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Proximate and Elemental Analysis of Some Selected Commercial Poultry Feeds in Nigeria

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Despite the important role played by the poultry subsector in reducing the scourge of poverty, unemployment and malnutrition in Nigeria; the poultry subsector is faced with numerous challenges, prominent among them being feed quality. To overcome such challenges, this research examined some commercially prepared poultry feeds. Two commercially prepared poultry feeds were selected and subjected to proximate and elemental analyses using AAS, X-ray fluorescence and UV/Visible spectroscopy. Moisture content ranges between 12.64±0.86 to 27.94±0.38 and 8.03 to 36.31 % while protein content ranges from 18.00±0.5 to 10.66±0.76 and 20.16±1.75 to 13.1±0.36 per 100g of sample for VSF and LSF respectively. The results show that both feeds meet the average minimum requirement recommended for poultry feeds by both National Research Council and Food and Agricultural Organisation.

Keywords: Poultry, feeds, Proximate, Elemental, Analysis.

1. Introduction

Since the diversification agenda of the Federal Republic of Nigeria, Agriculture has continued to play a leading role in the Nigeria economy. The poultry sub-sector is the most commercialized (capitalized) of all sub-sectors of the Nigerian Agricultural Sector, and as at the end of 2017, the Nigerian poultry industry was estimated to be worth $3.2 billion (₦1.2 trillion) (FAO, 2006; Adewole, 2017).

Poultry refers to all kinds of birds of economic value to man which are kept for the purpose of collecting their eggs, killing for meat, feathers or birds considered to be game which include (mostly) chickens, pigeons, quails, turkeys, ducks, guinea fowl and recently ostrich and pheasants (FAO, 2013). Poultry farming contributes significantly to poverty alleviation by providing employment opportunities to several category of Nigerians. There are direct and indirect jobs connected to poultry production such as feed industries, storage and marketing of eggs, slaughtering industries, food processing industries, meat conservation industries, industries producing machines and technical tools necessary for poultry production and so on, improvement of food security and gross domestic product (Grepay, 2009; Emokoro and Erhabor, 2014). There is a general consensus that intensification of production of meat and eggs derived from prolific animals like poultry birds are crucial to meeting animal protein requirement since they provide an excellent source of critically important amino acids, together with minerals and vitamins (Scanes, 2007; Heise et al, 2015; Yusuf et al, 2016).

In spite of the important role played by poultry production in reducing the scourge of poverty, unemployment, and malnutrition, the poultry subsector is faced with numerous challenges which mitigates against the efficiency of these industry such as poor finance, inconsistent policy, feed quality, diseases, weather among others. The most prominent being feed quality either commercially or personally prepared. It is a well-known fact that the major advantage of keeping poultry over other animals is the high conversion rate of feed to meat where the production of 1 kg of poultry meat require 2 – 2.5 kg (approximately) of feed while the production of 1 kg of red meat needs more than 7 kg of feed (Grepay, 2009). It is also observed that feed is the most important variable cost component, accounting for 65-70 % of production cost.

Thus, for high productivity and efficiency to be achieved, poultry must be fed nutritionally balanced feed that are formulated to meet the bird's nutritional requirements, hence the need for qualitative food cannot be over emphasized (FAO, 2013). The main objective of this research is to appraise the selected commercially prepared feeds by analysing the feeds for proximate composition and some important minerals.

2. Materials and Methods

2.1 Sample Collection

The samples were bought from two accredited dealers of commercially prepared feed (Vital feed and Livestock feed) in Maiduguri, Nigeria. Feed samples were collected and appropriately labelled as VSF (Vital feeds) Starter, Grower and Finisher and LSF (Livestock feeds) Starter, Grower and Finisher.

2.2 Sample Preparation

The feed samples were placed in an air-tight polythene bags for 24 h and preparation was based on the analyses carried.

2.3 Proximate Analysis

Moisture content, crude protein, ash content, and fat content were determined by Standard AOAC methods according to Nielsen (2010); the total carbohydrate content (%) in the samples was calculated by difference method. The calorific value was calculated by sum of the percentages of proteins and carbohydrates multiplied by a factor of 4 (kcal/g) according to Ooi et al (2012);

2.4 Mineral Analysis

The analyses of calcium, potassium and iron were carried out using x-ray fluorescence (EDX-7000 Shimadzu) machine as reported by Dakubu and Swaine (1982), zinc and copper were analyzed by AAS (Perkin Elmer AAnalyst 300) according to methods adopted from Jorlem (2000); while phosphorus as phosphate was analyzed by UV/Visible spectrophotometer(spectronic 200 Thermofisher) according to Nagendrappa et al (2007).

3. Results and Discussion

Table 1 presents the proximate analysis of VSF samples (starter, grower, and finisher). The moisture which was relatively high and can affect the shelf life of the feed making it not suitable for long storage since it can easily be infested by insects and encourages the growth of fungi (Nielsen, 2010; FAO, 1987).

