Boffin Access

Open Access Journal | Volume: 1.4

Journal of Water Technology and Treatment Methods

ISSN 2517-7427

Assessment of Heavy Metals Contents in Goat and Sheep Organs from Ashaka Cements, Gombe State, Nigeria

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Abstract

This study was carried out to assess the mean concentration of Cd, Cr, Cu, Fe, Mn, Pb and Zn (using Atomic Absorption Spectrophotometer AAS 6300) in goats and sheep's organs (liver, kidney, muscle and lung) reared and consumed within Ashaka Town, Gombe State Nigeria. The levels of metals in the organs were ranged between 0.0037 µg/g and 0.0021 µg/g for Cd, 0.0079 µg/g and 0.0050 µg/g for Cr, 0.0023 µg/g and 0.0017 µg/g for Cu, 0.0080 µg/g and 0.0063 µg/g for Fe, 0.0076 µg/g and 0.0073 µg/g for Mn, 0.0047 µg/g and 0.0046 µg/g for Pb and 0.0029 µg/g and 0.0027 µg/g for Zn. All the result obtained from the study is within the permissible limit prescribed by WHO and FAO. Therefore, they can be consumed without any hitch.

Keywords

Heavy metals; Goat; Sheep organs

Introduction

The term heavy metal is applied to a group of elements having atomic density value of more than 6 g/cm3 [1]. The heavy metals include mercury (Hg), cadmium (Cd), arsenic (As), chromium (Cr), thallium (Tl), and lead (Pb). Heavy metals are natural components of the Earth's crust [2]. They cannot be degraded or destroyed. To some extent they enter our bodies through food, drinking water and air. As trace elements, some heavy metals (e.g. copper, selenium, zinc) are essential to maintain the metabolism of the human body. However, at higher concentrations they can lead to poisoning. Most of the metals are carcinogenic, teratogenic and pose severe health problems like organ damage, reduced growth and development, nervous system impairments and oxidative stress [3].

The cement industry plays an important role in the economic development of Nigeria. Cement is considered as a strategic commodity because it is upstream of any construction activity and building infrastructure. The deposition of cement dust containing heavy metals not only alters the activity of soil but also inhibits plant nutrient resources to be submitted to necrosis and severe poisoning of plants sensitive to these compounds [4,5]. The Exhaust of the industry may be contaminated, which may be deposited on soil and may have an eventual effect on the grassing animals through polluted water sources, and thereby consumption of the affected animals may pose human health, thus eating habits of animal flesh may lead to bioaccumulation of heavy metals in the liver as it is a good iron source in the food supplement [6].

Risk assessment is an effective scientific tool which enables decision makers to manage sites so contaminated in a cost-effective manner while preserving public and ecosystem health [6]. A great concern for the assessment of the meat, water and soil of its pollutants as it enters into the food chain is to prevent the flow of toxic substances into ground surface, water, common consumed animals, plants and the human settlements. Global and local agencies have therefore established certain limits on the quantities of heavy metals being discharged into environment.

This study determined heavy metals (Cu, Zn, Fe, Pb, Mn, Cd and Cr) concentration, in some vital organs such as the liver, kidney, muscles and the lungs of goat and sheep reared in Ashaka town, thereby providing data in terms of heavy metal concentrations necessary for planning by government and other stake holders.

Materials and Methods

The samples were collected at Ashaka town Bajoga local Government area of Gombe State, about 80KM north from the State capital, the samples of the animal organs was purchased from the market; the animals were reared within the town. The organs (liver, kidneys, lungs and muscles) were removed from goats and sheep after slaughter, and were stored into a specimen bottles filled with 10% formalin. The organs samples were dried in a crucible for an hour; 10g of each sample (liver, kidney, lungs and meat) was introduced into the digestion flask, 20 mL of sulfuric acid was added into it and was heated for 30 min, it was allowed to flocculate

