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Response of Broiler Chickens to Three Different Energy Source Feedstuffs

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Abstract:- Objective: The aim of the study was to determine the effect of different energy sources in starter diet on broiler chicks. Methodology: The study was conducted at the Poultry Unit of the Teaching and Research Farm of the Department of Animal Health and Production, Binyaminu Usman Polytechnic, Hadejia, Jigawa State, Nigeria. A total of seventy-two (72) unsexed broiler birds were sourced from accredited Chikun Company Hadejia metropolis, Jigawa State. The birds were raised under intensive management system (on a floor pens). Three different diets (containing different energy sources) designated as Treatments 1, 2, and 3 for maize, sorghum and millet, respectively were used in this experiment. The parameters measured were the growth performance, haematological indices, proximate composition of the experimental diets and economic analysis. Data collected were subjected to analysis of variance using SAS package. Results: The growth performance, haematological indices and economic analysis showed non-significant ($p>0.05$) differences despite numerical variation that exist among the treatment groups. The different energy sources did not significantly affect the performance parameters measured. The reason for this was not clearly understood, however, numerically, some of the performance indices tended to be positively affected by the different diet and the broiler performance analysed were within the normal range. Conclusion: Based on the economic analysis, millet is recommended being the cheapest in terms of feed cost and feed cost per weight of bird.

Keywords:- *Broiler Chickens, Energy, Haematology, Growth Indices.*

I. INTRODUCTION

Poultry is a term used to explain all domestic birds bred for meat and eggs. There is a tendency to restrict this definition to the domestic chicken (*Gallus domesticus*), which dominates the attention of agricultural personnel to the neglect of other species like ducks and guinea fowls. Poultry serves as a rich source of protein which is vital in human nutrition. In Nigeria, the per capita consumption of meat protein is 13kg[1], while that across the African continent is 16kg, which is less than the recommended minimum of 16.5kg[2]. The consumption of animal protein is declining, especially in rural areas, where 85% of the extreme poor live[3]. This deficit has led to increased imports of poultry meat from developed countries[4].

The increasing demand for poultry products means that producers need to ensure an adequate supply of these products. This is because an increase in poultry weight leads to an increase in poultry production[5]. A study on poultry farming was conducted to examine the connection between various poultry feeds and body weight. This statistical analysis of poultry production has helped farmers and researchers to better describe and comprehend biological processes, enabling them to prioritize research objectives – from identifying study components to evaluating response variables. The study aimed to develop a model for the weight of broiler chickens that were fed different energy source diets, including maize, sorghum, and millet.

II. MATERIALS AND METHODS

The study was conducted at the Poultry Unit of the Teaching and Research Farm of the Department of Animal Health and Production, Binyaminu Usman Polytechnic, Hadejia, Jigawa State Nigeria. Hadejia town is the capital of Hadejia Emirate and is located at the central part of the emirate which lies between Longitude 10^0 02'28· 14" E and Latitude 12^0 27'12.49" N. A total of seventy-two (72) broiler birds were sourced from accredited Hatchery Chikun Company at Hadejia metropolis, Jigawa State. The birds were raised under intensive management system. Feed Ingredients used include; maize, sorghum, millet, methionine, lysine, premix, bone-meal, limestone, salt, soybean, groundnut cake and wheat offal. Other experimental materials used were; weighing balance, grinding mill, 5ml syringes, microscope, EDTA bottles, cotton wool, methylated spirit, burette, test tubes, distilled water, red blood cell (RBC), white blood cell (WBC) diluting fluids and laboratory oven.

Maize, sorghum, millet and other feed ingredients were sourced from the Hadejia market and were used in formulating the experimental diet. Individual ingredients were calculated, the quantity of each ingredient was weighed using weighing balance (for the higher quantity ingredients) and sensitive weighing balance (for the micro ingredients). Three different diets containing different energy sources were designated as T1, T2 and T3 for maize,

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sorghum and millet, respectively. The diet was subjected to proximate analysis using standard method of Association of Analytical Chemist[6].

