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Evaluation of Heavy Metals Found in Vegetables of Some Poultry Farms in Osun State, Nigeria

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ABSTRACT: Heavy metals are persistent in the ecosystem and are held responsible for natural accumulation at all feeding levels. Nevertheless, contact does not occur just because of the availability of a contaminant material in the ecosystem. This present work was aimed at evaluating the contents of heavy metals in vegetables sampled from some poultry farms in Osun State. Five vegetables, namely green vegetable, bitter leaf, gruty-stalked jatropha, scent leaf, and water leaf, were tested for heavy metals, such as arsenic, cadmium, copper, iron, lead, and zinc, using a flame atomic absorption spectrophotometer following wet digestion with HNO_3. Quality assurance techniques included blank testing, recovery testing, and calibration of concentrations. Descriptive statistics were used for data interpretation. The analytical results signified that those heavy metals were detected in all the vegetables from the various sites. Most of the contents are below the Food and Agriculture Organization/World Health Organization safe range in the vegetable section, with the exception of A. Drastic measures should be adopted to avoid the use of such health-toxic contents of metals in poultry feed. So, it was suggested that there should be constant monitoring of poultry sites to control, limit, and stop heavy metal contamination once and for all.

KEYWORDS: Environmental monitoring; health impact; poultry inputs; soil contamination; vegetables; heavy metals.

1. Introduction

Osun State is one of the fastest-growing states in Nigeria, where the level of urban sprawl and industrial development is expanding day after day [1]. These advancements are possible and could cause intense changes in the environment. Aside from several issues related to such developments, the leading one is pollution. Pollutions are of diverse kinds but the most harmful kind of pollution is the contamination of food items. It arises due to unsanitary conditions, factory effluents, vehicular emissions, inadequate urban infrastructure, inadequate wastewater management, untarred roads, the burning of bush and refuse, smoke and gases from industries, the dumping of scraps from old or damaged vehicles on the ground, the expansion of arable land, household wastes, and the application of insecticides and herbicides in crop farming and the poultry sector [2].

Poultry farms are farms that rear domestic fowl (chickens, ducks, turkeys, geese, guinea fowl, quail, and the like) for meat, eggs, and manure production. They are non-ruminants. Earlier, poultry farming entailed rearing chickens in the household yard for daily egg production and family intake. Nevertheless, poultry farming at present is a vast enterprise that is divided into various operations such as feed production and processing, fertility building, organic fertiliser manufacture, hatcheries and poultry factories as meat producers (broilers), or farms as egg producers (layers) [2]. Wastes are generated in all sorts of poultry production. Poultry farms dump large amounts of animal dung and agrochemicals into the environment each year, causing soil, aquatic, vegetation, and atmospheric pollution in the process [1]. Actually, the nutrient status of poultry droppings makes them fascinating as fertilizers, but when untreated wastes are utilised in cropland, consumers pose the risk of being infected with diseases such as cholera and hepatitis or incurring heavy metal contamination. Most food put up for animals is raised utilising a mixture of untreated chicken droppings and inorganic manures, both of which contain excessive quantities of nitrogen, phosphorus, and heavy metals like As, Cd, Cu, Fe, Pb, and Zn. Although most of these materials normally serve as nutrients that enrich crops, commercial farmers use too much of them to foster agricultural goods, and the leftovers that cannot be assimilated into the soil—particularly when it is already waterlogged after heavy showers—end up contaminating the soil while deteriorating its water holding capacity and fertility with time [1].

Vegetables are one of the essential nutritional diet components for human growth and development.It contains protein and vitamins, along with other essential minerals that have pronounced health impacts. It should be clean and safe from all toxic metals like As, Cd, Pb, and Hg. Vegetables consumed communally are sold in poultry farms, open markets, and even on road sides, and thereby various heavy metals get into vegetables and other food items and finally get into the human body, causing deadly diseases [1]. Contamination of food items via heavy metals has become a concern for producers and end users. The major sources of heavy metals to vegetable crops are their cultivation media (soil, air and the like emissions into the ecosystem**,** water, nutrient solutions) from which these heavy metals are picking up by the edible or nonedible parts. The dangers and negative effects of heavy metals become apparent only after prolonged consumption of contaminated vegetables.Continuous monitoring of heavy metals in vegetables and similar food products should be done with a view to control extreme accumulation of these heavy metals at the human feeding level [2]. Vegetables can take up and build up heavy metals in amounts extreme enough to pose a threat to humans. The daily metal intake estimate does not take into consideration the likely metabolic ejection of the metals but can readily reveal the potential ingestion rate of a specific metal. Dietary intake of food causes long-term low-content body buildup of heavy metals, and the adverse effect becomes manifest just after many years of contact [1]. There is growing evidence that micronutrient uptake has a significant impact on toxicity and carcinogenicity due to several chemicals. As a result, people's diets deficient in micronutrients are vulnerable to toxicity from inessential metals.There is a strong association between the nutritional state of the organisms and the level of buildup and the toxicity of heavy metals [2]. Food contamination with heavy metals is a major concern that has been identified in the majority of the world's nations.The study was carried out to assess selected heavy metals in edible vegetables, as the majority of these agents are ingested.