Article Information

DOI: 10.31021/jwt.20181117
Article Type: Research Article
Journal Type: Open Access
Volume: 1 **Issue:** 4
Manuscript ID: JWT-1-117
Publisher: Boffin Access Limited

Received Date: May 03, 2018
Accepted Date: June 08, 2018
Published Date: June 15, 2018

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Citation: Chadi AS, Abdulhameed A. Assessment of Heavy Metals Contents in Goat and Sheep Organs from Ashaka Cements, Gombe State, Nigeria. J Water Technol Treat Methods. 2018 Jun;1(4):117

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and settled, the flask was heated with high flame. After digestion, hydrogen peroxide was added drop wise until a clear solution formed, then content of the flask was filtered into a 50 mL volumetric flash and made up to the mark with distilled water. The samples were labelled after putting into plastic containers. The Determination of Cd, Cr, Cu, Fe, Mn, Pb and Zn in organ samples were made on the final solution using Atomic Absorption Spectroscopy (AAS) (AA 6300 Shimadzu) instrument, and stage was carried out in triplicate.

Result and Discussion

The investigation shows the mean concentration of cadmium (Cd), in the organs (Kidney, Lungs, Muscle and Liver) of male, female sheep and male, female goat.

Figure 1 shows the mean concentration of cadmium in males and females sheep and goats vital organs. The cadmium concentration is observed at highest level in the lungs of male sheep (0.0037 ± 0.04 µg/g) and the lowest concentration was found in the liver of male sheep (0.002 µg/g^{-1} ± 0.11 µg/g). Once inhalation occur in the lungs, from 10% to 50% of an inhaled dose is absorbed depending on particle size, solubility of the specific Cd compound inhaled and duration of exposure [7]. Cadmium is toxic to virtually every system in the animal body. It is almost absent in the human body at birth, however accumulates with age [8]. Cadmium accumulated in the kidney and liver over long time have been reported by [9] that cadmium interacts with a number of minerals mainly Zn, Fe, Cu and Se due to chemical similarities and competition for binding stage. It is also reported that Cd can affect Ca, P and bone metabolism in both industrial and people exposed to Cd in general environment [10]. Cadmium levels in the livers and kidneys of cattle in Poland and they found the cadmium concentration to be higher than the permissible limit set by FAO/WHO. Similarly, higher levels of cadmium and zinc in the livers and kidneys of the hens and chickens, which exceeded the official tolerance levels [11]. From the results of the present study, the concentration of cadmium in all the samples studied were found to be lower than the 0.5 µg/g permissible limit set by FAO/WHO, this was similar to the results obtained [12].

Chromium (Cr) concentration were observed in the liver, muscles, lungs and the kidney of males and female sheeps and goats and was observed higher in the liver of female goat (0.0099 ± 0.05 µg/g) and the lowest level in the lungs of female goats (0.0029 ± 0.14 µg/g) Cr is an essential element helping the body to use sugar, protein and fat, at the same time it is carcinogenic for organisms (institute of medicine) excessive amount of Cr may cause adverse health effects (ATSDR) Cr concentration studied were lower than the permissible limit of 0.10 µg/g (Figure 2).

The concentration of Cu in kidney was found to be highest 0.0023 ± 0.58 µg/g in male sheep and lowest in muscle of female

