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Determination of Lead (Pb) Residue in Kidney, Liver, and Muscle of Slaughtered Cattle in Jos Central Abattoir, Plateau State, Nigeria.

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Abstract: *Lead (Pb) concentration was determined in 150 samples (50 livers, 50 kidneys, and 50 muscles) of slaughtered cattle at Jos Central Abattoir. The samples were analyzed for lead using Atomic Absorption Spectrophotometer. The mean concentration of lead in liver, kidney, and muscle samples were 1.887 mg/kg, 1.2790 mg/kg, and 0.6680 mg/kg respectively. Out of the samples analyzed, only 21 samples (5 samples of liver, 6 samples of kidney and 10 samples of muscles) were within the recommended Food and Agricultural Organisation (FAO, 2002) permissible limits of lead concentration in liver, kidney and muscle of bovine. There was a significant difference (P<0.05) in the concentration of lead in the liver, kidney and muscle samples tested.*
Keywords: *Abattoir, Kidney, Lead (Pb), Liver, Muscle, Slaughtered Cattle, Plateau State, Nigeria*

I. Introduction

The only way to complete all the amino acids needed for proper tissue formation, growth and repair is through the intake of animal protein. The common animal protein sources in Nigeria include beef, fish, fowl, mutton, and other source of animal protein. The habitat of these animals are continually been polluted with lead metal as a result of indiscriminate dumping of waste materials on the land and water bodies, illegal mining of ores, painting of animal's houses, and the use of Tetra ethyl lead as an anti-knocking additive to improve the quality of petrol in Nigeria and many other developing countries. (Kamala and Kumar, 1998; Dioka *et al*., 2004), some of these waste materials may contain some heavy metals such as lead and others that are dangerous to human and animal health. Cattle and other ruminants graze freely on such environment and drink water from ponds, streams, rivers and other possible contaminated water sources. They graze along highways (roads) that might have been contaminated with exhaust from vehicle which contain lead. Animals in the process may be exposed to high levels of contaminants in the environment (Nwude *et al.,* 2010). These metals bio-accumulate in their organs and other tissues of these animals. When these animals are slaughtered for human consumption, the lead (Pb) may bio-accumulate in human tissues and organs (Miranda *et al.,* 2009). This explains why the presence of lead in animal products has continued to receive a lot of attention from health sector.

Lead is considered to be one of the major environmental pollutants, it continued to pose health hazards to animals and man in Nigeria and other part of the world, and has been incriminated as a cause of accidental poisoning in domestic animals more than any other substance (Casas and Sordo, 2006). Lead that contaminates the environment is largely air-borne, but is re-deposited by dust into soil and water and is taken up by or exists on the surface of plants which are grazed by livestock (Bolter *et al.,* 1975). Cattle, sheep, and horses are good indicators of pollution on vegetation (Debackere, 1983). Cattle of all ages are affected by lead poisoning, but are more common in calves (Blakley and Brockman, 1976*;* Botts, 1977). The highest incidence has been reported in dairy cattle (Botts, 1977). It has been estimated that 150,000 cattle worldwide are exposed annually to toxic levels of lead and that at least 20,000 acute deaths occur (Bratton and Zmudski, 1984). Cattle have indiscriminate eating habits especially during starvation or pica. They will readily drink from empty container of oil, lick machinery grease, and chew batteries (Blakley, 1984). In ruminants there is a tendency for metallic lead particles to settle in the reticulum; poisoning results from the gradual conversion of lead particles to soluble Lead Acetate due to the acidity of the fore stomachs (Blakley and Brockman, 1976). Young calves are more susceptible to lead poisoning because of their innate curiosity, their active calcium absorption mechanism, and the fact that milk and milk-replacer diets promote lead absorption (Zmudzki *et al.,* 1986a).

Lead can adversely affect many organs, systems and numerous conditions such as high blood pressure, anaemia, kidney damage, impaired hearing and mental retardation (Wagner,1995), elevated levels in women

may result in a shortened gestation period (Wagner,1995). While young children are considered at great risk, because of their ability to effectively absorb Lead and thereby suffer mental and physical development retardation (Kocak *et al.,* 2005).

Evaluation of lead accumulation in cattle raised in area contaminated with lead, observed that tissue accumulation in animals was related to concentrations of the lead in environment (Miranda *et al*. 2009). Apart from being in contact with polluted soil environment and grazing on contaminated plants, cattle could also be exposed to heavy metals through contaminated feeds (Miranda *et al*., 2005). Application of animal dung as manures and fertilizers may then result in pollution of agricultural lands by these metals (Poulsen, 1998) and uptake by plants; these then pose risks to grazing cattle.

This study was carried out to determine the levels of Lead residue in different organs (Livers, muscles, and Kidneys) of slaughtered cattle at Jos Central abattoir, Plateau State, Nigeria.

II. Materials and Method

2.1 Study Area

Jos is the capital of Plateau State, and is situated in the North-east area of North Central State of Nigeria. It lies between latitude 9º 55' N and longitude 8º 46' E of the Greenwich Meridian. The State is located in guinea savannah. The area is characterised by rocky, hills and many captivating rock formations. The temperate climatic condition is greatly influenced by its strategic location on the Plateau, making Jos climate nearly equivalent to that of temperate climate. Temperature ranges from 11º C to 30º C with an annual rainfall of 150cm, lasting between 6 to 7 months.

2.2 Source of Samples

The samples consist of three different parts of cattle (liver, kidney, and muscle) which were sampled at Jos abattoir.

