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Assessment of Heavy Metals in the Lungs, Hearts, and Muscles of Cow from Abattoirs in Anyigba, Ejule, and Ankpa

Onoja P. K[1], Omede S. N[2], Ichado A. S. P[3]

Associate Professor, Kogi State University, Anyigba, Nigeria
Principal, Kogi State University, Anyigba, Nigeria
Chief Technologist, Kogi State Polytechnic, Anyigba, Nigeria

ABSTRACT

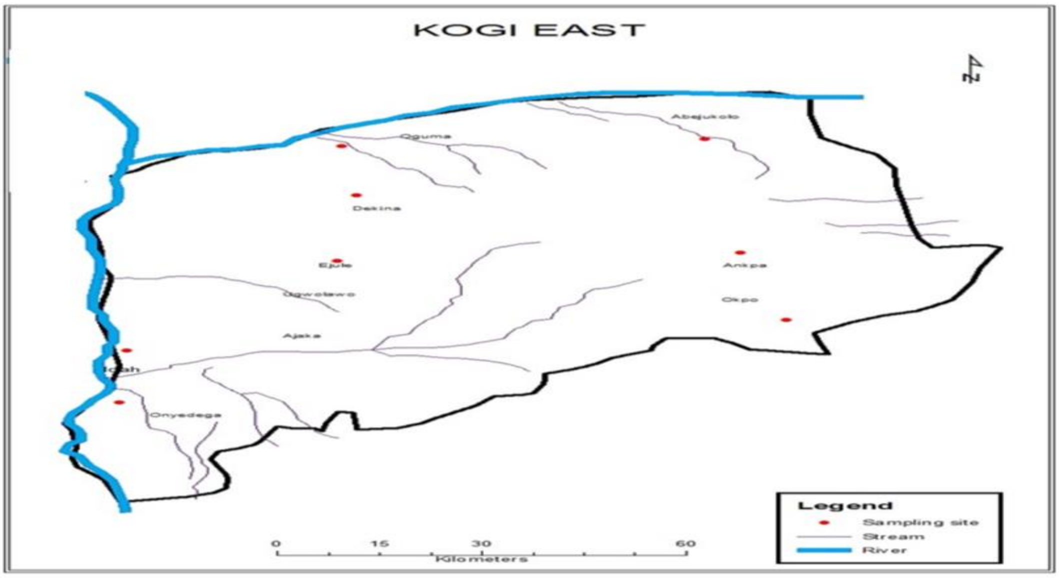
The recent widespread concern in human health due to the consumption of food product of animal origin has necessitated the need to monitor the level of heavy metal in animal tissues. This study was undertaken to evaluate the concentrations of heavy metals (Pb, Cd, Zn, Cu, Cr, Ni and Fe) in the Lung, heart, and Muscle of cow from selected abattoir in Anyigba, Ejule, and Ankpa in Kogi State, Nigeria, by using Atomic Absorption Spectroscopy (AAS). The levels of heavy metals in Lung, heart, and Muscle of cow have the following mean concentration 0.27, 0.29, 0.09 mg/kg Pb;0.22,0.14,0.09 mg/kg Cd;2.27,3.25,2.18 mg/kg Zn; 1.67,1.33,1.70 mg/kg Cu; 3.80,2.70,1.57mg/kg Cr. 0.72,0.75,0.71 mg/kg Ni and 56.7,58.92,62.04 mg/kg Fe; in Lung, Heart and Muscle respectfully in Ejule, 0.13,0.11,0.36mg/kg Pb; 0.29,0.91,0.06 mg/kg Cd; 2.12,1.66,1.74 mg/kg Zn; 2.48,1.98,2.10 mg/kg Cu; 2.39,2.09,1.40 mg/kg Cr: 1.29,0.90,1.66 Ni mg/kg and 72.60,66.90,72.38 mg/kg Fe in, Lung, Heart and Muscle respectfully in Anyigba, and 0.11,0.04,0.03mg/kgPb;0.03,0.04,0.03 mg/kg Cd; 1.99, 2.50, 1.78 mg/kg Zn; 2.08, 1.72, 0.39 mg/kg Cu; 0.75, 0.75, 0.39 mg/kg Cr: 1.03,0.74,0.79mg/kg Ni and 49.79, 44.49, 54.48 mg/kg Fe in Lung, Heart and Muscle respectfully in Ankpa. The concentrations of the metals in the various meat parts (lung, Heart, and muscle) were significantly different ($p<0.05$). The concentrations of Pb, Cr, Ni, were higher ($p<0.05$) than the permissible limits set EPA and WHO respectively; while the concentrations of Zn, Cu, and Fe were lower than EPA and WHO. However, the determined concentrations compared favorably ($p<0.05$) with values found in the literature.