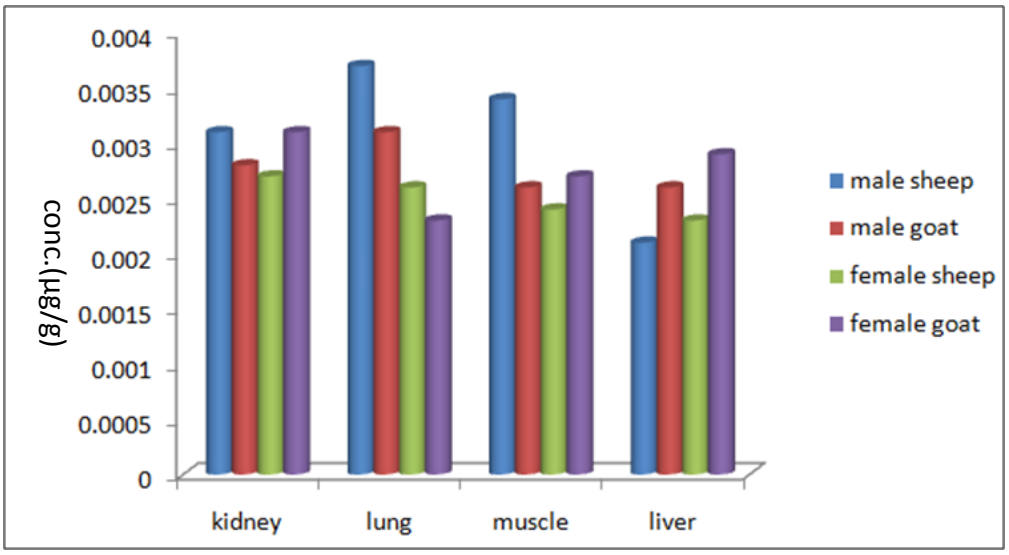

Figure 1: Mean concentration (µg/g) of Cd in male and female sheep and goats vital organs from Ashaka town Gombe State.

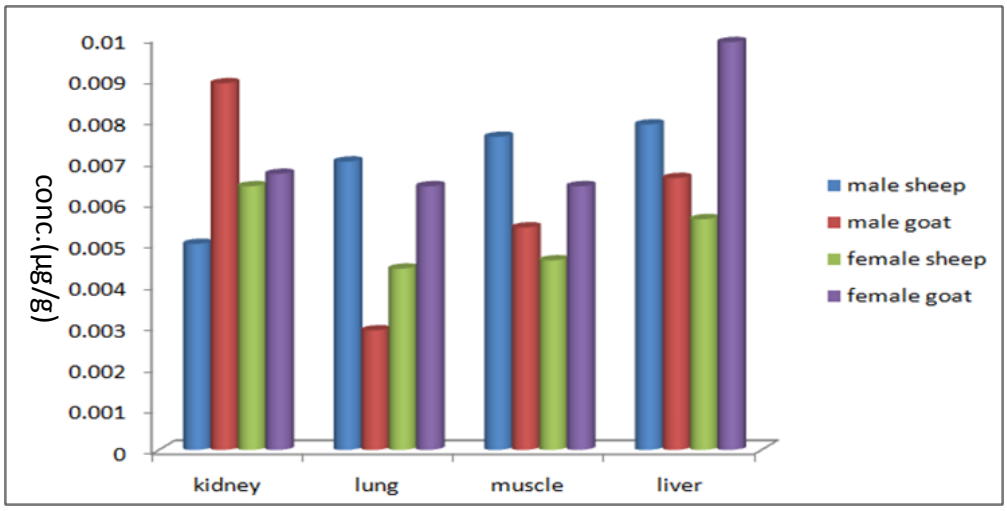

Figure 2: Mean concentration (µg/g) of Cr in male and female sheep and goats vital organs from Ashaka town Gombe State.

sheep 0.0009 ± 0.77 µg/g. Cu as an essential micronutrient required in the growth of both plant and animal and in human helps in the production of blood hemoglobin, but in high doses can cause anemia liver and kidney damage likewise stomach and intestinal irritation [13] (Figure 3).

In Figure 4, Fe concentration content in the kidney of female sheep shows the most high (0.0084 ± 0.26 µg/g) and its lowest in the female sheep lungs. Manganese Mn in the vital organs is more accumulated in muscle of the male goat (0.0087 ± 0.98 µg/g) and it's lower the kidney of female goats in all the male (0.0056 ± 0.81 µg/g). Out typically women with lower iron status are believed to be at risk for greater absorption of cd after oral exposure [2] (Figure 5).

