Quality assessment of some commercially produced animal feeds and two native forages in southern Nigeria

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Abstract

Samples of broiler starter feed, grower mash, broiler finisher feed and layers mash were collected from three commercial feed manufacturers and were coded commercial feed A (CFA), commercial feed B (CFB) and commercial feed C (CFC). The proximate compositions of the feed samples were determined using the methods of the Association of the Official Analytical Chemists (AOAC). Forage samples of *Andropogon gayanus* and *Panicum maximum* at young growth stage were also collected from two locations, Ado-Ekiti and Port Harcourt (PH). The proximate composition for broiler starter feed was 8.2% DM, 19.9%CP, 3.2% crude fat, 4.2% crude fibre, 10.3% ash, and 2893.8kcal/kg ME. Growers mash had 8.2% DM, 15.1% CP, 2.0 % crude fat, 5.3% crude fibre, 14.0% ash and 2663.3kcal/kg energy. The results of *A. gayanus* from Ado-Ekiti was 11.46% DM, 9.16% CP, 0.89 fat, 32.18% crude fibre, 8.07% ash, and 1103.6kcal/kg energy, while *P. maximum* had 16.37% DM, 11.50%CP, 1.21% crude fat, 32.65% crude fibre 8.78% ash and 1215.4kcal/kg energy. Proximate composition of *A. gayanus* from PH was 10.38% DM, 10.823% CP, 0.883% crude fat, 30.803% crude fibre, 8.807% ash, and 1176.382kcal/kg energy. The results of the poultry feeds revealed little variation from what the labels state. *Panicum maximum* showed more promise than *A. gayanus*. Results of the proximate analysis of the poultry feed and forages examined in this study suggest that the commercial feed producers largely maintain the required nutritive contents of the feed types they produce, and the forages hold quality promise as feed resource for ruminants and forage reserve consideration. It is therefore, recommended that regular monitoring and screening of feed and feed resources should be done and sustained to ensure the safety and quality of animal feed.

Keywords: Proximate composition; poultry feed; forages; feed quality.

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Introduction

One of the most important aspects of livestock venture is feed and feed resources. Feed accounts for 70% of the cost of livestock production (Oyediji 2001; Uchegbu *et al* 2009). Therefore, the quality and safety of feeds and feed resources must be of great concern to the farmer, as these have direct impact on the overall quality of the production of animals.

The commercial poultry production attracts many farmers, which has resulted in increased demand for commercial feed. In order to meet demand, it is possible that some feed manufacturers could lower standards to produce low quality or substandard feeds. This is especially dangerous since regulations are poorly implemented and most regulatory agencies are ineffective (Okoli *et al* 2007; Okoli *et al* 2009; Omede 2008; Uchegbu *et al* 2009).

The objective of animal nutrition is to maximize the economic production performance. Uchegbu *et al* (2009) reported that diets are formulated to provide specific level of nutrients that are needed for optimum performance. The main production criteria normally looked into are; feed conversion ratio, growth rate, health of the animal and their body conformation. The major determinants of these are the energy, protein and amino acids contents of the diets.

Feed production ethics of practices and assurance schemes are established features of livestock industries in developed countries, this is not too evident in

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developing countries. Nigeria for example, for many years, until recently has no defined system of evaluating the quality and quantity of animal feeds being sold to poultry farmers. Well defined implementable standards and policies backed by government legislation are not very evident (Fagbenro and Adebayo 2005; Oyedeji *et al* 2013). There has been great increase in the number of people who venture into feed production and the question of quality and safety of these feeds have been a major concern (Okoli *et al* 2007). Quality and safety of feed resources can be viewed from different perspective. Proximate composition analysis is a common feed analysis used to determine the nutrient quality of a feed resource. Proximate analysis is used to assay the quality of commercially produced animal feeds and the information is usually put on the labels of bags of such feeds.

Native forages such as *Andropogon gayanus* and *Panicum maximum* are used as feed resources for ruminant animals. When added to layers mash, it helps to improve shell quality and egg yolk colour. Proximate analysis is also carried out on these forages to determine their quality. Factors which contribute to potential hazards in foods include improper agricultural practices; poor hygiene at all stages of the food chain; lack of preventive controls in food processing and preparation operations; misuse of chemicals; contaminated raw materials, ingredients and water; inadequate or improper storage, etc. (FAO, 2003). Adulteration and improper storage processes are major sources of concern of food hazards that affect production.

