



## PROXIMATE ANALYSIS AND CONCENTRATION OF SOME HEAVY METALS IN SELECTED POULTRY FEEDS IN KANO METROPOLIS, NIGERIA

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### ABSTRACT

*Proximate analysis and some heavy metals determination were carried out in selected poultry feed samples used as starter, grower, layer and finisher which were obtained from Kano Metropolis, Nigeria. The heavy metals contents were determined using Atomic Absorption Spectroscopy and expressed in mg/kg while the proximate composition were expressed in %. Mean to standard deviation of the proximate composition of the feeds analyzed shows moisture content ranged from 11.33±4.48% - 04.98±01.58%, ash content 20.47±12.67% - 09.59±2.95%, lipid ranged between 06.91±01.92% to 4.14±1.90%, crude protein from 24.26±04.16% - 16.44±11.29%, crude fibre 15.90±16.46% - 03.41±00.17%, carbohydrate 50.70±21.63% - 39.67±10.68%. The mean results of the heavy metals concentration ranged from (2.26±0.67 to 1.20±0.51)mg/kg, (1.63±0.43 to 1.37±0.28)mg/kg and (0.56±0.26 to 0.47±0.13)mg/kg for cadmium, nickel and lead respectively. Ni and Pb levels in the feeds were within the permissible limits while Cd level in all the samples exceeded the permissible limit by regulatory bodies. These results were subjected to one way analysis of variance (ANOVA) ( $p < 0.05$ ).*

**Keywords:** Proximate composition; Heavy metals; Poultry feed; AAS,

### 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 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 economic, palatable and healthy food protein (Mahesar et al., 2010). Poultry feed is food for farm poultry, including chickens, ducks, geese and other domestic birds. Feed for poultry mostly consists of grains (Mark, 2008). The feed consist of grains such as corn, wheat or barley, oil seeds, cake meal (originating mainly from oil producing seeds such as soybeans) sunflower seeds, peanuts, cotton seed and protein products of animal origin such as fish meal, meat and bone meal (Bale et al., 2002). Poultry feeds are known as a complete feed, since it is prepared in such a way to contain all the vitamins, minerals, energy, protein and other nutrients essential for proper health of the birds, egg production and growth. Poultry farming is now one of the most important agricultural sectors in the world. It is expanding rapidly as an industry. Most of the commercial poultry farmers depend on commercial feeds for their stock. The role of these poultries is to meet up with the increasing demand for meats and eggs as protein. Dick (2002) suggested that harmonization of feed qualities can only be possible when a given standard is adopted nationwide. Nowadays, it has been noted that some of the commercial feeds producers failed to meet up with standards for the requirement of poultry and in many ways, the source of raw material for the production of the feeds tends to be contaminated with heavy metals. Heavy metals, which are defined as metals

with specific gravity of more than 5g/cm<sup>3</sup>, are serious threat human because of their toxicity, bioaccumulation and biomagnifications in food chain (Demirezen and Uruc, 2006). Although contamination of animal feeds by toxic metals cannot be entirely avoided given the prevalence of these pollutants 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). Some mineral elements such iron, manganese, copper and zinc are essential dietary nutrients for poultry and livestock. However, all mineral elements can have an adverse effect upon human and animals at excessively high or low concentration if included in the diet (Okoye et al., 2011). The aim of this study is to determine the proximate composition and concentration of some heavy metals in selected poultry feeds in Kano Metropolis, Nigeria.

### Sampling

Four different poultry feeds (Animal care, Hybrid, Niger, and Soviet coded as A, B, C and D respectively) commercially available in Kano metropolis were purchased from different locations within the metropolis.

### Materials and method

All plastic and glass wares used 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.

### Proximate Analysis

Samples were subject to proximate analysis in accordance with standard methods described by AOAC (2005).

**Moisture Content Determination**

This was done based on the difference between the net weight and the weight after drying to a constant weight. A clean dried petri-dish was weighed ( $W_1$ ) and 3g of the samples were placed on it, and then weighed ( $W_2$ ). This was then placed in an oven at 120°C for 3hrs. The dish was removed and cooled in a desiccator for 30mins and finally weighed ( $W_3$ ) AOAC (2005).