The highest concentration of Pb was observed in lung of female sheep 0.0079 µg/g and lowest was observed in liver of female sheep 0.028 µg/g. Inorganic lead is an enzyme inhibitor, which also affects the nervous system [14] (Figure 6). According to the WHO, the maximum permissible limit (MPL) of lead in drinking water is 0.05 µg/g (WHO, 1984). The presence of lead in drinking water above the permissible limit may cause adverse health effects such as anemia, encephalopathy, hepatitis, and nephritic syndrome [15]. Toxic effects of lead on the central nervous system are observed more in children. In adults, the effects of lead toxicity occur in the peripheral nervous system. Symptoms of chronic poisoning may vary. The acute form of poisoning known as lead colic is the general state of various spastic internal organs and neurological damage in the peripheral organs. In the entire animal none has exceeded the permitted levels enacted by EPA 2006 and ASTDR 1999.

The higher concentration is observed in female goats muscles (0.0034 µg/g) followed by female sheep liver (0.0030 µg/g) and the lowest is found in the female goats lungs (0.0026 µg/g). Zinc Zn as an essential element in human diet. Too little Zn can cause problems: however, too much Zn is harmful to human health [16]. The entire finding of this work none has exceeds the permissible limit of 200 µg/g [17] (Figure 7).

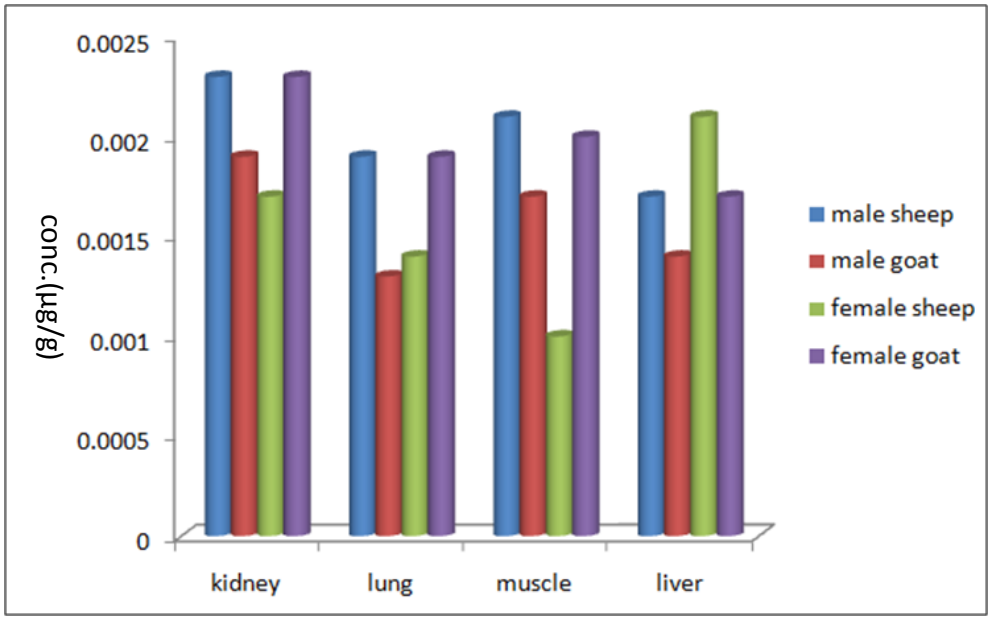

Figure 3: Mean concentration (µg/g) of Cu in male and female sheep and goat's vital organs from Ashaka town Gombe State.

