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Biochemical, Physical and Performance Evaluations of Some Commercial Growers and Layers Ration Manufactured in Nigeria

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Abstract: Biochemical, physical and performance evaluation studies were carried out in order to determine the quality of four commercial growers rations, (GF, SF, TF and VF) and five commercial layer rations (GF, SF, TF, VF and LF) manufactured in Nigeria. Percentage moisture content (% MC), Ash content (% AC), Ether extract (% NFE) and calculated metabolizable energy (ME) in MJ kg^{-1} were determined by proximate analysis and compared with the nutrient values declared on the brand labels. Performance was investigated using 60, 4-month-of-lay commercial laying birds in a 10-week experiment. Four treatment diets including three commercial rations (GF, SF and LF) and a control diet (CF) were fed to 3 replicated groups of the experimental birds each in a completely randomized design (CRD) experiment. Percentage MC of TF growers ration (14.75%) and GF layers ration (17.25%) were significantly ($p<0.05$) higher than others. Both the analyzed and declared values of crude protein in both feed types were statistically similar ($p<0.05$) for all feed brands. All other parameters showed either a significantly higher or lower values when comparing the analyzed values with the declared values of the nutrients in all feed brands. TF and GF recorded significantly higher ME (MJ kg^{-1}) in growers and layers rations respectively than the rest. The overall mean weights of feedbags ranged from 24.66±0.52 kg for GF to 25±0.02 for VF and were statistically similar to the declared 25 kg/bag of feed by manufacturers. Average feed intake was significantly ($p>0.05$) lower in the control diet (CF). Highest body weight change was recorded in LF and CF while GF and SF were similar. CF, SF and LF, though statistically similar ($p>0.05$) recorded higher percentages of her-day production than GF. LF, CF and GF on the other hand, recorded significantly higher average egg weight than SF ($p<0.05$). SF was the most economical in terms of cost of feed kg^{-1} egg and per kg feed. Commercial feed millers seem to more concerned with the CP% content of their feeds while compromising the quality of other nutrient components.

Key words: Commercial feeds, proximate composition, poultry, performance, Nigeria

INTRODUCTION

Quality control practices in the feed industry has been much easier in developed countries where clearly stated feed production codes of practices and assurance schemes have been developed. In developing countries such as Nigeria, quality control agencies in the feed industry are none-existent. There has hardly been any serious effort directed at evaluating and regulating the quality and hygiene of animal feeds being released to the public in the country.

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In Nigeria, inadequate supply, poor quality and high cost of feeds and feed raw materials has been recognized as major constraints to livestock production. Efforts to alleviate these inadequacies begin with informed knowledge of the nutritional characteristics of various available feed resources.

Income in livestock production is highly dependent on feed utilization, which accounts for 60-80% of the total production cost (Abebowale *et al*., 1998). It is therefore very important to ensure that quality feed with appropriate nutritional values and suitable for efficient production is invested in by the farmer. Since it is still a luxury as well as an ethical issue to feed high proportion of conventional protein and energy sources to livestock in a developing country like Nigeria when these sources are still far from meeting human needs (Adesduinwa *et al*., 2001), Nigerian feed manufacturers in their bid to save cost may not be very particular about the nutritional standards required of their products. Nutritive value on the other hand, is a function of digestibility biochemical composition and the presence or absence of anti-nutritional factors (Afolabi *et al*., 1998).

The nutritive values of animal feeds and feed stuffs could vary as a result of factors such as time and age of feed materials and processing methods (Esonu *et al*., 2001), seasonal variation and method of conservation (Ekwong *et al*., 1996), as well as possible presence of toxic substances (Ega *et al*., 1992; Day, 2001), amongst many others. Proper utilization of feed by animal may however be affected by milling efficiency, especially when lack of maintenances of the machines leads to production of finer or coarser grit of feed samples (AFFP, 2002).

