Assessment of heavy metals in chicken feeds sold in ijebujesa,Osun state.

ABSTRACT
Poultry farming is one of the most important aspects of agriculture with commercial layers and broilers contributing tremendously in meeting the upward protein demand of the increasing population through eggs and meats. Supplementation of some essential metals such as copper (Cu), zinc (Zn) and manganese (Mn) in chickens' diets is of great importance. Four brands (starter, grower, layer and finisher) of two commercial feeds (Animal care and Top feeds) commonly used by poultry farmers in Osun state were analysed for cadmium(Cd) ,Cobalt (Co), Copper (Cu) , Iron (Fe), Manganese (Mn), Nickel (Ni), Lead (Pb), Chromium (Cr), Zinc (Zn).The feeds were purchased from different retail stores at ijebu- jesa in Osun State. The feeds were ashed, digested, and subsequently analyzed for metal contamination using Atomic Absorption Spectrometer (AAS). The starter feed type consistently had the lowest concentration of the essential elements. The essential elements (zinc, iron, manganese and copper) were very low in the feed. Therefore, the nutritive values of the feed as estimated from the concentrations of the essential elements were very low. This shows that supplements were not added to the feeds as should have been expected. However there were very high concentrations of lead in the feed samples. This could be attributed to anthropogenic sources of lead pollution in the environment especially fossils fuels. There is a great need to adopt the alternative renewable energy sources such as biodiesel and bioethanol.

Keywords
Poultry, Grower, Heavy metals, chicken feeds, contamination

Introduction
Poultry farming is one of the major aspects of agriculture with commercial layers and broilers contributing tremendously in meeting the upward protein demand of the increasing population through eggs and meats. Supplementation of some essential metals such as copper (Cu), zinc (Zn) and manganese (Mn) in chickens' diets is of great importance. Copper prevents anaemia,

while Zn and Mn act as catalysts in many enzymatic and hormonal reactions that are related with growth, immunity and skeletal integrity (McDowell, 1992). Supplementation of Cu, Zn and Mn at 8, 40 and 60 ppm (µg/ml) respectively was recommended in broiler diets by NRC (1994) majorly in term of growth. However, Cu deficiency in birds can lead to rupture of the aorta. Diets deficient in Zn cause retarded growth, shortening and thickening of leg bones and enlargement of the hock joint, poor feathering, anorexia and mortality. Chicks hatched from Zn-deficient hens are weak, while a deficiency of Mn in the diet of chickens is one of the causes of perosis. Chickens are one of the main sources of protein for the south east population especially in IjebuJesa, Osun state where there are varieties of poultry farms and abundant market. The chickens are nourished by the feed they consume which as a result of heavy metal pollution in the country might be poisonous and therefore detrimental to the health of the human population that consumes the chickens. There is insufficient data as to the nutritive content of feeds consumed by chickens in the country and possible contamination of the feeds by the nutritive elements. So far no work has been carried out to cover the south west. Therefore this study was carried out to determine the concentration of zinc, iron, manganese, copper, lead, cadmium, nickel and cobalt in chicken feeds obtained in the south western part of Nigeria.

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. Heavy metals occur in all foods as natural or inherent component of plant and animal tissues and fluid along cycles of food chain and also may be present as a result of contamination or deliberate addition. Nickel is a transition metal with an atomic structure very similar to that of cobalt. Although it is not normally added to chicken diets, but nickel has been detected in liver, kidney and muscle of broilers (Coleman *et al.,* 1992). Evidence of nickel deficiencies in chicks has been reported (NAS, 1980) and dietary nickel levels of 0.1 – 0.3 parts/106 or µg/ml dry weight are considered adequate in poultry diets (Puls, 1988).

Heavy metals are ubiquitous and are being released continuously from man-made sources into the aquatic and terrestrial ecosystems, threatening the health of man and animals (Aschner, 2002; ,Abuludee*t al.* 2006). They are potentially dangerous due to their toxicity, bioaccumulation and biomagnification abilities when found within living tissue (Aycicek*et al.,* 2008), and are stored more quickly than they are excreted. The increase in urbanization, industrialization and agricultural activities has been shown to release heavy metals into the environment (Falandysz*et al.,* 2005). In early 2010, there was an incidence of heavy metal poisoning in Zamfara State, Nigeria due to indiscriminate mining by the locals (WWPPR, 2010).