Population contact with toxic metals is an additional issue by virtue of their indestructible properties. There is little data and very little work has been carried out to evaluate the impact of heavy metals on vegetables grown around some poultry farms in these regions and in Nigeria at large. This study is one of the attempts to assess the buildup of heavy metals via food and will give support to refocus people's attention on the safety of food items from all these pollutants.

Data from the literature indicates that most of the previous works on food product quality in the study sites of Ejigbo, Isundunrin, and Osogbo expressed primarily the effects of leachate from domestic open heap dunghills with some or no association with other in-situ hygiene conditions, especially the impact of in-field poultry waste disposal grounds. A good number of the revised works focused just on physiochemical parameters using some croplands, whereas this current study utilised cross-sectional data and has in-depth analysis on both vegetable and heavy metal variables of arable lands in poultry ecosystems. To that end, this paper deals with the pollution of vegetables in the Nigerian poultry environment, with an emphasis on the diverse sources of contamination of vegetables that are generally consumed by local people in Osun State. The prime importance of the study was to add to the background knowledge on the subject under analysis. Thus, it was expected that this study would add to the available literature on the subject. The findings of this study are useful in the following ways: 1) Provision of data on the suitability factor of vegetable sources for the community from the on-premise chicken farmyards; 2) Provision of pointer data on the influence of the poultry waste dump's nearness to croplands within chosen chicken farmyards; 3) Food item quality problems govern human beings and community health; hence, the more we study and monitor our food items, the better we will be able to identify and control pollution crises. The primary goal of this work is to assess the level of heavy metals in vegetables consumed by residents of these regions who grew them using untreated poultry manure.

2. Materials and Methods

2.1. Description and suitability of the sampling sites.

The analysis was conducted in Osun State, Nigeria. The sampling area entailed Ejigbo, Isundunrin, and Osogbo poultry farms (Figure 1). Osun State covers an area (land mass) of about 14,875 square kilometres and is located between longitudes 04°00‘E and 05°S and latitudes 05°558'N and 08°07'W. It has derived savanna vegetation. The prevailing rocks are sets of gneisses and quartzite [2]. The soil belongs to the class of heavily ferruginous tropic red soils found in basement complex rocks. Due to the dense, humid tree cover in the area, the soils are usually deep and of two types: deep clayey soils formed on underlying smooth hillcrests and upper slopes, and sandier hill wash soils on the lower slopes [3]. The estimated population for 2009, obtained from the 2006 census, is 3, 416,959 [1]. It is fringed by Ogun, Kwara, Oyo, Ondo, and Ekiti States in the south, north, west, and east, respectively. The tropical climate of the state has two largely characterised seasons: the wet or rainy season that starts in March or April and ends in October, and the dry season that lasts between November and March. The temperature ranges from 21.80°C to 31.40°C, and the humidity is moderate. The annual rainfall varies from 125 cm in the northern parts to 200 cm in the southern parts [2]. The main source of livelihood for the people in the state is agriculture, which offers 75% of all employment in the state [2]. The state is highly praised for having environmental factors that foster people in the state to venture into livestock rearing, like poultry, piggery, rabbitry, cane-rat, dairy, goats, sheep, apiculture, snail farming, fishing, and so on [2]. All study areas are slight in heavy industries, but light industries are available, like block factories, the food industry, steel rolling mills, the printing and publishing industry, bookshops, the garment industry, table water factories, soap factories, and feed mill factories. The main sources of heavy metal contamination of vegetables might be agrochemicals, refuse, dust particles from feedmills, exhaust from vehicles, surface runoff from roads, wastewater, decomposition from poultry dung, and irrigation.

