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Environmental Influence on Chicken Raised in Refused Dumpsites in the Zaria Metropolis

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Abstract- The research looked into how dumpsites affect the areas around them. They collected and tested the dust and heavy metals found in chickens raised near these waste sites during both dry and wet seasons. For three months, young chickens were fed solid waste and leachates from these sites, and then they were sacrificed for analysis. A standard method for testing dust and heavy metals was followed, as recommended by the World Health Organization (WHO). They used Atomic Adsorption Spectroscopy to find out how much heavy metal was present. The levels of Zn, Cd, Cu, Pb, and Hg in the dust varied by season, ranging from 1.40 (JK) to 210.60 (SA), BDL (CTR) to 3.74 (RA), 0.241 (KU) to 390.0 (JK), 2.26 (CTR) to 78.260 (SH), and BDL (CTR) to 25.69 (AJ). For the chicken samples, the heavy metal levels ranged from BDL (CTR) to 8.844 (JK), BDL (CTR) to 2.850 (BG), BDL (CTR) to 0.099 (BG), BDL (CTR) to 128.017 (NTC), and BDL (CTR) to 83.122 mg/kg (DD) for Zn, Pb, Cd, Cu, and Hg across different sites and seasons. Most of the metal levels in the chicken samples were below safe limits, but a few were not, indicating that people living near these dumpsites are affected. The Kaduna State Environmental Agency (KEPA) needs to work on reducing hazardous waste and provide better waste disposal options.

Keywords – Chicken, Heavy Metals, Refuse Dumpsites, Zaria IP.

I. INTRODUCTION

Pollution from heavy metals in surface and underground water sources leads to significant soil contamination, which tends to worsen as dumping increases (Obruche et al., 2019). When dumpsite soil gets polluted, it also affects the plants grown in that soil, especially since farmers often use waste soil from dumpsites as fertilizer. These metals build up in the tissues of living things. Animals that eat these contaminated plants and drink from polluted water, as well as sea creatures that live in water with heavy metal pollution, also gather these metals in their bodies, and in their milk if they are nursing (Ese et al., 2024). People can get exposed to heavy metals by eating these contaminated plants and animals, which can lead to different health problems. In short, all living things in an ecosystem get contaminated through the food chain.

Heavy metal pollutants can settle and stay inactive, which can harm the environment by forming compounds or by exchanging ions into the soil and mud (Abeokuta et al., 2025). Sometimes, plants, mushrooms, or tiny organisms are used to clean up some heavy metals like mercury. Certain plants that can absorb a lot of metals can help take heavy metals out of the soil by concentrating them in their tissues (Obruche et al., 2018; Akpoveta et al., 2024). Dumpsite soils are known to have various types and amounts of heavy metals based on the specific area (Clark et al., 2025). Many abandoned waste dumpsites in towns and villages in Nigeria are seen as good places to grow different kinds of crops (Umudi, 2011; Ogwuche & Obruche, 2020). According to Obruche (2025) heavy metals in dumpsite soils can build up to dangerous levels for the environment.

Heavy metals are pollutants can be added to dumpsite soils by human activities as by-products and finished products. The levels of heavy metals in the soil can be greatly affected by human activities like industry, farming, and waste disposal, etc. These metals are a big environmental issue because they can be toxic and can build up in the environment (Umudi, 2019). Contamination from heavy metals is a serious problem all over the world, affecting both local and regional areas, and it can harm the structure and function of ecosystems. Birds are especially vulnerable to the negative impacts of human activities on nature. Different biological and physiological factors, like what they eat, how they grow, their age, breeding, and moulting, can affect how much metal is found in birds (Obruche et al., 2019).

Many researchers have studied the levels of heavy metals in the internal tissues of chickens (Edema et al., 2009). However, there is still not much information about the levels of trace elements in chickens and other domestic birds in Nigeria. The build-up of heavy metals in birds' tissues has been a major focus because it can have serious effects, both lethal and sub-lethal, and birds are often at high levels in the food chain, making them good subjects for bioaccumulation studies. The danger of heavy metal contamination in meat is a big worry for food safety and human health due to the toxic nature of these metals, even in small amounts. Umudi et al. (2022) mention that some heavy metal ions that can be harmful include arsenic, cadmium, and lead, along with essential metals like iron, manganese, copper, zinc, selenium, nickel, and cobalt.

Toxic elements can be dangerous to birds even in low amounts if they are consumed over a long time (Itodo et al., 2021). However, the levels of heavy metals can differ between species. Chicken meat is a key source of protein for people and is eaten a lot in many countries around the world. Chicken meat is a great food that is full of important nutrients like protein (which includes essential amino acids), minerals (like iron, zinc, and selenium), vitamins (such as vitamin E), and fats (including essential fatty acids like Omega 3).

Umudi and Awatefe (2018) noted that heavy metals can move from polluted soil to plants and then to animals, eventually reaching humans through the food chain (Ekpo et al., 2025). It's not unusual to see animals like cows eating grass and birds eating insects and earthworms from dump sites. When there are high levels of heavy metals in the environment, they can build up and become harmful to plants and animals, which can also pose risks to human health.

Like many cities in Nigeria, Zaria has issues with environmental cleanliness, such as throwing trash near homes and poor waste collection (Erienu et al., 2022). For instance, it's common to see large trash dumps in residential areas and along both small and big roads. Because of this, it's important to conduct this research.

The purpose of this research was to find out how much heavy metals are in the tissues and organs of chickens that have been fed with waste from trash.

II. MATERIALS AND METHODS

Study area

Zaria Metropolis is situated at latitude 110 07‘ N and longitude 070 42‘ E and is currently one of the most significant cities in Northern Nigeria (Essiett et al., 2010). It covers a total area of 300Km2 and includes four main areas: Zaria City, Tudun Wada, Sabon Gari, and Samaru, which are part of two local government areas: Sabon Gari and Zaria (see figure 1).

Figure1. Map of Zaria, showing Study area

Description of sampling sites

A total of 10 significant dumpsites were chosen based on their dimensions and the volume of waste accumulated, alongside various activities such as tobacco cultivation, residential zones, the existence of wells, and workshops that contribute to the waste deposited. Additionally, a control site that is uncontaminated was selected, located 300 meters from the Kusfa dumpsite. The dumpsites selected include: Samaru (SA), Alkali Jae (AJ), Babban gwani (BG), Kusfa (KU), Shafi Road (SH), Prince Road (PR), Jeka-da-kwarinka (JK), Dandaji (DD), Nigerian Tobacco Company (NTC), and Railway Station (RA). Figure 2, presents the geographical locations of the sampling sites. In addition, figure 2 illustrates the map of Zaria metropolis, highlighting the locations of the dumpsites examined in this research (Obruche et al., 2025)

Figure 2. Railway Station Dumpsite

Preparation of chicken sample

The sample preparation methods were similar to the one of WHO, (2010) and Ekpo et al., (2025) with a few minor modifications. Chickens were acquired from the residents of the dumpsites and were exclusively fed with waste materials and wastewater from the dumpsite for duration of three months in each season.

Subsequently, they were slaughtered, and their respective organs including the oesophagus, lungs, bones, kidneys, intestines, heads, gizzards, feathers, wattles, skins, hearts, muscles, legs, livers, and brains were extracted and analyzed for the presence of Zn, Pb, Cu, Hg, and Cd. Figure 3 illustrates the various organs of the chicken samples used for toxicity studies (Umudi et al., 2025)

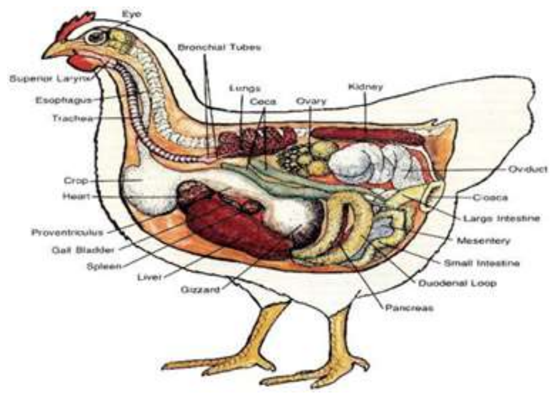

Figure 3: A Chicken Sample Showing the Various Tissues and Organs Analysed

Samples pre –treatment

The method of pretreatment used was done by employing the process that was described by (WHO, 2010; Festus-Amadi et al., 2021;Obruche et al., 2022). The chickens were processed for slaughter, and various tissues and organs were meticulously separated, stored in polyethylene bags, and appropriately labeled. Subsequently, they were promptly preserved in a refrigerator before undergoing digestion.