**Total Ash Determination**

A crucible was dried in an oven for 24hrs, cooled and weighed ( $W_1$ ). The dried sample weighed 2g ( $W_2$ ) was placed in a crucible and subjected to ashing in a muffle furnace at constant temperature of 550°C until a constant final weight for the ash was obtained. After ashing, the ash was covered with a lid and placed in desiccator prior to weighing. This was then measured as  $W_3$  AOAC (2005).

**Lipid Content Determination**

A quantity of the sample (3g) was weighed and folded in a filter paper. It's then placed in extraction thimble and cotton wools placed on top. The whole apparatus was then connected after the addition of about 300cm<sup>3</sup> of 60°-80°C petroleum ether into the weighed extraction flask. The extraction was then carried out for 3hrs using a heating mantle and making sure there was continuous flow of water in the condenser. The sample was then removed, air-dried and then placed in an oven at 80°C until a constant weight was obtained. The extractible lipid was then calculated as percentage lipid (%) AOAC (2005).

**Crude Protein**

Dried sample (0.15g) was weighed and the content was transferred into the kjeldahl digestion flask (capacity 30-35cm<sup>3</sup>). Catalyst 0.8g (0.7g sodium sulphate, 0.06g copper sulphate, and 0.04g mercury (II) oxide red) was added into the digestion flask; 2cm<sup>3</sup> of conc. H<sub>2</sub>SO<sub>4</sub> was also added. The mixture was heated on a heating mantle at an inclined position for 1hr until the liquid became clear. The digest was cooled and made alkaline with 15cm<sup>3</sup> of 40% w/v NaOH. The digest was then transferred to the steamed out apparatus. The ammonia steam distilled into 10cm<sup>3</sup> of 2% boric acid solution with 5 drops of methyl red indicator for 15mins. The distilled ammonia was then titrated with 0.02M HCl AOAC (2005).

**Crude fiber**

The crude fibre was determined by subjecting 3g of the residual powered sample from moisture analysis and ether extraction to successive treatments with boiling 200cm<sup>3</sup> of 0.1275M H<sub>2</sub>SO<sub>4</sub> acid under reflux for 30mins, washed several times with hot water until it is acid free. The residue was again subjected to the same treatment using 200cm<sup>3</sup> of 0.313M NaOH solution, washed thoroughly with hot water until it was base free. It was then dried to a constant weigh in an oven at 100°C, cooled in a desiccator and weighed. The weighed sample was incinerated in a muffle furnace at 550°C for 2hrs until a constant weight was obtained. The crude fibre was calculated as the loss in weight on ashing AOAC (2005).

**Carbohydrate Content Determination**

Total carbohydrate was determined by difference:  
Carbohydrate = [100 – (crude protein + crude fibre + lipid + moisture + ash)]. (Akubor et al., 2000)

**Sample digestion for heavy metals**

Samples 2.0g each were weighed in a crucibles using H30 Mettler Balance. Conc. nitric acid 1cm<sup>3</sup> 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 550°C for 3hrs after which they were allowed to cool. The samples were then dissolved using 5cm<sup>3</sup> of 30% HCl and then filtered using Whatman filter papers. The filtrates were individually poured into 50cm<sup>3</sup> standard flask and made-up to mark with deionized water. The samples solutions were then kept in sample bottles for further analysis using Atomic Absorption Spectroscopy (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 DISCUSSION**

The results of the analysis are presented in 1 – 6 below. The results indicated proximate composition of the various poultry feeds.