Foods in relation to animal products are sources of foodborne diseases and have remained important public health threat worldwide (Abanuslum *et al*., 2003). However, this public health threat is related to so many factors one which is the feeds and feedstuffs used in feeding the animals. For example attention has been drawn to contamination of eggs and animal fats with Olefins and n-alkenes arising from incorporation of mineral oils into animal feeds (Grob *et al*., 2001). Similarly, the Scientific Committee on Animal Nutrition of the European Union established that fishmeal and fish oil of European origin were heavily contaminated feedstuffs and animals fed with such contaminated fish meal could be affected in such a way that will reduce their production levels and the quality of their products (Immerseel *et al*., 2002).

Present study evaluates the biochemical, physical and performance characteristics of four commercial grower and layer rations manufactured in Nigeria.

MATERIALS AND METHODS

Samples Selection and Collection

An informal diagnostic survey of commercial poultry feed marketers in Owerri, Imo State, Nigeria was conducted, upon which a list of 8 commercial feed brands was drawn up. The four most popular brands were purposively selected from the study and popularity was established by a brand having up to five outlets in the city. The selected brands were coded GF, SF, TF and VF. It was ascertained that none of the batches of feed sampled had stayed over one week in the store. At each sampling site Grower Mash (GM) and Layer Mash (LM) were sampled.

Sampling was by carefully opening randomly selected bags and collecting about 3 g of feed into a clean cellophane bag. Five bags were sampled in this way per feed type and later pooled and homogenized thoroughly to form a representative sample of that feed type. Overall, about 15 g of each sample type was collected, sealed and carefully labeled. Altogether, eight samples made up of one homogenized sampled each of GM and LM from the four commercial feed brands (GF, SF, TF and VF) were collected.

Evaluation of Physical Characteristics

Five bags of each feed type were weighted in kilogram with a platform scale (Avery ®) and the mean weights as well as the nutrients values declared on the brand labels recorded. Each of the bags of

feed was further examined for other physical characteristics such as presence of insects, age, texture (pelleted or mash) and type of packaging materials used and the findings also recorded.

Biochemical Analysis

The biochemical compositions of the feed samples were determined according to the AOAC procedures (AOAC, 1990). Percentage Moisture Content (MC), Ash Content (AC), Ether Extract (EE), Crude Fiber (CF), Crude Protein (CP), Nitrogen Free Extract (NFE) and calculated Metabolizable Energy (ME) were determined and compared with the nutrient values declared on the brand labels. Metabolizable energy values les were calculated based on their proximate compositions using the prediction equation outlined by Morgan *et al*. (1975) as follows:

$$ME\ (MJ\ kg^{-1}) = 0.0416CP + 0.0605\ EE + 0.367\ NFE - 20.6$$

Where,

ME = Metabolizable energy,
CP = Crude protein,
EE = Ether extract,
NFE = Nitrogen free extract.

Performance Evaluation

Three commercial layers mashes GF, SF and LF (Livestock feed) and a control diet (CF) were used to conduct a feeding trial experiment to determine the performance characteristics of laying birds fed the commercial feeds, while CF was a formulated layers mash ration (Table 1). The cost of 1 kg of each commercial ration and the cost of producing 1 kg of the control diet in Naira (Nigerian Currency) were determined and recorded.

Sixty 4-month-of lay, commercial Bovan brown laying birds were used for the feeding trial experiment. The birds were divided into four groups of 15 birds each. Each group was further divided into 3 replicates of 5 birds each and kept in a 1×2 m compartment. The four groups were randomly assigned the treatment diets. The birds were reared on a deep-litter and subjected to the same experimental and management conditions. Water and feed were provided *ad libitum*. Feeds were weighed daily and fed to the birds every morning and the left over weighed the following morning to determine the daily feed intake. The birds were weighed at the beginning of the experiment and at the end of the experiment. Eggs were collected on daily basis and weighed for 10 weeks duration of the work.