Preparation of standard metal ions for calibration plots

The sample preparation methods were similar to the one of WHO, (2010) and Mughele et al., (2024). Stock solutions (1mM) of the metal ions (Pb, Cu, Cd, Hg, and Zn) were created by dissolving 0.03315 g, 0.0241 g, 0.03085 g, 0.03426 g, and 0.29749 g of Pb(NO3)2, Cu(NO3)2.3H2O, Cd(NO3)2.4H2O, Hg(NO3)2.H2O, and Zn(NO3)2.6H2O in 1 liter of supporting electrolyte (100mM saturated NaNO3).

These solutions were then utilized to prepare lower concentrations of the metal ions (0.2, 0.4, 0.6, and 1.0 µM) through serial dilution of the stock solutions. A 100 m M NaNO3 solution was prepared by dissolving 8.5 g of NaNO3 in 1 liter of deionized water. The peak currents of the standard solutions were measured using square wave voltammetry and employed for the calibration plots after being purged with nitrogen for a minimum of 8 minutes.

Digestion and analysis of chicken sample

The method of digestion used was done by employing the process that was described by (Othman, 2001; WHO, 2010; Umudi et al., 2025). A precise weight of 2.0 g from each sample (oesophagus, lungs, bones, kidney, intestine, head, gizzard, feather, wattles, skin, heart, muscles, legs, liver, and brain) was measured into a beaker and subjected to pre-digestion with 10ml of concentrated HNO3 on a hot plate set at 1350C until the solution became clear.

Following this, 10 mL of HNO3, 1 mL of concentrated HClO4, and 2 mL of H2O2 were introduced and heated on the hot plate, maintaining the temperature at 1350C for one hour until the solution turned colorless. The resulting digests were filtered into a 25 mL standard flask and diluted to the mark with 1M HNO3. The digested samples were then analyzed for heavy metals using atomic absorption spectroscopy.

Statistical Analysis

The results were subjected to statistical analysis utilizing the Statistical Analytical Systems (SAS, 1991) software package, employing the following methodologies: Means from triplicate analyses were computed using ANOVA, while standard deviations were determined through the Duncan Multiple Range Test. The Student t-test was utilized to rank means for significance levels at a 95% confidence interval ($P < 0.05$).

III. RESULTS AND DISCUSSION

This section presents the analyzed findings regarding the heavy metal content in the organs of chicken samples, as illustrated in Tables 1-10. The data in Tables 1 through 10 encapsulate the mean (± SD) concentrations of heavy metals in various chicken samples that were fed with dumpsite waste during both dry and wet seasons.

The observed range of zinc (Zn) in the samples was: BDL (CTR) to 4.27 mg/kg and BDL (CTR) to 5.77 mg/kg (KU) for the oesophagus of the contaminated chicken samples across the different sites. Likewise, the concentration ranges of Zn in the lungs of the chicken samples throughout the seasons (wet and dry) were: BDL (AJ, BG, CTR, DD, JK, SA, SH, PR) to 2.90 mg/kg (SA) and BDL (AJ, BG, CTR, DD, JK, SA, SH, PR) to 3.91 mg/kg (SA), respectively, as detailed in Tables 1 and 2.

Additionally, as shown in the tables, the concentrations of zinc recorded in the bones of the contaminated chicken samples across the sites and seasons were: BDL (AJ, BG, CTR, DD, JK, SA, SH, PR) to 3.89 mg/kg (RA) and BDL (AJ, BG, CTR, DD, JK, SA, SH, PR) to 5.25 mg/kg (RA). The concentration ranges of Zn noted in the kidneys of the chickens across the sites varied from BDL (CTR) to 1.324 mg/kg and BDL (CTR) to 1.787 mg/kg (DD), as presented in Tables 4.19 and 4.20, respectively.

These results are in agreement with the work of (Umudi et al., 2025) and Onder et al., (2007) in a dumpsite chicken. Furthermore, the concentration ranges of Zn in the intestines of the contaminated chicken samples were also analyzed.

Table 1: Concentrations (mg/kg) of Zinc in the contaminated chickens organs for the wet season

					Site							
Sample	AJ	BG	CTR	DD	JK	KU	SA	SH	RA	PR	NT	STD
OER	0.756±	0.781±		4.134±	1.064±	4.271±	2.760±	0.776±	0.103±	0.529±	0.154±	5.000
	0.005	0.006	BDL	0.029	0.008	0.030	0.020	0.006	0.001	0.004	0.001	
LUR	BDL	BDL	BDL	2.013± 0.014	1.241± 0.009	0.098± 0.001	2.89± 0.021	BDL	BDL	BDL	1.449± 0.010	5.000
BOR	BDL	BDL	BDL	BDL	BDL	1.051± 0.007	BDL	BDL	3.892± 0.028	BDL	1.639± 0.012	5.000
KIR	0.755±	0.967±		1.324±	0.986±	1.004±	0.751±	0.856±	0.494±	1.093±	0.852±	5.000
	0.747	0.957	BDL	1.311	0.976	0.994	0.743	0.847	0.489	1.082	0.843	
INTR	0.972±	1.388±	0.185±	0.721±	0.997±	1.210±	1.109±	1.146±	3.334±	0.166±	3.159±	5.000
	0.007	0.010	0.001	0.005	0.007	0.009	0.008	0.008	0.024	0.001	0.022	
HR	0.946±	1.051±		2.992±	1.063±	1.189±	1.694±	0.496±	0.117±	0.133±	3.214±	5.000
	0.007	0.007	BDL	0.021	0.008	0.008	0.012	0.004	0.001	0.001	0.023	
GIR	1.372±	1.303±		0.412±	2.373±	1.312±	2.696±	1.918±	0.147±	0.907±	1.960±	5.000
	0.010	0.009	BDL	0.003	0.017	0.009	0.019	0.014	0.001	0.006	0.014	
FER	2.529±	1.657±		0.420±	2.415±	2.988±	0.468±	1.912±	0.131±	0.89±	0.349±	5.000
	0.018	0.012	BDL	0.003	0.017	0.021	0.003	0.014	0.001	0.006	0.002	
WR	1.156± 0.008	0.631± 0.004	BDL	BDL	BDL	0.347± 0.002	BDL	1.205± 0.009	BDL	BDL	BDL	5.000
SKIR	0.916±	0.999±	0.144±	0.629±	4.806±	0.830±	1.995±	1.224±	4.553±	0.497±	0.889±	5.000
	0.007	0.007	0.001	0.004	0.034	0.006	0.014	0.009	0.032	0.004	0.006	
HER				2.236±	BDL	0.551±	1.919±	1.973±	2.560±		4.445±	5.000
	BDL	BDL	BDL	0.016		0.004	0.014	0.014	0.018	BDL	0.032	
MUR	0.672±	0.119±		0.822±	6.551±	0.507±	1.662±	0.434±	3.634±	2.726±	0.130±	5.000
	0.005	0.001	BDL	0.006	0.047	0.004	0.012	0.003	0.026	0.019	0.001	
LER	1.821±	0.569±	0.445±	0.664±	2.816±	2.573±	1.473±	3.002±	1.236±	2.314±	1.311±	5.000
	0.013	0.004	0.003	0.005	0.020	0.018	0.010	0.021	0.009	0.016	0.009	
LIR	0.751±	1.046±		0.175±	0.123±	1.232±	0.492±	1.910±	1.540±	1.449±	0.209±	5.000
	0.005	0.007	BDL	0.001	0.001	0.009	0.003	0.014	0.011	0.010	0.001	
BRR	BDL	BDL	BDL	BDL	BDL	BDL	2.429±	BDL	BDL	BDL	4.622	5.000