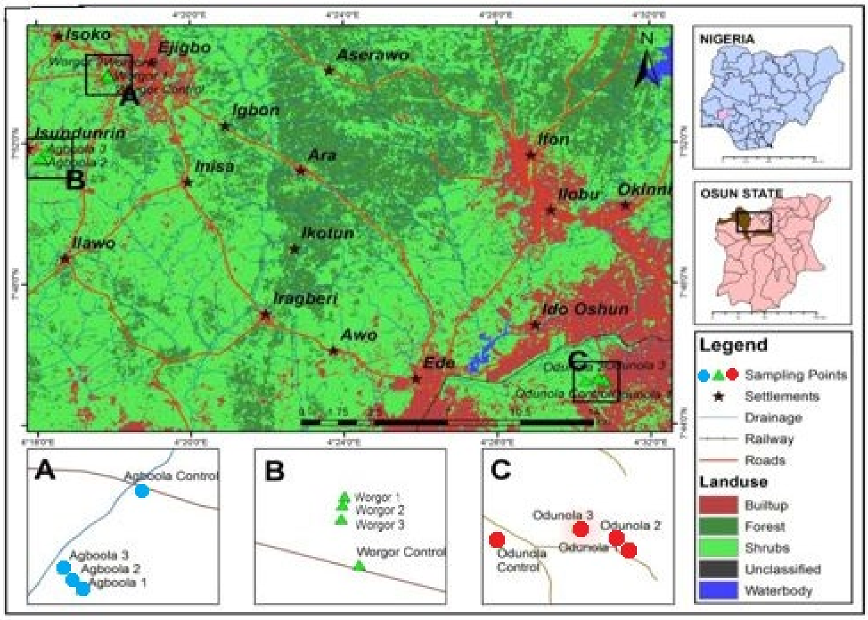

Figure 1. Map of the sampling area showing sample sites.

2.2. Vegetable sampling.

The vegetables used in the present study are green vegetable (*Amaranthus viridis* L. (1763)), gruty-stalked jatropha (*Jatropha podagrica* Hook), scent leaf (*Ocimum gratissimum* L. (1753)), bitter leaf (*Vernonia amygdalina* Delile), and water leaf (*Talinum triangulare* Jacq), which were all collected from designated farmlands in the assessment area (Figure 2). Samples were taken from 3 poultry farms once a month for a period of 4 months (June, July, August, and September 2019).

2.3. Analytical procedure of metal analysis.

Vegetable samples were collected with gloved hands to prevent contamination. In accordance with the guidelines specified by Witting [4] and Markert [5], which were reworked by Ogunwale et al. [2], five vegetable plants, *Amaranthus viridis* L. (1763) (green vegetable), *Jatropha podagrica* Hook (gruty-stalked jatropha), *Ocimum gratissimum* L. (1753) (scent leaf), *Talinum triangulare* Jacq (water leaf), and *Vernonia amygdalinda* Delile (a bitter leaf), were taken by arbitrarily collecting some mature plants dle was gathered from each farm where soil samples were taken. They were packed into a brown envelope each and labelled accordingly for laboratory preparation. Vegetable samples were washed with tap water and distilled water to remove dirt and other particulate matters, and afterwards cut to separate the root, stems, and leaves using a stainless knife after botanical identification. Each bundle was then partitioned to give three triplicate samples weighing about 100 g of fresh mass and air-dried for about two days to avoid biochemical alterations. Prior to assay, fresh vegetable samples were oven-dried to a constant measure at a temperature of 650°C with a view to preventing enzymatic activity. Dried vegetable samples were then pulverised by means of a porcelain mortar, sieved via a 2 mm mesh sieve, and stored in polythene bags in a desiccator until they were used for digestion.

Figure 2. The vegetables used in the present study: Water leaf/Gbure/Yakuwa (*Talinum triangulare*) (A); Gruty-stalked jatropha/Iyanapaja (*Jatropha podagrica*) (B); Bitter leaf/Ewuro/Chusar-doki (*Vernonia amygdalina*) (C); Green vegetable/Efo tete/Zogale (*Amaranthus viridis*) (D); Scent leaf/Efinrin/Daidoya/ Nchanwu (*Ocimum gratissimum*)(E).