Toxic metals are possible environmental pollutants domestic layer have the capacity to cause health problems in human selected poultry farm. Many studies showed that elements used in making poultry feed such as small grains (wheat, rice, feed deposit in body and cause harmful impacts. In case maize, millet, sorghum barley, dried sea food, blood of poultry industry deposition of heavy metals in body of animals, broken pulses and different vitamins) and heavy

broiler were result of their excessive use in poultry feed. Poultry feed is the combination of foodstuff and concentration of these toxic metals were also higher in Pre-mixers. Pre-mixers are combination of cadmium, zinc, copper, Lead, Chromium, Nickel, Barium, different heavy metals manufactured locally on demand Cobalt, Strontium, Titanium, Mercury and Silver were and their concentrations were not known to the poultry conducted. Samples of broiler feed (foodstuff + Pre-mixers) were with high concentrations of these heavy metals than and tissue of muscles, liver and skin were collected from the National Hygienic Standards. Similarly litter samples were amount of aluminum and arsenic concentrations were collected from each poultry farm. So, contamination of poultry products with heavy metals may result from the feed and water consumed by the chickens. The present study is therefore design to ascertain the possibility of contamination of chicken feeds with heavy metals.

Materials and Methods
Study Area

The study was conducted in Ijebu-jesa the capital of Oriade Local Government area in Osun State of Nigeria. It is a commuter city with connections to Ekiti State on one side, Ondo State on another and it has a border with the famous Ilesa the surrounding town's area Iwoye-jesa, Iloko-jesa, Ere and Ijeda. This city also serves as the main route to the Osun State College of Technology in Esa-Oke. ~~This city also has a private Polytechnic approved by the National Board for Technical Education (NBTE) Nigeria~~.

Comment [GdG1]: I suggest that authors remove it from the text, as it has no relevance to the topic addressed.

Ijebu-jesa which hitherto before now was known and called IjebuEgboro is the ancient historic town in the east of Osun State, Nigeria occupies a strategic position in Ijesaland. In Ijesa division, it is the next most important town politically and in term of history. Her Oba is the next to the OwaObokun of Ijesaland.

The town is situated eight kilometers north of Ilesa and about 128 kilometers east of Ibadan. It lies approximately on latitude 7.45 degrees north within the rain forest belt and so offers opportunity for farming on a large scale. The people are the core of Ijesa and are noted for their dogged industry.

Comment [GdG2]: I believe it would be quite interesting to put a picture of the study area with the respective location coordinates.

Sample Collection

All the plastic and glass wares were washed with detergent and rinsed with water before immersion in 10% nitric acid solution. They were finally rinsed with deionized water. Analar grade reagents and deionized water were used throughout the analysis. Sampling Four brands (Starter, Grower, Layer and Finisher) of two feeds (Animal care and Vital feed coded as A, B, C, D, E, F, G and H respectively) available in IjebuJesa Metropolis were purchased from different locations within the metropolis.

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 (Okoye et al., 2011).

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).

RESULT

Table 1: Heavy Metals of analysis of animal Feed sample A (Animal care). Concentration of Heavy Metals in animal feed was presented in (mg/kg).

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

Comment [GdG3]: I suggest that the authors make a table with the summary of measures of central tendency (mean, median, standard deviation, among others) and measures of dispersion via boxplot graph of metals, and discuss these results, as the article needs further subsidies on the behavior of metals. metals..

Table 2: Heavy Metals of analysis of animal Feed sample B(Vital feed). Concentration of Heavy Metals in animal feed was presented in (mg/kg).

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

Comment [GdG4]: I suggest that the authors make a table with the summary of measures of central tendency (mean, median, standard deviation, among others) and measures of dispersion via boxplot graph of metals, and discuss these results, as the article needs further subsidies on the behavior of metals. metals..

DISCUSSION

In poultry feed reference standard prepared by the Standard Organization of Nigeria (SON), there are requirements of some heavy metals mentioned as micro-nutrient but no standard as a contaminant in terms of maximum acceptable limit for the heavy metals was mentioned. Copper, zinc, manganese and iron which are heavy metals are included in the requirement as micro-nutrient. Zinc was mentioned as a nutrient at 40- 55mg/kg in starter, grower and finisher and 30-40mg/kg in layer feed. With the exception of feed A (Table 1) layer sample, all the other samples contained zinc below the micro-nutrient requirement. However, these was comparably lower than 54.3-482.2mg/kg obtained by Mahesar*et al*. (2010) and within the range of 33.945-49.950mg/kg obtained by Okoye *et al*. (2011) in their analysis of poultry feed.

