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Research Article

Influence of anthropogenic activities in the built environment on the quality of cows' milk slaughtered in Gwagwalada abattoir FCT, Abuja

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ABSTRACT

Milk is one of the basic foods requirements for human diet with great value as a nutritious healthy food; in the early years of human life, milk and dairy products are important nutritional fact in the diet of a baby. Cow milk is highly consumed in the north as one of their major foods. It is also considered as one of the food sources contaminated with heavy metals. The aim of this study was to assess the content of some selected heavy metals from Cow Milk and its related human health risks in the food chain. A total of five Cows were randomly selected from different parts of the FCT and its surroundings observing the quality control standard methods of sample collection. The concentrations of the following heavy metals were determined: Lead (Pb), copper (Cu), Cadmium (Cd), chromium (Cr), manganese (Mn), and iron (Fe) in the milk samples using Flame Atomic Absorption Spectrometry. Results show that the pH value range between 6.7 and 7.1. The variation in the heavy metals concentration was low in all the sampled cow milks except mercury in from the Cow 2 Milk that was high and that of Cow 2 Milk that was moderate. The mean concentration of the heavy meals in the sampled Cow Milk is in the following order: Mn(3.5 mg/l) >Fe(1.22 mg/l) >Pb(0.58 mg/l) >Cr(0.41 mg/l) >Cu(0.13 mg/l) >Cd(0.12 mg/l) >Hg(0.05 mg/l). Comparing the results of heavy metals concentration from the sampled Cow Milk and the Federal Ministry of Environment (FME) standard shows that only the value of Mn that was above the FME standard. It is then recommended that NAFDAC should include raw Cow Milk in her list of food products and enact a policy in order to regulate the rate of consumption of contaminated Milk in the society, especially check the level of hygiene of the Milk vendors.

Keywords: Contamination, food safety, heavy metals, hygiene, milk vendors

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INTRODUCTION

Milk is very rich and has a positive influence on human health. It is a balance died as such is considered as food since it contains proteins, fats, vitamin supplements, and major minerals.[1-5] It was reported that about 38 micro and trace elements were found in raw milk from different regions around the world.[6,7] The mineral contents in raw cow milk do vary depending on several factors such as the environment where the cows graze, their health conditions, seasonal variations, annual feed composition, and environmental contamination.[8,9] The condition at which the milk processing takes place may also influence the contents and retains of minerals in total composition of milk.[10,11] These minerals and the trace elements in cow milk occurred as inorganic ions and remain with proteins, peptides, carbohydrates, and other molecules.[12]

The survival of healthy animals and efficient production depend on minerals. This is because of their participation in physiological, structural, catalytic, and regulatory functions of animal organism. Thus, it became very essential as part of a balanced diet. However, excess intake of these minerals by the animals may cause acute poisoning or may cause chronic poisoning as soon as they ingest toxic doses constantly.

Excessive ingestion of mineral doses by animals may occur in different ways either by mistake in balancing mineral supplements in feed, intake of plants having high mineral concentration or grazing on plants grown from chemically

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fertile soils of plants been spread by herbicides, insecticides, and or fungicides. Moreover, the decomposition of urban and industrial wastes, leaks, and accidental spills of pollutants may result in the accumulation of toxic minerals in the environment.[13,14]

However, toxic doses, physiological changes during poisoning, symptoms, and mineral concentration in tissues from poisoned animals to confirm diagnosis are not completely known yet. The ever-increasing urbanization and indiscriminate disposal of waste might lead to heavy metal contamination of surface water and agricultural sectors, which, in turn, bioaccumulated and transmitted through the food chain.[15]

Heavy metals are critical pollutants due to their widespread implementation in various anthropogenic activities as well as their resistance in the environment and potential Heavy metals are kept under environmental pollutant category due to their toxic effects in plants, humans, and food. Some of the heavy metals, i.e., Arsenic (As), Cadmium (Cd), Lead (Pb), Mercury (Hg) are cumulative poison. These heavy metals are persistence, accumulate and not metabolized in other intermediate compounds and do not easily breakdown in environment. These metals are accumulating in food chain through uptake at primary producer level and than through consumption at consumer level. Metals are entering the human body either through inhalation or injection.