In a 100 cm^3 Teflon beaker, 2 g of oven-dried and ground samples of each type of vegetable were weighed in triplicates. This was followed by the addition of 10 cm^3 of mixtures of analytical-grade HNO_3 and $HClO_4$ in the ratio 3:1. The beakers were then enclosed with watch glasses and left overnight. Digestion was performed on a hot plate at a temperature of about 80–90°C in a fume hood until about 4 cm^3 of the mixture was left in the beaker. A further 10 cm^3 of the acid mixture was then included and dried to a volume of about 4 cm^3 while still on the hot plate, giving a clear solution. The solution obtained was cooled to room temperature and quantitatively transferred into a 25-cm^3 volumetric flask, where it was filled up to the desired level using distilled water. These were stored in polyethylene bottles prior to assay. The worked-up samples aforementioned were analysed for their heavy metal contents employing the Flame Atomic Absorption Spectrophotometer (Model: PG 990) present at the

Department of Chemistry and Industrial Chemistry Laboratory, Bowen University, Iwo, Nigeria. The analysis was performed in accordance with the manufacturer's recommendations.

2.4. Quality monitoring adopted.

Suitable quality monitoring techniques and safety measures were conducted to ascertain the validity of the data. All through the study, double-distilled, deionized water was utilised. The glassware was suitably rinsed, and the reagents used were of high quality. To validate the instrument interpretations, reagents-blank tests were used. For substantiation of the analytical method, a recovery analysis was conducted by spiking and homogenising diverse, already-analysed samples with varied quantities of standard solutions of the metals. Despite the fact that FAAS offers possible benefits like analytical specificity, a good detection limit, excellent precision, and a moderately low cost, its calibration is vital to assess the reaction of the analytical method in respect of identified quantities to the standards of the heavy metals of concern so that the reaction to unidentified amounts in the samples can be dependably estimated. For the FAAS 20, 17.5, 15, 12.5, 10, and 5 g/mL contents of each metal solution, newly prepared by serial dilution for the quantification of metals in vegetable samples, these solutions were run on the FAAS to procure the working calibration graph, which was utilised to evaluate the levels of heavy metals in the samples by automatic interpolation with the calibration graph. The coefficient of variation of replicate analyses was used to compute analytical precision for the measurements.

2.5. Chemicals utilized and their provenances.

All the chemicals utilized, namely nitric acid (HNO_3), (Riedel-deHaen, Germany), hydrochloric acid (HCl), (Sigma-Aldrich, Germany), hydrofluoric acid (HF), (British Drug House, BDH, Chemical Ltd, Poole, England), sulphuric acid (H_2SO_4), (Sigma-Aldrich, Germany), perchloric acid ($HClO_4$), (Sigma-Aldrich, Germany), acetic acid (HOAc), (Sigma-Aldrich, Germany), and doubly distilled water, were all of high quality. These were utilized to formulate standard solutions.

2.6. Data interpretation.

Normal statistical studies such as mean, minimum, maximum, standard deviation (SD), coefficient of variation (CV), and one-way ANOVA were used to gain an understanding of the comportment of the heavy metal findings. These studies were carried out using the Paleontological Statistics Software Package (PAST) version 2.17 to determine correlation as well as differences in the content between various variables.

3. Results and Discussion

3.1. Heavy metal content in the vegetables harvested at the three sampling locations.

The evaluation of heavy metal content in vegetables was conducted employing the flame atomic absorption spectrophotometer (FAAS) method. The results of the recovery test affirmed that the results of the analytical methods were suitable, with percentage (%) recoveries ranging from 87.05 for Cu^{2+} to 98.30 for Zn^{2+}. The result of heavy metal content in vegetable samples detected in the sampling area is presented in Table 1. Although the content varies from one sample to another, most of the content is below the FAO/WHO [6] safe range. Heavy metal content revealed differences among different vegetables sampled from Agboola, Odunola, and Worgor sites (Table 1).

Table 1. Mean results of heavy metals contents of vegetables from Agboola, Odunola and Worgor poultry farms, Osun State (mg/kg).