Table 2: Concentrations of zinc in chicken samples for dry season

						Site						
Sample	AJ	BG	CTR	DD	JK	KU	SA	SH	RA	PR	NT	STD
OED	1.021±	1.054±	BDL	5.581±	1.437±	5.767±	3.726±	1.048±	0.139±	0.715±	0.208±	5.000
	0.007	0.007		0.040	0.010	0.041	0.026	0.007	0.001	0.005	0.001	
LUD	BDL	BDL	BDL	2.717± 0.019	1.675± 0.012	0.131± 0.001	3.913± 0.028	BDL	BDL	BDL	1.957± 0.014	5.000
BOD		BDL	BDL	BDL	BDL	1.418±	BDL	BDL	5.254±	BDL	2.214±	5.000
	BDL					0.010	0.000	0.000	0.037	0.000	0.016	
KID	1.019±	1.305±	BDL	1.787±	1.331±	1.355±	1.014±	1.155±	0.666±	1.475±	1.150±	5.000
	1.009	1.292	0.000	1.770	1.318	1.342	1.004	1.144	0.660	1.461	1.139	
INTD	1.312±	1.874±	0.249±	0.974±	1.348±	1.635±	1.498±	1.547±	4.501±	0.224±	4.265±	5.000
	0.009	0.013	0.002	0.007	0.010	0.012	0.011	0.011	0.032	0.002	0.030	
HD	1.277±	1.418±		4.040±	1.436±	1.605±	2.287±	0.670±	0.159±	0.179±	4.338±	5.000
	0.009	0.010	BDL	0.029	0.010	0.011	0.016	0.005	0.001	0.001	0.031	

GID	1.852±	1.759±	BDL	0.557±	3.204±	1.771±	3.639±	2.589±	0.198±	1.225±	2.646±	5.000
	0.013	0.013		0.004	0.023	0.013	0.026	0.018	0.001	0.009	0.019	
FED	3.415±	2.237±		0.568±	3.261±	4.035±	0.633±	2.582±	0.177±	1.203±	0.471±	5.000
	0.024	0.016	BDL	0.004	0.023	0.029	0.004	0.018	0.001	0.009	0.003	
WD	1.561± 0.011	0.852± 0.006	BDL	BDL	BDL	0.468± 0.003	BDL	1.628± 0.012	BDL	BDL	BDL	5.000
SKID	1.237±	1.349±	0.194±	0.850±	6.489±	1.122±	2.693±	1.652±	6.146±	0.671±	1.201±	5.000
	0.009	0.010	0.001	0.006	0.046	0.008	0.019	0.012	0.044	0.005	0.009	
HED				3.019±		0.744±	2.591±	2.663±	3.456±		6.002±	5.000
	BDL	BDL	BDL	0.021	BDL	0.005	0.018	0.019	0.025	BDL	0.043	
MUD	0.908±	0.161±		1.111±	8.844±	0.685±	2.244±	0.585±	4.907±	3.681±	0.176±	5.000
	0.006	0.001	BDL	0.008	0.063	0.005	0.016	0.004	0.035	0.026	0.001	
LED	2.458±	0.768±	0.602±	0.896±	3.803±	3.474±	1.988±	4.053±	1.668±	3.124±	1.770±	5.000
LID	0.017 1.014± 0.007	0.005 1.412±	0.004	0.006 0.236±	0.027 0.167±	0.025 1.662±	0.014 0.663±	0.029 2.579±	0.012 2.079±	0.022 1.957±	0.013 0.283±	5.000
BRD	BDL	0.010 BDL	BDL BDL	0.002 BDL	0.001 BDL	0.012 BDL	0.005 3.280± 0.023	0.018 BDL	0.015 BDL	0.014 BDL	0.002 6.239± 0.044	5.000

The samples collected from various sites and seasons exhibited concentration ranges of Zn from 0.166 mg/kg (PR) to 3.334 mg/kg and from 0.224 mg/kg (PR) to 4.501 mg/kg (RA), respectively. The concentration levels of Zn in the head samples of the contaminated chicken were found to be BDL (CTR) to 3.214 mg/kg and BDL (CTR) to 4.339 mg/kg (NTC), respectively. Additionally, the concentrations measured in the gizzards of the chicken samples across different sites and seasons ranged from BDL (CTR) to 2.70 mg/kg (SA) and from BDL (CTR) to 3.64 mg/kg (SA), as detailed in Tables 1 and 2.

The concentration ranges of Zn in the feathers of the contaminated chicken samples across the sites and seasons were BDL (CTR) to 2.989 mg/kg (KU) and BDL (CTR) to 3.261 mg/kg (KU), respectively. The average concentrations of Zn in the wattles of the chicken samples across the sites and seasons ranged from BDL (CTR, DD, JK, SA, RA, PR, and NTC) to 1.206 mg/kg (SH) and from BDL (CTR, DD, JK, SA, RA, PR, and NTC) to 1.628 mg/kg, respectively. The concentrations observed in this study in the skin of the contaminated chicken samples across the sites and seasons ranged from 0.144 mg/kg (CTR) to 4.807 mg/kg (JK) and from 0.195 mg/kg (CTR) to 6.489 mg/kg (JK), respectively, as shown in Tables 1 and 2.

The concentration ranges of Zn in the hearts of the contaminated chicken samples across the sites and seasons were BDL (AJ, BG, CTR, JK, and PR) to 4.446 mg/kg (NT) and BDL (AJ, BG, CTR, JK, and PR) to 6.002 mg/kg (NT), respectively, as illustrated in Figure 4.63. The muscles of the contaminated chicken samples displayed the following concentration ranges of Zn across the sites and seasons: BDL (CTR) to 6.551 mg/kg and BDL (CTR) to 8.844 mg/kg (JK), respectively, as presented in Tables 1 and 2.

Additionally, the concentrations of Zn in the leg samples of contaminated chickens varied across different sites and seasons, ranging from 0.446 mg/kg (CTR) to 3.002 mg/kg and from 0.602 mg/kg (CTR) to 4.053 mg/kg (SH), as detailed in Tables 1 and 2. These tables illustrate the average Zn concentrations found in the liver of the contaminated chicken samples across various sites and seasons.

The concentration ranges for this metal across the sites and seasons were BDL (CTR) to 1.910 mg/kg (SH) and BDL (CTR) to 2.579 mg/kg, respectively. Furthermore, the zinc levels in the brain samples of the contaminated chickens were assessed across the sites and seasons, revealing that zinc was undetectable at most locations, except for two sites where concentrations of 2.430 mg/kg (SH) to 4.622 mg/kg (NTC) and 3.280 mg/kg (SA) to 6.240 mg/kg (NTC) were recorded, as shown in Tables 1 and 2. This gives excellent agreement with the previously reported by Okoh, and Trejo-Hernandez, (2006) and Umanah et al. (2025), who reported similar results.

Lead Concentration in Chicken Samples

Tables 3 and 4 present the average lead concentrations in chicken samples across various sites during both wet and dry seasons. The concentration ranges of lead in the oesophagus samples during these seasons were BDL (NTC, PR, RA, JK, SA, and CTR) to 0.457 mg/kg (KU) and BDL (NTC, PR, RA, JK, SA, and CTR) to 0.639 mg/kg (KU), as indicated in Tables 3 and 4.

The lead concentrations in the lung, head, and bone samples were all below the detection limit across the seasons, as shown in Tables 3 and 4. However, the levels recorded in the kidney samples ranged from BDL (CTR, SA, RA, PR, and NTC) to 0.338 mg/kg (BG) and from BDL (CTR, SA, RA, PR, and NTC) to 0.539 mg/kg (BG), as presented in Tables 3 and 4. The

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concentration ranges of lead found in the intestines of the contaminated chickens across the sites and seasons were BDL (CTR, JK, SA, RA, PR, NT) to 0.557 ± 0.004 mg/kg (NTC) and from BDL (CTR, JK, SA, RA, PR, NTC) to 0.752 ± 0.005 mg/kg (NTC), as illustrated in the table.

Moreover, the concentration detected in the head of the contaminated chicken was below the detection limit at all sites, as indicated in the Tables. The concentration ranges for lead found in the feathers of the contaminated chickens varied from BDL (AJ, SA, RA, CTR, and PR) to 0.338 mg/kg (BG) and from BDL (AJ, CTR, SA, RA, and PR) to 0.457 mg/kg (BG), as detailed in the Tables.

The concentration ranges of lead measured in the gizzards of the contaminated chickens across different sites and seasons (both wet and dry) were: BDL (CTR, DD, JK, SA, PR, and NTC) to 0.379 ± 0.003 (RA) and BDL (CTR, DD, JK, SA, PR, and NTC) to 0.550 (RA), respectively, as shown in Tables 4.21 to 4.22. In a similar manner, the concentration ranges of lead found in the local chicken wattle samples across the sites and seasons were as follows: BDL (AJ, DD, JK, SA, RA, PR, NTC, and CTR) to 0.408 mg/kg (BG) and from (JK, SA, RA, PR, NTC, and CTR) to 0.551 mg/kg (BG), respectively. Additionally, the levels recorded in the skin samples across the sites and seasons ranged from BDL (RA, SH, CTR) to 0.826 mg/kg (PR) and from BDL (CTR, RA, SH) to 1.115 mg/kg, respectively.

