



An Evaluation of the Presence of Heavy Metals in the Poultry Feeds Marketed in Ijebu Jesa, Osun State

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

One of the most crucial areas of agriculture is poultry production, with commercial layers and broilers making a significant contribution to supplying the rising need for protein from the growing population through eggs and meats. It's crucial that hens have enough of certain necessary metals like copper (Cu), zinc (Zn), and manganese (Mn) in their meals. We examined the levels of cadmium (Cd), cobalt (Co), copper (Cu), iron (Fe), manganese (Mn), nickel (Ni), lead (Pb), chromium (Cr), and zinc (Zn) in four brands of two commercial feeds (Animal care and Top feeds) that are often used by chicken farmers in Osun state. The meals were bought at Ijebu-Jesa, Osun State, from several retail establishments. Atomic Absorption Spectrometer (AAS) analysis was done after the feeds had been ashed, digested, and examined for metal contamination. The concentration of the key components was consistently lowest in starting feed. The feed had

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relatively little of the necessary components (copper, zinc, iron, and manganese). Because of this, the projected nutritional values of the feed based on the concentrations of the necessary components were extremely low. This demonstrates that supplements were not provided to the diets as was reasonable to expect. The feed samples, however, had very high levels of lead. Anthropogenic sources of lead contamination in the environment, particularly fossil fuels, may be to blame for this. Adoption of alternative renewable energy sources like biodiesel and bioethanol is highly necessary.

Keywords: Poultry; grower; heavy metals; chicken feeds; contamination.

1. INTRODUCTION

Poultry is a group of household birds kept by humans for the intention of keeping their eggs, or killing them for meat. Chicken is the second most widely known meat eaten by majority of people in the world, accounting for about 30% of meat production worldwide, after beef at 38% (Bukar and Saeed, 2014). Poultry is known to be a source of economic growth and major way by which portentous food is been obtained (Mahesar et al., 2010). Feed in poultry farming is a food for farm poultry, including chickens, ducks, geese and other household birds that support their growth and development. Feed made available for poultry birds mostly consists of grains, protein supplements such as soybean oil meal, mineral supplements and vitamin supplements (Mark, 2008).

Zinc is a chemical and essential element needed by your body in small quantity for growth of cells, building proteins and supporting healthy immune system. Without enough zinc in the diet, there could be loss of appetite, decreased immune function, slow wound healing, and skin sores. Human diets with too little manganese can lead to slowed blood clotting, skin problems, lowered cholesterol levels, and other alterations in metabolism. Eating too little manganese can affect the normal growth, bone formation, and reproduction of poultry birds. Copper is an essential element for all known living organisms including humans and other animals which requires low levels of consumption. Moreover, exposure to higher quantity can cause harmful effects to the birds. Exposure to copper dust for long period can lead to irritation of your nose, mouth, and eyes, and cause headaches, dizziness, nausea, and diarrhea [1]. Exposure to high level of Lead has been attributed to elevated blood pressure and hypertension (Martin 2006). Toxic chemical present in Cadmium toxicity has linkage with prostate cancer and cancer in liver, kidney and stomach. It has been documented by Berge and Skyberg, that exposure to nickel has the most serious harmful health effects ranging

from reduced lung function, and cancer of the lung respiratory tract irritation and asthma. Excess cobalt in the body causes harmful effects in the body such as trouble breathing, serious effects on the lungs, asthma and skin rashes [2].

Chicken is a popular known meat and great sources of protein food for the south east population especially in IjebuJesa, Osun state, where there are several poultry farms and a thriving market, chickens are one of the primary sources of nourishment for the people in the southeast. The feed that the hens eat may be hazardous and thus harmful to the health of the human population that eats the chickens. The nutrient composition of the feeds used by hens in the nation and any potential nutrient contamination of the feeds are not well known. The south west has not been covered at this time by any work. In order to find out how much zinc, iron, manganese, copper, lead, cadmium, nickel, and cobalt are present in chicken diets sourced from the southwest of Nigeria, this study was conducted.