2.3 Sample Collection and Preservation

A total of 150 fresh samples of liver, kidney, and muscle of slaughtered cattle at Jos Central Abattoir of Plateau State were sampled. The samples were collected between the month of January and February 2012, the animals were selected randomly, the age of the slaughtered cattle were not determined. About 100g of liver and muscle, and a whole kidney of each selected animal were packed in a sterile polythene bags, properly labelled with permanent marker, frozen and stored in a freezer. The frozen samples were then transported in a cold chain to National Research Institute for Chemical Technology Zaria, Kaduna State, Nigeria for further processing and analysis.

2.4 Processing of Sample

2.4.1 Digestion of Sample (Dry Digestion)

Liver, kidney, and muscle samples were dried at 45^{o} C using oven, after drying, individual sample were crushed into fine powder using mortar and pestle, and 1.0 g of the fine powdered sample was weigh into porcelain crucible. The crucible and the fine powdered samples were ignited in a muffle furnace at 500^{o}C for six to eight hours. The Samples were then removed from the furnace and allowed to cool in desiccators, and weighed again. The difference between the weight of the crucible and ash and the weight of the crucible alone was used to calculate the percentage ash content of the sample. $5cm^3$ of 1M Trioxonitrate (v) acid (HNO_3) solution was added to the left-over ash and evaporated to dryness on a hot plate and returned to the furnace for heating again at 400^{o}C for 15-20 minutes until perfect grayish-white ash was obtained. The samples were then allowed to cool in desiccators. 15ml (cm^3) hydrochloric acid (HCl) was then added to the ash to dissolve it and the solution was filtered into 100 cm^3 volumetric flask. The volume was made to $100cm^3$ with distilled water.

2.4.2 Spectrophotometry Techniques for Lead (Pb) Detection

In the prepared liver, kidney and muscle samples, Lead (Pb) residue was determined under specified condition according to the manufacturer (AA-6800, Shimadzu Atomic Absorption Spectrophotometer) (Szkoda and Żmudzki, 2005).

2.5. Statistical analysis

Data were presented in tables**;** ANOVA (Analysis of Variance) was used to compare the mean concentration of lead in liver, kidney, and muscle of slaughtered cattle. The results were analysed using Graphpad Instat **3.10**.

III. Result and Discussion

The concentration of lead in the liver samples ranged from 0 (not detectable (ND)) to 3.468 mg/kg, with mean and standard deviation of 1.887 ±0.6376 mg/kg, kidney is from 0 (not detectable (ND)) to 2.388 mg/kg with a mean and standard deviation of 1.2790 ±0.3827 mg/kg and muscle had a range from 0 (not detectable (ND)) to 0.5116 mg/kg, with a mean and standard deviation of 0.6680 ±0.3252 mg/kg. 5 liver samples were within the food and Agricultural Organization (FAO) 2002 permissible level, 6 kidney samples were also within the permissible level and 10 of the muscle samples were within the FAO accepted limit.

Table 1: Range, Mean and Standard Deviation of Lead Concentrations (mg/kg) in Bovine Livers, Kidneys and Muscles.

Type of Samples	No. of Samples Tested	Lead concentration (mg/kg)	
		Range	Mean and standard deviation
Liver	50	ND to 3.468	1.887 ±0.6376
Kidney	50	ND to 2.388	1.2790 ±0.3827
Muscle	50	ND to 0.512	0.6680 ±0.3252

ND= Not Detectable, No= number

Table 2: Number of samples that are within the permissible level of lead recommended by FAO (2002) of 0.1mg/kg.

Type of Samples	No. of Samples Tested	No. of Samples with Lead Conc. within FAO limit
Liver	50	5
Kidney	50	6
Muscle	50	10

No= number

The highest concentration of lead in liver, kidney, and muscle were 3.468 mg/kg, 2.388 mg/kg, and 0.512 mg/kg respectively. Out of 150 samples tested for lead, only 21 samples are within the permissible concentration level of lead recommended by FAO (2002).

The range and mean concentration of lead in liver and kidney in this study is higher compare to that reported by Iwegbue, 2008 in Southern Nigeria, who reported range and mean concentration in liver to be ND-1.23 mg/kg, and 0.08 mg/kg and range and mean concentration in kidney to be ND-0.95 mg/kg, 0.04 mg/kg respectively.

From this study, liver have the highest concentration of lead, followed by kidney and then muscles which had the least, this is inline with Bala *et al.*, 2012 who also reported high concentration of lead in liver than in the kidney. The highest concentration observed in the liver and kidney may be as a result of detoxification of toxic substance by the liver, since lead is a toxic metal, while the concentration found in kidney may be as a result of excretory function of the kidney, in which some toxic substances are mobilised from the body tissues and are send to the kidney for excretion. These may be the same reason why the concentration of lead is higher in liver and kidney than in the muscle, and these may also explain why the number of muscle samples that are within the recommended Food and Agricultural Organisation (FAO, 2002) permissible level of lead are higher than that of liver and kidney. There was a significant difference ($P< 0.5$) in the concentration of lead in liver, kidney, and muscle of slaughtered cattle in Jos Central Abattoir. This results was in line with those reported by Doyle and Spaulding 1978, and Stabel-Tancher *et al*., 1975, they also reported higher concentration of lead in liver and kidney than in the muscle.

The different level of mean concentration of lead in liver, kidney, and muscle of slaughtered cattle in this study may as a result exposure of these cattle to lead materials either through contaminated pasture or contaminated water. It may also be as a result of contamination of carcasses during processing, by using water is contaminated with lead materials. Further study can be carried out to determine the source of lead contamination of slaughtered cattle in Jos Central Abattoir, Plateau State, Nigeria.

IV. Conclusion

Lead concentration was determine in liver, kidney and muscle samples of slaughtered cattle at Jos Central Abattoir and there was a significant different in the concentration of lead in different parts (liver, kidney and muscle) of the samples. Muscles are considered to more safe for human and animal's consumption compare to that of liver and kidney.

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