**Table 1: Percentage of moisture in the feed samples**

Sample	A	B	C	D
<b>Starter</b>	04.17	08.00	07.40	15.00
<b>Grower</b>	03.81	09.60	08.59	15.00
<b>Layer</b>	07.29	08.80	07.92	09.40
<b>Finisher</b>	04.65	07.83	07.50	05.90
<b>Mean</b>	04.98	08.56	07.85	11.33
<b>S.D</b>	01.58	00.81	00.54	04.48

**Table 2: Percentage of Ash content in the feed samples**

Sample	A	B	C	D
<b>Starter</b>	12.24	14.99	13.42	09.33
<b>Grower</b>	07.24	14.93	12.29	38.65
<b>Layer</b>	12.03	18.54	14.06	15.90
<b>Finisher</b>	06.84	16.00	11.34	17.99
<b>Mean</b>	09.59	16.12	12.78	20.47
<b>S.D</b>	02.95	01.69	01.21	12.67

Where A= Animal care, B = Hybrid, C = Niger, D = Sovet

**Table 3: Percentage of Lipid in the feed samples**

Sample	A	B	C	D
<b>Starter</b>	06.87	06.28	04.56	05.98
<b>Grower</b>	06.97	09.20	06.60	01.47
<b>Layer</b>	03.07	04.66	06.50	04.57
<b>Finisher</b>	06.60	07.48	05.20	04.55
<b>Mean</b>	05.88	06.91	05.72	04.14
<b>S.D</b>	01.88	01.92	01.00	01.90

**Table 4: Percentage of Crude protein in the feed samples**

Sample	A	B	C	D
<b>Starter</b>	17.50	17.00	23.56	15.16
<b>Grower</b>	09.30	32.20	19.80	16.30
<b>Layer</b>	09.36	08.86	23.80	26.80
<b>Finisher</b>	14.46	07.70	29.86	25.66
<b>Mean</b>	12.66	16.44	24.26	20.98
<b>S.D</b>	04.04	11.29	04.16	06.09

Where A= Animal care, B = Hybrid, C = Niger, D = Sovet

**Table 5: Percentage of crude fiber in the feed samples**

Sample	A	B	C	D
<b>Starter</b>	38.75	03.65	04.05	03.66
<b>Grower</b>	03.67	11.59	03.67	03.33
<b>Layer</b>	17.12	04.00	02.99	03.36
<b>Finisher</b>	04.07	03.60	03.03	03.30
<b>Mean</b>	15.90	05.71	03.44	03.41
<b>S.D</b>	16.46	03.92	00.52	00.17

**Table 6: Percentage of Carbohydrate in the feed samples**

Sample	A	B	C	D
<b>Starter</b>	20.47	50.08	47.01	50.87
<b>Grower</b>	68.83	22.48	49.05	25.25
<b>Layer</b>	50.13	55.14	44.73	39.97
<b>Finisher</b>	63.38	57.39	43.07	42.60
<b>Mean</b>	50.70	46.27	45.97	39.67
<b>S.D</b>	21.63	16.15	02.62	10.68

Where A= Animal care, B = Hybrid, C = Niger, D = Sovet

The moisture content ranges from 3.81-7.29%, 7.83-9.60%, 7.40-8.59% and 5.90-15.00% for feed (A, B, C & D), respectively. Where Feed A was observed to have the least moisture content in grower (3.81%). There was significant difference observed in the moisture content of the entire feeds sample ( $p < 0.05$ ). Ash content of a poultry feeds relates to the inorganic mineral content. The ash content found in feeds (A, B,

C & D) are in the range of 6.84-12.24%, 14.93-18.54%, 11.34-14.06% and 9.33-38.65% respectively. Lipid in poultry diets is often incorporated to enhance the energy levels. The lipid content in the feed were detected in the range of 3.07-6.97%, 4.66-9.20%, 4.56-6.60% and 1.47-5.98% for feed A, B, C and D, respectively. The lipid content in all the feeds is low with the least in starter (1.47%).

Crude protein is one of the most important nutrients to quantify in a prospective feed due to the fact that it is one of the most costly to supply and deficiency of protein has a drastic effect on growth and production (Mahesar *et al.*, 2010). Crude protein were found in the range of 9.30-17.50%, 7.70-32.20%, 19.80-29.86% and 15.16-26.80% respectively for feeds A, B, C and D. Finisher shows the least in crude protein (7.70%).

Crude fiber content of the feeds were in the ranges of 4.07-38.75%, 3.60-11.59%, 2.99-4.05%, and 3.30-3.66%, for feed A, B, C and D, respectively. However, Feed C showed the least crude fiber in layer (2.99%) whereas feed A starter was found to have the highest with 38.75%.