Sampling location	**Metal (mg/kg)**					
	As	Cd	Cu	Fe	Pb	Zn
			Bitter leaf			
Agboola	20.12	0.32	6.70	35.10	1.36	28.63
Odunola	16.70	0.60	8.90	42.30	1.28	36.50
Worgor	18.20	0.65	13.50	38.40	1.80	44.70
Mean±Sd	18.34±1.40	0.52±0.08	9.70±0.83	39.60±1.91	1.48±0.22	36.61±1.56
			Green vegetable			
Agboola	31.04	0.63	4.73	20.50	1.20	25.55
Odunola	43.06	0.78	8.56	26.70	1.60	31.60
Worgor	49.50	0.82	16.20	33.10	2.20	38.30
Mean±Sd	41.20±2.65	0.74±0.06	9.83±0.86	26.77±1.40	1.67±0.28	31.82±1.52
			Jatropha			
Agboola	26.95	0.33	7.80	18.60	0.40	28.80
Odunola	30.80	0.42	9.60	22.10	0.69	35.70
Worgor	32.40	0.57	12.70	29.40	0.64	44.10
Mean±Sd	30.05±1.48	0.44±0.03	10.03±0.88	23.37±1.35	0.58±0.06	36.20±1.60
			Scent leaf			
Agboola	16.60	0.93	3.50	41.05	0.83	45.10
Odunola	30.10	1.10	6.40	32.02	0.60	38.20
Worgor	27.30	0.88	10.20	37.10	1.65	42.40
Mean±Sd	24.67±1.43	0.97±0.08	6.70±0.74	36.72±1.82	1.03±0.09	41.90±1.90
			Water leaf			
Agboola	33.30	0.52	5.50	32.20	0.63	41.20
Odunola	38.40	0.44	8.60	39.50	0.70	48.30
Worgor	43.60	0.61	11.20	44.60	0.84	55.60
Mean±Sd	38.43±1.73	0.52±0.06	8.43±0.84	38.77±1.86	0.72±0.05	48.37±2.87
FAO/WHO, Safe range	5.00	1.50	40	48	2.50	60

Variations in heavy metal content in vegetables grown in the same location may be attributed to differences in their morphology and physiology for heavy metal absorption, acceptance, buildup, and reservation [2]. Also, the content of all the heavy metals studied differs from one site to the next. Vegetables varied in their power to build up and absorb elements in their edible portions; variations between them were considerable, which was well agreed with in the investigations conducted by Ogunwale et al. [2]. The differences in heavy metal contents in vegetables were a result of differences in their assimilation and accumulation trends. The absorption and biological accumulation of heavy metals in vegetables are governed by several factors, like climate, atmospheric fallouts, the contents of heavy metals in soils, the characteristics of soil, and the maturity level of the plants at the time of the sampling [2]. The range and mean value of heavy metals (mg/kg) in leafy vegetables were revealed in Table 1, respectively. In vegetables (bitter leaf, green vegetable, jatropha, scent leaf, and water leaf), the content of heavy metals (mg/kg) varied between 16.60 and 49.50 for As, 0.32-1.10 for Cd, 3.50 and 16.20 for Cu, 18.60 and 44.60 for Fe, and 0.40 and 2.20 for Pb.

The maximum As content of green vegetables (49.50 mg/kg) was this fold higher than the PFA (Prevention of Food Adulteration) safe range [7]. The overall mean AS values in vegetables were from 18.34 to 41.20 mg/kg, which was below the result signified by vegetables in Titagarh, West Bengal, India, by Gupta et al. [8]. Nevertheless, it was higher than the results of Sharma et al. [9] (1.81–7.57 mg/kg) in Varanasi, India, and Rattan et al. (8.78–21.50 mg/kg) in Delhi, India [10]. The value of As is higher than the FAO/WHO safe range of 5 mg kg1 in all the samples from Agboola, Odunola, and Worgor [6]. As levels in a given leafy vegetable may be elevated due to contamination in irrigation water, soil, or poultry farm activities, as well as automobile emissions, because As is used in poultry feed as a feed preservative for illness prevention, an increase in body size, feed conversion, and increased egg production [1,2].Pesticides are the prime sources of As in arable soils. Several instances of the contamination of arable soils as a result of arsenic-containing pesticides have been indicated. From the recent 1800s until the discovery of dichlorodiphenyltrichloroethane (DDT), lead arsenate ($PbAsO_4$), calcium arsenate ($CaAsO_4$), magnesium arsenate ($MgAsO_4$), zinc arsenate ($ZnAsO_4$), and Paris green ($Cu(CH_3COO)_2*3Cu(AsO_2)_2$) were commonly used as pesticides in farming. Soil pollution through pesticides has been widely recognised by Ogunwale et al. [3].