The concentration ranges for lead in the hearts of the analyzed chicken samples across the sites were BDL (CTR, DD, RA, PR) to 0.670 mg/kg (SH) and BDL (CTR, DD, RA, PR) to 0.904 (SH), respectively. Likewise, as presented in Tables 3 and 4, the concentration ranges of lead in the chicken leg samples were: BDL (CTR, DD, JK, SA, RA, PR, and NTC) to 0.292 mg/kg (KU) and BDL (CTR, DD, JK, SA, RA, NT) to 0.394 mg/kg (KU) across the sites. These results agreed with the work of Onwerenmadu, and Duruigbo, (2007) and Obruche et al.,(2025) he carried out in same dumpsite.

Table 3: Concentrations of lead in chicken organs for wet season

	sites											
Sample	AJ	BG	CTR	DD	JK	KU	SA	SH	RA	PR	NT	STD
OER	0.268± 0.002	0.245± 0.002		0.473± 0.003	BDL	0.456± 0.003	BDL	0.247± 0.002	BDL	BDL	BDL	0.010
LUR	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.010
BOR	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.010
KIR	0.157± 0.001	0.330± 0.002	BDL	0.124± 0.001	0.110± 0.001	0.355± 0.003		0.296± 0.0021	BDL	BDL	BDL	0.010
INTR	0.243± 0.002	0.203± 0.001	BDL	0.449± 0.003	BDL	0.259± 0.0018	BDL	0.215± 0.002	BDL	BDL	0.557± 0.0040	0.010
HR	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.010
GIR	0.308± 0.002	0.159± 0.001	BDL	BDL	BDL	0.253± 0.0018	BDL	0.379± 0.003	0.407± 0.0029	BDL	BDL	0.010
FER	BDL	0.338± 0.002	BDL	0.019± 0.001	0.132± 0.001	0.434± 0.0031	BDL	0.298± 0.002	BDL	BDL	0.065± 0.001	0.010
WR	BDL	0.407± 0.003	BDL	BDL	BDL	0.246± 0.0018	BDL	0.238± 0.0017	BDL	BDL	BDL	0.010
SKIR	0.320± 0.002	0.316± 0.002	BDL	0.367± 0.003	0.307± 0.002	0.131± 0.001	0.578± 0.004	BDL	BDL	0.825± 0.0059	0.820± 0.006	0.010
HER	0.337± 0.002	0.135± 0.001	BDL	BDL	0.048± 0.001	0.335± 0.002	0.005± 0.001	0.669± 0.005	BDL	BDL	0.084± 0.001	0.010
MUR	0.314± 0.002	0.344± 0.002	BDL	0.558± 0.004	BDL	BDL	0.428± 0.003	0.198± 0.001	0.817± 0.0058	BDL	BDL	0.010
LER	0.254± 0.002	0.163± 0.001	BDL	BDL	BDL	0.291± 0.002	BDL	0.199± 0.001	BDL	BDL	BDL	0.010
LIR	0.187±	0.283±				0.434±		0.415±				0.010

	0.001	0.002	BDL	BDL	BDL	0.003	BDL	0.003	BDL	BDL	BDL	
BRR	BDL	2.111± 0.015	2.213± 0.016	0.807± 0.006	1.501± 0.011		0.478± 0.003			1.925± 0.014	0.807± 0.0057	0.010
						BDL		BDL	BDL			

Table 4: Concentrations of lead in chicken organs for dry season

	Sites											
Sample	AJ	BG	CTR	DD	JK	KU	SA	SH	RA	PR	NT	STD
OED	0.362±	0.331±	BDL	0.639±	BDL	0.616±	BDL	0.334±	BDL	BDL	BDL	0.010
	0.003	0.002		0.005		0.004		0.002				
LUD	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.010
BOD	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.010
KID	0.250±	0.539±	BDL	0.198±	0.176±	0.566±	BDL	0.472±	BDL	BDL	BDL	0.010
	0.053	0.114		0.042	0.037	0.119		0.100				
INTD	0.329±	0.275±	BDL	0.607±	BDL	0.350±	BDL	0.291±	BDL	BDL	0.752 ±	0.010
	0.002	0.002		0.004		0.003		0.002			0.005	
HD	BDL	BDL	BDL	BDL	BDL	0.001	BDL	BDL	BDL	BDL	BDL	0.010
						0.003						
GID	0.416±	0.214±	BDL	BDL	BDL	0.342±	BDL	0.511±	0.550±	BDL	BDL	0.010
	0.003	0.002				0.002		0.004	0.0039			
FED	0.400±	0.456±	BDL	0.026±	0.178±	0.587±	BDL	0.402±	BDL	BDL	0.087 ±	0.010
		0.003		0.001	0.001	0.004		0.003			0.001	
WD	BDL	0.550±	BDL	BDL	BDL	0.333±	BDL	0.322±	BDL	BDL	BDL	0.010
		0.004				0.002		0.002				
SKID	0.432±	0.427±	BDL	0.494±	0.415±	0.177±	0.780±	BDL	BDL	1.114±	1.108 ±	0.010
	0.003	0.003		0.004	0.003	0.001	0.006			0.008	0.008	
HED	0.455±	0.182±	BDL	BDL	0.064±	0.452±	0.006±	0.904±	BDL	BDL	0.112 ±	0.010
	0.003	0.001			0.001	0.003		0.006			0.001	
MUD	0.424±	0.464±	BDL	0.753±	BDL	BDL	0.578±	0.267±	1.104±	BDL	BDL	0.010
	0.003	0.003		0.005			0.004	0.002	0.0078			
LED	0.343±	0.220±	BDL	BDL	BDL	0.393±	BDL	0.268±	BDL	BDL	BDL	0.010
	0.002	0.002				0.003		0.002				
LID	0.252±	0.382±	BDL	BDL	BDL	0.587±	BDL	0.561±	BDL	BDL	BDL	0.010
	0.002	0.003				0.0042		0.004				
BRD	BDL	2.850±	2.988±	1.090±	2.026±	BDL	0.646±	BDL	BDL	2.599±	1.091 ±	0.010
		0.020	0.021	0.008	0.014		0.005			0.019	0.008	

The sites and seasons (wet and dry) were analyzed, respectively. The concentration ranges observed in the chicken liver samples throughout the seasons were BDL (CTR, DD, JK, SA, RA, PR, and NTC) at 0.43 mg/kg (KU) and BDL (CTR, DD, JK, SA, RA, PR, and NT) to 0.587 mg/kg (KU), as detailed in Tables 3 and 4.

Additionally, the elevated levels of lead found in the brains of the contaminated chicken samples across various sites and seasons ranged from BDL (AJ, KU, SH, RA) to 2.111 mg/kg (SH) and from BDL (AJ, KU, SH, RA) to 2.850 mg/kg (BG), as shown in the Tables. Osuji, and Chukwunedum, (2001) and Ogwuche and Obruche, (2020) had similar view in their findings in the analysis of PAH in fish, sediment and water in same State

Concentration of Cd in chicken samples

Tables 5 and 6 illustrate the average concentrations of cadmium in the chicken samples across different sites and seasons. The cadmium concentrations in the oesophagus of the contaminated chicken samples across the sites and seasons are presented in Tables 5 and 6. The concentration ranges were BDL (CTR) to

0.086 mg/kg (RA) and BDL (CTR) to 0.082 mg/kg (BG and JK) for the wet and dry seasons, respectively.

Likewise, the concentration ranges for cadmium in the lung samples of the contaminated chicken samples were BDL (CTR) to 0.090 mg/kg (NTC) and BDL (CTR) to 0.121 mg/kg (NTC), respectively, as shown in Tables 5 and 6. Furthermore, the cadmium concentrations recorded in the bone samples of the contaminated chicken samples across the sites and seasons were BDL (AJ, BG, CTR, DD, KU, SH, and PR) for both the wet and dry seasons. Moreover, the concentration ranges of cadmium in the kidneys of the contaminated chicken samples across the sites and seasons were 0.020 mg/kg (CTR) to 0.075 mg/kg (RA) and 0.027 mg/kg (CTR) to 0.101 mg/kg (RA), respectively, for the wet and dry seasons, as presented in Tables 5 and 6.