Keywords: *Metals, Meat, Organs, Anyigba, Ejule, Ankpa.*

1. INTRODUCTION

Pollution of heavy metals is a global threat to the environment as they are widely present in the earth's crust, in air, water, and food [1] Metals and chemicals from the food affect the human health. Some are useful having biological functions necessary for the body, such as copper, iron, selenium, and zinc, which can become toxic when highly concentrated [2]. Some do not have any known function, for example, cadmium, lead, mercury, and arsenic. They may be harmful to the public health especially with high exposures [3]. Heavy metals including arsenic, are considered the most widespread and dangerous pollutants to the environment. 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 of exposure to high levels of the contaminant. These metals accumulate in the organs and other tissues. The muscles, liver, kidney and other organs are sold in the market for consumption as a special delicacy [4].Those metals that are equivocally essential, owe their essentiality to being constituents of enzymes and other important proteins involved in key metabolic pathways. Hence, a deficient supply of micro nutrients will result in a shortage of enzymes which leads to metabolic dysfunction causing disease, whereas, so-called toxic metals cause toxicity at levels which exceed the tolerance limit of the organism, but do not cause deficiency disorders like the essential metals [5]. For example, lead can adversely affect many organs, systems and numerous conditions such as high pressure, anaemia, kidney damage, impaired hearing and mental retardation [6]. [7] reported high levels of some toxic and trace metals in calves and kids from a polluted area of Northern Spain [10] it is worthy of note that heavy metals tend to bioaccumulate in different parts of the body but particularly in vital organs and tissues such as liver, kidneys, blood, stomach, and intestines [8] Despite the underscored nutritional value of meat and meat products, its quality in some cases may be compromised by chemical contaminants. Some of these chemical contaminants are ubiquitous as a result of anthropogenic activities that mobilize them into the environment.

Thsathiyapriyar49@gmail.comese may make the contaminants bound to become bioavailable to animals which are the source of the meat produced by the food chain. Heavy metals are among these chemical contaminants that are prevalent in our environment. They are widely distributed as a result of leaching into the environment by erosion, industrial and agricultural processes. They also exist naturally in soils at low concentrations. In high concentrations, they are a very important group of environmental toxicants since they are potent metabolic poison to humans, animals, fish, and plants [9]. In Nigeria, internal organs (liver, kidneys, heart, and lungs) are sold and consumed as a valuable food source. Therefore, evaluating heavy metal levels in internal organs is important for safety and health purposes.



2. MATERIALS AND METHODS

Samples and Sampling Techniques

During this period, meat samples from (muscles, lungs and hears) of the cow were randomly collected from three respective sites (abattoirs) in Anyigba, Ejule, and Ankpa in triplicates. Meat sample of (muscles/ lungs/ hearts) of the cow were collected in a small polythene bags and the defatted. The samples were kept frozen at -4^{o}c pending analysis.