Environmental contamination and pollution with heavy metals, has taken a global dimension. Heavy metals have been reported in water; soil; food and even in the atmosphere at varying concentrations: at trace and /or toxic levels, in different parts of the world. All meals include heavy metals since they are a natural or ingrained part of plant and animal tissues and fluid along the food chain cycles. They can also be present due to contamination or intentional inclusion. The atomic structure of nickel, a transition metal, is strikingly similar to that of cobalt. Nickel has been found in broilers' liver, kidney, and muscle, despite the fact that it is not typically added to chicken diets [3].

Evidence of nickel deficiency in chicks has been observed (NAS, 1980), and dietary nickel levels of 0.1 to 0.3 parts/106 or g/ml dry weight are regarded sufficient in chicken diets [4].

The health of people and animals is at risk due to the pervasiveness of heavy metals and their ongoing release from man-made sources into aquatic and terrestrial ecosystems [5,6]. They are potentially harmful because they are stored more quickly than they are eliminated and have the ability to bioaccumulate and biomagnify when discovered in live tissue [7]. According to research by Falandysz et al. [8], growing urbanization, industrialisation, and agricultural activity all release heavy metals into the environment. Due to villagers' indiscriminate mining, there was a case of heavy metal poisoning in Zamfara State, Nigeria, at the beginning of 2010 (WWPPR, 2010).

Toxic metals are potential environmental contaminants that can have a negative impact on human health in poultry farms that raise only humane chickens. Numerous studies have demonstrated the detrimental effects of ingredients used in poultry feed, such as small grains (wheat, rice, and feed), on the body. When heavy metals from the poultry industry's blood are deposited in the bodies of animals, broken pulses and other vitamins) and heavy broilers are the result of their excessive usage in poultry feed. Poultry feed is a mixture of foodstuffs and pre-mixers had greater concentrations of these hazardous metals.

Cadmium, zinc, copper, lead, chromium, nickel, barium, and other heavy metals are combined to make pre-mixers, which are produced locally and on demand. The poultry experiment included cobalt, strontium, titanium, mercury, and silver, although its amounts were unknown. High quantities of these heavy metals were found in samples of broiler feed (food + pre-mixers), which were also obtained from the National Hygienic Standards along with muscle, liver, and skin tissue. From each chicken farm, samples of litter with similar quantities of aluminum and arsenic were taken. Therefore, the water and feed that the birds ingest may contaminate poultry products with heavy metals. Determining if heavy metal contamination of chicken feeds is a possibility is the purpose of the current investigation.

2. MATERIALS AND METHODS

2.1 Study Area

The research study was carried-out in Ijebu-jesa which is capital of Oriade Local Government area in Osun State of Nigeria. It is a city where people come from different area to work. The road is

connected to different state which include Ekiti and Ondo State. The town also has linkage with a famous town called Ilesa. It is also surrounded with Iwoye-jesa, Iloko-jesa, Ere and Ijeda towns. In the year past, Ijebu-jesa was formally known and called Ijebu Egboro according to history. The town is sited eight kilometers north of Ilesa and about 128 kilometers east of Ibadan. It is situated approximately on latitude 7.45 degrees north within the rain forest belt and so provides opportunity for farmer to produce on a large scale. The community is inhabited by core Ijesa and is noted for their dogged industry.

2.2 Sample Collection

Four brands (Starter, Grower, Layer and Finisher) of two feeds (Animal care and Vital feed) sold commercially, were purchased from different location in Ijebu-Jesa.

2.3 Sample Preparation

Dried sample weighed 2.0g was placed in crucibles. Conc. nitric acid (1cm³) was added as ashing aid and then pre-ashed by placing the crucible on a heater until the content charred. The pre-ashed samples were then transferred into a muffle furnace at a temperature of 480oC for 2-3hrs until a constant weight is obtained, after which they were allowed to cool. The cooled samples were dissolved using 5cm³ of 30% HCl and then filtered using Whatman filter papers. The filtrates were individually poured into 50cm³ volumetric flask and made up to the mark with deionized water. The sample solution was then kept in sample bottles for further analysis [2].