Crude fibre of 5%, crude protein of 22% and metabolizable energy of 2850kcal/kg for broiler starter chicken and Crude fiber of 5.5%, crude protein of 20% and metabolizable energy of 2900kcal/kg for broiler finisher chicken are the recommended nutritional requirement (Obioha 1992; Singh 2019; Ugwoke 2016). It was also recommended that the nutritional requirement for metabolizable energy should be 2800kcal/kg for broiler starter chicken and 3000kcal/kg broiler for finisher chicken. Furthermore, it was observed that crude protein values for all the commercial feeds ranged from 18.50-21.00% for starter diets and 18-19% for finisher diets. The crude fibre values of 4.40-5.55% for broiler starter and 5-5.55% for broiler finisher was reported for the commercial feeds. However, slight variation exists between the recommended nutrient value and the nutrient values of some commercial feeds. Proximate analysis is a very common routine chemical test for the composition of nutrient in feed, but information of nutrients on labels of commercially produced animal feed may not truly represent what they state and this can easily undermine optimal animal productivity (Aduku 2004; Uchegbu *et al* 2009).

Comparatively, conclusion could be made by mere looking at some grasses that one maybe more nutritious than the other. Perception from human vantage is not enough to tell the nutritional quality of grasses (Lloyd *et al* 1978). Proximate analysis allows for legitimate and quantitative comparison of feeds on the basis of specific nutrients (Gizzi and Givens 2004). Practical knowledge of all the proximate components of various feeds is useful in predicting performance of livestock fed with these feeds (Lloyd *et al* 1978). Factors related to performance such as digestibility and intake are predicted using proximate analysis to estimate performance. However, it has been noted that the proximate system has problems, as such; it is not an excellent predictive tool for performance (Mueller-Harvey 2004).

Permanent selection of plants to create varieties to supply better feeds for animal nutrition generally has been ongoing for thousands of years. Selection should be based on improved organic matter digestibility and consequently an increased energy value, a reduction of the presence of anti-nutritional factors or a better resistance against diseases or unfavorable environmental condition (Decuypere *et al* 1998). The objective of this study therefore, is to assess the nutritional quality of commercially produced animal feeds and selected native forages (*A. gayanus* and *P. maximum*) using proximate analyses techniques.

Materials and methods

Sample collection

Commercially produced poultry feed were collected from three major distributors in Port Harcourt; Top Feed, Vital Feed and Hybrid Feed and were coded Commercial Feed A (CFA), Commercial Feed B (CFB), and Commercial Feed C (CFC), respectively. Four different feed types were collected from each of these brands, these were the Broiler starter feed, Broiler finisher feed, Grower mash and Layers mash.

The native forages, *A. gayanus* and *P. maximum* were collected from both Ado-Ekiti and Port Harcourt. The location sampling was at Afe Babalola University, Ado-Ekiti, and Port Harcourt sampling was at the University of Port Harcourt and Choba bridge area, Obio-Akpor Local Government Area (LGA). All samples were collected between July, 2013 and January, 2014.

Sample analyses

Feed samples of 500g were finely ground using grinding machine in the Animal Care laboratory at the feed analysis laboratory, Asaba and kept in an airtight container before chemical analysis. The Forage samples were air dried and analysed in three replicates at the Ibadan laboratory of Animal Care LTD, while the poultry feed samples were analysed in the Asaba laboratory.

Proximate composition analysis

Analytical methods The proximate composition (Dry Matter, Crude protein, Crude lipid, Ash, Nitrogen free extracts (NFE) and Crude fibre) of the different commercial poultry feeds and native forages were analysed according to standard procedures in Association of Official Analytical Chemists (AOAC, 1989). Triplicate samples of each commercial poultry feed types and native forages were used to determine the chemical compositions.

Statistical analysis

The Statistical Package for the Social Sciences (SPSS) was used for all statistical analyses. Analysis of variance (ANOVA) was used to compare the means analytes. Significance was determined at $p<0.05$.