Sample Preparation

Digestion/Sample Preparation

Collected meat samples of the lungs, hearts, and muscles were dry digested. 2.00 g of each dried meat sample was weighed with a mettler balance (Mettler P162N, Gallenkamp, Switzerland) into a 100 mL polyethylene bottle. 10 mL of the digestion mixture (3:2 65%v/v HNO_3 and 70% v/v $HClO_4$) were added to the meat samples (Clark, 1989). The bottles were tightly closed and the contents were gently swirled and allowed to stand overnight. The samples were heated for 3 hours in a water bath adjusted to 70oC with occasional swirling at 30 minutes interval to ensure complete digestion of the samples. Finally, the digest was allowed to cool and then transferred to a 20 mL standard flask, rinsing with de-ionized water and later made up to mark with de-ionized water. The solutions were transferred into acid-leached polyethylene bottles and kept at room temperature until analysis with AAS. Sample blanks were prepared by taking 10 mL of the reagents mixture through the same procedure

Analytical Procedure (Heavy Metal Analysis)

Heavy metal (Pb, Cd, Cr, As, Cu, and Ni) in the lungs heart and muscles were determined by atomic absorption spectrophotometric method (Licata et al, 2004) the concentration of the various metals will be determined by the method of atomic absorption spectroscopy. The atomic absorption spectroscopy determination of Cd, Cr, Ni, As, Hg, and Pb corrected for the background by means of the zee man effect, will be carried out with an AAS Buck Scientific Model 210.Type was used. Standard solution of the various metal was prepared by dilution starting from a concentration of 0.5 mg/lt in HNO_3/H_2O_3 (5.2) to obtain analytical concentrations.

Statistical Analysis

Means and standard deviation of the concentrations of the heavy metals for the various samples were calculated with Microsoft Office Excel (2013) spread sheet. Concentrations of heavy metals were expresses as mean ± SDM (Standard Deviation of the mean).While the Data obtained were subjected to Analysis of Variance (ANOVA) using statistical programmed for social science (Spss) version 20 with values P S = 0.05 considered significantly different. Least Significant Difference (LSD) was used to identify Significant Differences between the means. Results were presented in graphs, bar charts, and table.

3. RESULTS AND DISCUSSION

Table 1. Showing Concentration of Heavy Metal in Three Organs in Ejule

Sample	Lead Pb	Cadmium Cd	Zinc Zn	Copper Cu	Chromium Cr	Nickel Ni	Iron Fe
Lungs	0.72	0.05	3.18	2.01	3.08	0.78±	50.02
	0.07	0.11	2.08	1.01	2.37	0.58	70.12
	0.02	0.05	3	2	3.8	0.79	50
Mean	0.27±0.3	0.22±0.00	2.75± 0.7	1.67±0.7	6.72±1.0	0.72±0.03	56.7± 8.9
Hearts	0.11	0.16	3.06	1	2.78	0.58	58.33
	0.05	0.19	4.36	2	2.64	0.98	58.43
	0.72	0.08	2.32	1	2.67	0.68	60
Mean	0.29±0.18	0.14±0.04	3.25±0.74	1.33±0.44	2.7±0.05	0.75±0.16	58.92±0.72
Muscles	0.16	0.02	2.45	1.32	2.21	0.72	40 56
	0.11	0.22	2.65	2.35	1.29	0.67	82 76
	0.01	0.04	1.43	1.43	1.22	0.73	62.8
Mean	0.09±0.056	0.09±0.08	2.18±0.5	1.7±0.43	1.57± 0.42	0.71± 0.02	62.04±0.00

Table 2. Showing Concentration of Heavy Metal in Three Organs in Anyigba

Sample	Lead Pb	Cadmium Cd	Zinc Zn	Copper Cu	Chromium Cr	Nickel Ni	Iron Fe
Lungs	0.35	0.78	3 .00	1.49	2.22	0.76	57.7
	0.05	0.09	1.9	3 73	2.76	1.43	90.3
	BDL	BDL	1.45	2.22	2.2	0.68	69.9
Mean	0.13±0.15	0.29±0.35	2.12±0.23	2.48±0.34	2.39±0.24	1.29±0.32	72.6±11.7
Hearts	0.01	0.67	3.21	1.43	1.21	0.98	54.9
	0.18	0.13	1.58	2.63	2.21	1.83	85.36
	0.01	0.11	3.12	1.89	2.87	0.32	76.43
Mean	0.07±0.06	0.91±0.24	1.66±0.70	1.98±0.43	2.09±0.59	1.04±0.52	72.23±11.5
Muscles	0.07	0.09	1.12	0.33	0.9	0.9	66.9
	0.99	0.07	2.11	3.55	1.32	3.41	67.44
	0.02	0.03	2	2.41	` 1.98	0.67	82.8
Mean	0.36±0.42	0.06±0.02	1.74±0.42	2.1±1.18	1.4±0.21	1.66±1.17	72.38±6.9

