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# Response of broilers to three different commercial feeds

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**Abstract**

*Poultry farmers who rely on commercial feeds sourced from the market always suffer some forms of financial loss due to sub-standard nature of such feeds. The normal practice is to formulate a balanced diet and compound the feeds with good quality ingredients. These conditions are not always within the control of the farmers who rely on buying finished feeds from the market. There is dearth of information on the quality of these common types of feeds in the market with the aim of recommending the best to the farmers. This study was therefore, carried out to examine the response of broilers to three commercial feeds at the starter and finisher phases. One hundred and eighty 1-day-old unsexed Marshal broilers at three replicates of twenty birds each were used for the study; and lasted for eight weeks. Feed and water were supplied ad libitum. The performance, carcass, haematological and biochemical parameters of the experimental birds were measured. The three diets were tagged Diets 1, 2 and 3 each representing a treatment. The average final live weight (AFLW), daily weight gain (ADWG), daily feed intake (ADFI) and feed conversion ratio (FCR) were significantly (P < 0.05) influenced by the feed types (dietary treatments). The highest AFLW (758.37g/b) was obtained for broiler starters fed Diet 2 compared to 689.60g/b (Diet 1) and 263.37g/b (Diet 3). The ADWG followed the same trend with birds fed Diet 2 having the highest value (25.67g/b) compared with 23.22g/b (Diet 1) and 8.00g/b (Diet 3). The ADFI (starters) were 72.88, 80.36 and 62.20g/b respectively for birds fed Diets 1, 2 and 3. The corresponding ADFI (g/b/d) for the finishers were 133.63 (Diet 1), 177.53 (Diet 2) and 58.57 (Diet 3); and ADWG (g/b/d) 42.49 (Diet 1), 51.79 (Diet 2) and 8.57 (Diet 3). Diet 2 gave the best performance in terms of weight gain, followed by Diet 1 and Diet 3 in that order for the finishers. However, the average cost per kg weight gain of the birds for the 2 phases were ₦307.88 (Diet 1), ₦309.29 (Diet 2), and ₦582.74 (Diet 3). All the carcass (live weight, bled weight, plucked weight, eviscerated weight, dressed weight and abdominal fat); and internal organs such as heart, lung, liver, kidney, pancreas, intestine and proventriculus were significantly (P < 0.05) affected by dietary treatments. The RBC, Hb, Basophils, total protein, albumin and globulin differed significantly (P < 0.05) across the diets. It can be concluded that birds fed Diet 1 gave the best overall economic, carcass, haematology and serological performance. Commercial Diet (feed) 1 is therefore recommended for broiler farmers.*

**Keywords:** Broilers, performance, commercial feeds, haematology, serology

## Introduction

High cost of igredients used to compound livestock feeds is contributing to cutting corners by some commercial feed millers. In some instances, feeds are formulated such that the nutrients are not sufficient to meet the nutritional requirements of the stock for which it was formulated. Erratic changes in price of feed materials constantly force feed manufacturers to change formula used to produce feed in order to maintain reasonable gross margin (Edache *et al.,* 2018). The quality of the ingredients may also be sub-standard (low quality ingredients) to compound feeds. Livestock farmers who rely on these feed millers for the supply of their feeds may suffer some losses in terms of sub-optimal performance of the animals fed with such feeds. In order to avoid this, it is necessary to call the attention of farmers to availability of sub-standard feeds in the market. This information could be sourced from results of research works. Olajide and Adeleye, (2015) monitored the performance, carcass and blood indices of broilers started with super starter and or starter diet of a particular type of commercial feed. The duo concluded that feeding broilers with the starters for four weeks and finishers for four weeks was economical than using broiler super starter. Since animals are the best judge of feeds, there is the need to investigate the performance of broilers fed the commonly available three commercial feeds in the study area. This was done through holistic investigation of the performance, carcass, organs and blood indices of the experimental birds.