Results

The proximate compositions of broiler starter feed are presented in Table 1. The result show that CFC has the highest protein level (23.2%) while CFA and CFB had lower value (18.20%) CP. CFC also had the highest energy content (3015.70kcal/kg). The proximate composition of growers mash feed results are shown in Table 2, CFA has very low protein content (12.7%), while CFB had the highest CP content (17.3%), while CFC had high ash content (19.59%). The proximate composition of broiler finisher feed results as presented in Table 3, showed that CFA had the lowest crude protein content value (15.8%), CFB had the highest CP (20.7%) and CFC had (17%) CP. The proximate composition of layer mash feed results are presented in the Table 4, CFB has the lowest CP (15.4%). The results of the proximate composition of the two forages from Ado-Ekiti and Port Harcourt are shown in Table 5, *A. gayanus* collected from Ado-Ekiti had moisture content of 11.46%, crude protein, 9.16%, fat, 0.89%, fibre, 32.18%, Ash, 8.07 and the energy was 1103.6kcal/kg. The results of proximate composition of *A. gayanus* collected from Port Harcourt showed DM content to be 10.83%, crude protein, 10.38%, fat, 0.88%, fibre, 30.80%, Ash, 8.80 and the energy was 1176.38kcal/kg. The results of proximate composition for *P. maximum* collected from Ado-Ekiti showed that moisture content was 16.37%, crude protein, 11.50%, fat, 1.21%, fibre, 32.65%, Ash, 8.72 and energy was 1215.4kcal/kg. The results of proximate composition for *P. maximum* collected from Port Harcourt showed DM content was 16.2%, crude protein, 10.89%, fat, 1.03%, fiber, 32.03%, Ash, 8.80 and energy was 1254.92kcal/kg.

Table 1: Proximate composition of broiler starter of the three commercially produced poultry feed

Nutrients	CFA	CFB	CFC	SEM
DM (%)	8.40	9.20	7.10	0.60
CP (%)	18.20	18.20	23.20	1.70
Fat (%)	3.60	1.90	4.00	0.60
Fibre (%)	6.30	3.60	2.60	1.10
Ash (%)	11.40	11.30	8.24	1.00
NFE(%)	52.10	55.80	54.80	1.20
Gross Energy (kcal/kg)	2793.83	2781.82	3105.70	106.00

- CFA, CFB and CFC denotes Commercial Feed A, B, C and are code names for Top Feed, Vital feed and Hybrid feed, respectively, DM = dry matter, CP = crude protein , NFE = nitrogen free extract
- SEM: Standard Error of the Mean

Table 2: Proximate composition of growers mash of the three commercially produced poultry feed

Nutrients	CFA	CFB	CFC	SEM
DM (%)	8.00	8.60	7.90	0.20
CP (%)	12.70	17.30	15.20	1.30
Fat (%)	1.70	0.90	3.50	0.80
Fibre (%)	5.40	5.80	4.70	0.30
Ash (%)	12.10	10.40	19.50	2.80
NFE(%)	60.08	56.99	49.17	3.30
Gross Energy (kcal/kg)	2711.76	2708.37	2569.65	46.80

- CFA, CFB and CFC denotes Commercial Feed A, B, C and are code names for Top Feed, Vital feed and Hybrid feed, respectively, DM = dry matter, CP = crude protein, NFE = nitrogen free extract
-SEM: Standard Error of the Mean

Table 3: Proximate analysis of broiler finisher of three commercially produced poultry feed

NUTRIENTS	CFA	CFB	CFC	SEM
DM (%)	6.90	7.80	8.4.00	0.40
CP (%)	15.80	20.70	17.00	1.50
Fat (%)	2.90	3.80	1.80	0.60
Fibre (%)	5.00	4.80	4.30	0.20
Ash (%)	14.53	8.78	11.88	1.70
NFE(%)	54.87	54.12	56.62	0.80
Gross Energy (kcal/kg)	2732.27	2970.94	2757.94	75.60

CFA, CFB and CFC denotes Commercial Feed A,B, C and are code names for Top Feed, Vital feed and Hybrid feed respectively
SEM: Standard Error of the Mean

Table 4: Proximate analysis of layer mash of three commercially produced poultry feed