Table 3. Showing Concentration of Heavy Metal in Three Organs in Ankpa

Sample	Lead Pb	Cadmium Cd	Zinc Zn	Copper Cu	Chromium Cr	Nickel Ni	Iron Fe
Lungs	0.02	0.07	1.49	1.34	BDL	1.42	50.5
	0.09	0.01	2.44	1.7	2.22	1.55	45.47
	0.22	BDL	2.03	3.2	0.03	0.11	53.4
Mean	0.11±0.07	0.03±0.03	1.99±0.33	2.08±0.75	0.75±1.10	1.03±0.61	49.79±2.88
Hearts	0.01	0.04	2.0	1.45	BDL	1.0	43.97
	0.04	0,07	4.01	1.49	2.2	1.2	56.6
	0.08	BDL	1.48	2.22	0.05	0.02	41.91
Mean	0.04±0.02	0.04±0	2.5±1.00	1.72±0.33	0.75±0.8	0.74±0.48	49.49±6.07
Muscles	0.00	0.06	2.07	`1.21`	BDL	` 1.17	59.46
	0.06	0.02	1.05	1.52	1.1	1.11	60.8
	0.03	BDL	2.22	1.08	0.08	0.09	43.2
Mean	0.03±0.02	0.03±0.02	1.78±0.49	1.27±0.22	0.39±0.51	0.79±0.51	54.48±7.52