## Materials and methods

### *Experimental site*

This study was carried out at the Poultry Unit of the Teaching and Research Farm, Joseph Ayo Babalola University, Ikeji-Arakeji, Osun State, Nigeria. Ikeji -Arakeji is situated on 350.52m above sea level at latitude $7^0$ 25'N and at longitude $5^0$ 19'E. The vegetation of the area is that of the rainforest characterized by hot and humid climate. The mean annual rainfall is 1500mm and the rain period is bimodal with a short break in August with mean annual relative humidity of 75% and mean temperature of 26-28$^0$ C (Laoye, 2014).

### *Experimental birds and management*

One hundred and eighty 1-day-old unsexed Marshal broilers used for this study were purchased from a reputable Hatchery in Ibadan, Oyo State, Nigeria. There were sixty birds randomly distributed into each of the diets, with each feed representing a treatment. There were three replicates of twenty birds each in a completely randomized design (CRD) experiment. The birds were raised on deep litter pen earlier washed, disinfected; with wood shaving as litter material. Feed and water were supplied *ad libitum* throughout the period of the study. The vaccination and medication schedules were strictly followed.

### *Experimental diets*

Three types of freshly supplied Commercial feeds (starters and finishers) were used for this study which lasted for eight weeks; the first four weeks as starter and the next four as finisher. The feeds were tagged Diets 1, 2 and 3 each representing a treatment, respectively for the two phases of broiler production.

### Data collection

### *Growth performance*

Data were collected on the growth performance including average initial live weight, average final live weight, average daily weight gain and average daily feed intake. The last 2 parameters were used to compute the feed conversion ratio, as average daily feed intake divided by average daily weight gain. The cost per kg feed was obtained from the price of 25 kg bag feed; and this was subsequently used to calculate the cost of feed consumed to produce a kg live weight.

### *Carcass and organ evaluation*

At the end of the 8$^{th}$ week feeding trial, a total of 45 birds (15 birds/diet) at the rate of five birds per replicate were randomly selected for carcass and organ parameters evaluation. The birds were starved overnight to minimize the contents of the gastro-intestinal tract. The fasted live weight of the birds was recorded before slaughter. The birds were slaughtered by severing the jugular vein, thoroughly bled and scalded by immersion in warm water with temperature ranges from 52 -55 $^{\circ}$C for about two minutes before defeathering. The bled, plucked, eviscerated and dressed weights were taken at different stages of processing. The organs (heart, lung, liver, kidney, pancreas, intestine and proventriculus) were expressed as percentage of carcass. Carcass parts were also calculated as percentage of live weight.

***Haematological and serological parameters evaluation***

A total of twenty-seven randomly selected birds (nine birds per diet) were bled via the jugular vein in order to collect blood for haematological and serological indices evaluation. Blood samples for haematological parameters were collected into bottles pre-treated with Ethylene Diamine Tetra Acetic acid (EDTA), an anti-coagulant. Blood samples for serological analysis were collected into another sample bottles containing no EDTA. The ESr, RBC, Hb, lymphocytes, neutrophils, monocytes, basophils and eosinophils were investigated. Total protein, albumin, globulin and glucose were also monitored.

***Chemical analysis***

Proximate determination of the test diets was according to the method of AOAC, (2005). The ME was calculated according to procedure of Pauzenga (1985) as :

ME (kcal/kg DM) = 37 x % Protein + 81.8 x % Fat + 35.5 x NFE

***Statistical analysis***

Mean of the data collected were subjected to analysis of variance using SAS statistical package, SAS (2001); and the treatment means compared using Duncan option of the software.

**Results**

The proximate composition of the experimental starter and finisher diets are presented in Table 1. The percentage crude protein (CP) of the starter diets were 22.05 (D1), 24.15 (D2) and 18.90 (D3). The crude fibre (CF) were 4.00% (D1), 4.00% (D2) and 5.00% (D3). The ME (kcal/kg DM) were 3155.10, 3485.74 and 2848.03. The finisher diets had CP of 20.49, 20.84 and 17.81% respectively for D1, D2 and D3. The corresponding CF were 5.98, 5.64 and 9.12 %. The ME in the same order were 2835.03, 2868.37 and 2500.73 kcal/kg DM.