The levels of cadmium found in the intestines of the contaminated chicken samples were measured at 0.002 (CTR) to 0.082 mg/kg (RA) for the wet season and 0.003 (CTR) to 0.110 mg/kg (RA) for the dry season. Additionally, the concentrations of cadmium in the head samples of the contaminated chicken across various sites and seasons ranged from BDL (CTR) to 0.063 mg/kg (AJ) and from BDL (CTR) to 0.081 mg/kg (AJ), respectively. The cadmium levels recorded in the gizzard of the contaminated chicken samples were between 0.021 (CTR) to 0.071 mg/kg (SH) and 0.028 (CTR) to 0.095 mg/kg (JK), as indicated in the table. The highest concentrations were observed at the JK and SH sites.

Furthermore, the cadmium concentrations in the feathers of the contaminated chicken samples across different sites and seasons ranged from BDL (CTR) to 0.065 mg/kg and from BDL (CTR) to 0.088 mg/kg (BG), as shown in Tables 5 and 6, respectively. The cadmium concentrations in the wattle samples of the contaminated chicken across various sites and seasons were also recorded. The ranges for the wet and dry seasons were BDL (CTR, DD, JK, SA, SH, RA, PR, and NTC) to 0.074 mg/kg (AJ) and BDL (CTR, DD, JK, SA, SH, RA, PR, and NTC) to 0.099 mg/kg (AJ), respectively, as presented in Tables 5 and 6. Similarly, as shown in Tables 5 and 6, the concentrations of cadmium in the skin of the contaminated chicken samples were found to be 0.021 (CTR) to 0.066 mg/kg (RA) and 0.028 (CTR) to 0.089 mg/kg during the wet and dry seasons, respectively. This finding aligns with a study of Obruche et al., (2019) and Ekpo et al., (2023) in ughelli major dumpsite.

Table 5: Concentrations of cadmium in chicken samples for the wet season

			Site								
Sample	AJ	BG	CTR	DD	JK	KU	SA	SH	RA	PR	NT	STD
OER	0.067± 0.0005	0.061± 0.0004	BDL	0.042± 0.0003	0.061± 0.0004	0.054± 0.0004	0.051± 0.0004	0.054± 0.0004	0.086± 0.0006	0.042± 0.0003	0.051± 0.0004	0.05
LUR	0.045± 0.0003	0.046± 0.0003	BDL	0.056± 0.0004	0.047± 0.0003	0.075± 0.0005	0.079± 0.0006	0.061± 0.0004	0.084± 0.0006	0.074± 0.0005	0.089± 0.0006	0.05
BOR	BDL	BDL	BDL	BDL	BDL	BDL	0.0716± 0.0005	BDL	0.081± 0.0006	BDL	0.048± 0.0003	0.05
KIR	0.055± 0.0004	0.066± 0.0005	0.019± 0.0001	0.049± 0.0004	0.041± 0.0003	0.059± 0.0004	0.051± 0.0004	0.062± 0.0004	0.075± 0.0005	0.044± 0.0003	0.054± 0.0004	0.05
INTR	0.061± 0.0004	0.048± 0.0003	0.002± 0.001	0.051± 0.0004	0.049± 0.0003	0.049± 0.0004	0.069± 0.0005	0.049± 0.0004	0.082± 0.0006	0.042± 0.0003	0.061± 0.0004	0.05
HR	0.062± 0.0004	0.046± 0.0003	BDL	0.059± 0.0004	0.052± 0.0004	0.055± 0.0004	0.039± 0.0003	0.056± 0.0004	0.019± 0.0001	0.043± 0.0003	0.053± 0.0004	0.05
GIR	0.059± 0.0004	0.041± 0.0003	0.021± 0.0001	0.047± 0.0003	0.071± 0.0005	0.040± 0.0003	0.069± 0.0005	0.071± 0.0005	0.058± 0.0004	0.039± 0.0003	0.062± 0.0004	0.05
FER	0.045± 0.0016	0.065± 0.0024	BDL	0.042± 0.0015	0.051± 0.0018	0.072± 0.0026	0.047± 0.0017	0.055± 0.0020	0.039± 0.0014	0.045± 0.0016	0.047± 0.0017	0.05
WR	0.073± 0.0005	0.065± 0.0005	BDL	BDL	BDL	0.068± 0.0005	BDL	BDL	BDL	BDL	BDL	0.05
SKIR	0.063± 0.0004	0.059± 0.0004	0.021± 0.0001	0.039± 0.0003	0.062± 0.0004	0.041± 0.0003	0.046± 0.0003	0.053± 0.0004	0.066± 0.0005	0.049± 0.0003	0.057± 0.0004	0.05
HER	BDL	BDL	BDL	0.061± 0.0004	0.036± 0.0003	BDL	0.079± 0.0006	BDL	0.071± 0.0005	BDL	0.076± 0.0005	0.05
MUR	0.063± 0.0047	0.073 0.0054	0.002± 0.0001	0.056± 0.0042	0.055± 0.0041	0.065± 0.0048	0.048± 0.0036	0.049± 0.0037	0.084± 0.0062	0.047± 0.0035	0.079± 0.0059	0.05
LER	0.061± 0.0045	0.065± 0.0048	BDL	0.039± 0.0029	0.051± 0.0038	0.061± 0.0045	0.041± 0.0030	0.059± 0.0045	0.064± 0.0047	0.064± 0.0047	0.050± 0.0037	0.05

LIR	0.044±	0.055±	BDL	0.041±	0.042±	0.054±	0.053±	0.067±	BDL	0.047±	0.045±	0.05
	0.0033	0.0041		0.0030	0.0031	0.0040	0.0040	0.0049		0.0035	0.0033	
BRR	BDL	BDL	BDL	0.001	0.055±	BDL	0.058±	BDL	BDL	0.062±	0.000	0.05

Table 6: Concentrations (mg/kg) of cadmium in chickens organs dry season

Sample	AJ	BG	CTR	DD	JK	KU	SA	SH	RA	PR	NT	STD
OED	0.089±	0.082±		0.056±	0.082±	0.073±	0.069±	0.073±	0.116±	0.056±	0.068±	0.05
	0.001	0.001	BDL	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	
LUD	0.060±	0.062±		0.075±	0.063±	0.101±	0.106±	0.082±	0.113±	0.099±	0.121±	0.05
	0.001	0.001	BDL	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	
BOD	BDL	BDL	BDL	BDL	BDL	BDL	0.097± 0.0007	BDL	0.109± 0.0008	BDL 0.0000	0.066± 0.0005	0.05
KID	0.074±	0.089±	0.027±	0.067±	0.056±	0.081±	0.069±	0.083±	0.1007±	0.059±	0.073±	0.05
	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	
INTD	0.082±	0.064±	0.003±	0.069±	0.066±	0.067±	0.094±	0.067±	0.110±	0.056±	0.082±	0.05
	0.0006	0.0005	0.001	0.0005	0.0005	0.0005	0.0007	0.0005	0.0008	0.0004	0.0006	
HD	0.085±	0.062±		0.079±	0.069±	0.074±	0.052±	0.075±	0.027±	0.0578±	0.0712±	0.05
	0.0006	0.0004	BDL	0.0006	0.0005	0.0005	0.0004	0.0005	0.0002	0.0004	0.0005	
GID	0.080±	0.055±	0.028±	0.063±	0.095±	0.054±	0.094±	0.095±	0.078±	0.052±	0.083±	0.05
	0.0006	0.0004	0.0002	0.0004	0.0007	0.0004	0.0007	0.0007	0.0006	0.0004	0.0006	
FED	0.060±	0.088±		0.057±	0.068±	0.097±	0.063±	0.074±	0.054±	0.061±	0.063±	0.05
	0.002	0.003	BDL	0.002	0.003	0.004	0.002	0.003	0.002	0.002	0.002	
WD	0.099± 0.001	0.087± 0.001	BDL	BDL	BDL	0.091± 0.006	BDL	BDL	BDL	BDL	BDL	0.05
SKID	0.085±	0.081±	0.028±	0.052±	0.083±	0.055±	0.062±	0.071±	0.088±	0.066±	0.077±	0.05
	0.001	0.001	0.002	0.002	0.001	0.002	0.006	0.001	0.001	0.003	0.001	
HED	BDL	BDL	BDL	0.082± 0.0006	0.048± 0.0003	BDL	0.106± 0.0008	BDL	0.095± 0.0007	BDL	0.102± 0.0007	0.05
MUD	0.085±	0.099±	0.003±	0.076±	0.074±	0.087±	0.065±	0.067±	0.113±	0.063±	0.107±	0.01
	0.006	0.007	0.001	0.006	0.006	0.007	0.005	0.005	0.008	0.005	0.008	
LED	0.082±	0.087±		0.053±	0.069±	0.082±	0.055±	0.081±	0.086±	0.086±	0.068±	0.05
	0.006	0.007	BDL	0.004	0.005	0.006	0.004	0.006	0.006	0.006	0.005	
LID	0.059	0.074±	BDL	0.055±	0.056±	0.073±	0.072±	0.089±	BDL	0.063±	0.060±	0.05

Sample	BG	CTR	DD	JK	KU	SA	SH	RA	PR	NT	STD
	0.0055		0.0041	0.0042	0.0054	0.0053	0.0067		0.0047	0.0045	
BRD				0.074± 0.055		0.078± 0.0058			0.083± 0.0062		0.05
BDL	BDL	BDL	BDL		BDL		BDL	BDL		BDL	

The levels of cadmium found in the heart samples of contaminated chicken across various sites and seasons are detailed in Tables 5 and 6. The concentration ranges observed during the wet and dry seasons were BDL (AJ, BG, CTR, KU, SH, PR) to 0.079 mg/kg (SA) and BDL (AJ, BG, CTR, KU, SH, PR) to 0.106 mg/kg (SA), respectively. Tables 5 and 6 illustrate the cadmium concentrations in the muscles of the contaminated chicken samples across different sites and seasons (wet and dry seasons).