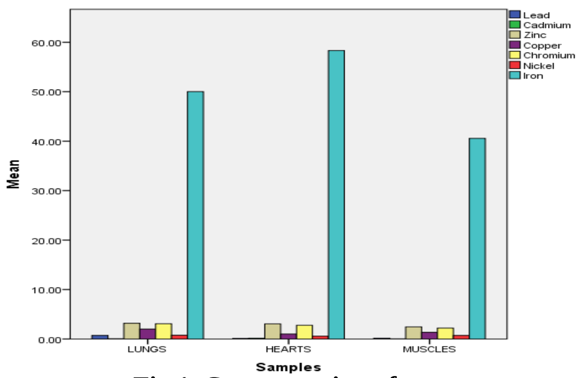


Fig 1. Concentration of heavy metals in the organs in Ejule1 Abattoir

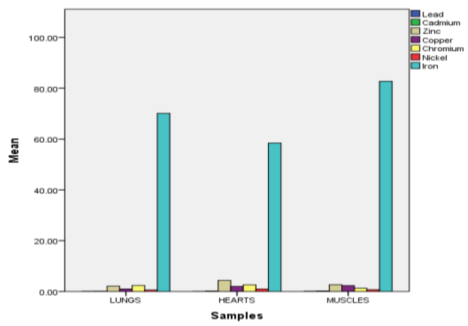


Fig 2. Concentration of heavy metals in the organs in Ejule2 Abattoir

Figure for Anyigba Sampling Area

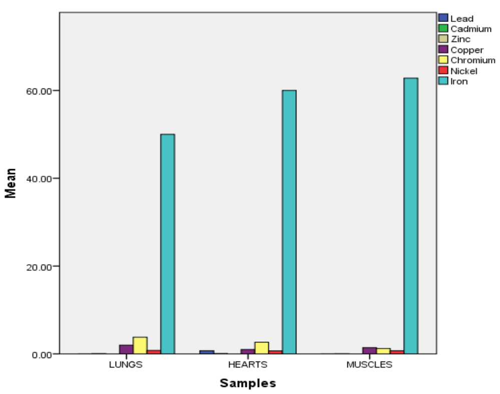


Fig 3.0 Concentration of heavy metals in the organs in Ejule 3 Abattoir

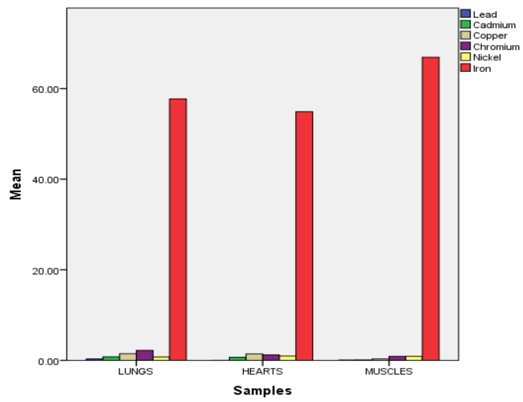


Fig 4.0 Concentration of heavy metals in the organs in Anyagba1 Abattoir

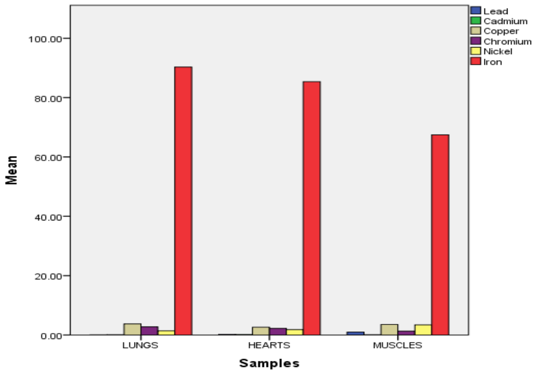


Fig 5.0 Concentration of heavy metals in the organs in Anyigba 2 Abattoir

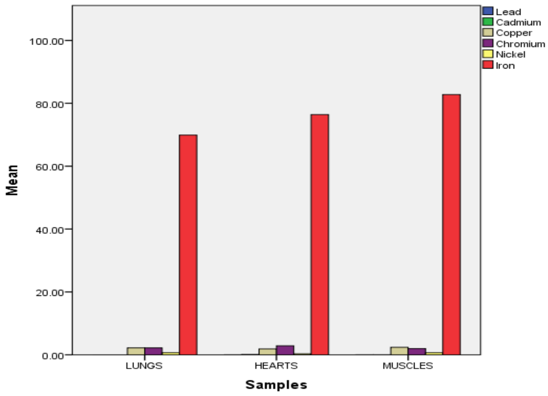


Fig 6. Concentration of heavy metals in the organs in Anyigba 3 Abattoir

Figure for Ankpa Sampling Area

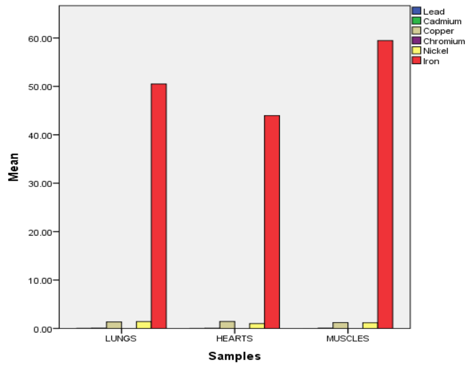


Fig 7. Concentration of heavy metals in the organs in Ankpa 1 Abattoir

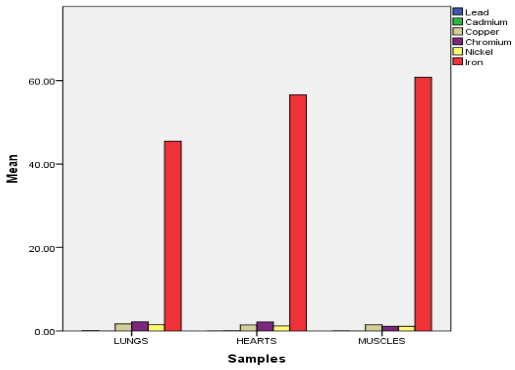
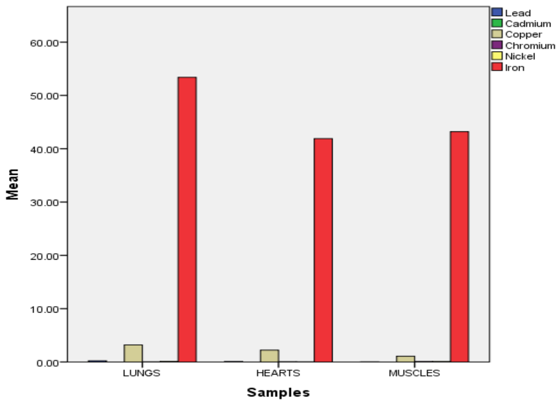
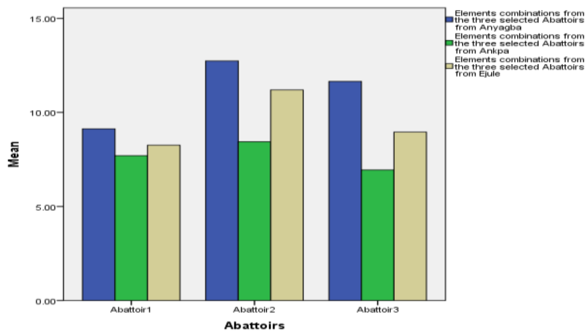


Fig 8. Concentration of heavy metals in the organs in Ankpa 2 Abattoir





The mean concentration of heavy metals in lungs, hearts, and muscles in ppm of cows slaughtered in Ankpa, Anyigba and Ejule are presented in table (4.0-12.0) Lead shows high concentration in the lungs in Ejule and Anyigba Pb(0.27)and Pb(0.28) Table (4.0and7.0) respectively, its concentration in the heart was low in Anyigba with mean concentration of Pb(0.07ppm) Table (8.0) also the concentration was observed