A total of 72-day-old chicks were purchased and then randomly allocated to three dietary groups based on their weight. Each group had a different energy source. All sanitary procedures, such as cleaning, washing, and disinfecting the pen and other equipment, were followed. The chicks were initially kept in a deep litter system and brooded for 1 week. Afterward, they were transferred into individual pens. Throughout the six-week experiment, the chicks were provided with feed (twice daily, in the early morning and late evening) and water ad libitum. They were vaccinated orally via drinking water and given multivitamins twice a week, as part of their regular health care routine.

III. EXPERIMENTAL DESIGN

A completely randomized design (CRD) containing three (3) treatment groups with four (4) replications consisting of different energy sources in each treatment was used in this experiment.

Table 1: Composition of Experiment Diets

INGREDIENTS	DIETS		
	T1 (Maize)	T2 (Sorghum)	T3 (Millet)
Maize	52.91	_	_
Sorghum	_	56.02	_
Millet	_	_	57.98
Soya bean meal	26.98	29.04	29.04
Wheat offal	5.01	3.98	2.70
GNC	11.00	6.98	6.98
Bone meal	1.50	1.50	1.50
Limestone	1.50	1.50	1.50
Vitamin premix	0.26	0.26	0.26
Methionine	0.26	0.26	0.26
Lysine	0.26	0.26	0.26
Common salt	0.36	0.36	0.36
Total	100	100	100
Calculated Nutrients (%) Unless Otherwise Stated.			
ME (kcal/kg)	2891	2890	2508
Crude protein (%)	20.90	20.63	21.51
Crude fibre (%)	4.19	5.20	6.99
Calcium (%)	0.99	0.99	0.76
Phosphorus (Av.) (%)	0.54	0.58	0.40
Ether extract (%)	9.50	5.20	9.60
Lysine (%)	1.28	1.27	1.34
Methionine (%)	0.59	0.58	0.34

ME = Metabolizable energy

IV. DATA COLLECTION

➢ *Growth Performance*

The growth performance of the broiler chickens was monitored and determined by measuring their weights, feed intake, and feed conversion ratio (FCR). The initial body weights of the broiler chicks were recorded upon arrival, and subsequent body weight gains were measured at the end of every week during the 6-week experiment. Body weight gain was calculated as the difference between the body weight gain for the given week and the previous week. Finally, the body weights of the birds were recorded at the end of the experiment.

Body weight gain (g) = Final body weight (g) - Initial weight gain (g)

A known quantity of feed was given to the broiler chicken while the leftover of the feed was weighed to determine daily feed intake for each treatment. Feed intake for each week was obtained from the difference between the feed given per week and leftover.

Total feed intake (g) = daily feed intake multiplied by 42 days.

Feed conversion ratio (FCR): The feed conversion ratio of the birds was determined by calculating the ratio of their feed intake to weight gain.

$$\text{FCR} = \frac{\text{Total Feed Intake}}{\textit{Total Body Weight Gain}}$$

➢ *Haematological Indices*

At 42nd day, 2.5ml blood samples were collected from one bird in each replicate using needle and syringe through wing veins directly into ethylene-diamine tetra-acetic acid (EDTA) containing bottles and taken to the laboratory for the determination of haematological Indices.

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V. STATISTICAL ANALYSIS

Data obtained from the study were subjected to one-way analysis of variance (ANOVA) using General linear model (GLM) procedure of statistical analysis system (SAS®) version 2013[7]. Duncan's multiple range test[8] was used to test the significant difference among the treatments at 5% significance level.

VI. RESULTS

Proximate composition of diets containing different energy sources is presented in Table 2. In spite of numerical variation among the experimental groups, no significant difference ($p>0.05$) was observed among all parameters except crude protein. Hence, all the values obtained were within the normal range.

