Detection of Lead (Pb), Cadmium (Cd), Chromium (Cr) Nickel (Ni) and Magnesium Residue in Kidney and Liver of Slaughtered Cattle in Sokoto Central Abattoir, Sokoto State, Nigeria

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Rec. Date: Jul 05, 2013 07:44, Accepted Date: Oct 02, 2013 07:24

Abstract

The prevalence of lead, cadmium, chromium, nickel, and magnesium in liver and kidney samples of slaughtered cattle at Sokoto abattoir was determined using Atomic Absorption Spectrophotometer. A total of twenty four samples were collected for analyses. Among the samples 19, 21, 23, 16, and 24 were positive for Lead, cadmium, chromium, nickel, and magnesium respectively. The mean concentration of lead, cadmium, chromium, nickel, and magnesium in liver of the slaughtered cattle were 1.523 mg/kg, 2.687 mg/kg, 4.775 mg/kg, 0.938 mg/kg, and 76.167 mg/kg respectively, while the mean concentration of Lead, cadmium, chromium, nickel, and magnesium in kidney of slaughtered cattle were 0.8442 mg/kg, 2.058 mg/kg, 4.894 mg/kg, 0.772 mg/kg, and 68.258 mg/kg respectively. There was significant difference in the concentration of lead, cadmium, chromium, nickel and magnesium in liver and kidney of slaughtered cattle (P< 0.05). The mean concentration of lead, cadmium, chromium, in both liver and kidney of slaughtered cattle were higher than the permissible limit recommended by Food and Agricultural Organization.

Keywords: Abattoir, cattle, kidney, liver, Nigeria, Slaughter, Sokoto.

Introduction

In Nigeria there is 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 (Kamala and Kumar, 1998; Dioka et al., 2004), some of these waste materials may contain some heavy metals such as Lead, cadmium, arsenic and others that are dangerous to both 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. Animals in the process may be exposed to high levels of these metals in the environment (Nwude et al., 2010). These metals may bio-accumulate in organs and tissues of these animals. When these animals are slaughtered for human and other animal’s consumption, these heavy metals may in turn bio-accumulate in...
human and other animal’s tissues and organs (Miranda et al., 2009). This explains why the presence of heavy metals in animal products has continued to receive a lot of attention from health sector.

Lead, cadmium, arsenic are considered to be one of the major environmental pollutants, it continued to pose health hazards to animals and humans 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). Some of these heavy metals are air-borne, and it can be transported to a few kilometer by atmospheric transport before deposited into soil, plants surface, and water, (Bolter et al., 1975). Cattle, sheep, and horses serves as good indicators of environmental pollution by heavy metals (Debackere, 1983).

Different researchers have reported the instances of contamination of heavy metals in meat products during processing (Brito et al., 2005; Santhi et al., 2008). Heavy metals residues were found in meat and meat product of food animals fed with contaminated feed and reared in proximity to polluted environments (Korenekova et al., 2002; Sabir et al., 2003; Miranda et al., 2005).

The above statements show how heavy metals posed serious health hazard to general public. The main objective of this study was to determine the level of of Lead (Pb), Cadmium (Cd), Chromium (Cr) Nickel (Ni) and Magnesium Residue in liver and kidneys of slaughtered cattle at Sokoto Abattoir Sokoto State Nigeria.

Materials and Methods

Study area

The study area is Sokoto abattoir, which is located in Sokoto North local government area of Sokoto State, Nigeria. Sokoto State is geographically located at the North Western part of Nigeria, between longitudes 4°8'E and 6°54' E and latitudes 12° N and 13°58'N. The State share boundaries with Niger Republic to the North, Kebbi State to the West and Zamfara State to the East. Sokoto State covers a total land area of about 32,000 square Kilometres with an estimated human population of 3,696,999 (NPC, 2006). The State ranks second in the Nigerian livestock population with an estimated 3 million cattle, 3 million sheep, 5 million goats, 4,600 camels, 52,000 donkeys and host of other species of local and exotic poultry species (MOCIT, 2002; Mamman, 2005).
Samples types
The samples consist of liver and kidney of 24 randomly selected slaughtered cattle at Sokoto Central abattoir.

Samples Collection and Preservation
Twelve fresh samples each of liver and kidney of slaughtered cattle at Sokoto abattoir were collected between the month of September and October, 2011, the animals were selected randomly, the age and the sex of the selected slaughtered cattle were not determined. About 100g of liver and a whole kidney of each selected animal were packed in a sterile polythene bags, properly labelled with permanent marker, and transported to Veterinary Public Health and Preventive Medicine laboratory of Usmanu Danfodiyo University Sokoto, Sokoto State, Nigeria where it was frozen and stored in a freezer. The frozen samples were then transported in a cold chain to Biochemistry Department of Bayaro University Kano, Kano State, Nigeria for further processing and analysis.

Processing of Samples
Digestion of Samples (Dry Digestion)
Liver and kidney samples were dried at 45° C using oven, after drying, individual sample was 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° 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. 5cm³ of 1 M trioxonitrate (v) acid (HNO₃) 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°C for 15-20 minutes until perfect grayish-white ash was obtained. The samples were then allowed to cool in desiccators. 15cm³ hydrochloric acid (HCl) was then added to the ash to dissolve it and the solution was filtered into 100cm³ volumetric flask. The volume was made to 100cm³ with distilled water.

Spectrophotometry Techniques for heavy metals Detection
In the prepared liver and kidney samples, Cadmium (Cd), lead (Pb), chromium (Cr), agnesium (Mg), nickel (Ni) residue were determined under specified condition according to the
manufacturer (AA-6800, Shimadzu Atomic Absorption Spectrophotometer) (Szkoda and Żmudzki, 2005).