Generally, the carbohydrate which is also referring to nitrogen free extract is high in all the feeds. Carbohydrates are essential source of energy. Carbohydrate content were in the range of 20.47-68.83%, 22.48-57.39%, 43.07-49.05%, 25.25-50.87% for feed A, B, C and D respectively. Carbohydrate was found to be lowest in feed B grower with 22.48%.

#### Heavy Metals

Tables 7-10 below show the results of the heavy metal concentration in mg/kg with the mean, and standard deviation for the various feeds. Where A = Animal care B= Hybrid, C= Niger D= Sovet

**Table 7: Heavy metals concentration of feed A in mg/kg**

Sample	Starter	Grower	Layer	Finisher	Mean ± S.D
Cd	2.13	1.60	1.60	2.13	1.86 ± 0.31
Ni	1.37	1.37	1.71	2.06	1.63 ± 0.33
Pb	0.27	0.80	0.53	0.27	0.47 ± 0.26

**Table 8: Heavy metals concentration of feed B in mg/kg**

Sample	Starter	Grower	Layer	Finisher	Mean ± S.D
Cd	1.60	2.13	3.19	2.13	2.26 ± 0.67
Ni	1.37	1.37	1.71	1.03	1.37 ± 0.28
Pb	0.53	0.80	0.80	0.27	0.56 ± 0.26

**Table 9: Heavy metals concentration of feed C in mg/kg**

Sample	Starter	Grower	Layer	Finisher	Mean ± S.D
Cd	1.06	0.53	1.60	1.60	1.20 ± 0.51
Ni	1.03	1.71	1.03	1.71	1.37 ± 0.40
Pb	0.53	0.80	0.53	0.27	0.53 ± 0.22

**Table 10: Heavy metals concentration of feed D in mg/kg**

Sample	Starter	Grower	Layer	Finisher	Mean ± S.D
Cd	1.06	2.13	1.60	2.67	1.86 ± 0.69
Ni	1.71	1.03	1.71	2.06	1.63 ± 0.43
Pb	0.53	0.53	0.53	0.27	0.47 ± 0.13

Where A = Animal care, B= Hybrid, C= Niger D= Sovet

Table 7 shows the concentration of the heavy metals in feed A with ranged from 0.27-2.13mg/kg. In feed A, lead has the lowest concentration of heavy metal with 0.27mg/kg in both starter and finisher. Table 8 shows concentration level of the heavy metals in feed B. The concentration ranged from 0.27-3.19mg/kg where cadmium has the highest concentration of 3.19mg/kg in layer feed. Table 9 shows the concentration of the heavy metals in feed C with ranged from 0.27-1.71mg/kg. In this feed, nickel has the highest concentration in grower and finisher while lead has the lowest in finisher feed. Table 10 above shows the concentration of heavy metals in feed D. The concentration of the heavy metals ranged from 0.27-2.67mg/kg, where finisher feed has the highest concentration of 2.67mg/kg.

In general, 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. Cadmium levels were found in all samples to exceed the permissible limit FAO/WHO (1mg/kg), except for feed C grower which was found to be within the limit with (0.532mg/kg). Nickel level was detected in the feed but all were found to be within the maximum acceptance limit of 4.05mg/kg of the Act No. 21, NRC (2006). Lead concentrations in all the samples were within the permissible limit of 5mg/kg set by FAO/WHO. The results for lead 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 (2011) in their analysis of poultry feeds respectively.

#### CONCLUSION

In conclusion, data obtained in the proximate analysis represent a great variation among the quality of the poultry feeds from selected manufacturers. Nickel and lead were found to be within the maximum acceptable limits set by regulatory bodies.

However, Cadmium concentration was found to exceed the maximum acceptable limit with the exception of feed C grower. This makes the feeds contaminated with Cadmium and not safe for poultry consumption since heavy metals are bio-accumulative

and have the tendency to be transferred to human after consumption. Therefore extra care needs to be carried out by manufacturers in order to reduce the heavy metals in the feeds to the permissible levels.

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