Table 1: Ingredient composition of the control diet (CF)

Ingredients	Percentage
Maize	52.00
Soybean	10.00
Wheat offal	13.00
Palm kernel cake	9.00
Fish meal	2.00
Blood meal	2.00
Bone meal	7.00
Limestone	4.00
Vitamin/premix	0.25
L-lysine	0.25
L-methonire	0.25
Salt	0.25
Total	100.00

Micro-mix premix layers, 2.5 kg of the premix contains: Vit A-10,000,000 I.U; Vit D_3-2,000,000 I.U; Vit E-23,600 mg; Vit K_3-2,00 mg; Vit B_1-3,000 mg; Vit B_2-6,000 mg; Niacin-50,000 mg; Calcium panhothenate-10,000 mg; Vit B6-5,000 mg; Vit B_{12}-25 mg; Folic acid-1,000 mg; Biofin-50 mg; Choline chloride-400,000 mg; Manganese-120,000 mg; Iron-100,000 mg; Zinc-80,000 mg; Copper-8,500 mg; Iodine-1,500 mg; Cobalt-300 mg; Selenium-12 mg; Anti-oxidant-120,000 mg

Data Analysis

Data generated (proximate and brand label values, feed weights, feed intake, Initial and final body weights, Hen day production, egg weight) were subjected to one-way analysis of variance as outlined by Steel and Torrie (1980). Where the analysis of variance indicated significant treatment effects, means were compared using the Least Significant Difference (LDS) and student t-test methods as outlined by Steel and Torrie (1980).

RESULTS

Physical Characteristics

Table 2a shows the mean gross weights in kilogram of the commercial growers and layers ration bags. The overall mean gross weights were statistically similar to the 25 kg declared by the various manufacturers. Table 2b showed that GF and VF were pelleted while the other brands were not. VF growers mash at 5 days of age was the oldest feed in the sampled retail stores. Most of the feed brands were just 2 days old. All feeds were packaged with polyethylene woven bags and none harbored any visible insect.

Biochemical Characteristics

Table 3 shows the biochemical composition of the commercial growers and layers rations. Moisture content of TF growers mash and GF layers mash were significantly ($p<0.05$) higher than others, while VF had the least moisture content values both in growers and layers ration. GF had a

Table 2: Physical characteristics of commercial growers and layers ration manufactured in Nigeria

A. Mean weights in kilogram of the feedbags (brand label declared weight = 25 kg) feed brands

Feed types	GF	SF	TF	VF
GM	24.40±0.89	24.75±0.55	24.98±0.04	25.96±0.04
LM	24.92±0.25	24.76±0.54	25.60±0.00	25.00±0.00
Overall mean	24.66±0.52	24.75±0.01	24.99±0.02	25.01±0.02

B. Other physical characteristics

	GF		SF		TF		VF	
Parameters	GM	LM	GM	LM	GM	LM	GM	LM
Insects	NP	NP	NP	NP	NP	NP	NP	NP
Pelleted	+	+	-	-	-	-	+	+
Age in days	2	2	2	2	3	2	5	3
Type of bag	PWS	PWS	PWS	PWS	PWS	PWS	PWS	PWS

NP = Not Pelleted, PWS = Polyethene Woven Sack

Table 3: Biochemical composition commercial growers and layers rations manufactured in Nigeria feed brand

Parameters	Feed type	GF	SF	TF	VF	SEM
MC (%)	GM	10.50^{b}	11.75^{ab}	14.75^{a}	8.25^{b}	1.36
	LM	17.25^{a}	9.75^{b}	12.50^{ab}	6.50^{b}	2.28
AC (%)	GM	8.00^{a}	6.00^{ab}	4.00^{b}	5.50^{b}	0.83
	LM	11.00^{a}	8.50^{ab}	7.50^{b}	12.00^{a}	1.05
CF (%)	GM	8.52^{ab}	9.75^{a}	7.85^{b}	7.56^{b}	0.49
	LM	5.00^{a}	9.00^{a}	7.00^{ab}	5.75^{b}	0.87
EE (%)	GM	6.43	5.35	5.12	5.84	0.69
	LM	5.85^{a}	5.70^{a}	4.13^{b}	4.88^{ab}	0.42
NFE (%)	GM	52.33^{b}	51.45^{b}	52.63^{b}	57.82^{a}	1.44
	LM	55.50^{a}	49.75^{b}	51.57^{bc}	54.17^{ac}	1.30
ME (MJ kg^{-1})	GM	8.52^{b}	8.06^{b}	8.32^{b}	10.40^{a}	0.53
	LM	10.13^{a}	8.30^{b}	7.69^{b}	9.11^{b}	0.53