The proximate analysis of VSF also shows it contains protein ranging from 18.00±0.5 to 10.66±0.76 which was less than the 18 to 23 % minimum requirement recommended by NRC (1994), and in consequence, can lead to reduction or cessation of growth and productivity because body proteins are in dynamic state. (Applegate and Angel, 2008; Mbajiorgu et al, 2011).

Fat contents were also observed to be greater than the recommended 1% minimum requirement by NRC (1994) which is a good indication of the possibility of absorbing fat-soluble vitamins A,D,E,K and a good source of energy to the poultry since fats provide nine calories of energy per gram (Jacob, 2018). Furthermore, fat increases the palatability of the feeds and allow better absorption of all nutrients by reducing the passage rate of the digesta in gastrointestinal tract (Baiao and Lara 2005).

Carbohydrates are source of energy for chickens since they form part of energy yielding nutrients (carbohydrates, fats and protein) which are oxidised in the course of metabolism to provide energy needed for maintenance and body tissue building (NRC, 1994; FAO, 2010). The results of proximate analysis from Table 1 shows high carbohydrates content for VSF starter, grower and finisher ration which indicates availability of energy in the feeds and it equally indicate that chickens fed with such feed will perform well in terms of their energy needs.

Ash content analysis reveals that values obtained for VSF are good enough since they are large enough to provide the minimum mineral requirement needed for growth and development of the chickens.

Furthermore, the analysis of calcium (Ca), phosphorous (P) and potassium (K) which are known as macro minerals and cannot be synthesized by the body except supplied through the diet according to Thompson and Fowler (1990) shows that the VSF starter and grower rations have optimum Ca requirement that are needed for healthy bones, enzymes activation, hormone secretion and for good egg shell quality as reported by Campbell *et al.* (2006). While the finisher ration contains 0.5% Ca which was less than the 1% recommended by N.R.C (1994). This can lead to Ca deficiency thereby causing diseases like rickets, osteoporosis, reduced eggshell quality and abnormal bone development, since Ca is mobilised from bone to overcome a dietary deficiency in consequence eroding the cortical bone (Cynthia et al, 2008).

Phosphorus content was found to be lower the minimum requirements (NRC (1984). Chickens fed with such feed might be deficient in Phosphorus and in consequence may lead to various diseases such as loss of appetite, stiff joints, muscular weakness, poor fertility and reduced calcification of bones. In order to optimize the absorption of these two minerals a calcium-phosphorus ratio of 2:1 is highly recommended (Fleck, 1976; Campbell et al 2006; FAO, 2010).

Table 1. Proximate composition of Vital feeds (VSF)

Nutrient(g/100g)	Starter	Grower	Finisher
Protein	18.00±0.5	15.22±1.65	10.66±0.76
Fat	11.15±1.53	8.83±1.18	11.50±0.30
Moisture	27.94±0.38	18.85±1.19	12.64±0.46
Ash	8.26±0.31	10.36±0.73	12.28±0.41
Carbohydrate	34.65±0.77	46.74±2.50	52.92±1.32
Metabolizable energy(kcal/kg)	*2106.00*	2478.40	2543.20

Results are mean ± SD of three determinations on dry weight (DW

Table 2. Mineral analysis of vital feeds (VSF)

Mineral content	Starter	Grower	Finisher
Calcium (%)	1.490	1.120	0.540
Phosphorus (%)	0.040	0.022	0.072
Potassium (%)	1.810	1.650	1.110
Iron (mg/kg)	134.500	133.000	134.000
Zinc (mg/kg)	55.900	40.800	64.000
Copper (mg/kg)	52.800	40.020	30.650

Table 3. Proximate composition of Livestock feeds (LSF)

Nutrient(g/100g)	Starter	Grower	Finisher
Protein	20.16±1.75	14.55±0.37	13.10±0.36
Fat	7.50±0.50	6.04±0.15	6.03±0.25
Moisture	8.03±0.45	0.17±0.13	36.31±0.38
Ash	11.53±1.45	10.30±0.31	8.05±0.57
Carbohydrate	52.78±0.66	68.94±0.58	36.51±1.16
Metabolizable energy(kcal/kg)	*2917.60*	3339.60	1984.40

Results are mean ± SD of three determinations on dry weight (DW) basis.

Table 4. Mineral analysis of livestock feeds (LSF)

Mineral content	Starter	Grower	Finisher
Calcium (%)	1.560	0.890	1.580
Phosphorus (%)	0.050	0.090	0.110
Potassium (%)	2.720	1.660	0.690
Iron (mg/kg)	157.000	145.000	138.000
Zinc (mg/kg)	65.000	58.000	64.700
Copper (mg/kg)	54.500	50.600	53.500

Potassium is believed to be the third most abundant mineral element in the animal body (Mc-Dowell, 1992). It functions primarily in maintaining the right acid-base balance, osmotic pressure regulation, activation of intra-cellular enzymes such as pyruvate kinase and facilitates the uptake of amino acids and glucose (Oliveira et al, 2005). It also helps in nerve and muscle excitability as stated by Banergee (1992). Mineral analysis of VSF from Table 3 shows that the feed rations contain adequate amount of potassium which are above the minimum requirement recommended by NRC (1994) ranging from 1.11 to 1.81% of Total and chickens raised with this feed rations will perform optimally.

