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Determination of Heavy Metals in the Muscles of Beef (Cow) from Three Abattoirs in Lokoja Metropolis

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Abstract

The present study was to determine the concentration of heavy metals (Cu, Zn, Co, Mn, Mg, Cr, Cd, As, Ni and Pb) in beef (cow) muscles from three abattoirs in the metropolis of Lokoja, State of Kogi, Nigerian using the atomic absorption spectroscopy model Bunk Scientific 210 (AAS). The concentration of all metals in beef muscle in the three slaughterhouses was statistically significant (p<0.05). Generally, the sample from Ganaja village abattoir has the highest significant level of metals followed by the sample from Felele abattoir while Old market abattoir showed the least concentrations of heavy metals. When compared to one another on location, there did show significant differences hence the concentration of all the metals were within the permissible limits set by WHO, FAO and ANZFA

Keywords: ***Heavy metals; Muscles of Beef; Nigeria; AAS.***

Introduction

With the increase of industrialization, the high number of metals is entering the terrestrial environment. These metals remain permanent because they cannot be further degraded in the environment. They enter food materials and from there eventually make their way into the fabric [1]. Lead, cadmium, mercury and arsenic are among the most toxic metals that accumulate in the food chain and have the cumulative effect [2].

Toxic metals can be defined as that metals which are neither essential nor has a beneficial effect. It displays severe toxicological symptoms at a low level and can equally be defined as a metal with a specific weight more than 5×10^6 ppm. Food items that constitute human diet and even animals are contaminated when they come in contact with polluted environmental media-air, soil and water. Ingestion of these contaminants by animals causes deposition of residues in meat [3]. The effect of heavy metal contamination in meat is of great concern for both food safety and human health because of the toxic nature of these metals even at low concentration when ingested over a long period of time due to their ability to accumulate in the human and animal body [4,5].

In Nigeria cattle are free grazing and drink water from ditches, streams, rivers and other possible contaminated water sources. They graze along runways and other sites that might have been contaminated with toxic substances hence the risk to exposure to high levels of contaminant. These metals accumulate in the organs and other tissues. The muscles and other organs are sold in the market for consumption [6].

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Meat is a very rich and convenient source of nutrients and microelements. The chemical composition of the meat depends both on the type and on the degree of the food. The need for mineral compounds depends on age, physiological status and food intake and living conditions [1]. Heavy metal contamination is a serious threat due to their toxicity, bioaccumulation and bioingrandimenti in the food chain [7]. Although the contamination of toxic animal feeds cannot be completely avoided given the prevalence of these pollutants in the environment, there is a clear need to minimize this contamination, in order to reduce both the direct effects on animal health and the indirect effects on human health [8]. The toxic effects of metals have been described in animals at relatively low levels of metal exposure [9)]; one of the first effects is the destruction of the metabolism of trace elements [1,10].

Materials/Method

10% (v / v) washed with hydrochloric acid 10% (v / v) with nitric acid and all the glasses were soaked overnight after deionized / distilled water and dried. A Buck Synthetic (Model 210) and Atomic absorption spectroscopy was used to identify concentrations of heavy metals in the sample.

Reagent

Concentrated nitric acid, concentrated hydrogen tetraoxosulphate IV, hypochlorusacids (HClO4) and distilled water.

Study area

The study area is Lokoja urban area of kogi state, Nigeria situated at latitude 7.8167N and 6.7500E of Lokoja with population of about 60,579 [12]. The cattle use for the study was monitored for seven (7) months (February to September 2015) from its grazing area in Jegbe from Ajaokuta local government area which is about 13 km from Lokoja town. They were equally water from streams ponds and overrunning surface water from farm land.

Sample collection

The meat samples (muscle) were collected from three abattoirs, old market abattoir, felale abattoir and ganaja village abattoir. Those abattoirs purchase their cattle from among the monitored cattle. The samples were collected in polyethylene bag and transported to the laboratory for analysis. The samples were frozen in the refrigerator at the temperature of 4ºC.

