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Determination of Some Heavy Metals in Selected Poultry Feeds Available in Kano Metropolis, Nigeria.

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ABSTRACT

Heavy metals determination was carried out in some selected poultry feed samples used as starter, grower, layer and finisher obtained from Kano Metropolis. Heavy metals content was determined using Atomic Absorption Spectroscopy and expressed in mg/kg. The results show different concentration levels of Cadmium, Cobalt, Copper, Iron, Manganese, Nickel, Lead, Chromium and Zinc detected in all samples. They ranged from 0.53±0.02-3.19±0.01mg/kg, 0.13±0.01-3.33±0.06mg/kg, 2.03±0.01-5.41±0.01mg/kg, 08.79±0.06-19.74±0.06mg/kg, 12.50±0.01-37.50±0.01mg/kg, 1.03±0.06-2.06±0.01mg/kg, 0.27±0.06-0.80±0.06mg/kg, 2.38±0.01mg/kg-0.47±0.06 and 16.30±0.01-38.04±0.06mg/kg respectively. The levels of Zinc, Iron, Manganese and Copper were found to be below the requirement set by SON. Cadmium levels were found in all samples to exceed the permissible limits FAO/WHO which both are 1mg/kg; with the exception of feed C grower (0.532mg/kg) which falls below the limit. The metals were found to be statistically significant $p>0.05$ in the feeds.

Keywords: Atomic Absorption Spectroscopy, Finisher, Grower, Heavy metals, Layer, Poultry feed, Starter

INTRODUCTION

Poultry is a category of domesticated birds kept by humans for the purpose of collecting their eggs, or killing for their meat and/or feathers. Poultry meat is the second most widely eaten meat in the world, accounting for about 30% of meat production worldwide, after beef at 38% (Raloff, 2003). Poultry is basically a source of economical, palatable and healthy food protein (Mahesar *et al*., 2010). It has been noted that most commercial feeds failed to meet up with the national requirement of birds and in many way the source of raw materials for the production of the feeds can be associated with heavy metals pollution (Mahesar *et al*., 2010). Certain mineral elements such as Copper, Zinc, Manganese and Iron are essential dietary nutrients for poultry apart from other nutrients. However, all mineral elements, whether considered to be essential or potentially toxic, can have an adverse food effect upon the humans and animals if included in the diet at excessively high concentration (Okoye *et al.*, 2011). Heavy metal which is defined as metals with a specific weight more than $5g/cm^3$, is a serious threat because of their toxicity, bioaccumulation and biomagnifications in food chain (Damirezen and Uruc, 2006). Although contamination of animal feeds by toxic metals cannot be entirely avoided given the prevalence of these pollutant in the environment, there is need for such contamination to be minimized, with the aim of reducing both direct effects on animal health and indirect effects on human health (SCAN, 2003). The risk of heavy metals contamination in meat is of great concern for both food safety and human health because of the toxic nature of these metals at relatively minute concentration (Santhi *et al*., 2008).

Copper is an essential element for all living organism including humans at low concentration. It is regarded as a micro-nutrient in humans as it functions as a co-factor for many enzymes (Chaney, 1992). However, exposure to higher doses can be harmful (Scheinberg, 1991). Long term exposure to copper dust can irritate nose, mouth, eyes and cause headache, dizziness, nausea and diarrhea (Gerberding, 2004). Zinc is also an essential micro-nutrient element in the feed, needed by the body in small amounts. Without enough zinc in the diet, there could be decreased in immune function, slow wound healing and skin sores (Gerberding, 2005). Human diets with too little Manganese can lead to slowed blood clothing, skin problems, lowered cholesterol levels and cause a poisoning syndrome in mammals, with

neurological damage which is sometimes irreversible. In animals, eating too little manganese can interfere with normal growth, bone formation and reproduction (Koplar, 2000). It forms part of the hemoglobin, the compound of the blood that carries oxygen throughout the body.

MATERIAL AND METHODS

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 four feeds (Animal care, Hybrid, Niger, Sovet, Superb, Top feed and Vital feed coded as A, B, C, D, E, F, G respectively) available in Kano Metropolis were purchased from different locations within the metropolis.