$^{a, b, c}$Means with different superscript within the same raw are significantly different; GM: Growers Mash, LM = Layers Mash; GF, SF, TF and VF represent 4 brands of feed used in this study; SEM = Stand Error of the Mean; MC = Moisture Content, AC = ASH Content, CF = Crude Fiber, EE = Either Extract, CP = Crude Protein, NFC = Nitrogen Free Extract, ME = Metabolizable Energy

significantly higher ash content value in its growers mash than the rest ($p<0.05$) except SF. Also GF recorded a significantly higher ash content value ($p<0.05$) than the rest of the feeds in its layers ration. The crude fiber values of SF were significantly higher than the values recorded in other feed brands both in the growers and layers rations except in GF and TF, respectively ($p<0.05$). There was no significant difference in the ether extract values of all the feed brands in their growers rations, however significant difference ($p<0.05$) was observed when comparing the layers ration figures of GF, SF and VF with that of TF while TF and VF were not significantly different from each other.

In crude protein, while SF, TP and VF where not significantly different from each other in their growers ration, SF and TF were significantly ($p<0.05$) higher than GF in their crude protein values. SF on the other hand, was significantly higher than GF and TF in their layers ration. The Nitrogen free extract values of GF, SF and VF were significantly ($p<0.05$) lower than that of VF in their grower rations while GF had the highest nitrogen free extract value which was significantly different from the values of SF and TF in the layers rations. The calculated metabolizable energy value of VF grower ration was significantly ($p<0.05$) higher than the rest while GF was equally highest among the layers rations.

All the brands declared crude fiber, either extract and crude protein values on their labels, while the metabolizable energy content of SF was not declared (Table 4). Only GF has its Ash content declared and had a significantly ($p<0.05$) higher declared value in layers mash. Analyzed crude fiber values of GF, SF and VF in growers ration and SF, TF and VF in layers ration were significantly ($p<0.05$) higher than the declared values on their labels. Also, all the analyzed values of the ether extract in GF, SF and TF growers ration and GF, SF, TF and VF layers ration were significantly ($p<0.05$) higher than the declared values.

Both the analyzed and declared values of crude protein in both rations across all feed brands were statistically similar ($p<0.05$). Only TF showed a significantly ($p<0.05$) lower analyzed values in both feed types while the rest brands showed statistically similar values ($p<0.05$) in both values.

Table 4: Composition of laboratory analysis and brands label declared biochemical composition of commercial growers and layers ration manufactured in Nigeria

	Growers mash			Layer mash		
Parameters	Analyzed	Label	p-value	Analyzed	Label	p-value
AC (%)**						
GF	8.60	8.00	0.0001	11.00	12.90	0.51*
SF	6.00	ND	-	8.50	ND	-
TF	4.00	ND	-	7.50	ND	-
VF	5.50	ND	-	12.00	ND	-
CF (%)						
GF	8.52	7.20	0.053	5.00	5.00	<0.0001
SF	9.75	8.00	0.063	9.00	5.00	0.177*
TF	7.85	5.50	0.111	7.00	4.50	0.136*
VF	7.56	7.20	0.016	5.75	4.60	0.070*
EE (%)						
GF	6.43	4.80	0.016	5.85	4.00	0.118*
SF	5.35	3.50	0.092	5.70	3.50	0.149*
TF	5.12	3.00	0.131	4.13	3.00	0.100*
VF	5.84	7.00	0.163	4.88	4.00	0.063*
CP (%)						
GF	14.50	14.50	0.0001	16.40	16.50	0.064
SF	15.73	15.00	0.015	17.30	16.50	0.002
TF	15.65	15.00	0.014	16.51	16.00	0.015
VF	15.03	14.50	0.011	16.70	16.00	0.010
ME (MJ kg^{-1})						
GF	8.52	9.62	0.039	10.13	9.62	0.005
SF	8.06	ND	-	8.30	9.62	-
TF	8.32	11.00	0.088	7.69	ND	0.098*
VF	10.40	10.46	0.002	9.11	10.60	0.048