With the advent of organochlorine pesticides, there has been a change from inorganic to organic pesticides (monosodium methylarsonate (MSMA), disodium methylarsonate (DSMA), dimethylarsinic acid (cacodylic acid), and arsenic acid). Owing to the important role of As in animal nutrition, organic arsenicals perform an essential role as food additives to support the growth of livestock animals [1,2]. It was usually utilised in the pharmaceutical industry as an additive in some drugs. Additionally, they are utilised as desiccants and insecticides in the cotton industry and for weed prevention [3]. Despite extensive debate, arsenic acid is still used as a constituent in the microprocessor chip industry and glass factories, similar to creosotes and dopant gas, and sodium arsenite solutions are used for debarking trees, poultry, cattle, and sheep dips, and aquatic weed prevention [1,2,3]. The introduction of As into the feeding level may result in a variety of clinical effects, including inflammatory bowel disease and decreased erythrocyte and leukocyte formation.It may also increase the chances of having burning sensations in your hands, feet, and skin, cardiovascular damage, fatigue, and an increased risk of lung, kidney, bladder, liver, lymphatic, and prostate cancer [3]. It is also linked to female infertility and miscarriage.Thus, investigations about the assimilation of vegetables have greater significance.

The highest uptake of Cd was observed in scent leaf (0.97 mg/kg), followed by this green vegetable (0.74 mg/kg), water leaf (0.53 mg/kg), bitter leaf (0.52 mg/kg), and jatropha (0.44 mg/kg), which was less than the WHO/FAO safe limit. This work revealed that the overall mean Cd value (0.97 mg/kg) analysed in vegetables from some poultry farms in Osun metropolis was less than that of vegetables from Titagarh, West Bengal, India (10.37–17.79 mg/kg) [8] and vegetables from Turkey (25.00 mg/kg) [11]. Moreover, our result was similar to the results of Sharma et al. (0.5–4.36 mg/kg) in vegetables coming from Varanasi, India [12]. Cadmium has wide applications in the synthesis of NiCad batteries or that of colourants and stabilisers for polyvinyl chloride (PVC); in the metallurgic and electronic industries, it is one of the most constantly listed metallic contaminants. It enters the environment through emissions from metal refining operations or the use of phosphate fertilizers, manure, and pesticides on arable land.Detergents, disinfectants, and oil commodities may also add to its distribution as an ecological contaminant. Individuals vulnerable to CD can contract endometriosis, lethargy, eosinophilic leukocytosis, arteriosclerosis, and renal tubular failure. In humans, prolonged contact with Cd toxicity can lead to renal malfunction, restrictive lung disease, and Itai-Itai disease, where individuals have desalinization of the bone ruptures, acute pain, albuminuria, extreme rickets, and bone disease [1]. In this assessment, "Cd content" means "low," indicating that the Cd concentration is below the safe level.

The overall mean Cu content in vegetables (6.70, 8.43, 9.70, 9.83, and 10.03 mg/kg) was less than the finding indicated in Titagarh, West Bengal, India (15.66–34.49 mg/kg) [8] and likewise less than the Cu content in vegetables (61.20 mg/kg) originating from Zhengzhou, China [13]. Nonetheless, the variation in Cu level in vegetables in the current study was strongly supported by all findings (5.21-18.2 mg/kg) of Arora et al. [14] and was similarly supported by the contents in Varanasi, India (10.95-28.58 mg/kg) of Sharma et al. [15]. Maximal Cu content (16.20 mg/kg) was observed in leaf vegetables, whereas the overall mean content was 6.70, 8.43, 9.70, 9.83, and 10.03 mg/kg, which was less than the mean levels of 32.74 mg/kg and 36.41 mg/kg, respectively, as indicated by Sharma et al. in Varanasi, India, of the similar vegetables [9]. Furthermore, Cu levels in vegetables revealed positive concord, with the major values for leafy greens (15.50–8.51 mg/kg) coming from Samata Village, Jessor, Bangladesh, observed through Alam et al. [16]. The concentration of Cu detected in vegetables in this paper indicates less accumulation of heavy metals in plants harvested in chicken farm regions of Osun, which was lower than that of the previously mentioned researchers. Copper is an indispensable trace element for the human system and is an essential constituent of several enzyme systems; nevertheless, a few disease-causing properties are ascribed to this element. Copper is an indispensable substance to living creatures as it is involved in the uptake, depository, and anabolism of Fe, but at elevated concentrations it can lead to ischemia, hepatic, and renal failures, as well as gut and alimentary sensation. The sources of Cu entry into the human system are drinking water from Cu pipes, the utilisation of brass cooking utensils, agrochemicals, and decomposition from poultry dung and irrigation. The Cu content observed in this study indicated a positive value and was found to be less than the FAO and WHO safe range for the entire sampling [6].