Sample preparation

Dried sample weighed 2.0g was placed in crucibles. Conc. nitric acid ($1cm^3$) 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 480^oC for 2-3hrs until a constant weight is obtained, after which they were allowed to cool. The cooled samples were dissolved using $5cm^3$ of 30% HCl and then filtered using Whatman filter papers. The filtrate were individually poured into $50cm^3$ 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).

Statistical Analysis

Data collected were subjected to one way analysis of variance (ANOVA) ($p<0.05$) to assess whether they varied significantly between the feeds. All statistical calculations were performed with excel window 2007.

RESULTS AND DICUSSION

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 – 7) was found in all samples to exceed the permissible limits of FAO/WHO which both are 1mg/kg; with the exception of feed C (Table 3) grower (0.532mg/kg) which falls below the limit. 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 as 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 feed E (Table 5) 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 ($p<0.05$).

Table 1: Heavy Metals Concentration of Feed A

	Metals (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	1.71±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

Table 2: Heavy Metals Concentration of Feed B

	Metals (mg/kg)								
Sample	**Cd**	**Co**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Cr**	**Zn**
Starter	1.60±0.07	1.67±0.01	2.70±0.06	10.96±0.01	25.01±0.01	1.37±0.01	0.53±0.06	0.47±0.06	27.72±0.06
Grower	2.13±0.02	2.51±0.02	3.38±0.01	13.32±0.01	12.50±0.06	1.37±0.01	0.80±0.06	1.42±0.06	32.61±0.06
Layer	3.19±0.01	1.67±0.01	2.70±0.06	13.32±0.01	25.01±0.01	1.71±0.06	0.80±0.06	1.89±0.01	32.61±0.06
Finisher	2.13±0.02	0.83±0.02	3.38±0.01	10.96±0.01	25.01±0.01	1.03±0.06	0.27±0.06	0.94±0.06	21.74±0.01

Table 3: Heavy Metals Concentration of Feed C

	Metals (mg/kg)								
Sample	**Cd**	**Co**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Cr**	**Zn**
Starter	1.06±0.01	0.83±0.01	2.03±0.01	10.96±0.01	18.89±0.06	1.03±0.06	0.53±0.02	0.94±0.01	38.04±0.06
Grower	0.53±0.02	1.67±0.01	3.38±0.01	13.32±0.06	12.50±0.01	1.71±0.06	0.80±0.01	1.41±0.06	21.74±0.01
Layer	1.60±0.06	2.50±0.01	2.70±0.06	13.32±0.06	12.50±0.01	1.03±0.06	0.53±0.01	0.94±0.01	21.74±0.01
Finisher	1.60±0.06	3.33±0.01	3.38±0.01	10.96±0.01	12.50±0.01	1.71±0.06	0.25±0.01	0.94±0.01	16.30±0.01

Table 4: Heavy Metals Concentration of Feed D

	Metals (mg/kg)								
Sample	**Cd**	**Co**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Cr**	**Zn**
Starter	1.06±0.01	2.50±0.01	2.70±0.06	10.96±0.01	12.50±0.01	1.72±0.06	0.53±0.06	0.94±0.06	32.61±0.06
Grower	2.13±0.06	1.67±0.01	2.70±0.06	19.74±0.06	18.86±0.06	1.03±0.06	0.53±0.06	1.89±0.01	27.72±0.06
Layer	1.60±0.06	1.67±0.01	5.40±0.01	13.32±0.06	18.86±0.06	1.72±0.06	0.53±0.06	0.94±0.06	21.74±0.01
Finisher	2.67±0.06	1.67±0.01	4.05±0.01	15.35±0.06	12.50±0.01	2.05±0.01	0.27±0.01	1.89±0.01	16.74±0.01

Table 5: Heavy Metals Concentration of Feed E

	Metals (mg/kg)								
Sample	**Cd**	**Co**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Cr**	**Zn**
Starter	2.67±0.01	1.67±0.01	4.05±0.02	08.78±0.06	18.88±0.01	1.71±0.02	0.53±0.06	1.42±0.01	16.30±0.01
Grower	1.60±0.06	0.83±0.01	2.03±0.01	10.96±0.01	18.88±0.06	1.37±0.01	0.80±0.02	0.94±0.01	27.72±0.06
Layer	1.06±0.01	0.83±0.01	3.38±0.01	10.96±0.01	12.50±0.01	2.05±0.01	0.27±0.01	1.42±0.06	21.74±0.01
Finisher	1.60±0.06	2.50±0.01	3.38±0.01	10.96±0.01	18.88±0.06	1.37±0.01	0.27±0.01	1.89±0.01	21.74±0.04