Table 3 shows the result of growth performance of broiler chicken fed diet of different energy sources. The result showed non-significant ($p>0.05$) difference but numerical variation exist; In terms of final body weight, sorghum (T2) and millet (T3) are superior to maize (T1).

Table 4 shows the result of haematological parameters of broiler chicken fed diet containing different energy sources. The results showed non-significant ($p>0.05$) differences among the test materials, and for all the energy sources, the values of haematological parameters were within the normal range.

Table 5 shows the result of economic analysis of broiler chickens fed diet containing different energy sources. The results showed non-significant ($p>0.05$) difference but numerical variation exist.

VII. DISCUSSION

Table 2 displays the proximate composition of the experimental diets. According to Adamu *et al.*[9], sorghum has a nutritional value comparable to maize. Additionally, Ahmed *et al.*[10] observed that the metabolizable energy (ME) of sorghum was 14.40 MJ/kg, whereas the metabolizable energy of millet was 14.17 MJ/kg. Due to their similar compositions, sorghum and millet can be used as a source of energy in poultry diets. The amino acid composition of the two cereals reveals a fairly distributed content. Sorghum contains a low level of lysine but a high level of tryptophan content in comparison to maize[11,12]. McDonald *et al.*[13] reported that maize, millet, and sorghum have the main limiting indispensable amino acids, which include arginine, lysine, methionine, cysteine, and tryptophan. The crude protein (CP) content of the three test materials (maize, sorghum, and millet) showed significant variation ($P<0.05$). Specifically, the CP content of T1 was higher than that of T2 and T3, and this difference could be attributed to the fact that maize contained a significant amount of protein compared to sorghum and millet. The Ether Extract (EE) also exhibited significant variation ($P<0.05$) among the three experimental diets, with treatment 3 having a higher EE content compared to the other experimental diets[14]. The findings are consistent with the results of Etuk *et al.*[14], who reported that the EE content of millet is significantly higher than that of maize, cassava, and sorghum. However, this contradicts the findings of Purseglove[12], who reported a higher amount of EE in maize than in millet.

In Table 3, the growth performance results are displayed. Birds fed a diet containing millet as an energy source showed higher average feed consumption. This finding aligns with the results of Adamu *et al.*[15], who observed significant differences in daily feed intake when yellow sorghum was used as a replacement for maize. The total feed intake in T2 (3382 g) was higher than that of the other treatments, attributed to its high crude protein (CP) content (13%) and high oil content (5-6%), as well as a lower portion of less digestible prolamines[16]. During the starter phase, the average daily feed intake was not significantly affected across the dietary treatments. This finding is consistent with Adamu *et al.*[9], who replaced millet with maize, and Mohammed *et al.*[17], who replaced quality protein maize with normal maize, both of whom found no statistical difference in daily feed intake. This result is also in line with the findings of Pour-Reza and Edriss[18], who stated that all dietary maize portions can be replaced with low-tannin sorghum in broiler diets without adverse effects on feed intake. Across all treatment groups, no significant ($p>0.05$) difference was observed in feed conversion ratio, with the best feed conversion ratio seen in diet 3 (1.24). In diet 1, the poor FCR could be due to the presence of tannin, which reduces the utilization of energy, protein, and specific amino acids[19,20]. Ibitoye *et al.*[21] reported that deficiencies in crude protein and anti-nutritional factors in maize-based diets may impair nutrient digestion, absorption, and utilization. Sullivan *et al.* [22] and Bramel-Cox *et al.*[23] also reported better feed conversion ratio in millet-based diets.