The concentration ranges of Cd in these samples varied from 0.002 mg/kg (CTR) to 0.084 mg/kg (RA) and from 0.003 mg/kg (CTR) to 0.113 mg/kg (RA). In the leg samples of the contaminated chicken, the concentration ranges during the wet and dry seasons were recorded as BDL (CTR) to 0.065 mg/kg (BG) and BDL (CTR) to 0.087 mg/kg (BG), respectively. The cadmium levels in the liver of the contaminated chicken

samples across the sites and seasons are also presented in the Tables. The concentration ranges across the sites and seasons were BDL (CTR, RA) to 0.067 mg/kg (SH) and BDL (CTR, RA) to 0.090 mg/kg (SH) for the wet and dry seasons, respectively. Likewise, the concentrations recorded in the brain samples across the sites and seasons were as follows: BDL (AJ, BG, CTR, DD, KU, SH, RA, NTC) to 0.062 mg/kg (PR) and

BDL (AJ, BG, CTR, DD, KU, SH, RA, NTC) to 0.083 mg/kg (PR) for the wet and dry seasons, as shown in Tables 5 and 6. This finding aligns with a study of Ukpong et al., (2012) in same environment.

Concentration of Cu in chicken samples

The average concentration levels of copper in the examined chicken samples from various sites and seasons (wet and dry) are detailed in Tables 7 and 8, respectively. The recorded concentration ranges of copper in the oesophagus of the contaminated chicken across the sites and seasons (wet and dry) were: BDL (CTR, PR) – 30.746 (NTC) and BDL (CTR, PR)–41.506 mg/kg (NTC), as shown in the Tables. Additionally, the concentration ranges of copper found in the lungs of the contaminated chicken varied from BDL (CTR, KU) to 0.438 (SH) and BDL (CTR, KU) to 0.591 mg/kg (SH), respectively, as indicated in Tables 7 and 8.

The concentration ranges of copper in the bones of the contaminated chicken across the sites and seasons (wet and dry) were BDL (CTR, DD, JK, KU) to 0.300 (AJ, SH) and BDL (CTR, DD, JK) to 0.406 mg/kg (SH, AJ), as presented in the Tables. Furthermore, the concentration ranges for copper in the kidneys across the sites and seasons (wet and dry) were BDL (CTR, DD, JK) to 1.432 (PR) and BDL (CTR, DD, JK) to 1.933 mg/kg (NTC), respectively, as shown in the Tables.

The results for the concentration ranges of copper in the intestines of the contaminated chicken, as presented in the Tables, were BDL (CTR) to 6.255 (NTC) and BDL (CTR) to 8.443 mg/kg (NTC), respectively. Lastly, the concentration ranges of copper in the heads of the contaminated chicken samples, as detailed in Tables 7 and 8 across the sites, were BDL (CTR) to 66.148 (NTC) and BDL (CTR) to 89.299 (NTC), respectively. Ese et al., (2024) had similar view in their findings in the analysis of heavy metals in chicken in Warri dumpsite.

Table 7: Concentrations of copper in chicken samples for wet season

					Site							
Sample	AJ	BG	CTR	DD	JK	KU	SA	SH	RA	PR	NT	STD
OER	0.049±	0.087±	BDL	0.093±	0.104±	0.038±	0.101±	0.036±	0.187±	BDL	30.745±	2.000
	0.004	0.0006		0.0007	0.0007	0.0003	0.0007	0.0003	0.0013		0.2185	
LUR	0.209±	0.126±	BDL	0.258±	0.134±	BDL	0.109±	0.438±	0.126±	0.142±	0.107±	2.000
	0.002	0.0009		0.0018	0.0010		0.0008	0.0031	0.0009	0.0010	0.0008	
BOR	0.300±	0.221±	BDL	BDL	BDL	BDL	0.063±	0.300±	0.269±	0.221±	0.128±	2.000
	0.0021	0.0016					0.0004	0.0021	0.0019	0.0016	0.0009	
KIR	0.026±	0.082±	BDL	BDL	BDL	0.069±	0.215±	0.064±	0.082±	0.234±	1.432±	2.000
	0.002	0.0006				0.0005	0.0015	0.0005	0.0006	0.0017	0.0102	
INTR	0.059±	0.031±	BDL	0.195±	0.325±	0.068±	0.209±	0.059±	0.097±	0.214±	6.255±	2.000
	0.004	0.0002		0.0014	0.0023	0.0005	0.0015	0.0004	0.0007	0.0015	0.0444	
HR	0.136±	0.147±	BDL	0.246±	0.0269±	0.159±	0.306±	0.181±	0.279±	0.334±	66.148±	2.000
	0.001	0.0010		0.0017	0.0002	0.0011	0.0022	0.0013	0.0020	0.0024	0.4701	
GIR	0.077±	0.028±	BDL	0.143±	0.174±	0.033±	0.143±	0.084±	0.0229±	0.173±	128.017±	2.000
	0.005	0.0002		0.0010	0.0012	0.0002	0.0010	0.0006	0.0002	0.0012	0.9098	
FER	0.074±	0.085±	BDL	0.3045±	0.089±	0.046±	0.112±	0.076±	BDL	0.041±		2.000
	0.0005	0.0006	BDL	0.0022	0.0006	0.0003	0.0008	0.0005		0.0003		
WR	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.123±	BDL	BDL	BDL	2.000
				0.0000				0.0009				
SKIR	0.059±	0.059±	BDL	0.703±	0.183±	0.002±	0.052±	0.024±	0.071±	0.068±	BDL	2.000
	0.004	0.004		0.0050	0.0013		0.0004	0.0002	0.0005	0.0005		
HER	BDL	BDL	BDL	0.201±	BDL	BDL	0.301±	0.269±	0.082±	BDL	0.249±	2.000
				0.0014			0.0021	0.0019	0.0006		0.0018	
MUR	0.024±	0.173±	BDL	0.027±	0.10±	0.019±	0.296±	0.019±	0.045±	1.259±	7.217±	2.000
	0.002	0.0012		0.0002	0.0007	0.0001	0.0021	0.0001	0.0003	0.0089	0.0513	
LER	0.019±	0.0009±	BDL	0.138±	0.103±	0.049±	0.138±	0.013±	0.123±	0.082±	15.366±	2.000
	0.004	0.0002		0.0030	0.0022	0.0011	0.0030	0.0003	0.0027	0.0018	0.3309	
LIR	0.064±	0.148±	BDL	0.171±	0.149±	0.191±	0.195±	0.184±	BDL	0.0029±	319.378±	2.000

	0.001	0.003		0.0037	0.0032	0.0041	0.0042	0.0040		0.0001	6.878	
BRR	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.000