**All abbreviation carry the same meaning as in Table 3; *$p<0.05$; ND = Not Declared

Table 5: Chemical composition of the experimental diets (label values)

Nutrients	CF*	GF	SF	LF (livestock)
Crude protein	16.50	16.0	16.5	16.0
Crude fibre	4.29	5.0	5.0	6.5
Crude fat	4.42	4.0	3.5	5.0
ME (kcal kg^{-1})	2513.00	2300.0	-	2500.0

*NB: The values under CF are calculated values. All abbreviation carry the same meaning as in Table 3

Table 6: Performance of laying hens fed various commercial layers ration manufactured in Nigeria

	CF**	GF	SF	LF	
Parameters	Control	Guinea	Sanders	Livestock	SEM
Ave. initial body wt. (kg)	1.48^{a}	1.48^{a}	1.46^{a}	1.49^{a}	0.01
Ave. final body wt. (kg)	1.56^{a}	1.54^{a}	1.52^{a}	1.57^{a}	0.02
Body wt. change (g)	80.00^{a}	60.00^{b}	60.00^{b}	80.00^{a}	5.77
Hen-day production (g $bird^{-1}$ day^{-1})	69.21^{a}	60.15^{b}	68.09^{b}	68.10^{a}	2.10
Ave egg wt.	65.60^{a}	64.42^{a}	63.24^{b}	65.90^{a}	0.61
Ave feed intake (g $bird^{-1}$ day^{-1})	117.54^{b}	129.06^{a}	125.63^{a}	125.90^{a}	2.46
kg feed kg^{-1} egg	1.79^{b}	2.00^{a}	1.99^{a}	1.91^{ab}	0.05
Cost consideration					
kg feed kg^{-1} egg	1.79	2.00	1.99	1.91	
Cost of feed kg^{-1} (N*/kg)	34.10	44.80	41.80	44.80	
Cost of feed kg^{-1} egg	61.04	86.60	83.81	85.57	

*N = Naira, the official Currency of Nigeria.*CF = Control feed or diet, All abbreviation carry the same meaning as in Table 3

Performance Characteristics

GF gave a significantly lower egg ($p<0.05$) production than CF, SF and LF which were similar statistically ($p>0.05$). SF produced a significantly ($p<0.05$) lower egg weight than the control, CF, GF and LF (Table 5). The lowest feed intake was recorded in the control group and was significantly ($p>0.05$) lower than the commercial diets, while the highest feed intake was recorded with the birds feed GF. Birds fed CF and LF showed a significantly ($p<0.05$) higher body weight gain than those fed on GF and SF.

Similarly, Birds on CF and LF produced the best kg feed kg^{-1} egg values of 1.79 and 1.91, respectively. However, the feed that seemed to be most economical among the commercial diets was SF (41.0 kg^{-1} feed) while the control diet CF was generally, the cheapest at (34.10 kg^{-1} feed) (Table 6).

DISCUSSION

Information provided by the commercial poultry feeds manufactures in Nigeria is incomplete. Only the manufactures of GF gave the ash content values of their feeds on the label, while SF labels did not contain information on metabolizable energy which is an important factor in animal nutrition. Similarly, none of the feed manufactures declared information on the moisture and nitrogen free extract contents of their feeds. This information is very important since results of proximate analysis could reveal estimates of the nutrient potentials of feedstuffs (Okoli *et al*., 2003).