2.4 Sample Analysis

Each brand of the same feed sample obtained from different locations, mixed, homogenized thoroughly, and 1g each of chick mash, growers mash, layers mash, broiler starter and broiler finisher was weighed using Mettler weighing balance. Each sample was then transferred into a 50ml Kjeldahl digestion flask, 10ml of concentrated nitric acid were added and then 2ml of perchloric acid were also added. The content was swirled gently and digested at about 3700 C heat first in a digestion block. Increasing the heat slowly to about 4500 C for 15min, after the appearance of white fumes, the digested samples were allowed to cool. The samples were dissolved using 10ml of distilled water and then filtered using Whatman filter papers. The filtrates

were poured individually into 50ml prewashed sample bottles; the samples were analyzed using Atomic Absorption Spectrophotometry (AAS).

3. RESULTS AND DISCUSSION

The Standard Organization of Nigeria (SON) gave requirements for some heavy metals (copper, iron, zinc and manganese mentioned as micro nutrients) in poultry feeds though they did not provide standards in terms of maximum acceptable limits for heavy metals in the feed.

Analysis of zinc metal in starter, grower and finisher feed of both samples (Animal care and vital feed) products were below the recommended concentrations of 40 -50 mg/kg (Table 1). Concentration of zinc in feeds for layer birds in both samples was above the recommended limits of 30-40 mg/kg by SON. These values however were below the values of 54.3 - 482.2 mg/kg by Mahesar et al., (2010) and within the range of 33.945-49.950 mg/kg obtained by Okoye et al. [2] in their analysis of poultry feeds.

Cadmium concentrations for both feeds in all the samples analysed exceed the permissible limit of 1 mg/kg of FAO/WHO.

Lead concentration level in all the samples for both feeds ranged from 0.27 ± 0.06 to 0.80 ± 0.01 . These levels were compared with the levels obtained by Okoye et al. [2] and Mahesar et al. (2010) and were found to be lower than the limits (Table 1). The values were also lower than the maximum acceptable limits of 5mg/kg of FAO/WHO.

Chromium concentrations in the feeds ranged from 0.47 ± 0.01 mg/kg to 1.42 ± 0.01 mg/kg. These values were above the maximum acceptable limits of 0.3 mg/kg in feeds (Act No 21, NRC, 2006). Nickel concentration in the feeds ranged from 1.37 ± 0.01 mg/kg to 2.06 ± 0.01 and were found to be below the maximum acceptable limits of 4.05 mg/kg (Act No 21, NRC, 2006). Also, the concentrations were found to be lower than 2.250-4.875 mg/kg obtained by Okoye et al. [2].

Iron concentrations in the feed ranged from 8.79 ± 0.06 to 13.32 ± 0.06 . These values were below the permissible level of 45-80 mg/kg as specified by FAO and 90-95 mg/kg as specified by SON for starter, grower and finisher. Feeds for layers had iron concentration of 10.96 ± 0.01 , a level much lower than 50-60 mg/kg stipulated for layer feed by SON.