In Table 4, the results of the haematological parameters are presented. The highest value of RBC (2.98µl) was observed in T1. According to Fayeye *et al.*[24], the RBC value was within the normal range for adult chickens. Similarly, according to Mitruka and Rawnsley[25], the RBC values of the experimental birds were also within the normal range (1.5 - 3.5*10⁶/µl). The result for PCV did not show any statistical difference ($p>0.05$), but there was a numerical variation between the treatment groups. T1 (33.62%) showed the highest percentage, followed by T3 and T2. The normal value for PCV ranges from 22-43%[24]. The values for Mean corpuscular haemoglobin concentration showed no significant variation ($p>0.05$). The mean corpuscular hemoglobin concentration values observed in our study (60-70g/dl) were similar to the normal range reported by Mitruka and Rawnsley[25]. Hemoglobin and mean corpuscular hemoglobin (MCH) are important indicators for assessing red blood cells in the circulatory system and are significant in diagnosing anemia[26]. They also serve as useful indicators for evaluating the bone marrow's capacity to produce red blood cells in mammals[27].

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Table 5 shows the results of an economic analysis. A significant cost reduction was observed when sorghum was used instead of maize in broiler diets[14, 15, 21, 28]. However, Aladeen et al.28 found contradicting results, reporting that the Total Cost of Feed (TCF) and Total Weight Gain per Weight of Feed (TWG) showed a reduction in the cost of production when sorghum replaced maize.

VIII. CONCLUSION

The different energy source feedstuffs used in this study did not significantly affect the general performance parameters evaluated. However, the no mortality was recorded and values obtained for haematological indices which were within the recommended range which indicates the safety of the diets and good management. Based on the economic analysis, millet is recommended being the cheapest in terms of feed cost and feed cost per weight of bird.

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Table 2: Proximate Composition of Experimental Diets containing different Energy Sources

Parameters (%)	**Dietary**	**Treatments**	
	T1	**T2**	**T3**
Ash	5.53	5.18	5.08
Moisture	3.50	4.06	4.02
Dry Matter	96.61	96.04	95.99
Crude Fibre	7.84	5.89	6.73
Ether Extract	4.38	4.17	4.52
Crude Protein	21.25	20.23	19.42
Nitrogen Free Extract	7.48	3.66	5.48

Table 3: Growth Performance of Broiler Chickens Fed Diet Containing Different Energy Sources.

Parameter	**Treatments**			**SEM**
	T1	**T2**	**T3**	
IBW(g)	270.80	291.60	291.70	0.23
FBW(g)	1500	1529	1479	0.79
BWG/ bird(g)	1204	1237	1187	0.75
TFI /bird(g)	3282	3487	3458	0.89
DWG/ bird(g)	0.26	0.26	0.25	0.81
DFI/ bird(g)	93.00	99.60	98.80	0.96
FCR	1.22	1.23	1.24	0.60

IBW: Initial body weight, FBW: Final body weight, BWG: Body weight gain, TFI: Total feed intake, DWG: Daily weight gain, DFI: Daily feed intake and FCR: Feed Conversion ratio

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Table 4: Haematological Parameters of Broiler Chicken Fed Diets Containing Different Energy Source

PARAMETERS	TREATMENTS			Fr. Value
	T1	T2	T3	
RBC (10^6/µl)	2.98	2.89	2.95	0.99
WBC (10^3/µl)	111	122	108	0.68
HB (g/dl)	21.03	19.93	20.73	0.92
MCV (g/dl)	108.70	109.00	110.00	0.91
MCH (g/dl)	68.17	68.80	70.37	0.64
MCHC (g/dl)	62.80	63.23	68.87	0.23
LYM	10.23	9.80	11.10	0.23
PCV (%)	33.62	31.46	32.47	0.89

WBC: White Blood Cells. RBC: Red Blood Cells, HB; haemoglobin, MCV; means corpuscular volume; PCV; Pack cells volume, MCH; Means cells haemoglobin MCHC; Mean Corpuscular haemoglobin concentration.

Table 5: Economic Analysis of Broiler Chickens fed Diets Containing Different Energy Sources

Parameter	Treatments		
	T1	T2	T3
Feed Cost (₦/kg)	528	497	487
Feed Cost per weight (₦/bird)	1204	1237	1187
Cost of Feed Consumed/bird	1706	1813	1800
Mortality (%)	0.00	0.00	0.00