Cadmium levels (Table 1 – 2) was found in all samples to exceed the permissible limits of FAO/WHO which both are 1mg/kg.

Lead concentration level in all the samples was below the permissible limit of 1mg/kg in the United Kingdom (Nicholson, 1999), however it is also lower than the maximum acceptance limit of 5mg/kg by FAO/WHO. The values obtained in this study were lower than 1.10-7.85mg/kg and 23.2- 32.6mg/kg obtained by Okeoye*et al*. (2011) and Mahesar*et al.* (2010) in their analysis of poultry feed respectively. Chromium was also detected in all the feed samples and was found to be above the maximum acceptable limit of 0.3mg/kg (Act No. 21 NRC, 2006) where Nickel was detected but found to be below the maximum acceptable limit of 4.05mg/kg (Act No. 21, NRC 2006). However, comparing the values obtained with that of Okoye *et al*. (2011) of 2.250-4.875mg/kg, the values were found to be lower. Iron was found in all samples but below the permissible level of 45-80mg/kg as stipulated by FAO and comparing with that of SON (90-95mg/kg) for starter; grower and finisher while 50- 60mg/kg for layer, it was also observed that all the values obtained in this study are below requirement. Feed A grower and starter contained lowest content of Zinc (08.787mg/kg) which will not suffice the nutritional requirement of the poultry. In the case of Cobalt, comparing the values obtained with the maximum acceptable limit of 1mg/kg as stipulated by FAO/WHO (2010), only five (5) of the feed samples are below the limit. Manganese and copper being part of the essential trace minerals are also detected in the entire feed samples. Comparing the values obtained for manganese with that of the maximum acceptance limit of 20-60mg/kg as stipulated by FAO, it was found that all the feeds are below with the exception of eight (8) of them, which are within the limit of 20-60mg/kg while

Manganese which is also a micro-nutrient mentioned by SON (2012) at 55-60mg/kg for starter and finisher, 30-40mg/kg for grower and 50- 60mg/kg for layer. It was found that, all the samples are below requirement. Copper was referred to as micro-nutrient at (0.0-10mg/kg) level in starter and (9-10mg/kg) in grower, layer and finisher. In the samples, all the feeds for starter are within the ranged but for the grower; layer and finisher are found to be below the ranged. Statistically, significant difference is observed in all the metals ($p<0.05$).

The study revealed the presence of Pb and Cd in chicken feeds at non toxic levels. To maintain the safety of food chain and to further minimize the heavy metals contamination therefore, it is mandatory for the nation's chicken feed producers to always observe and maintain these standards for heavy metals in chicken feeds, then any activity allowing heavy metals to gain access into food chain beyond those limits can automatically be regarded as unsafe and will be prescribed for alleviation strategies. On the other hand, zinc, copper and manganese appeared in all the feed samples at a level below what is required by chickens. Therefore, efforts should be made to increase supplementation of these micro-elements in chicken feeds.

CONCLUSION

The essential elements zinc, iron, manganese and copper were found to be low in the feed and the nutritive values of the feeds are estimated from the concentration level of the essential elements. Some of the heavy metals are found to be above the maximum acceptable limit whereas majority fall below the limit. The metals in the whole feeds were found to be statistically significant (p is less than 0.05)

Therefore, a definite standard for heavy metals should be provided as a contaminant so as to maintain the food chain safe from heavy metals and subsequent consequences. Extra care need to be carried out by manufacturers in order eliminate/reduce heavy metal content in the feed and there is also need for the manufacturers to increase the quantity of supplements been added so as to increase its nutritional value.

The starter feed type consistently had the lowest concentration of the essential elements. The essential elements (zinc, iron, manganese and copper) were very low in the feed. Therefore, the nutritive values of the feed as estimated from the concentrations of the essential elements were very low. This shows that supplements were not added to the feeds as should have been expected. However there were very high concentrations of lead in the feed samples. This could be attributed to anthropogenic sources of lead pollution in the environment especially fossils fuels. There is a great need to adopt the alternative renewable energy sources such as biodiesel and bioethanol.

Comment [GdG5]: In the article, the authors state that lead contamination and that it may be due to anthropogenic sources of pollution without even carrying out a study to justify such a statement, I suggest withdrawing that statement, as it was not clear how this statement was based on only on merely vague conjectures.

Further studies should be done to cover more locations/states in western part of the country. Also, other poultry feeds available in the region should be screened for heavy metal contamination. Feed companies should periodically carry out heavy metal assessment of their feed products so as to keep them at a safe level.

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