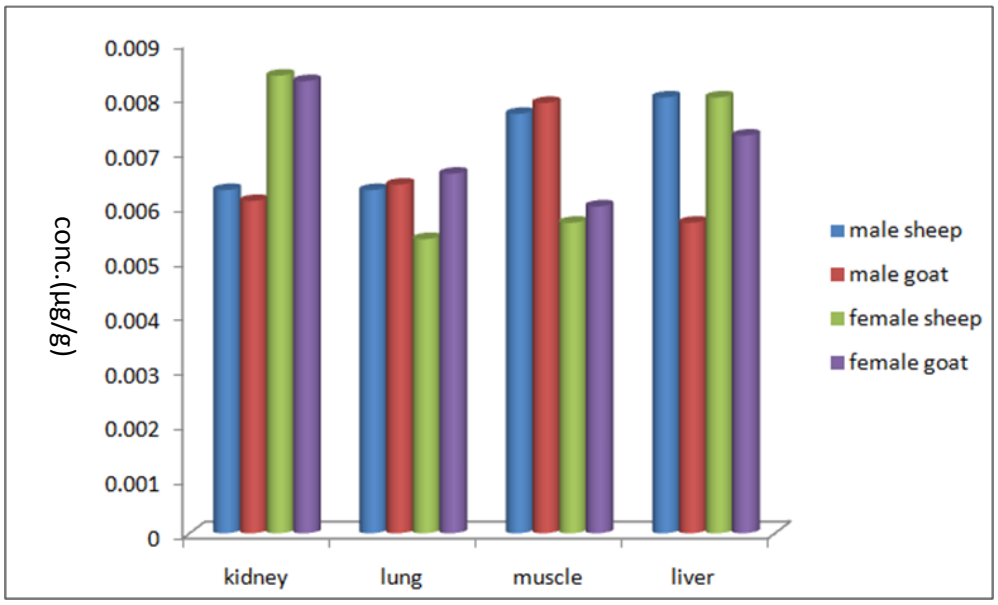

Figure 4: Mean concentration (µg/g) of Fe in male and female sheep and goat's vital organs from Ashaka town Gombe State.

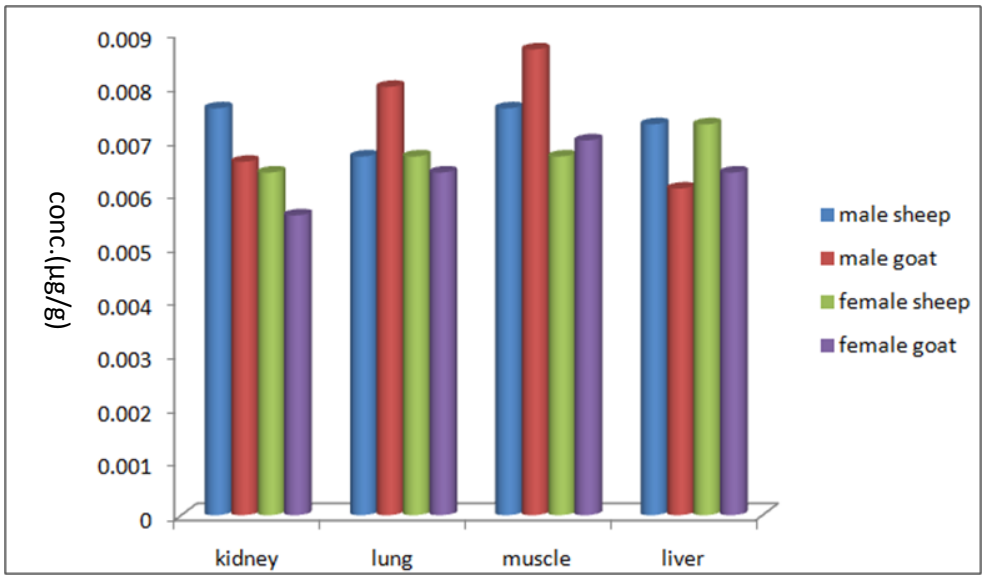

Figure 5: Mean concentration (µg/g) of Mn in male and female sheep and goat's vital organs from Ashaka town Gombe State.