**Table 1: Proximate composition of the experimental starter and finisher diets**

| Parameters | Starter Diets | | | Finisher Diets | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 1 | 2 | 3 |
| Dry Matter (%) | 89.12 | 89.50 | 88.95 | 91.84 | 91.72 | 90.85 |
| Crude Protein (%) | 22.05 | 24.15 | 18.90 | 20.49 | 20.84 | 17.81 |
| Ether Extract (%) | 7.00 | 6.78 | 6.50 | 8.30 | 8.41 | 7.66 |
| Crude Fibre (%) | 4.00 | 4.00 | 5.00 | 5.98 | 5.64 | 9.12 |
| Ash (%) | 6.00 | 7.00 | 13.00 | 17.67 | 17.13 | 22.03 |
| NFE (%) | 49.93 | 52.43 | 45.55 | 39.40 | 39.70 | 34.23 |
| ME (kcal/kg DM) | 3155.10 | 3485.74 | 2848.03 | 2835.03 | 2868.37 | 2500.73 |

NFE = Nitrogen Free Extract; ME = Metabolisable Energy

Performance characteristics of the experimental birds at the starter phase are presented in Table 2. The average final live weight (AFLW), daily weight gain (ADWG), daily feed intake (ADFI) and feed conversion ratio (FCR) were significantly ($P < 0.05$) influenced by the feed types (dietary treatments). The highest AFLW (758.37g/b) was obtained for birds fed Diet 2 compared to 689.60g/b (Diet 1) and 263.37g/b (Diet 3). The ADWG followed the same trend with birds fed Diet 2 having the highest value (25.67g/b) compared with 23.22g/b (Diet 1) and 8.00g/b (Diet 3). The ADFI were 72.88, 80.36 and 62.20g/b respectively for birds fed Diets 1, 2 and 3. Cost of feed per kg live weight were Ɛ332.84 (D1), Ɛ313.00 (D2) and Ɛ684.64 (D3). Average initial live weight already balanced was not affected ($P > 0.05$) accross the Diets. Diet 2 gave the best performance in terms of weight gain, followed by Diet 1 and Diet 3 in that order. All the performance parameters at the finishing phase though significantly (*P < 0.05*) different except cost of feed/kg live weight gain, followed the trends at the starters (Table 3). The AFLW (g/b) were 2208.49 (D2), 1879.32 (D1) and 503.33 (D3); and ADWG (g/b/d) were 51.79 (D2), 42.49 (D1) and 8.57 (D3). The ADFI (g/b/d) were 177.53 (D2), 133.63 (D1) and 58.57 (D3). The FCR values were 3.14, 3.43 and 6.83 respectively for birds fed Diets 1, 2 and 3. The lowest cost of feed per kg live weight gain ₦282.91 obtained in birds fed Diet 1 compared with ₦305.58 and ₦480.83 respectively for birds fed diets 2 and 3 at the finisher phase. The average cost of feed per kg live weight gain for the 2 phases were ₦307.88 (D1), ₦309.29 (D2), and ₦582.74 (D3).

**Table 2: Performance characteristics of broiler starters fed three different commercial diets**

| | Diets | | | |
|---|---|---|---|---|
| Parameters | 1 | 2 | 3 | SEM |
| Average initial live weight (g/b) | 39.50 | 39.50 | 39.50 | 0.36 |
| Average final live weight (g/b) | 689.60[b] | 758.37[a] | 263.37[c] | 28.48 |
| Average daily weight gain (g/b/d) | 23.22[b] | 25.67[a] | 8.00[c] | 2.11 |
| Average daily feed intake (g/b/d) | 72.88[b] | 80.36[a] | 62.20[c] | 6.69 |
| Feed conversion ratio | 3.14[b] | 3.13[b] | 7.78[a] | 0.98 |
| Cost/kg feed (₦) | 106.00 | 100.00 | 88.00 | NSA |
| Cost of feed/kg weight gain (Ɛ) | 332.84 | 313.00 | 684.64 | NSA |

