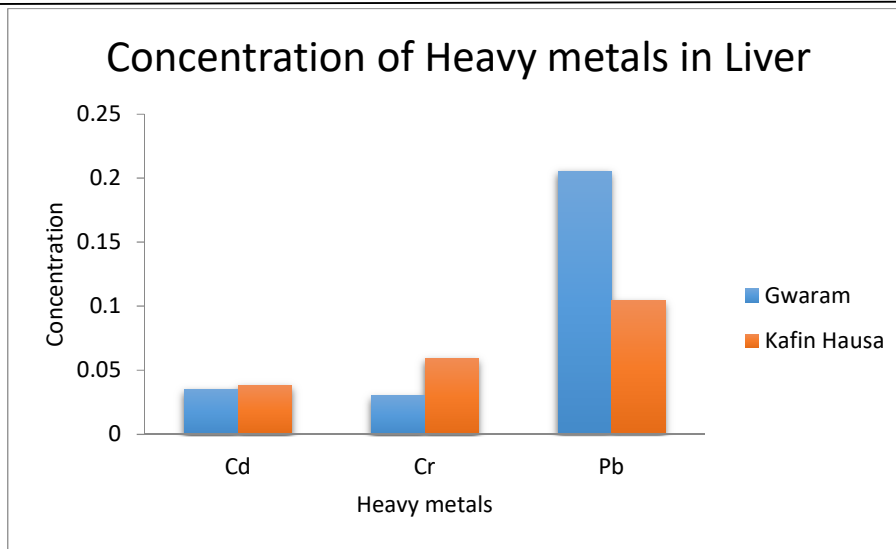


Figure 2: The effect of Location on the Concentration of Toxic Heavy Metals in Liver from Gwaram and Kafin Hausa Local Government Areas (mg/kg)

The effect of location on the concentration of toxic heavy metals in kidney from Gwaram and Kafin Hausa Local Government Areas is shown in Figure 3. The result shows that, mean value of cadmium in kidney from Gwaram is

slightly higher than that of Kafin Hausa. As with chromium, Gwaram had the highest mean value while lead content obtained from Gwaram and Kafin Hausa in kidney tissue is found to be having similar mean values.

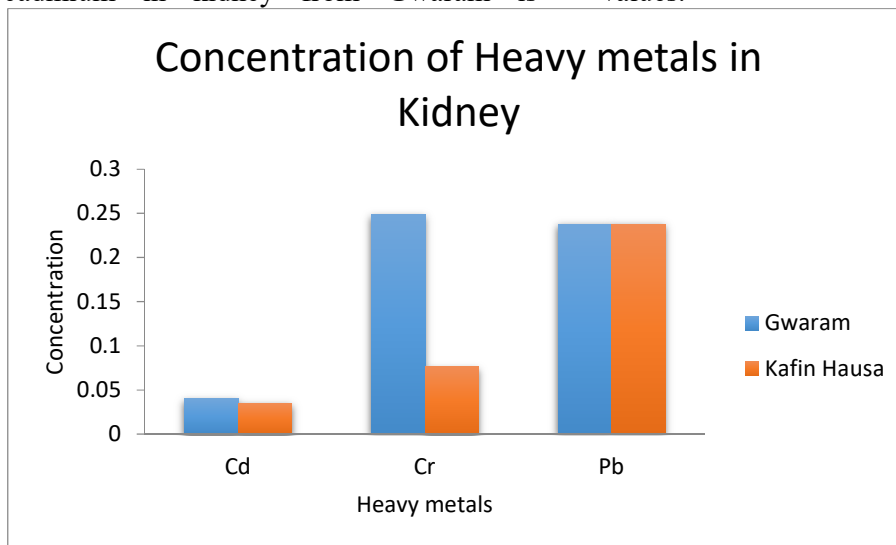


Figure 3: The effect of Location on the Concentration of Toxic Heavy Metals in kidney from Gwaram and Kafin Hausa Local Government Areas (mg/kg).

Discussion

The Effect of Location on the Concentration of Toxic Heavy Metals in Muscle from Gwaram and Kafin Hausa Local Government Areas (mg/kg) are

presented in Figures 1-3. The occurrence of toxic heavy metals in raw meat has been reported by many authors. The bio-accumulation of toxic heavy metals in the body happens when animals are exposed to

low doses over a long period of time (Adesakin, 2021) and leads to a diversity of toxic effects on a variety of body tissues and organs (Mahdi *et al.*, 2021). The results of the present study revealed that location had significant ($P < 0.05$) effect on toxic heavy metals in different organs with cadmium concentration high in Kafin Hausa (0.037mg/kg).