to be high in the muscles of cow slaughtered in Anyigba (0.36)Table (9.0) The monitoring of lead concentration in heavy metals is important for human health .lead is known to induced cognitive development and intellectual performance in children and increases blood pressure and cardiovascular diseases in adult[11]. This result fell in line with reports of [12] which observed that free-range cows and pigs tend to accumulate slightly higher in the concentration of various heavy metals than the confirmed cows and pigs. This is due to their feeding habit and their free movement from one location to the other. Therefore the result of lead observed in Lungs and Heart observed in Ejule and Anyigba are slightly above the permissible limit as proposed by WHO and FAO and most countries standard. Table (10.0, 11.0 and 12.0) From the observed result it should be noted that Zn, Fe, Cu, Ni, Cd and Pb Concentrations in the samples from Ankpa are low and they all bellow the permissive limits set by WHO, FAO and Standards set by other countries it is possible to say that *meat from this samples* is safer from heavy metal contamination. Thus continuous monitoring and evaluation of these toxic metals are important to evaluate the dietary safety of the individuals. This result also agrees with that obtained by [13] T.V Pb (0.070) Cu (1.571) As (0.0374) Ni (0.069) the result also agrees with that of [14] who obtained the following metal in cow heart Pb (0.17) Cd (0.03) Cu (0.29)