Food stuffs contamination due to heavy metals and other toxins in the environment is one of the most important issues today in developing countries. Studies associated with health risks have been conducted around the world, for instance; arsenic in cultivated rice in Srilanka,[16] trace metal and alfatoxin in cassava flour in West Africa,[17] metals contaminated mushroom in Ethiopia,[18] also health risk for contamination of foods and soils in China[19] and India[20] vegetables contamination by Leachates around Mpape dump site in Abuja, Nigeria[21,22] investigated the prevalence of foreign substances in the stomach of ruminants in Abuja and Minna in Nigeria. However, it was observed that continuous long term exposures of consumers to heavy metal by consumption of cow milks get less emphasis in developing countries especially in Nigeria. Base on the aforementioned issues, this study was designed to investigate the concentration of some selected heavy metals contaminating cow milk in Gwagwalada FCT.

MATERIALS AND METHODS

The Study Area

Gwagwalada is located about 55 km Southwest of the Capital City, along the Lokoja-Kaduna road. It is the administrative headquarters of Gwagwalada Area Council. The town, which was the second-largest settlement within the FCT, as at the time of the creation of the Territory in 1976, is situated between Lat. 8°55' and 8°60' North, and Long. 7°05' and 7°11' East [Figure 1]. Gwagwalada Abattoir is located at new Kutunku ward of the town, beside one of the tributary streams of River Usuma, which drains through the town.

Gwagwalada town, with an aerial extent of about 118 km², has an elevation of between 142.2 m and 213.3m in the southern and northern parts of the town, respectively. The town has recorded mean annual temperatures that range from 30° C to 37° C, and total annual rainfall of about 1650 mm. Relative humidity range from about 25% to 50% in the dry and rainy seasons respectively. The Abattoir is located between Longitude 7°03'54"E, 7°03'50"E and Latitude 8°55'59''N, 8°55'55''N. It is located in a high-density residential area, and it consists of three sections.

A reconnaissance survey was conducted within the study area in the month of August 2021. There are three major sections in the abattoir; these are slaughtering section, the processing and the dumping sections. During this reconnaissance survey, the sources from which the cows were brought were identified.

Types and Sources of Data

The data for this research work was obtained from two sources, which include primary and secondary sources. The primary data were source from the Milk samples collected from the cows in the abattoir, and included information collected from the butchers during interaction, while the secondary data are the information from past studies in journals and other publications.

Population of the Study Area

The study covers Gwagwalada Abattoir of Gwagwalada area council of the FCT, Abuja. The total populations of 20–30 cows are slaughtered daily, making 210 cows per week and 840 cows per mouth.[23]

Sample Size and Sampling Procedure

In each of the visits, all the female cows assembled for slaughtering were identified and one female cow was randomly sampled using the table of random numbers; this was repeated for the five visits. A total of 5 Cows were randomly selected from different parts of the FCT and its surroundings observing the quality control standard methods of sample collection.

The sampled cows were then taken to the slaughterhouse, and the milk samples were collected by the veterinary doctor using a 5 mls syringes and transferred to a sterile glass bottle well-labeled following standard methods and stored at 4°C until analysis.

Method of Laboratory Analysis

The collected samples were then taken to the laboratory for analysis. Flame Atomic Absorption Spectroscopy

(Model: AA-6300, Atomic Absorption Spectrophotometer, SHIMADZU, Japan) was used for the heavy metal analysis as described by the manufacturer. The data obtained were subjected to descriptive analysis as well as inferential statistical such as analysis of variance which was used to determine the variation between the samples, while student t-test was used to determine the mean difference of the samples with the Federal Ministry of Environment (FME) Standard.

RESULTS AND DISCUSSION

The result in Table 1 presents a descriptive analysis of the results of the five cow milk of the cows slaughtered in Gwagwalada abattoir. The value of mean pH ranges from 6.7 and 7.1, where the milk from Cow 5 is having the lowest value of pH 6.70, while milk from Cow 1 has the highest value of 7.05 with low coefficient of variation. The Mean Value of cadmium ranges from 0.01mg/l to 0.31mg/l, with Cow 3 having the lowest value while the Cow 4 is having the highest concentration and high coefficient of variation in their distribution. Generally, the variation in the heavy metals concentration in all the parameters tested was low in the entire sampled Cows' milk except mercury in Cow 1 Milk that was high and that of Cow 2 Milk that was moderate.

Figure 2 presents the mean concentration of the pH and the selected heavy metals in the sampled cow's milk. The mean concentration of the heavy meals in the sampled Cow's Milk is in the following order: Mn (3.5mg/l) >Fe (1.22 mg/l) >Pb (0.58 mg/l) >Cr (0.41 mg/l) > Cu (0.13 mg/l) >Cd (0.12 mg/l) >Hg (0.05 mg/l). This study shows that Mn, Fe, Pb, Cr, Cu, Cd, Hg. and Cd are transferred to milk in that order.