The result of cadmium level in muscle in this study is 0.035mg/kg and 0.040mg/kg in Gwaram and Kafin Hausa, respectively. The mean values obtained is a little bit higher than mean values obtained by several authors (Chiedozie, 2009; Makanjuola, 2016; Mathaiyan *et al.*, 2021; Odoh *et al.*, 2018; Njoga *et al.*, 2021; Sabuwa and Nafarnda, 2020). Meanwhile, Cadmium is found to be lower than mean values obtained in the work of other authors (Suleiman *et al.*, 2022; Okareh and Oladipo, 2015; Bilal, 2010; Adnan, 2021). However, Chromium mean value from Gwaram was 0.089mg/kg and it was not detected in Kafin Hausa. The result is in agreement with the work of Makanjuola (2016) who also found that Cr was not detected in muscle meat in his study area. Most of the similar studies were in contrast with the finding of this study. As most studies reported higher mean values (Suleiman *et al.*, 2022; Okareh and Oladipo, 2015; Chiedozie, 2009; Wafaa *et al.*, 2018; Terver *et al.*, 2017; Sabuwa and Nafarnda, 2020). But the finding had higher value of Cr than the finding of (Odoh *et al.*, 2018). Lead mean value was 0.109mg/kg from Gwaram and 0.090mg/kg from Kafin Hausa. The result of this work is similar to the finding of Okareh and Oladipo (2015) who reported mean value of 0.11mg/kg in his study. The result is higher than the findings of (Suleiman *et al.*, 2022; Chiedozie, 2009; Makanjuola; Odoh *et al.*, 2018; Njoga *et al.*, 2021; Sabuwa and Nafarnda, 2020) this is possibly as a result of the mining activity taking place in the study area and flooding incidence. In contrast, the finding of this study is lower

than values reported by (Mathaiyan *et al.*, 2021).

The Effect of Location on the Concentration of Toxic Heavy Metals in Liver from Gwaram and Kafin Hausa Local Government Areas (mg/kg)

Cadmium content in liver from Gwaram and Kafin Hausa is 0.035 and 0.038mg/kg, respectively. Similar research work reported higher values of cadmium in liver (Bilal, 2010; Okareh and Oladipo, 2015; Suleiman, Shehu and Adebayo, 2022; Chiedozie, 2009), meanwhile other authors reported lower values (Njoga, *et al.*, 2021; Sabuwa and Nafarnda, 2020; Mathaiyan *et al.*, 2021). Chromium from Gwaram and Kafin Hausa were 0.030mg/kg and 0.059mg/kg. All similar research findings reported higher values of chromium to exceed standard limit (Suleiman *et al.*, 2022; Okareh and Oladipo, 2015; Terver *et al.*, 2017; Sabuwa and Nafarnda, 2020). Pb content was found to be higher for the reason that, it exists in an ionized form in plasma, later bound to an inert form when it is conjugated with metallo thionein and then delivered to the liver (Lentini *et al.*, 2017). Mean concentration of lead in the study was in agreement with the finding of Suleiman, Shehu and Adebayo (2022) who reported Pb mean value of 0.15mg/kg. Okareh and Oladipo (2015), Adnan (2021) and Sabuwa and Nafarnda (2020) reported lower values of Pb in liver in their study. However, Mathaiyan *et al.*, (2021), Njoga *et al.*, (2021) reported higher values than the findings of this research.

The Effect of Location on the Concentration of Toxic Heavy Metals in Kidney from Gwaram and Kafin Hausa Local Government Areas (mg/kg)

Cadmium in Gwaram and Kafin Hausa were similar in this finding. The result is in disagreement with other researches that found Cd higher than this finding (Njoga, *et al.*, 2021; Okareh and Oladipo, 2015; Adnan, 2021). Meanwhile others reported lower values (Bilal, 2010; Mathaiyan *et al.*,

2021; Sabuwa and Nafarnda, 2020). Chromium concentration is found to be higher in Gwaram with 0.248 mg/kg. With the high concentration the result is lower than the findings of (Sabuwa and Nafarnda, 2020; Okareh and Oladipo, 2015). The lead content in Kidney was similar from both locations. And the high content of lead in kidney against other parts is evident for its ability to filter, reabsorb and concentrate divalent ions (Lentini *et al.*, 2017). Lower values of Lead were reported (Okareh and Oladipo, 2015; Mathaiyan *et al.*, 2021; Sabuwa and Nafarnda, 2020). However, Njoga *et al.* 2021 reported higher mean value.

Conclusion

The study revealed the presence of toxic heavy metals in different meat parts. The presence of toxic heavy metals in the study locations could be attributed to mining activities, contaminated soils, flooding and intense usage of agro-chemicals.

Recommendations

Based on the findings of this study, it was recommended that:

- i. There is need to embark on massive public health awareness on the need to reduce illegal mining activities near grazing areas.
- ii. Regulation on the use of agro chemicals.
- iii. Collaboration with other experts in the field of agriculture, biochemistry and other fields in developing biomarkers that can be used to assay for levels of toxic heavy metals in live animals is recommended.

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