Table 8: Concentrations of copper in chicken samples for dry season

							Site					
Sample	AJ	BG	CTR	DD	JK	KU	SA	SH	RA	PR	NT	STD
OED	0.0677±	0.117±	BDL	0.125±	0.141±	0.0523±	0.137±	0.048±	0.253±	BDL	41.506±	2.000
	0.0005	0.0008		0.0009	0.0010	0.0004	0.0010	0.0003	0.0018		0.2950	
LUD	0.283±	0.171±	BDL	0.349±	0.181±	BDL	0.148±	0.591±	0.171±	0.191±	0.145±	2.000
	0.0020	0.0012		0.0025	0.0013		0.0011	0.0042	0.0012	0.0014	0.0010	
BOD	0.406±	0.298±	BDL	BDL	BDL	BDL	0.085±	0.406±	0.364±	0.298±	0.173±	2.000
	0.0029	0.0021					0.0006	0.0029	0.0026	0.0021	0.0012	
KID	0.035±	0.11±	BDL	BDL	BDL	0.094±	0.290±	0.086±	0.110±	0.315±	1.933±	2.000
	0.0002	0.0008				0.0007	0.0021	0.0006	0.0008	0.0022	0.0137	
INTD	0.081±	0.042±	BDL	0.263±	0.439±	0.092±	0.283±	0.081±	0.130±	0.289±	8.443±	2.000
	0.0006	0.0003		0.0019	0.0031	0.0007	0.0020	0.0006	0.0009	0.0021	0.0600	
HD	0.184±	0.199±	BDL	0.332±	0.036±	0.214±	0.414±	0.244±	0.377±	0.451±	89.299±	2.000
	0.0013	0.0014		0.0024	0.0003	0.0015	0.0029	0.0017	0.0027	0.0032	0.6346	
GID	0.103±	0.038±	BDL	0.193±	0.235±	0.045±	0.193±	0.113±	0.031±	0.233±	172.822±	2.000
	0.0007	0.0003		0.0014	0.0017	0.0003	0.0014	0.0008	0.0002	0.0017	1.2282	
FED	0.099±	0.114±	BDL	0.411±	0.119±	0.062±	0.152±	0.102±	BDL	0.055±	BDL	2.000
	0.0007	0.0008		0.0029	0.0008	0.0004	0.0011	0.0007		0.0004		
WD	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.167±	BDL	BDL	BDL	2.000
								0.001				
SKID	0.079±	0.081±	BDL	0.949±	0.247±	0.0027±	0.069±	0.032±	0.095±	0.091±	BDL	2.000
	0.0006	0.0006		0.0067	0.0018	0.0000	0.0005	0.0002	0.0007	0.0006		
HED	BDL	BDL	BDL	0.272±	BDL	BDL	0.407±	0.363±	0.110±	BDL	0.337±	2.000
				0.0019			0.0029	0.0026	0.0008		0.0024	
MUD	0.032±	0.234±	BDL	0.036±	0.141±	0.026±	0.400±	0.025±	0.062±	1.699±	9.743±	2.000
	0.0002	0.0017		0.0003	0.0010	0.0002	0.0028	0.0002	0.0004	0.0121	0.0692	
LED	0.030±	0.001±	BDL	0.186±	0.139±	0.066±	0.186±	0.017±	0.166±	0.110±	20.744±	2.000
	0.0005	0.001		0.0040	0.0030	0.0014	0.0040	0.0004	0.0036	0.0024	0.4468	
LID	0.086±	0.199±	BDL	0.231±	0.201±	0.257±	0.263±	0.248±	BDL	0.004±	431.158±	2.000
	0.0019	0.0043		0.0050	0.0043	0.0056	0.0057	0.0054		0.0001	9.2855	
BRD	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.000

The concentration levels of copper found in the gizzard of contaminated chickens, as detailed in Tables 4.25 and 4.26, varied across different sites and seasons (wet and dry), ranging from BDL (CTR) to 128.017 (NTC) and BDL (CTR) to 172.822 (NTC), respectively. The copper concentration ranges observed in the feathers of the contaminated chicken samples across the seasons and sites were BDL (CTR, RA, NTC) to 0.305 (DD) and BDL (CTR, RA, NTC) to 0.411 mg/kg (DD), as shown in Tables 7 and 8, respectively. The concentrations measured in the wattles of the contaminated chickens remained below the toxic threshold across all sites and seasons, except for the SH-site, where concentrations of 0.123 (SH) and 0.167 mg/kg (SH) were noted, as illustrated in Tables 7 and 8, respectively.

The concentration ranges of copper detected in the skin of the contaminated chicken samples across various sites and seasons (wet and dry), as presented in Tables 7 and 8, were BDL (CTR, NTC) to 0.703 (DD) and BDL (CTR, NTC) to 0.949 mg/kg (DD), respectively. In addition, the concentration ranges of copper in the heart of the contaminated chickens were BDL (CTR, BG, CTR, JK, KU, and PR) to 0.301 mg/kg (SA) and BDL (CTR, BG, CTR, JK, KU, and PR) to 0.407 mg/kg (SA), as shown in Tables 7 and 8, respectively.

Moreover, the copper concentrations were also assessed in the muscles of the contaminated chicken samples across the sites and seasons, with recorded ranges of BDL (CTR) to 7.217 (NTC) and BDL (CTR) to 9.743 mg/kg (NTC), as detailed in Tables 4.25 and 4.26, respectively. Furthermore, the concentration ranges of copper examined in the legs of the contaminated chickens across the sites and seasons were BDL (CTR) to 15.366 mg/kg (NTC) and BDL (CTR) to 20.744 mg/kg (NTC), as presented in Tables 7 and 8, respectively. The findings regarding copper contamination in the livers of the contaminated chickens across various sites and seasons were also presented in the Tables.

The concentration ranges observed during both the dry and wet seasons varied from BDL (CTR) to 319.378 (NTC) and from BDL (CTR) to 431.158 mg/kg (NTC), as detailed in the Tables. In contrast, the copper concentrations found in the brains of the contaminated chicken samples were below the detection limit and were not detected at any of the sites, as shown in Tables 7 and 8, respectively. These results are in agreement with the work of (Umudi et al., 2025) and Udosen et al., (2012).

Concentration of Hg in chicken samples

The mercury concentration ranges measured in the oesophagus across different sites and seasons (wet and dry) were 1.029 (CTR) to 4.968 mg/kg (RA) and 1.389 (CTR) to 6.707 mg/kg (RA), as indicated in Tables 9 and 10, respectively. Additionally, the concentration ranges of mercury in the lungs of the chicken samples across the sites and seasons (wet and dry) were BDL (CTR) to 4.171 mg/kg (JK) and BDL (CTR) to 5.631 mg/kg (JK), as reflected in Tables 9 and 10. The concentration ranges of mercury in the bones of the contaminated chickens across the sites and seasons, as presented in Tables 9 and 10, were BDL (AJ, BG, CTR, DD, JK, KU) to 2.126 mg/kg (SA) and BDL (AJ, BG, CTR, DD, JK, KU) to 2.866 mg/kg (SA), respectively.

The concentration ranges of mercury recorded in the kidneys of the contaminated chickens across the sites and seasons (wet and dry) were BDL (CTR) to 12.236 mg/kg (RA) and BDL (CTR) to 16.518 mg/kg (RA), as shown in Tables 9 and 10, respectively. The mercury levels found in the intestines of the contaminated chickens across the sites were BDL (CTR) to 6.87 mg/kg (RA) and BDL (CTR) to 9.282 ± 0.120 mg/kg (RA), respectively. These concentrations exceeded the permissible limit of 0.010 mg/kg across the sites and seasons. Furthermore, the mercury concentrations recorded in the heads of the contaminated chickens across the sites and seasons were presented in the Tables. This gives excellent agreement with the previously reported by Umanah et al. (2025), who reported similar results.