**Statistical Analysis**

Data from the study were presented in tables and percentages; ANOVA (Analysis of Variance) was used to compare the mean concentration of Cadmium in liver and kidney in different age groups. The results were analysed using Graphpad Instat 3.10, 32 bit for window.

**Results and Discussion**

The Percentage (%) Positive and prevalence of lead (Pb), Cadmium (Cd), Chromium (Cr), Nickel (Ni), and Magnesium (Mg), in Liver and Kidney Sample are shown in Tables 1. While the Mean and standard deviation (Mean ± SD) of lead (Pb), Cadmium (Cd), Chromium (Cr), Nickel (Ni), and Magnesium (Mg) concentration (mg/Kg) in liver and kidney samples are shown in table 2. The prevalence of lead, cadmium and chromium in this were 79.17%, 87.5%, and 95.83% respectively, these prevalence were lower compare to Bala et al., 2012 whose prevalence were 100% for lead, cadmium and chromium. This may be due to different season of samples collection.

The mean and standard deviation (Mean ± SD) of lead (Pb), Cadmium (Cd), Chromium (Cr), Nickel (Ni), and Magnesium in liver were 1.523±1.143 mg/kg, 2.687±1.877 mg/kg, 4.775±4.336 mg/kg, 0.938±0.745 mg/kg, and 76.167±35.633 mg/kg respectively. The mean concentration of lead, cadmium and chromium in liver in this study were higher compare to Bala et al., 2012, this may also be due to different season of sample collection.

**Table 1:** Percentage (%) of lead (Pb), Cadmium (Cd), Chromium (Cr), Nickel (Ni), and Magnesium (Mg), positive liver and kidney sample

<table>
<thead>
<tr>
<th>Name of Metal</th>
<th>No of sample tested</th>
<th>Positive Sample (liver and kidney)</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead</td>
<td>24</td>
<td>19</td>
<td>79.17</td>
</tr>
<tr>
<td>Cadmium</td>
<td>24</td>
<td>21</td>
<td>87.5</td>
</tr>
<tr>
<td>Chromium</td>
<td>24</td>
<td>23</td>
<td>95.83</td>
</tr>
<tr>
<td>Nickel</td>
<td>24</td>
<td>16</td>
<td>66.67</td>
</tr>
<tr>
<td>Magnesium</td>
<td>24</td>
<td>24</td>
<td>100</td>
</tr>
</tbody>
</table>

%= percentage
Table 2: Mean and standard deviation (Mean ± SD) of lead (Pb), Cadmium (Cd), Chromium (Cr), Nickel (Ni), and Magnesium (Mg) concentration (mg/Kg) in liver and kidney samples

<table>
<thead>
<tr>
<th>Name of metal</th>
<th>mean and SD in liver (mg/kg)</th>
<th>mean and SD in kidney (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead</td>
<td>1.523±1.143</td>
<td>0.8442±1.132</td>
</tr>
<tr>
<td>Cadmium</td>
<td>2.687±1.877</td>
<td>2.058±1.737</td>
</tr>
<tr>
<td>Chromium</td>
<td>4.775±4.336</td>
<td>4.894±1.894</td>
</tr>
<tr>
<td>Nickel</td>
<td>0.938±0.745</td>
<td>0.772±0.779</td>
</tr>
<tr>
<td>Magnesium</td>
<td>76.167±35.633</td>
<td>68.258±20.717</td>
</tr>
</tbody>
</table>

P value is < 0.001

While the mean and standard deviation (Mean ± SD) of lead (Pb), Cadmium (Cd), Chromium (Cr), Nickel (Ni), and Magnesium (Mg) concentration (mg/Kg) in kidney were 0.8442±1.132 mg/kg, 2.058±1.737 mg/kg, 4.894±1.894 mg/kg, 0.772±0.779 mg/kg, and 68.258±20.717 mg/kg respectively. The mean concentration of lead, cadmium and chromium in kidney of slaughtered cattle were also higher compare to Bala et al., 2012.

Generally the mean concentration of lead, cadmium, nickel, and magnesium were slightly higher in liver than in the kidney except that of chromium which is slightly higher in kidney than in the liver. The higher concentration of lead, cadmium, Nickel, and magnesium were higher in liver, this result was in line with the findings of Akan et al., 2010 who recorded high concentration of Cadmium, chromium in the liver than the kidney, this may be due to detoxification of toxic substances by the liver, where these metals were mobilized to the liver for detoxification.

Nickel is found in small amount in air, water, soil, and in food. Soluble nickel compounds are more toxic than insoluble compound (Goyer 1991).when animal or human consumed nickel up to 5g, it may lead to toxicity (Daldrup et al., 1983). Some of the site effect of nickel include: vomiting, nausea, headache, diarrhea, lung damage and death. The suggested permissible limit for human and animals was 75 μg per day by Nielsen (1992). Nickel is known to be toxic at high doses and this will lead to health hazard to both animals and human.
According to the results of this study, there was significant difference in the concentration of lead, cadmium, chromium, nickel and magnesium in liver and kidney of slaughtered cattle (P≤ 0.05).

The mean concentrations of Lead in liver and kidney samples were higher than 0.1 mg/kg recommended daily intake of Lead by Food and Agricultural Organization (FAO) (2002) and Egyptian Organization for Standardization (EOS) (1993). while the mean concentration of Cadmium in liver and kidneys of slaughtered cattle at Sokoto Central abattoir were higher than the permissible level of 0.5 mg/kg and 1 mg/kg in liver and kidney respectively as recommended by FAO/WHO (2000).

References