NUTRIENTS	CFA	CFB	CFC	SEM
DM (%)	8.40	8.20	8.60	0.10
CP (%)	16.70	15.40	16.2	0.40
Fat (%)	2.80	0.80	1.60	0.60
Fibre (%)	5.40	5.40	6.80	0.50
Ash (%)	12.92	13.76	13.61	0.30
NFE(%)	53.78	56.44	53.19	0.90
Gross Energy (kcal/kg)	2729.24	2781.82	2591.93	56.6

CFA, CFB and CFC denotes Commercial Feed A,B, C and are code names for Top Feed, Vital feed and Hybrid feed respectively
SEM: Standard Error of the Mean

Table 5: Proximate Composition of Selected Forages

	Andropogon gayanus			*Panicum maximum*		
	Ado-Ekiti	Port Harcourt	SEM	Ado-Ekiti	Port Harcourt	SEM
DM (%)	11.46	10.83	0.31	16.37	16.29	0.04
CP (%)	9.16	10.38	0.61	11.50	10.89	0.30
FAT (%)	0.89	0.89	0.00	1.21	1.03	0.09
FIBRE (%)	32.18	30.80	0.69	32.65	32.03	0.31
ASH (%)	8.07	8.80	0.36	8.72	8.81	0.04
NFE(%)	38.24	38.30	003	29.55	30.95	0.70
GROSS ENERGY (kcal/kg)	1103.6	1176.38	36.39	1215.90	1254.92	19.51

SEM: Standard Error of the Mean, DM = dry matter CP= crude protein

Discussion

Feeds are assessed so that the nutrient requirements of animals are met. Laboratory methods have been used to help define animal feeds, assess their nutritive value and provide data for the prediction of animal's performance. Ultimately, any assessment of feed's worth must be based on its ability to support life, growth and reproduction in the animal (Oyedeji *et al* 2013). The crude protein standard for broiler starter feed is 23% in the tropics. Results in this study showed that CFC was slightly higher than CFA and CFB. The energy level for CFC was also within the standard requirement while CFA and CFB were lower than the NRC standard (Aduku 2004). In the tropics, allowances are usually made for the increase of standards set for temperate region. Usually, energy levels of 3000kcal/kg to 3200kcal/kg may be required. The entire nutrient requirement must be increased in the appropriate proportion. For birds' feed to satisfy their energy level, a balance ration should be maintained to sustain the quality of production (Oyedeji *et al* 2013). Oyedeji *et al* (2013) stated that in most cases the crude fat percentages of the commercial feeds were much higher than the values declared on bag labels. However, it was observed that the crude fat percentages were lower for most of the samples than those declared on the labels and the standard requirement and variation in observation could be adduced to differences in feed sources.

Fat, among other functions is used as a source of energy in poultry feeds. However, the consequences of high fat contents in feeds produced in tropical environment include feed deterioration as a result of oxidative rancidity and possible bad odour development. Such feeds can cause serious health hazards to the birds when subjected to long storage. The optimal fat content for broiler starter was reported to be between 3.0-5.0 (CARII 1989), in this study we observed a mean fat value of 3.2 although lower values of 1.9% were reported for CFB. The results of proximate composition of grower mash feed showed that metabolizable energy values were lower for CFA, CFB and CFC. The recommended value required for tropical region is actually 2650kcal/kg (Aduku 2004), which was close to the result obtained. CFA and CFB had higher values of 2711.76kcal/kg and 2708.37kcal/kg respectively. The crude protein of 12.7%, 17.3% and 15.2% were obtained for CFA, CFB, and CFC, respectively with an average value of 15.1%, which is in consonance with the value of 15% on their labels. However, CFA had lower CP value of 12.7%, which is below the recommended range of 16-17% (Aduku 2004; CARII 1989).

The fat (optimum) for growers mash was reported to be between 3.0 and 5.0% (CARII 1989). However, 2.0% was reported, which is lower than the recommended value. Fats are regularly used in poultry feed to satisfy the energy need of the animal as lipids have more than twice the amount of metabolizable energy compared with carbohydrates or proteins per kilogram. The value of crude fibre on the labels was between 8.6% and 10%. However, a lower value (5.3%) was estimated in this study, which was lower than the recommended value of 6-7%.