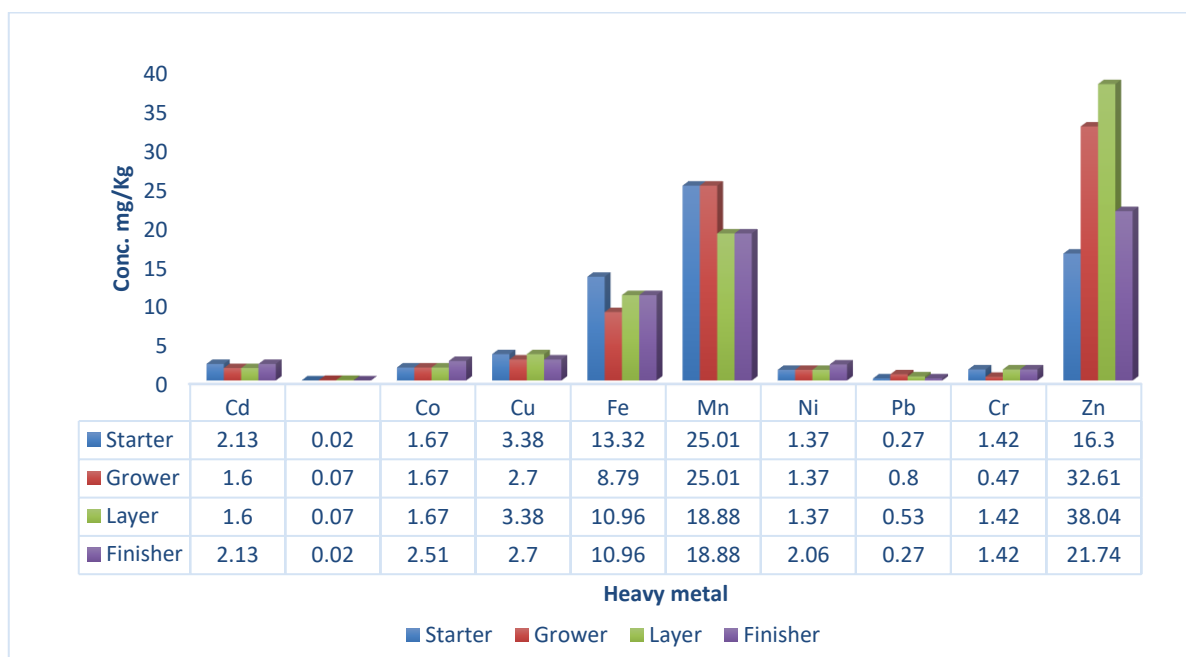


Chart 1. Animal feed samples A

Table 1. Heavy Metals of analysis of animal Feed sample B (Vital feed)

Sample	Cd	Co	Cu	Fe	Mn	Ni	Pb	Cr	Zn
Starter	2.13±0.02	1.67±0.01	3.38±0.01	13.32±0.06	25.01±0.01	1.37±0.01	0.27±0.06	1.42±0.01	16.30±0.01
Grower	1.60±0.07	1.67±0.01	2.70±0.01	08.79±0.06	25.01±0.01	1.37±0.01	0.80±0.01	0.47±0.01	32.61±0.05
Layer	1.60±0.07	1.67±0.01	3.38±0.01	10.96±0.01	18.88±0.06	1.37±0.01	0.53±0.06	1.42±0.01	38.04±0.06
Finisher	2.13±0.02	2.51±0.12	2.70±0.01	10.96±0.01	18.88±0.06	2.06±0.01	0.27±0.06	1.42±0.01	21.74±0.01

Concentration of Heavy Metals in animal feed was presented in (mg/kg)

Table 2. Heavy Metals of analysis of animal Feed sample B (Vital feed)

Sample	Cd	Co	Cu	Fe	Mn	Ni	Pb	Cr	Zn
Starter	2.13±0.02	1.67±0.01	3.38±0.01	13.32±0.06	25.01±0.01	1.37±0.01	0.27±0.06	1.42±0.01	16.30±0.01
Grower	1.60±0.07	1.67±0.01	2.70±0.01	08.79±0.06	25.01±0.01	1.37±0.01	0.80±0.01	0.47±0.01	32.61±0.05
Layer	1.60±0.07	1.67±0.01	3.38±0.01	10.96±0.01	18.88±0.06	1.37±0.01	0.53±0.06	1.42±0.01	38.04±0.06
Finisher	2.13±0.02	2.51±0.12	2.70±0.01	10.96±0.01	18.88±0.06	2.06±0.01	0.27±0.06	1.42±0.01	21.74±0.01

Concentration of Heavy Metals in animal feed was presented in (mg/kg)