Table 9: Mercury contents in chicken samples for wet season

SAMPLE	AJ	BG	CTR	DD	JK	KU	SA	SH	RA	PR	NT	STD
OER	1.403±	1.135±	1.029±	2.134±	1.929±	2.614±	1.577±	4.232±	4.968±	4.377±	1.542±	0.010
	0.030	0.024	0.022	0.046	0.041	0.056	0.034	0.091	0.107	0.094	0.033	
LUR	0.944±	0.983±		1.502±	4.171±	1.283±					1.399±	0.010
	0.020	0.021	BDL	0.032	0.089	0.028	BDL	BDL	BDL	BDL	0.030	
BOR							2.126±	2.036±	1.508±	1.663±	1.319±	0.010
	BDL	BDL	BDL	BDL	BDL	BDL	0.046	0.044	0.033	0.035	0.028	
KIR	2.287±	1.682±	BDL	0.779±	8.147±	1.352±	3.864±	1.319±	12.236±	2.159±	2.429±	0.010
	0.049	0.036		0.017	0.176	0.029	0.083	0.028	0.264	0.047	0.052	
INTR	2.603±	1.853±	BDL	1.666±	0.989±	2.269±	1.981±	1.641±	6.875±	3.672±	1.332±	0.010
	0.056	0.040		0.036	0.021	0.049	0.043	0.035	0.148	0.079	0.029	
HR	4.153±	2.332±	BDL	3.054±	2.335±	3.323±	2.967±	2.421±	53.508±	2.351±	0.945±	0.010
	0.0894	0.050		0.066	0.050	0.072	0.064	0.052	1.152	0.051	0.020	
GIR	9.139±	1.579±	BDL	0.982±	1.416±	3.438±	0.601±	1.634±	0.966±	2.185±	0.424±	0.010
	0.197	0.034		0.021	0.031	0.074	0.013	0.035	0.021	0.0471	0.009	
FER	1.571±	1.521±	0.774±	2.689±	35.425±	1.919±	1.176±	1.440±	35.425±	1.595±	5.351±	0.010
	0.034	0.033	0.017	0.058	0.763	0.041	0.0253	0.031	0.763	0.034	0.115	
WR	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.010
SKIR	1.342±	1.525±	BDL	1.837±	1.669±	1.527±	1.180±	2.211±	2.354±	1.102±	1.451±	0.010
	0.029	0.033		0.040	0.036	0.033	0.025	0.048	0.051	0.024	0.031	
HER	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.010
MUR	1.579±	2.085±	0.527±	3.498±	2.174±	0.865±	5.749±	3.215±	1.533±	1.065±	1.269±	0.010
	0.034	0.045	0.011	0.075	0.047	0.019	0.124	0.069	0.033	0.023	0.027	
LER	1.205±	1.731±	BDL	61.572±	11.937±	1.302±	0.842±	1.172±	10.097±	0.792±	0.866±	0.010
	0.026	0.037		1.326	0.257	0.028	0.018	0.025	0.218	0.017	0.019	
LIR	1.222±	2.354±		6.041±	0.524±	2.554±	1.020±	1.407±	6.041±	2.145±	1.257±	0.010

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	0.026	0.051	BDL	0.130	0.011	0.055	0.022	0.030	0.130	0.046	0.027
BRR	BDL	BDL	BDL	BDL	BDL	BDL	1.019±	BDL	BDL	BDL	BDL	0.010

Table 10: Mercury contents in chickens organs dry season

SAMPLE	BG	CTR	DD	JK	KU	SA	SH	RA	PR	NT	STD	
OER	1.532	1.389±	2.882±	2.605±	3.529±	2.130±	5.713±	6.707±	5.909±	2.081±	0.010	
	0.033	0.030	0.062	0.056	0.076	0.046	0.123	0.144	0.127	0.045		
LUR	1.327± 0.029	BDL	2.028± 0.044	5.631± 0.121	1.733± 0.037	BDL	BDL	BDL	BDL	1.889± 0.041	0.010	
BOR	BDL	BDL	BDL	BDL	BDL	2.866± 0.062	2.748± 0.059	2.035± 0.044	2.245± 0.048	1.781± 0.038	0.010	
KIR	2.270±		1.052±	10.998±	1.826±	5.217±	1.782±	16.518±	2.915±	3.281±	0.010	
	0.049	BDL	0.023	0.237	0.039	0.112	0.038	0.356	0.063	0.071		
INTR	2.501±		2.249±	1.336±	3.063±	2.674±	2.215±	9.282±	4.957±	1.798±	0.010	
	0.054	BDL	0.048	0.029	0.066	0.058	0.048	0.200	0.107	0.039		
HR	3.149±		4.122±	3.150±	4.487±	4.005±	3.269±	72.236±	3.174±	1.275±	0.010	
	0.068	BDL	0.089	0.068	0.096	0.086	0.070	1.556	0.068	0.028		
GIR	2.132±		1.326±	1.912±	4.641±	0.811±	2.206±	1.304±	2.949±	0.572±	0.010	
	0.046	BDL	0.029	0.041	0.100	0.018	0.048	0.028	0.064	0.012		
FER	2.05±	1.045±	3.630±	47.823±	2.592±	1.588±	1.944±	47.823±	2.153±	7.223±	0.010	
	0.044	0.023	0.078	1.030	0.056	0.034	0.042	1.030	0.046	0.156		
WR	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.010	
SKIR	2.058±	BDL	2.479±	2.253±	2.061±	1.593±	2.985±	3.178±	1.487±	1.958±	0.010	
	0.044		0.053	0.049	0.044	0.034	0.064	0.068	0.032	0.042		
HER	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.010	
MUR	2.82±	0.711±	4.722±	2.935±	1.167±	7.762±	4.340±	2.069±	1.437±	1.714±	0.010	
	0.061	0.015	0.102	0.063	0.025	0.167	0.094	0.045	0.031	0.037		
LER	2.34±	BDL	83.122±	16.115±	1.758±	1.137±	1.582±	13.631±	1.070±	1.169±	0.010	
	0.050		1.790	0.347	0.038	0.025	0.034	0.294	0.023	0.025		
LIR	3.18±		8.155±	0.707±	3.448±	1.378±	1.899±	8.155±	2.896±	1.697±	0.010	
	0.068	BDL	0.176	0.015	0.074	0.030	0.041	0.177	0.062	0.037		
BRR	BDL	BDL	BDL	BDL	BDL	1.376±0.030	BDL	BDL	BDL	BDL	0.010	

The concentrations observed ranged from BDL (CTR) to 53.508 mg/kg (RA) and from BDL (CTR) to 72.236 mg/kg (RA), respectively. The mercury concentration ranges measured in the gizzard across various sites and seasons (wet and dry) were BDL (CTR) to 9.139 ± 0.197 mg/kg (AJ) and BDL (CTR) to 12.337 mg/kg (AJ), as detailed in Tables 9 to 10, respectively. Additionally, the mercury concentration ranges found in the feathers of the contaminated chickens across the sites and seasons (wet and dry) were 1.045 (CTR) to 47.823 mg/kg (RA) and 0.774 ± 0.017 (CTR) to 35.425 mg/kg (RA), as shown in Tables 9 and 10, respectively.

Mercury was not detected at any of the sites or during any of the seasons, with all recorded concentrations falling below the detection limit, as indicated in the Tables. Likewise, the concentration ranges of mercury found in the skin of the contaminated chickens across the sites and seasons were BDL (CTR) to 2.354 mg/kg (RA) and BDL (CTR) to 3.178 mg/kg (RA), as presented in Tables 9 and 10, respectively. The concentration ranges of mercury in the hearts of the investigated chicken samples across the sites were all below the detection limit and were not detected across the sites and seasons, as reflected in Tables 9 and 10.

The concentration ranges of mercury recorded in the muscles of the contaminated chicken samples across the sites for both wet and dry seasons were 0.527 (CTR) to 5.749 (SH) and 0.711 mg/kg (CTR) to 7.762 mg/kg (SA), respectively, as shown in Tables 9 and 10. The concentration ranges of mercury in the legs of the investigated chicken samples were BDL (CTR) to 61.572 mg/kg (DD) and BDL (CTR) to 83.122 mg/kg (DD), as presented in Tables 9 and 10, respectively.

These results agreed with the work of Udosen et al., (2012). Furthermore, the levels of mercury were examined in the livers of contaminated chickens across various sites, with the recorded ranges during the wet and dry seasons being BDL (CTR) to 6.041 mg/kg (DD) and BDL (CTR) to 8.155 mg/kg (DD, RA), as detailed in Tables 9 and 10, respectively. In addition, the mercury levels found in the brain samples of the contaminated chickens across the sites and seasons ranged from BDL (AJ, BG, CTR, DD, JK, KU, SH, RA, NTC, PR) to 1.019 mg/kg (SA) and from BDL (AJ, BG, CTR, DD, JK, KU, SH, RA, NTC, PR) to 1.376 mg/kg (SA), as shown in Tables 9 and 9. Uboh et al., (2025) and Udosen et al., (2012) had similar view in their findings in the analysis of duck in Unenurhie dumpsite.

IV. CONCLUSION

In summary, the analysis results indicated that the chicken samples were significantly contaminated with Cd, Pb, and Hg. This contamination poses a serious health risk to the local population near these dumpsites, potentially leading to metabolic disorders. The pollution surrounding the dumpsite adversely affects residents through the food chain. It is advisable that the area around the dumpsites be thoroughly treated to mitigate health risks such as kidney damage, cancer, impaired mental development in infants, and toxicity to both the central and peripheral nervous systems associated with the accumulation of mercury, cadmium, and lead. The Kaduna State Environmental Agency (KEPA) should ensure the reduction of hazardous waste generation and provide sufficient waste disposal facilities.

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