Table 2 presents the results of the correlation coefficient for various heavy metals in the sampled Cows' Milk. The

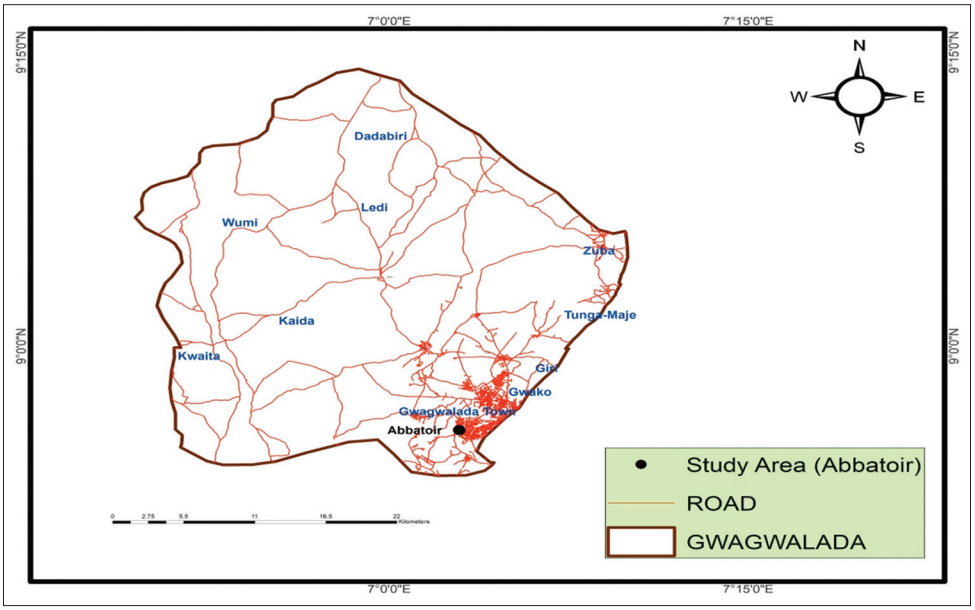

Figure 1: Gwagwalada Area Council Showing the abattoir. Source: Modify with ARCGIS, 2021

Table 1: Concentration of heavy metals and pH in Milk samples

Parameter	COW 1 Mean±SD	COV	COW 2 Mean±SD	COV	COW 3 Mean±SD	COV	COW 4 Mean±SD	COV	COW 5 Mean±SD	COV
Ph	6.91±0.08	1.16	6.72±0.25	3.72	7.05±0.07	0.99	7.04±0.82	11.6	6.70±0.24	3.58
Cd	0.23±0.41	178.3	0.03±0.04	133.3	0.010.04	400	0.31±0.17	54.8	0.03±0.01	33.3
Cr	0.30±0.10	33.3	0.24±0.11	45.8	0.70±0.21	30	0.10±0.33	330	0.73±0.10	13.7
Cu	0.06±0.01	16.7	0.31±0.04	12.9	0.07±0.01	14.3	0.06±0.01	16.7	0.162±0.0	0
Fe	1.33±0.03	2.26	1.34±0.02	1.49	1.30±0.01	0.77	1.20±0.02	2.80	1.40±0.02	1.43
Pb	0.81±0.12	14.8	0.56±0.51	91.1	0.50±0.20	40	0.21±0.99	471.4	0.81±0.12	14.8
Mn	4.31±0.4	9.28	4.30±0.7	16.3	3.71±0.41	11.05	3.21±0.76	23.7	2.14±0.0	0
Hg	0.04±0.01	25	0.02±0.01	50	0.05±0.01	20	0.06±0.01	16.7	0.06±0.01	16.7

SD: Standard deviation. Source: Field work, (2021), Pb: Lead, Cu: Copper, Cd: Cadmium, Cr: Chromium, Mn: Manganese, Fe: iron

Table 2: Pearson Correlation coefficient matrix of heavy metals in the sampled cows' Milk

Parameter	Cd	Cr	Cu	Fe	Pb	Mn	Hg
Cd	1						
Cr	−0.740	1					
Cu	−0.558	−0.074	1				
Fe	−0.764	0.636	0.408	1			
Pb	−0.399	0.504	0.166	0.865	1		
Mn	0.122	−0.496	0.138	0.102	−0.057	1	
Hg	0.285	0.335	−0.700	−0.423	−0.188	−0.792	1