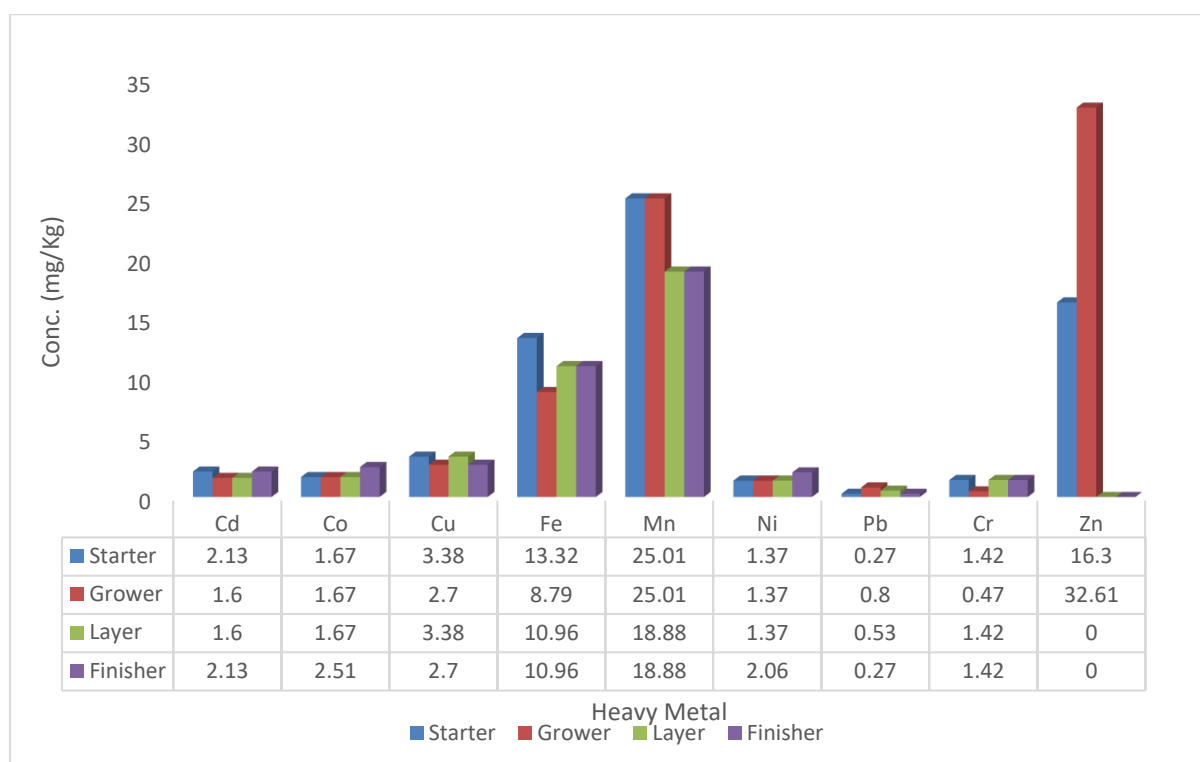


Chart 2. Heavy metals of animal feed sample B(vital Feed)

Manganese and copper are also essential trace elements in poultry feeds as mentioned by SON, 2012. Manganese concentration in the samples analysed ranged from 18.88 \pm 0.06 to 25.01 \pm 0.01; values which are much lower than 55-60 mg/kg for starter and finisher; 30-40 mg/kg for grower and 50-60 mg/kg for layers (Table 1; SON, 2012).

Copper ranged from 2.70 \pm 0.01 to 3.38 \pm 0.01. Copper was referred to as micro nutrients at 0.0-10mg/kg level in starter and 9-10 mg/kg in grower, layer and finisher (Table 1).

This study revealed that the metals studied have concentrations within the permissible limits for starter feed while they are found to be below the range for grower, layer and finisher feeds indicating that poultry birds taking these feeds are not receiving adequate nutrients from their feed. The study also revealed that lead and cadmium are present in chicken feeds at non toxic level. This must be maintained to make sure they do not gain access into food chain beyond their safe limits.

4. CONCLUSION

Essential elements studied (zinc, iron, manganese and copper) in the selected poultry

feeds were significantly low in levels. These metals must however be monitored to ensure that they remain within the permissible levels.

The starter feed type consistently had the lowest concentration of essential elements. It can therefore be deduced that the nutritive value of starter feed is low. Feed manufacturers should constantly analyze their feed products to ascertain the nutritive value it gives poultry birds at different stages while taking extra care to eliminate/reduce heavy metal contamination of the feed products so as to keep them at safe level.

A definite standard should be provided for minimum and maximum acceptable limits for micro nutrients in feeds in a bid of ensuring that poultry birds receive appropriate nutrients at every stage of growth.

Further studies should be done on other brands of poultry feeds to screen them of heavy metal contamination and also ascertain the nutritive value they give to poultry birds at different stages so as to make sure that heavy metals do not gain access into food chain beyond the limits that are regarded as been safe.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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