The Analysis of Variance (ANOVA) test on the concentrations of all the metals in the heart, Lungs, and Muscles resulted in (p>0.05), (see Appendix) i.e. there is no significant difference in the amount of the elements in this samples. The various parts of cattle consumed in Ejule, Ankpa and Anyigba metropolis in Kogi State, Nigeria, seem to be safe for consumption, considering the concentrations of Cadmium, lead, zinc, iron, nickel, and copper present in them. It is expected that animals that graze freely will accumulate high concentrations of toxic metals in their organs, but from this findings, the levels of the metals were generally low. This may be due to low levels of industrialization in this part of the country where the animals are raised. The concentrations of these metals seem to be moderate for the body. However, since there can be an accumulation of these elements resulting in toxicity, it is advisable to limit their consumption most especially the liver and kidney and routine monitoring of heavy metals is necessary for good health. Continuous and rapid growth in population, urbanization, industrialization, and transportation in Nigeria in recent years has resulted in an indiscriminate exploitation of the natural resources and environment. Several industrial establishments of varying sizes and capacities, including chemical manufacturing, iron/steel foundries and re-rolling mills, paints/pigments, agro-chemicals, leather tanning, electroplating, electric cables and appliances, plastics, brick kilns, petroleum refining and servicing industries are situated in different parts of the country. The environmental management practices are virtually poor. As a result of poor environmental management due to unavailability of some standards and un-operational environmental pollution laws, toxic wastes generated by these industries are discharged into the air, soil, and water, with least or no treatment. This results in undue levels of toxic chemicals e.g. heavy metals in the local environment. Farm animals could potentially pick these heavy metals from the environment given the challenges of free-range grazing, scavenging in open waste dumps for fodder, drinking water from polluted drains and streams and exposure to atmospheric depositions especially from automobile fumes and open burning of solid waste. Close correlation has been reported between heavy metals concentration in cattle tissues with that in the soil, feed, and drinking water (Qiu *et al*., 2008). Although the levels of the studied trace metals in the muscle of cow were low, the accumulation of cadmium, zinc, chromium, and nickel has been appreciable when compared to permissible limits stipulated by some international standards. This high level is indicative of the general contamination level of the environment. Most of the heavy metals studied are accumulated in the liver and kidney, thus, this storage sites can be good indicators in the monitoring of these metals in livestock, and consumers may be exposed to high doses of these metals. The dietary exposure analysis on the studied population (Ankpa, Anyigba, and Ejule) revealed low exposure of these metals from cow meat. His/her intellectual capacity. With greater exposure and more severe health effects, chemicals in food are more harmful to children than adults (Pronczuk de Garbino, 2004). On the whole, with the exception of chromium, the dietary intake of these metals from cow meat poses no danger to the populace. However, there is a need for other food materials to be studied and also to cover a larger population of the country. One of the most critical steps in the analytical process that can affect heavy metal content in food samples is sample preparation. In most cases, treatment stage includes several operations, such as drying, homogenization, grinding, digestion, and dissolution. Each of these stages may be a potential source of contamination; thus a great attention was paid to preserve the original chemical constitution of the samples. This was done by washing all laboratory wares and subsequent leaching of the wares with acid; drying the meat samples in a watch-glass; grinding the dried samples with porcelain mortar and pestle; carrying out wet digestion at low temperature to avoid loss of volatile metals; acidifying the standard solutions and use of high purity reagent and de-ionized water.

4. CONCLUSION

The Analysis of Variance (ANOVA) test on the concentrations of all the metals in the heart, Lungs, and Muscles resulted in (p>0.05), (Appendix 4, 8, 12) i.e. there is no significant difference in the amount of the elements in this samples. The various parts of cattle consumed in Ejule, Ankpa and Anyigba metropolis in Kogi State, Nigeria, seem to be safe for consumption, considering the concentrations of Cadmium, lead, zinc, iron, nickel and copper present in them. Based on the WHO and USEPA acceptable standards of heavy metals in Agricultural food Stuff and the findings of this research, it can be concluded that the concentrations of all the metals in the heart, Lungs, and Muscles i.e. the levels of Pb, Cu, Fe and Zn Ni and Cd are within the recommended standards.

5. RECOMMENDATIONS

- Nigeria Environmental Protection Agency should strategies and device new improved and better ways of operation so as to reduce and control environmental pollution.
- Due to the health problems associated with these heavy metals, there is the need to continually examine the levels of heavy metals in foodstuffs in and around Anyigba, Ejule, and Ankpa in order to maintain and/or improve measures to reduce their levels in foodstuffs and ultimately prevent these avoidable health problems.
- The right institution mandated to set local standards of acceptable levels of heavy metals in foodstuffs in Nigeria should do so and make the information available to the public as to the best of my knowledge, at the time of this research there was no standard set by Nigeri

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