[abc] Means within the same row with different superscripts differ significantly (P< 0.05)
SEM = Standard Error of the Mean; NSA = Not statistically analysed

**Table 3: Performance characteristics of broiler finishers fed three different commercial diets**

| | Diets | | | |
|---|---|---|---|---|
| Parameters | 1 | 2 | 3 | SEM |
| Average initial live weight (g/b) | 689.60[a] | 758.37[a] | 263.37[b] | 28.48 |
| Average final live weight (g/b) | 1879.32[b] | 2208.49[a] | 503.33[c] | 54.76 |
| Average daily weight gain (g/b/d) | 42.49[b] | 51.79[a] | 8.57[c] | 2.45 |
| Average daily feed intake (g/b/d) | 133.63[b] | 177.53[a] | 58.57[c] | 6.89 |
| Feed conversion ratio | 3.14[b] | 3.43[b] | 6.83[a] | 0.96 |
| Cost/kg feed (Ɛ) | 90.10 | 89.09 | 70.40 | NSA |
| Cost of feed/kg weight gain (Ɛ) | 282.91 | 305.58 | 480.83 | NSA |

[abc] Means within the same row with different superscripts differ significantly (P< 0.05)
SEM = Standard Error of the Mean; NSA = Not statistically analysed

Table 4 shows the carcass and organ characteristics of the experimental birds. All the carcass (live weight, bled weight, plucked weight, eviscerated weight, dressed weight and abdominal fat); and internal organs such as heart, lung, liver, kidney, pancreas, intestine and proventriculus were significantly (*P < 0.05*) affected by dietary treatments. The live weight (kg/b) were 1.93 (D1), 1.75 (D2) and 0.55 (D3). The percentage bled weight of 97.35 (D1) and 97.14 (D2) were higher (P < 0.05) than 91.43 (D3). The plucked weight 92.05 (D1) and 92.81 (D2) were similar but both significantly (*P < 0.05*) higher than 86.61 (D3). The corresponding eviscerated weight, 77.28 (D1) and 81.54 (D2) were both significantly (P < 0.05) higher than 63.69 (D3). Percentage dressed weights were 71.21 (D1), 70.02 (D2) and 53.57 (D3); while the percentage abdominal fat was 1.36 (D1), 1.01 (D2) and 0.31 (D3). The highest percentage heart (0.82), lung (0.79), liver (4.42), kidney (0.80), pancreas (0.39), intestine (11.38), and proventriculus (0.73) were obtained in birds fed D3. These were significantly (P < 0.05) higher than 0.55, 0.54, 2.09, 0.58, 0.24, 6.82 and 0.40% (D2); and corresponding 0.58, 0.68, 2.19, 0.49, 0.23, 6.50 and 0.46% (D1).

**Table 4: Carcass and organ characteristics of broiler chickens fed three different commercial diets**

| Parameters | Diets 1 | 2 | 3 | SEM |
|---|---|---|---|---|
| Live Weight (g) | $1.93^{a}$ | $1.75^{a}$ | $0.55^{b}$ | 0.10 |
| Bled weight (%) | $97.35^{a}$ | $97.14^{a}$ | $91.43^{b}$ | 2.35 |
| Plucked weight (%) | $92.05^{a}$ | $92.81^{a}$ | $86.61^{b}$ | 3.12 |
| Eviscerated weight (%) | $77.28^{a}$ | $81.54^{a}$ | $63.69^{b}$ | 3.74 |
| Dressed weight (%) | $71.21^{a}$ | $70.02^{a}$ | $53.57^{b}$ | 3.65 |
| Abdominal fat (%) | $1.36^{a}$ | $1.01^{a}$ | $0.31^{b}$ | 0.08 |
| **Organs (% of carcass)** | | | | |
| Heart | $0.58^{ab}$ | $0.55^{b}$ | $0.82^{a}$ | 0.03 |
| Lung | $0.68^{ab}$ | $0.54^{b}$ | $0.79^{a}$ | 0.03 |
| Liver | $2.19^{b}$ | $2.09^{b}$ | $4.42^{a}$ | 0.11 |
| Kidney | $0.49^{c}$ | $0.58^{b}$ | $0.80^{a}$ | 0.05 |
| Pancreas | $0.23^{b}$ | $0.24^{b}$ | $0.39^{a}$ | 0.01 |
| Intestine | $6.50^{b}$ | $6.82^{b}$ | $11.38^{a}$ | 0.88 |
| Proventriculus | $0.46^{b}$ | $0.40^{b}$ | $0.73^{a}$ | 0.04 |