Digestion of sample

The collected samples were decomposed by wet digestion method for the determination of various metals. The method of J C Akan was adopted. A known quantity, 10 g of each sample (muscle) was introduced into the digestion flask. 20 ml of sulphuric acid was added into it followed by the addition of 10ml nitric acid and 5 ml hypochlorous acid. The digestion flask was heated for 30 min. After flocculation had settled, the flask was heated on high flame. After digestion, hydrogen peroxide was added drop wise until a clear solution was obtained. The content of the flask was filtered into 50ml volumetric flask and made up to the mark with distilled water.

Collected samples are dried in wet digestive system for the determination of various metals. J C Akan et al adopted the 2010 approach. A known size, 10 g (muscle) of each sample belongs to the digestive tract. 20 ml sulfuric acid is included. After 10ml nitric acid and 5 ml. Hypocloresocides are included. Gastrointestinal pots are heated for 30 min. After flacculation was established, this was heated on a high flame. After digestion, hydrogen peroxide has been removed until a clear solution is reached. The content of the flask is distinguished by size of 50 mm and made up of distilled water until mark.

Statistical analysis

The data collected was submitted as an average and standard deviation and an analysis was taken to determine ANOVA ($p < 0.05$) to be significantly different between different organs. All statistical calculation was performed with SPSS 9.0 for windows.

Discussion

Copper

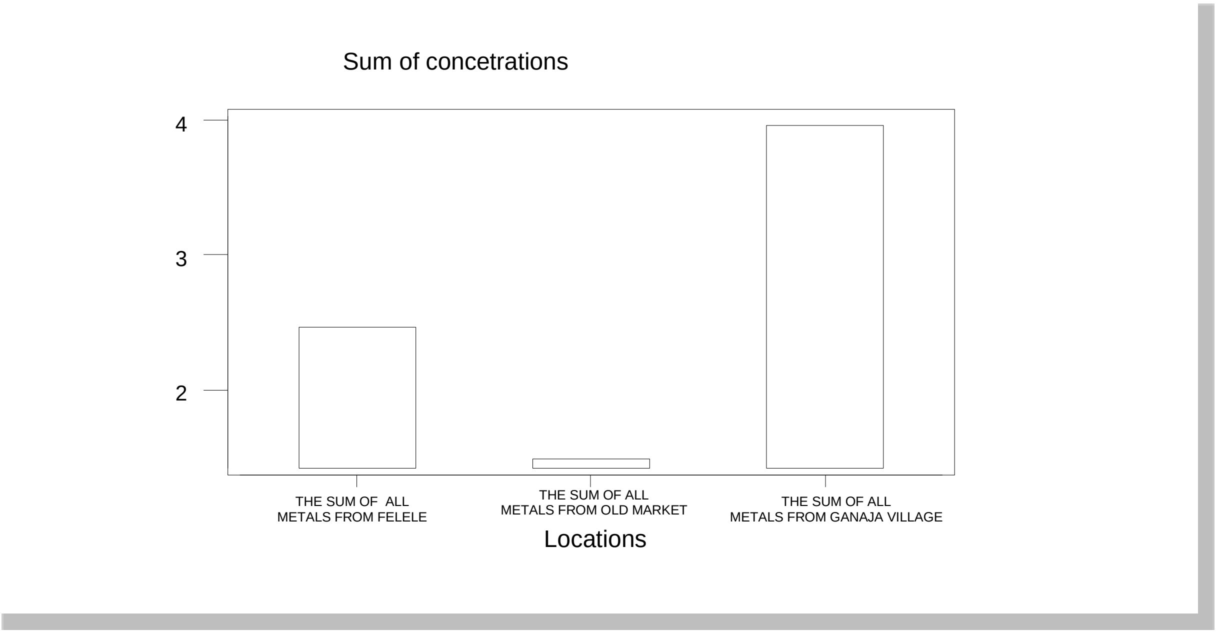
Felele from the three abattoirs, Old Market, and Ganja Village presented in **TABLE 1** as a result of sampling analysis from muscle abattoirs. It shows that the sample from old market abattoir has the highest concentration of copper of 1.2 3ppm followed by the sample from Felele abattoir with concentration of 0.28 ppm and sample from Ganaja village abattoir has the least concentration of 0.27 ppm of copper.