Table 6: Heavy Metals Concentration of Feed F

	Metals (mg/kg)								
Sample	**Cd**	**Co**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Cr**	**Zn**
Starter	1.60±0.01	2.50±0.06	2.07±0.02	17.54±0.06	35.25±0.01	1.03±0.02	0.27±0.01	0.94±0.01	21.74±0.01
Grower	2.66±0.06	0.13±0.01	4.05±0.01	13.32±0.01	12.50±0.01	1.71±0.01	0.80±0.02	1.42±0.01	32.61±0.01
Layer	1.06±0.01	2.50±0.06	3.38±0.01	13.32±0.01	18.88±0.06	1.71±0.01	0.27±0.01	1.42±0.06	32.61±0.01
Finisher	1.06±0.01	2.50±0.06	4.05±0.01	13.32±0.02	25.01±0.02	1.71±0.06	0.27±0.01	0.94±0.01	27.72±0.01

Table 7: Heavy Metals Concentration of Feed G

	Metals (mg/kg)								
Sample	**Cd**	**Co**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Cr**	**Zn**
Starter	1.60±0.05	3.33±0.06	4.05±0.01	13.32±0.06	37.50±0.01	1.03±0.06	0.80±0.01	0.94±0.01	27.72±0.01
Grower	1.06±0.01	2.50±0.01	4.73±0.02	13.32±0.01	12.50±0.01	1.37±0.01	0.80±0.02	0.94±0.01	32.61±0.01
Layer	1.60±0.01	2.50±0.06	4.05±0.01	10.96±0.01	18.88±0.01	1.36±0.02	0.27±0.01	2.38±0.01	27.72±0.01
Finisher	1.60±0.01	2.50±0.01	4.05±0.01	13.32±0.02	18.88±0.02	1.37±0.01	0.27±0.01	1.42±0.06	32.61±0.01

CONCULSION

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 ($p<0.05$).

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.

REFERENCE

A.O.A.C. (2005): Official Methods of Analysis 18th edition, Association of Official Analytical Chemist, Washington D. C. U.S.A

Chaney, S.G. (1992) Principles of nutrition II: micronutrients. In Thomas M. Devlin (ed.) Textbook of Biochemistry with Clinical Correlations, 3/e. John Wiley and Sons, Inc. pp. 1116-1147.

Demirezen, D. and K. Uruc (2006). Comparative study of trace elements in certain fish, meat and meat products. Meat sci., 74:255-260.

Gerberding J.L., (2005). Toxicological profile for zinc. Atlanta Georgia. 2005, pp 22 and 23.

Gerberding J.L., (2004). Toxicological profile for zinc. Atlanta Georgia. 2004, pp22 and 26.

Koplan J.H.,(2000). Toxicological effect of Manganese on human health. Atlanta Georgia, 2000, 26p.

Mahesar S.A, Sherazi S.T.H, Abdul Niaz M.I, Bhanger S. A. (2010). Simultaneous assessment of zinc, cadmium, lead and copper in poultry feeds by differential pulse anodic striping voltammetry. *Food and Chemical Toxicology* doi: 10.1016/j.fct.2010.05.071.

Okoye, C.O.B, Ibeto, C.N and Ihedioha, J.N (2011). Assessment of heavy metals in chicken feeds sold in south eastern, Nigeria. Advance in Applied science Research, 2(3):63-68.

Raloff, Janet (2003). Food for thought: Global Food Trends. Science new online. May 31, 2003.

Santhi, D., V. Balakrishan, A. Kalaikannan and K.T. Radhakrishnan, (2008). Presence of heavy metals in pork products in Chennai (India). Am J. food Technol., 3(3):192-199.

SCAN (2003), Scientific Committee on animal Nutrition: Opinion of the undesirable substance in feed. Retrieved from: http:/Europe.eu.int/comm./food/fs/sc/scan/out 126_bis_en.pdf.

Scheinberg, J.H (1991). Copper in Merian E. (ed). Metals and their compounds in the environment. New York p. 893-908