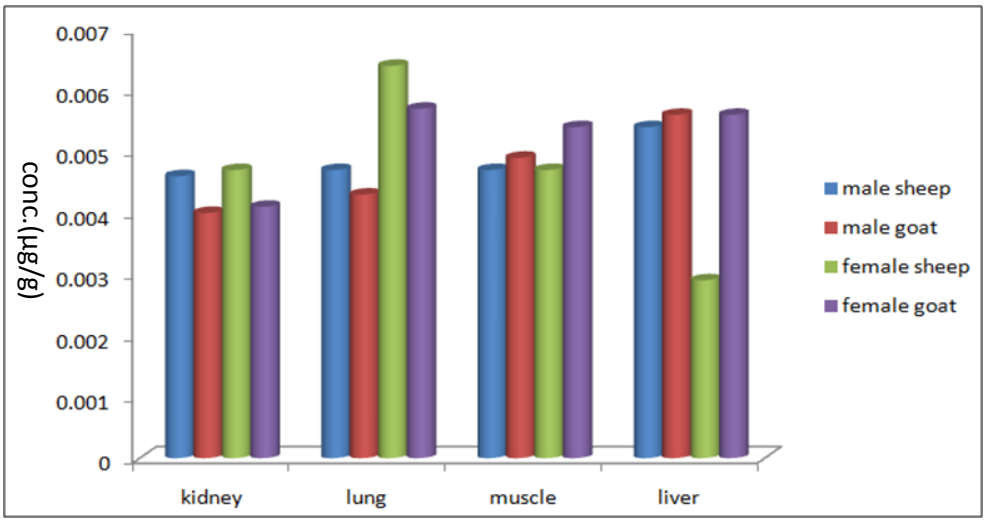

Figure 6: Mean concentration (µg/g) of Pb in male and female sheep and goat's vital organs from Ashaka town Gombe State.

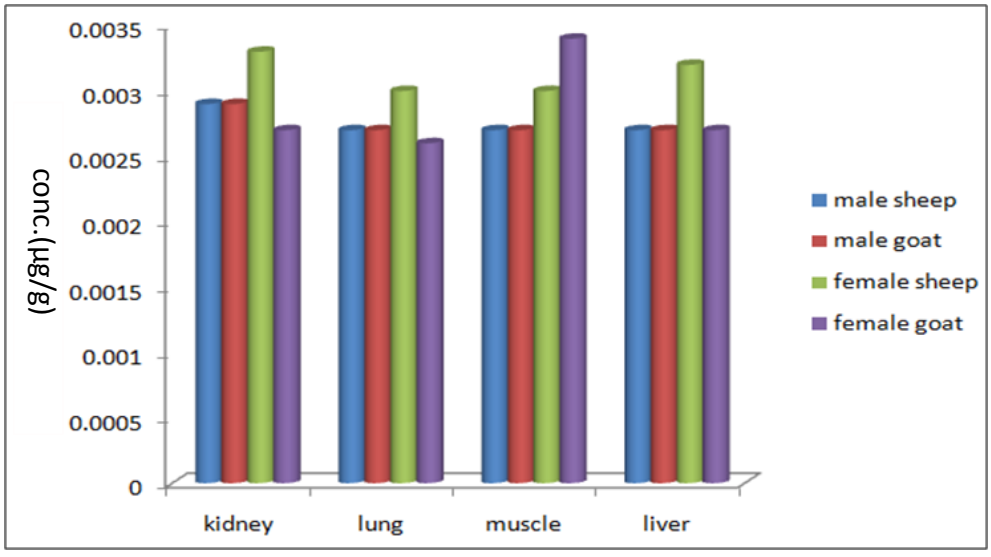

Figure 7: Mean concentration (µg/g) of Zn in male and female sheep and goat's vital organs from Ashaka town Gombe State.

Conclusion

The results obtained in this study show low levels of Cd, Cr, Cu, Fe, Mn, Pb and Zn determined in the kidneys, lungs, muscles and livers samples of sheep and goats in Ashaka town. This could be indicative of low and substantial contamination of the water, meat and the environment by these heavy metals. Thus the low level of these metals determined in these animals organs, does not impaired the meat quality obtained from them, however, the levels determined were relatively within the safe limit.

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