Copper is an essential component of various enzymes and plays a significant role in maintaining the integrity of bone structure, skeletal mineralization and binding tissue. The value of iron is 0.76 ppm, followed by 0.71 ppm with kidneys and low-valued muscle 0.40 ppm. Copper requires a lot of good health, but much more can cause a health problem such as liver and kidney damage [14]. Copper also causes public health issues in high concentration [15].

In human 10-30 mg of orally ingested copper from food stored in copper vessels can cause intestinal discomfort, dizziness and headaches while excess accumulation of copper in the liver may result in hepatitis or cirrhosis and in a hemelytra crisis similar to that seen in copper poisoning [16].

The mean concentration of copper in the muscles from the three abattoirs is 0.207 ± 0.104 ppm. However, none of these samples from the three abattoirs in the study had copper content exceeding the maximum permissible limit (MPL) of 200 ppm [17]. When the mean concentration of heavy metal was taken across the three locations it showed that all the concentration of heavy metals from Ganaja village abattoir have the highest concentration followed by the sum of heavy metal from Felele abattoir and then the Old market abattoir as shown in **CHART 1.**

CHART 1**. Response and induction time of PANI and PANI/Zeolite erionite composites.**



Iron

The sample of three abattoirs as indicated in the table indicates that iron concentration foil is the highest concentration of 0.51 ppm of iron in the sample from abattoir. The old market shows 0.40ppm of sample iron from abattoir and of sample iron from Ganja village abattoir. The toxicity of iron is maintained by absorption in the iron state through gallstones of gallstones. Ferritin is a unique iron storage protein containing 24 storage proteins, which is absorbed with high iron content in the body of high ferretine, ferrititin is the most abundant in the heart and liver, and therefore these organs and iron storage [18].

The body can only produce so much of this protein; however, iron builds up in the organ can cause the liver to become cirrhotic. Hepatoma the primary cancer of the liver has become the most common cause of death among patients with hemochromatosis [19]. Also when sliders become severe in young people, myocardial disease is a common cause of death [19]. Impotence may occur in young men and amenorrhea may occur in young women. Both of these sexually related problems are due to iron loading in the anterior pituitary. The maximum permissible limit for iron is 15mg/day for male and18mg/day for female ages from 19-50 [19]. From the above result in **TABLE 1**, the concentration of each of the sample is less than the permissible limit for both male and female as set by [19].

TABLE 1**. Concentration of heavy metals in the muscle from three abattoirs (On location) in ppm.**

Heavy Metals	Cu	Fe	Zn	Mn	Pb	Cd	Co	Cr	Ni	As
Felele	0.41	0.51	0.49	0.02	0.00	0.01	0.01	0.06	0.89	0.07
Old Mkt	0.07	0.40	0.80	0.02	0.00	0.01	0.00	0.03	0.08	0.03
Ganaja	0.14	0.36	3.01	0.02	0.00	0.01	0.00	0.02	0.10	0.02

Zinc

The sample from Ganaja village abattoir have the highest concentration of 3.01 ppm of zinc followed by sample from Old market abattoir with 0.80 ppm of zinc and the sample from Felele abattoir have the least concentration of 0.49 ppm of zinc. In **TABLE 2**, the mean concentration of the three samples is 1.433 ± 0.793 ppm. Therefore, the whole model, including average concentration, is less than the allowable limit of 150ppm set by zinc concentration [13]. Zinc is an important element in human diet. Zinc is too small to be harmful to human health and most zinc is harmful to human health [14].