Two native forages (*A. gayanus* and *P. maximum*) were analysed for proximate composition. The crude protein for *A. gayanus* and *P. maximum* from Ado-Ekiti had mean values of 9.16% and 11.50% respectively. For Port Harcourt samples, the mean values were 10.38% and 10.89% for *A. gayanus* and *P. maximum*, respectively. Earlier research works had reported 8.9% CP for *A. gayanus* and 8.4% CP for *P. maximum* (Aremu *et al* 2007). Also, Odedire and Babayemi (2008) reported mean CP of 6.72% for *A. gayanus* and 9.36% for *P. maximum*. The CP contents of both forage types were within the required values for optimal performance of ruminants (NRC 1981). The CP values of the *P. maximum* and *A. gayanus* studied were above the critical CP level of 7% is recommended by ARC (1980) and the 8% suggested by (Norton 1994) for proper rumen function.

The fat composition in these grasses was 0.89% and 1.21% for *A. gayanus* and *P. maximum*, respectively in Ado-Ekiti. Port Harcourt forage sample had fat value of 0.88% for *A. gayanus* and 1.03% for *P. maximum.* Aremu *et al* (2007) reported values of 6.3% and 5.4% for *A. gayanus* and *P. maximum*, respectively. The difference could be due to a number of factors, which may include season of harvest or location. The energy derivable from the grasses is used by the animal for body maintenance and production.

The fibre contents have implication on the digestibility of plants. For temperate region 19% to 21% is recommended for ruminant animal (Moorby and Fraser 2021). Forages from both sampling locations showed higher values. The crude fibre content of *A. gayanus* and *P. maximum* from Ado-Ekiti were 32.18% and 32.65%, respectively, while for Port Harcourt, it was 30.80% and 32.03% for *A. gayanus* and *P. maximum*, respectively. The neutral detergent fibre (NDF) is inversely related to the plants' digestibility (Gillespie 1998; McDonald *et al* 1995). The NDF, which we did not consider independently, is a measure of the plants' chemical component of cell wall contents, this determines its rate of digestion. The higher the NDF value, the lower the plant's digestible energy.

Lignin content of a plant is the most indigestible component of the fibre fractions (Gillespie 1998; Aremu *et al* 2007) and its amount will also influence the plant's digestibility. Therefore, since the lignin content of *P. maximum* (7.0%) is lower than *A. gayanus* (9.0%), the former can easily be digested by grazing animals compared to the latter (Aremu *et al* 2007). The ash content represents the inorganic (mineral matter) content in a feed. It contains mainly phosphorus, calcium, or potassium and large amounts of silica (Bogdan 1977; Aremu *et al* 2007). The values obtained for both grasses in Ado-Ekiti and Port Harcourt fall within the range of 8.07-8.8%. Odedire *et al* (2008) reported values of 10.50-12.0%, Gillespie reported (1998) values of 3-12%, Bogdan (1977) reported values of 8-12% while Aremu *et al* (2007) reported values of 8.7-14.1%. This study has shown that the studied commercially produced animal feeds contain nutrients in the right amounts necessary for proper, qualitative and safe livestock production. Generally, the crude protein, fat, fibre and metabolizable energy were within the ranges in the labels, which are also in consonance with the widely acceptable range for nutrient requirement for poultry (Odedire *et al* 2008). However, the broiler finisher for CFA and CFC showed very low CP as against the label and broiler finisher requirement. This could lead to low market weight of the birds resulting in economic loss for the farmer.

Andropogon gayanus and *P. maximum* showed ideal proximate composition in both Ado-Ekiti samples and Port Harcourt samples. Crude protein range for *A. gayanus* and *P. maximum* were higher than that recorded in previous studies (Aremu *et al* 2007 and Odedire *et al* 2008). Ash values were within the range for forages but fat values were very low for both grasses.

Conclusion

This study shows that most of the sampled feeds had the same proximate composition as stated on the labels. The results also showed that the content of the feeds are within the recommended standards. Furthermore, the proximate analysis of the native forages were consistent with the observation that *P. maximum* was a more nutritious forage than *A. gayanus*, as earlier observed. *Panicum maximum* may also have better yield than *A. gayanus.* Based on our results, sourcing of feeds from known manufactures, regular monitoring and enforcement of regulations are recommended to ensure production of animals of high quality.

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