$^{abc}$ Means within the same row with different superscripts differ significantly (P< 0.05)
SEM = Standard Error of the Mean

Carcass cut parts of the experimental birds are presented in Table 5. The head, neck, drum stick, thigh, wings, breast, and lower back significantly (*P < 0.05*) differed across the treatments. The percentage values of the head were 2.62 (D1), 3.22 (D2) and 4.79 (D3); and the corresponding values of the neck were 5.09 (D1), 4.78 (D2) and 4.54 (D3). The drum sticks were 10.35 (D1), 11.49 (D2) and 9.92 (D3); and the thigh were 9.95 (D1), 10.87 (D2) and 9.71 (D3). Wings were 9.42 (D1), 10.62 (D2) and 9.94 (D3) with breast having 18.52 (D1), 17.45 (D2) and 12.12 (D3). The lower back values were 8.35 (D1), 7.65 (D2) and 6.53 (D3). However, variations obtained in the legs and upper back were similar (*P > 0.05*).

**Table 5: Carcass cut parts of broiler chickens fed three different commercial diets (expressed as % live weight)**

| Parameters (%) | Diets 1 | 2 | 3 | SEM |
|---|---|---|---|---|
| Head | $2.62^{b}$ | $3.22^{b}$ | $4.79^{a}$ | 0.21 |
| Neck | $5.09^{a}$ | $4.78^{ab}$ | $4.54^{b}$ | 0.66 |
| Leg | 4.96 | 5.91 | 6.47 | 0.78 |
| Drum stick | $10.35^{b}$ | $11.49^{a}$ | $9.92^{b}$ | 0.69 |
| Thigh | $9.95^{b}$ | $10.87^{a}$ | $9.71^{b}$ | 0.67 |
| Wings | $9.42^{b}$ | $10.62^{a}$ | $9.94^{ab}$ | 0.78 |
| Breast | $18.52^{a}$ | $17.45^{a}$ | $12.12^{b}$ | 0.97 |
| Upper back | 5.98 | 6.06 | 5.66 | 0.51 |
| Lower back | $8.35^{a}$ | $7.65^{ab}$ | $6.53^{c}$ | 0.45 |

$^{abc}$ Means within the same row with different superscripts differ significantly (P< 0.05)
SEM = Standard Error of the Mean

Table 6 shows the haematological and serological parameters of the experimental birds. The RBC, Hb, Basophils, total protein, albumin and globulin differed significantly (*P < 0.05*) across the diets. The RBC (x $10^{6}mm^{-3}$) values were 124.50 (D1), 199.50 (D2) and 74.50 (D3); and the Hb (g/dl) were 5.67 (D1), 8.67 (D2) and 4.67 (D3). Basophils (%) were 3.00 (D1), 2.00 (D2) and 2.00 (D3). Total protein (g/dl) were 33.89 (D1), 35.14 (D2) and 25.34 (D3). The albumin (g/dl) were 19.53 (D1), 19.22 (D2) and 13.75 (D3); and globulin (g/dl) 14.36 (D1), 15.92 (D2) and 11.59 (D3). The PCV, lymphocytes, neutrophils, monocytes, eosinophils, and glucose were not significantly (*P < 0.05*) affected by the diets.