The overall mean Fe value had been between 23.37 and 38.77 mg/kg for each vegetable that had been suitable for the contents (111-378 mg/kg) obtained in vegetables by Arora et al. [14]. The highest content of Fe was in bitter leaf (39.60 mg/kg), followed in order by water leaf (38.77 mg/kg), scent leaf (36.72 mg/kg), green vegetables (26.77 mg/kg), and jatropha (23.37 mg/kg), whereas the contents of Fe in all the vegetables were below the prescribed safe range of WHO/FAO [6]. According to the diversity of heavy metals in the vegetables sampled, iron was found to be the second-most abundant metal.Iron is essential for most living things, partaking in a wider range of metabolic activities like oxygen transport, nucleic acid synthesis, and neutron transport. It denotes that adequate Fe in a nutrient is critical for lowering the incidence of anemia.Your body can normally concentrate Fe; however, high Fe levels in the body have been linked to heart disease, cancer, diabetes, and other diseases.Dietary factors, such as the intake of iron-containing supplements, were considerable risk factors. In this assessment, Fe content is moderate to high in the bitter leaf sample. The Fe found is below the safe range, but continued exposure will have negative effects on humans, animals, and plants.

The highest content of Pb was demonstrated by green vegetables (1.67 mg/kg), and after that, bitter leaf (1.48 mg kg1), which was lower than the permissible safe range of the FAO and WHO for Pb by three folds, respectively. Lead values in eatable portions of all the vegetables analysed in this paper had been lower than the acceptable ranges set by WHO/FAO [7]. The overall mean Pb value in vegetables (0.58, 0.72, 1.03, 1.48, and 1.48 mg/kg) was lower than the contents observed in Titagarh, West Bengal (21.59-57.63 mg/kg) [8], as well as moderately lower than the Pb levels observed in China (0.18-7.75 mg/kg) [17], and Varansi, India (3.09-15.74 mg/kg) [9]. Also, it was also considerably below the mean content of Pb (409 mg/kg) noted in vegetables coming from Turkey via Turkdogan et al. [11]. The findings of this study indicated that the levels of Pb in the vegetable samples were acceptable. The Pb content in all vegetable samples was good, indicating that the Pb content is too low to be harmful. Lead is a harmful heavy metal and can induce extreme clinical hazards like stomachache, hypersensitivities, congestive heart failure, dejection, renal disruption, and so on.

The maximum mean content of Zn was observed in water leaf (48.38 mg/kg), followed by scent leaf (41.90 mg/kg), bitter leaf (36.61 mg/kg), jatropha (36.20 mg/kg), and green vegetables (31.82 mg/kg). Worgor farm produced the most content, while Agboola farm produced the least.The overall mean content of Zn in vegetables of a few chicken farmlands in Osun State was very related to the vegetables coming from Beijing, China (32.01-69.26 mg/kg) [17], as well as from Rajasthan, India (21.10-46.40 mg/kg) [16], but considerably less than the Zn values (3.00-171.03 mg/kg) in vegetables out of Titagarh, India [9], Harare, Zimbabwe (1,038-1,872 mg/kg) [18], and also the vegetables of Varanasi [15] and Delhi, India (31.9] [10]. Zinc is needed for protein substrates that take part in body microphoning activities and also as a stimulant for transducing agents accountable for controlling chromosomal characteristics. Zinc performs an essential function in the body's defences and is an inhibitor in a living organism [1,2]. Zinc inadequacy can disrupt zinc upkeep in the physical body. The health implications of Zn inadequacy in human beings are intestinal disorders, vomiting, stomach pains, growth restriction, neuropsychiatric disorders, eczema, hair loss, looseness of the bowels, high exposure to illnesses, and anorexia [1]. Zinc content is within the safe range. So it seems that the content of Zn in this assessment of vegetable samples was within the safe limit.