Some trace minerals including iron, copper and zinc which are required in very small amounts were also analyzed. Iron which has a very specific role in all animals as component of protein heme found in the red blood cell, hemoglobin and myoglobin of muscle and some enzymes essential for oxygen utilization at cellular level. Iron was found to be greater than the 80 mg/kg minimum recommended by NRC (1994) but not up to the toxicity levels reported in Oluyemi and Roberts (2000).

Copper also plays an important role in poultry nutrition such as iron metabolism, as part of enzyme that plays an important role in oxidation of ferrous to ferric iron, collagen formation, melanin production, red blood cell formation, feather development as well as feather color via its role in disulphide bond formation. The VSF samples contained amounts of copper which were far more than the 8 mg/kg requirement recommended by NRC (1994) but no toxicity is expected due to the result of works by Aoyagi and Baker (1993) showing better performance by chicks fed with diet containing 25 mg/kg than those fed with diet of 8 mg/kg. Diseases related to copper deficiency such as anemia, poor growth, infertility, depigmentation of hair and feathers would not affect chickens fed with such rations (Campbell et al, 2006).

Zinc metalloenzymes are recognized in all six enzymes types which include oxidareductase, transferase, hydrolyse, lyse, isomerase and ligase and are important in metabolism and reproduction (Park et al, 2004). Classic symptoms of zinc deficiency such as suppressed immune system, poor feathering and dermatitis and so on are not expected since the values obtained for the starter, grower and finisher rations are very much in agreement with the minimum requirement of NRC (1994).

The proximate analysis of Livestock (LSF) was also carried out and the results is presented in Table 3. The moisture content shows that LSF will have a longer shelf life since moisture content of feeds varies inversely as shelf life (Aremu *et al.*, 2006).

From Table 3, the proximate analysis of LSF give protein contents which are a little less than the recommended minimum by NRC (1994). Symptoms due to protein deficiency may likely occur due to continuous synthesis and degradation in building of body parts such as nerves, muscles, cartilage etc. according to Applegate and Angel (2008) as also collaborated by Mbajiorgu *et al* (2011).

Fat contents were also at appreciable levels, which are above the minimum limit according NRC (1994). It is expected that these feeds will be of great benefit to the chickens by increasing absorption of fat soluble vitamins A,D,E,K and other nutrients since fat in feeds lowers the passage of digesta in the gastrointestinal tract (Baiao and Lara, 2005; Jacob, 2018).

The carbohydrate contents just like the fat which are the source of metabolizable energy was found to be in agreement with values obtained by Ooi et al (2012) and are in concurrence with values recommended by both NRC (1994) and FAO (2010).

Ash content of LSF was also found to be promising, since large value of Ash Content indicate the presence of sizeable amount of mineral in the feeds (Nielsen, 2010). In addition; analysis of macro and trace minerals were carried out and presented in Table 4.

Table 4 shows the amount of calcium (Ca) to be above the minimum requirement for poultry as recommended by NRC (1994) and Kekeocha (1984). Chickens fed with such feeds are expected to have healthy bones, good enzymes activation, hormone secretion and blood clotting (Campbell et al, 2006).

Phosphorus content of LSF starter, grower and finisher rations were found to be below the minimum requirement needed to overcome diseases relating to phosphorus deficiency, in other words, phosphorus related diseases may occur (Fleck, 1976; Campbell et al, 2006; FAO, 2010).

Potassium content of LSF from Table 4 were found to be high. Chickens fed with such feed will be healthy as the feeds contains optimum amount of Potassium needed for proper growth and development of the chickens. Diseases due to poor acid-base balance, poor uptake of amino acids and glucose and lack of muscles excitability are not expected in the chickens (Barneegee, 1992; Oliviera, 2005).

It can also be seen from Table 4 that LSF is very rich in trace minerals like iron, zinc and copper. These values are good enough for optimum growth of the chickens since it is above the minimum requirement recommended by NRC (1994) but not up to the toxicity levels cited in Oluyemi and Roberts (2000). Chickens fed with such feeds will have better metabolism and reproduction performance, good feathering etc (Park et al, 2004). Zinc deficiency symptoms cannot be anticipated because the amount present are above the 40 mg/kg minimum recommended by NRC (1994). Also, the copper content from Table 4 , which are higher than the required minimum of 8 mg but not up to the 250-806 mg/kg toxicity levels capable of causing adverse effects such as mortality, reduced growth, gizzard erosion, exudative diathesis and muscular dystrophy (NRC, 1994; Abduljaleel, 2016).

4. Conclusion

The results have shown that both VSF and LSF poultry feeds companies have optimum nutrients in their feeds which meet most of the requirements recommended by both NRC and FAO. Therefore, they are safe and can be used by poultry farmers in raising their poultry.

Conflict of interest

The authors declare no conflict of interest.

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