Manganese

Manganese is needed for growth and good health in humans; otherwise the manganese's deficiency can accelerate the nervous system [20]. The sample from the three abattoirs has the same concentrations of 0.02 ppm of manganese. The mean concentration of the manganese as shown in **TABLE 2** is 0.027 ± 0.009 ppm. The maximum permissible limit of manganese is 2.9 ppm [13]. No lead was detected in the three samples from the three abattoirs.

TAB.2. **The Mean Concentration of heavy metals in the muscle in PPM.**

Heavy Metals	Cu	Fe	Zn	Mn	Pb	Cd	Co	Cr	Ni	As
Muscles	0.207 ± 0.104	0.423 ± 0.045	1.43 ± 0.793	0.017 ± 0.003	0.007 ± 0.007	0.01 ± 0	0.01 ± 0.003	0.037 ± 0.012	0.09 ± 0.004	0.05 ± 0.015

Cadmium

Cadmium concentrations in the entire sample from the three abattoirs have the same concentration of 0.01ppm. The mean concentration of cadmium of the sample from the three abattoirs is 0.01 ± 0.00 ppm. From this result the concentration of cadmium in the entire sample studied were found to be lower than 0.5 ppm, the permissible limit is set [19]. When Cadmium toxic to virtually every system animal body actually joins the vicious age of each system. and its accumulates in the kidney and liver in the long run period melting causes all (1999), resulting from chemical similarities and consumption to the binding stage that cadmium interacts with many chemical minerals Zn, Fe, Cu and Se. This affects the calcium, phosphorus and bone metabolism in cadmium individuals in the industrial and general environment of Cd [21].

Cobalt

The sample from Felele abattoir showed the concentration of 0.01 ppm while the sample from Old market and Ganaja village abattoirs shows no detection. The mean concentration of cobalt from the three abattoirs is 0.0067 ± 0.003 ppm. The concentration of cobalt in the sample is low compare to the permissible limit of 2.0 ppm set by [19]. Cobalt is required in the form of cobalt containing vitamin B12 cobalt is widely distributed in the animal organ in relatively high concentration in the liver, kidney, bone and glandular kidney [6,22].

Chromium

The high concentration of the sample chromium is from 0.02ppm, but the sample from the old market abattoir contains 0,03 ppm and the samana in the Ganaja village contains at least the concentration of 0.02 ppm. Chromium is an important factor that helps to use sugar, protein and fatty foods to the body, which is a cancer causing agent [23]. Excessive amounts of chromium may cause adverse health effects [19]. The concentration of all the metals in the entire sample studied from the three abattoir were lowered than the permissible limit of 0.1 ppm [13].

Nickel

Nickel concentration from Felele abattoir showed the highest concentration of 0.89 ppm of nickel Ganaja village abattoir showed 0.10 ppm and Old market abattoir showed concentration of 0.08 ppm. The mean concentration from the three abattoir is 0.09 ± 0.004 ppm. 1ne concentration is lower than the permissible limit of 1-2 ppm [19]. Small amount of nickel is needed by the human body to produce red blood cells but when in excess nickel can become mildly toxic. Long term exposure to nickel can cause decreased in the body weight heart and liver damage and skin irritation [22].

Arsenic

Felele abattoir showed the highest concentration of arsenic of 0.07 ppm followed by Old market abattoir with 0.03 ppm while Ganaja village have the least concentration of 0.02 ppm. The permissible limit arsenic in the liver of cow has been reported as 2.0 ppm.

Conclusion

From these studies, the muscles as parts of the cattle consumed in the metropolis of Lokoja in the state of Kogi, Nigeria, seem to be safe for consumption considering the concentration of cadmium, copper, iron, chromium, zinc, lead, manganese, arsenic, nickel and cobalt present in they. It is expected that the animals that freely graze around Jegbe, about 20 km from Ajaokuta, an industrial area will accumulate a high concentration of toxic metals in their organs, but from these results, the levels of metals were generally low and within permitted limits set by CHI, FAO and ANZFA. The concentrations of these metals seem to be moderate for the body. However, since there can be accumulation of these elements resulting to toxicity, it is advisable to limit the consumption especially of the liver and kidney.

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