**Table 6: Haematology and serum biochemical indices of broiler chickens fed three different commercial diets**

| Parameters | Diets 1 | 2 | 3 | SEM |
|---|---|---|---|---|
| Esr (mm/hr) | 12.50 | 5.00 | 13.50 | 1.92 |
| Packed cell volume (%) | 17.00 | 26.00 | 16.00 | 2.40 |
| Red blood cells ( x $10^6$mm$^{-3}$) | 124.50$^{ab}$ | 199.50$^{a}$ | 74.50$^{b}$ | 17.79 |
| Haemoglobin (g/dl) | 5.67$^{ab}$ | 8.67$^{a}$ | 4.67$^{b}$ | 0.85 |
| Lymphocytes (%) | 62.50 | 61.50 | 59.50 | 0.97 |
| Neutrophils (%) | 21.50 | 21.50 | 22.00 | 0.49 |
| Monocytes (%) | 11.50 | 13.00 | 12.00 | 0.65 |
| Basophils (%) | 3.00$^{a}$ | 2.00$^{b}$ | 2.00$^{b}$ | 0.17 |
| Eosinophils (%) | 1.50 | 2.00 | 1.50 | 0.14 |
| Glucose (g/dl) | 2.27 | 2.71 | 3.00 | 0.37 |
| Total protein (g/dl) | 33.89$^{b}$ | 35.14$^{a}$ | 25.34$^{c}$ | 2.80 |
| Albumin (g/dl) | 19.53$^{a}$ | 19.22$^{a}$ | 13.75$^{b}$ | 2.01 |
| Globulin (g/dl) | 14.36$^{a}$ | 15.92$^{a}$ | 11.59$^{b}$ | 2.03 |

$^{abc}$ Means within the same row with different superscripts differ significantly (P< 0.05)
SEM = Standard Error of the Mean