Source: Field survey, (2021), Pb: Lead, Cu: Copper, Cd: Cadmium, Cr: Chromium, Mn: Manganese, Fe: iron

Table 3: comparative analysis the value of heavy metals content in the sampled Cows'

Parameter	Milk and FME Safety Limit						
	COW 1	COW 2	COW 3	COW 4	COW 5	Mean	FME
pH	6.91	6.72	7.05	7.04	6.7	6.88	6–9
Cd	0.23	0.03	0.01	0.31	0.03	0.12	<1
Cr	0.3	0.24	0.7	0.1	0.73	0.41	<1
Cu	0.06	0.31	0.07	0.06	0.16	0.13	<1
Fe	1.33	1.34	1.3	0.71	1.4	1.22	1.5
Pb	0.81	0.56	0.5	0.21	0.81	0.58	<1
Mn	4.31	4.3	3.71	3.21	2.14	3.53	0.2
Hg	0.04	0.02	0.05	0.06	0.06	0.05	<1

Pb: Lead, Cu: Copper, Cd: Cadmium, Cr: Chromium, Mn: Manganese, Fe: iron

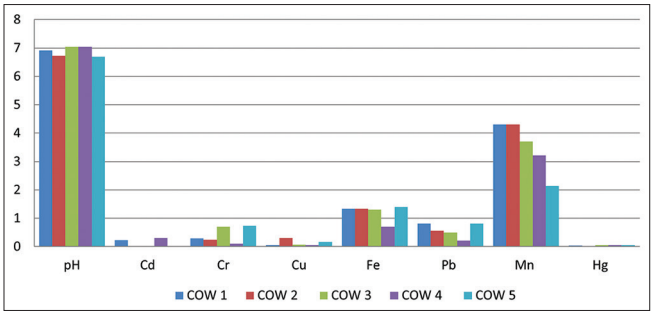

Figure 2: Mean concentration of the heavy metals concentration of the sampled cows

results show that there is relationship between the parameters analyzed, but the relationship is not significant. There is a positive but insignificant correlation between Cd and Mn, Cd and Hg, Cr and Fe, Cr and Pb, Cr and Hg, Cu and Fe, Cu and Pb, Cu and Mn, Fe and Pb, Fe and Mn, and insignificant negative correlation between Cd and Cr, Fe and Cd, Cd and Pb, Cr and Cu, Cr and Mn, Cu and Hg, Fe and Hg, Pb and Mn, Pb and Hg, Mn and Hg, Recall that the positive correlation implies that increase in one metal would results to an increase in the other metal and vice versa. Furthermore, a negative correlation signifies that their sources are quite different. Correlation studies, therefore, help in the understanding of the chemistry of heavy metals in the milk and their association.

Comparing the results of heavy metals concentration from the sampled Cow Milk and the FME standard as presented in Table 3, the results show that only the value of Mn was observed to be above the FME standard. The value of Cadmium (Cd) though within the FME acceptable limit, but greater than the value reported in Ecuador (0.46 ppm), and 0.016 mg/kg in Peru,[24] but less than those reported in Egypt, Italy, Mexico, Pakistan and Romania as 0.11 ppm, 0.02 ppm, 0.29 ppm, 0.06 ppm and 0.01 ppm, respectively. Because Cadmium has the capacity of bioaccumulation and bioamplification in the food chain,[25] is associated with renal diseases, hypertension, anemia, osteoporosis, osteomalacia, diabetes, anosmia, chronic rhinitis, and eosinophilia.[26-30] Cadmium is a carcinogen that causes leukemia and pancreatic, lung, breast, and prostate cancer.[29-31] The values of Lead (0.58 mg/l) which is greater than that of Pakistan(0.058 ppm) and Peru, 0.38 mg/kg by,[24] but less than those of Ecuador, Egypt, Italy, and Mexico, which were 7.77 ppm, 0.96 ppm, 1.32 ppm, and 0.74 ppm respectively.

CONCLUSION AND RECOMMENDATIONS

This study has revealed that all the Milk samples from the cows contained Mn, Fe, Pb, Cr, Cu, Cd, Hg. and Cd. Though all except Mn are within the FME limit, but the fact that these

heavy metals are bioaccummulative in nature, percussions must be taken in order to minimize their menace. It is then recommended that NAFDAC being a regulatory agency should include Raw cow milk in the list of the products to be monitored. For this reason, a policy ensuring the quality of Cow Milk consumption should be enacted in order to checkmate the rate of Milk contamination in the society, especially the level of hygiene of the Milk vendors.

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