The medium-fold maximum contents of all the heavy metals had been obtained in all the vegetables except for As. The dumping of poultry litters on cropland repeatedly all year without an appropriate treatment strategy might enhance the intake and accumulation of heavy metals in the plants. The variation in the content of heavy metals in vegetable samples may be due to the degree of contamination, animal feeds, butchering places, feed additives, and antibiotics. This is in good agreement with accounts of moderate levels of heavy metals in vegetables from chicken farm sites, as compared to the agricultural soil of poultry sites treated with poultry dumps. Table 1 shows that among heavy metals, Zn was the most concentrated in the vegetable elements, followed by Fe, As, Cu, and Pb in that order, and Cd was the least concentrated.Related findings had been observed by Abou Audu et al. [19], who investigated the accumulation of heavy metals (Fe, Zn, Pb, and Cd) on crops in the Gaza Strip. Zhang et al. [20] discovered similar results, stating that the highest content was Zn, followed by Cu, Cr, Ni, Pb, and Cd for two crops (*Cyperus malaccensis* and *Scirpus triqueter*).The findings indicated that the metal content in water leaf was greater than that of green vegetables, scent leaves, bitter leaves, and Jatropha*.* Water leaf represented a greater ability than the others to concentrate these metals out of soils.The variation in the content of heavy metal pollution among various vegetables is a result of their morpho-physiological variations in relation to heavy metal level, acceptance, buildup, growth deposit, and reservation productivity. The level of metal intake by the vegetables could have been influenced by more conditions like vegetable stage, types of vegetables, life cycles of vegetable species, soil condition, biotic condition, and climate, and this in sequence would influence the value of heavy metal reported. Differences in translocation content may also have contributed to variations in metal accumulation via various vegetables, resulting in diverse metal values [2].

The data taken were also analysed with one-way analysis of variance (ANOVA) to determine whether heavy metals varied considerably between the site and vegetables from the farm; probabilities below 0.05 ($p < 0.05$) were regarded as significant differences. From the statistical data obtained, all the heavy metals across the study locations and vegetables revealed that there were no statistical differences in the metal occurrence at $p < 0.05$, which indicates that there is an insignificant relationship between the overall means of As, Cd, Cu, Fe, Pb, and Zn in the chicken farm vegetables of the study region at the 95% possibility level $\{F_{calculated}$ $(0.72) < F_{tabulated}$ $(2.21)\}$. This strongly indicates that the six chemical species may have originated from an identical source.

The insignificant ANOVA could most likely be due to the heterogeneous nature of the sources of contamination, like open dumpsites of bird faeces and wastes, which can add to the soil's metal contents, which is a general practise in several poultry industries in Osun State. Also, the insignificant ANOVA could be pertinent to the texture and source of the soil parent substance [2]. We can also conclude that the operations carried out on those farms were related, and that the effects of external forces such as vehicular emissions were minimal. Several of the heavy metals that arose from the biota were the products of the local ecosystem that is going on within the farm (Table 2).

Table 2. Analysis of variance of total metal determination.

Source of variation	**DF**	**Sum of Squares**	**Mean Sum**	**F_{ratio}**	**$F_{critical}$**
Treatment	5	544,696.17	4447.96	0.72	2.21
Error	84	522,456.38	6219.72		
Total	89				

4. Conclusion

The paper evaluated the heavy metal content of the vegetables grown in the poultry farmyard area of Osun State, Nigeria. This research discovered that the vegetables being studied may cause clinical problems to those who consume them because they were found to be low in essential minerals and high in toxic heavy metals, despite the fact that the residents were unaware of the health risks posed by the poultry farmyard establishment. Due to this, the ministries of Public Health and Sanitation and Agriculture and the Environment ought to design health education courses for the common people on the threats of intake of food items cultivated in and nearby the poultry farmyard plots with untreated manure. The study likewise affirmed the suitability of bitter leaf, green vegetable, jatropha, scent leaf, and water leaf as great biological indicators of environmental pollutants, with water leaf distinguished as the most outstanding phytoremediator of the five plant species. A longitudinal study is, therefore, needed to fathom the impact of poultry manure on vegetable status in Nigerian soils. This is the first such assessment carried out in Osun State to assess the impacts of chicken manure utilisation on vegetable production ecosystems and farm output. Further studies on biological experiments of people residing and working in the poultry farm are supposed to be considered for assay, and specimens of the air, soil, and water provenances in this survey area should also be assayed, along with other crops like cereals, legumes, roots and tubers, fruits, spices, and oil grown within the poultry farm should be analysed to evaluate heavy metal contents and relate to the previous pollution studies. The government of Nigeria should task and resource researchers to enact the safe ranges for heavy metal values in vegetable crops, while steps should be taken to diminish heavy metal contamination and fertility loading of poultry manure and vegetables to preserve the safety of both growers and end users. The study provided information on the level of chicken manure utilisation on vegetable production ecosystems on farm output to quantify the environmental health of the sampling area. The paper had likewise contributed to the baseline information on heavy metals in our environment.

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Competing Interest

The authors declare that they have no competing interests.

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