## Discussion

The CP values of diet 3 at both the starter and finisher phases were lower than the conventionally accepted and recommended 23 and 20%. The same for the ME. The CF on the other hand were higher than 4 – 5% recommended for the two phases of growth of broilers (NRC, 1994). The best performance obtained in birds fed diet 2 (starters) could be linked to higher nutrient (CP) and energy content (ME); and lower crude fibre (CF) compared with birds fed the other 2 diets. This was followed by birds fed Diet 1, and the least performance in birds fed Diet 3. There is probability that the high CF in Diet 3 would have impaired digestibility, availability and utilization of other nutrients in the diet. This agrees with the submissions of previous authors (King *et al.,* 2000; Baidoo *et al.,* 2003; Safari *et al.,* 2005; Longe, 2006; and Olajide *et al.,* 2009). This is particularly so since the FCR values were highest for birds fed diet 3 at both phases. The lower the FCR the better. The energy-protein relationship may also be an important factor. The dietary energy and crude protein may individually be adequate but may be poorly adjusted such that this reduces the performance of the birds or causes deposition of fat in their carcasses. Olomu (1995) recommended calorie: protein ratio of 150:1 for finisher diets in the tropics compared with 160:1 recommended for the temperate region by NRC, (1994). Results of the work of Tion *et al.* (2005) on broilers however showed that calorie: protein ratio as wide as 178: 1 can be gainfully utilized in Nigeria for finishing broilers to market weight of more than 2kg in 63 days. The final cost of a unit of product (meat or egg ) depends on the cost of feed and how efficiently the nutrients were utilized (FCR). Diet 3 despite having the lowest cost per kg feed did not translate to optimal growth, compared with those birds fed Diets 1 and 2. Birds fed diet 1 had the best FCR and cost per kg live weight gain at the finisher phase though with lower ADWG than those fed diet 2. Birds fed a type of these Commercial feed gave FCR of 1.95 and 2.32; and ADWG of 26.13 and 58.08g/b respectively for starters and finishers (Olajide and Adeleye, 2015). The average cost per kg live weight gain of the birds for the 2 phases were ₦307.88 (Diet 1), ₦309.29 (Diet 2), and ₦582.74 (Diet 3). The mean live weight of the experimental birds used for carcass and organ analyses was reflection of the performance of the birds. The dismally low live weight, bled weight, plucked weight, eviscerated weight and more importantly the dressed weight obtained in birds fed Diet 3 were as a result of poor performance of these birds. These parameters were comparable for birds fed Diets 1 and 2. The adequacy of crude protein and energy, coupled with minimal crude fiber in Diets 1 and 2 could have contributed to the desirable carcass indices obtained in these birds. The lower values of eviscerated and dressed weights for birds fed Diet 3 could be as a result of lower CP, ME, and higher CF in the diet (Gardner 1971; Cecil 1991; Zaczek *et al.,* 2003). Zaczek *et al.* (2003) observed that increasing concentration of fiber in diets have a negative linear effect on body weight. The blood volume 2.65% (D1) and 2.86% (D2) represented by the bled weight falls within the standard range of 2.50 – 6.50% reported for normal chickens (Mitruka and Rawnsley, 1977). However, the value (8.57%) obtained for birds fed D3 was higher. Highest values of all organs (heart, lung, liver, kidney, pancreas, intestine and proventriculus) obtained in birds fed Diet 3 was also pointing to very low live weight or carcass weight of these birds, since the organs were expressed as percentages of live weight. The inference that can possibly be drawn from heart, lung and pancreas is that these organs have to do with anatomical differences and live weight. The highest heart weight in birds fed Diet 3 could be as a result of extra workload imposed by stress of handling anti-nutrients including fibers, and digestibility (Carew *et al.,* 2003). That the liver and kidney were also highest for these birds fed Diet 3 could point to the need to deal with some intrinsic factors including anti-nutritional factors. This may not be uncommon when feed millers would want to use any cheap available feed ingredients to formulate diets not minding the inherent anti-nutrients just to cut cost. Both organs are involved in biotransformation, assisting the birds to handle toxins and metabolic wastes (Onyeyilli *et al.,* 1998; Olajide and Adeniyi, 2015). High intestinal and proventriculus contents in birds fed Diet 3 may also suggest a lot of undigested feeds in the GIT. This could have been caused by high fiber content in this diet. This agrees with the submission of Olajide *et al.* (2009) that fibers in the diets affect digestibility of nutrients. In some cases, the proportion of the cut-up parts to the live weight may be anatomical. However, good values of breast/chest obtained in birds fed Diets 1 and 2 compared to Diet 3 were pluses for the first 2 diets. This is because this meaty part of the broiler is actually the saleable portion which command high price tag. High RBC and Hb values obtained in birds fed Diets 1 and 2 are desirable. This is because these two haematological indices are involved in transport of oxygen in animals' body. Low levels of these constituents may also impair respiration and likely to have bearing on size of the lung. Lower values of PCV, Hb, and total protein was linked to low level of nutrition especially protein deficiency (Oladele *et al.,* 2001). Low PCV and RBC, anaemic conditions recorded in scavenging Nigerian indigenous chicken was also linked to poor nutrition (Ikhimioya *et al.,* 2000). Meanwhile, the PCV (D2) was within and D1 closer to the range values recommended for normal chickens (Mitruka and Rawnsley, 1977) than D3. The RBC of birds fed D1 and D2 were also within 1.58 - 4.10 (x $10^6 mm^{-3}$) with that of D3 extremely below. The Hb of birds fed D1 and D2 were also close to 7.40 - 13.10g/dl (Mitruka and Rawnsley, 1977) but D3 lower. However, lymphocytes and monocytes were within 43.90 - 81.20% and 15.60 – 43.90% respectively recommended. The Basophils were very close to 2.50 – 5.36% recommended for normal chickens. High protein and albumin values obtained in birds fed Diets 1 and 2 may also point to adequacy of this nutrient in these diets. The lowest absolute values of these serum indices in birds fed Diet 3, coupled with this same group of birds having the highest globulin (45.74% of total protein compared with 45.30% and 42.37%) for birds fed Diets 2 and 1. High globulin may be an indication of reaction to presence of antinutrients in the diet.

## Conclusion

The study showed that birds fed diet 1 gave the best overall economic, carcass, haematology and serological performance. Commercial diet (feed) 1 is therefore recommended for broiler farmers.

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