Slight variations were observed in the gross weight of the feedbags. This could be as a result of using different weighting equipments. The feed manufactures may also have used a more sensitive scale while a bathroom scale was used for this study. Moisture losses and dust storage and transportation or handling respectively, may have equally accounted for the variations in gross weights.

The optimal moisture content maintenance level for feeds of less than 14-15% (Esonu, 2000; Mabbett, 1998) were exceeded by some feed brands, for example, GF layers ration. Such higher percentage MC could support the growth of fungal organism in the feed when stored for too long (Vieira, 2003). Appreciable proportion of the declared weight of such a feed will be made up of water, thus making the farmer to receive less feed for his money's worth. This unethical inclusion of excess moisture in commercial feeds by manufactures seems to deliberate.

Feed manufactures may be using more fibrous feed raw materials other than conventional energy source since the results showed higher crude fiber values obtained from the laboratory analyses of the feed samples. Grains such as maize are costly these days, hence feed manufactures may aim only at ensuring that farmers' need of having enough feeds for their animals is not at the expense of quality.

From eight results for percentage EE, only VF grower mash showed a significantly lower analyzed value than the declared. The remaining seven results were significantly higher than the declared values as indicated on the feed manufactures' labels. The consequence of high fat content in feeds produced in tropical environments is that it could lead to early deterioration as a result of rancidity and possibly bad odor development. Such feeds can cause serious health hazards to the birds when subjected to extended storage.

It is very surprising to notice that no significant differences exists between the analyzed and brand labels declared crude protein values especially when compared with the degree of differences observed in the other nutritional parameters. This is suggestive of the probability of feed manufacturers. Being aware of the fact that the farmers are always on the lookout for percentage CP of the feed, they pay close attention to the balancing of CP content of their feeds while other nutritional compositions are apparently ignored.

The energy component of all commercial poultry rations usually make up the bulk of a feed. This also is the costliest part of the feed. The two values from TF show that energy in the form of calculated ME may be under supplied and may probably be deliberate and driven by an unethical desire to cut costs while compromising quality.

The reduced performance of birds fed GF layers ration could be attributed to its lower metabolizable energy when compared to the control diet and LF. Although the ME value for SF was not declared on the label, the calculated ME and the performance shown by the birds raised on it met the requirements for laying hens. Obioha (1992) noted that although feeds may be formulated to have identical energy, protein and mineral contents, one may be superior to the others if it contains less fiber, a higher amount of essential amino acids and more readily available forms of other nutrients.

The difference in egg weight among the commercial diets could be related to nutritional differences among other factors. Whitehead (2002) reported that most lipids in egg yolk is formed in the liver by using fatty acids obtained from the diet or from *de novo* synthesis and that providing dietary fat decreases the need for hepatic fatty acid synthesis and generally increases yolk formation and the weight of the egg.

While the lowest feed intake was seen in the control group, the highest numerical feed intake recorded with GF group is partly a reflection of its low density calorie (2300 kcal kg^{-1}), as the birds generally adjust feed consumption to meet their energy needs irrespective of the fact that it is palletized (Babatunde *et al*., 1999; Uko *et al*., 2001; Balagun *et al*., 2001).

The control diet and LF had better kg feed kg^{-1} egg as well as body weight gain than GF and SF. This may be supported by the fact that CF and LF had better energy to protein balance as well as the required ME values of both feed being met appropriately. However, it will be most economical to place the laying hens on the control diet judging from the result obtained from this study.

CONCLUSIONS

Due to lack of quality control agencies in the feed milling industry in Nigeria, it seems feed manufactures are less careful about meeting required standards in nutritional composition values of their feeds except crude protein. While the calculated metabolizable energy may not give a conclusive indication of the energy values of the commercial feeds, the performance evaluation of the control diet, LF and SF in terms of body weight gain, hen-day production, cost of feed kg^{-1} egg, average egg weight suggest they are better feeds, while farmers are encouraged to learn the technique of ration formulation so as to achieve better egg production and cost efficiency.

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