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Original Article

Effect of sorghum and maize – sorghum mixture on performance and blood profile of Broiler Chickens

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ABSTRACT

This study evaluated the effects of maize and maize-sorghum mixtures on the growth performance and haematology of broilers chicken production. A total of 200-day-old broilers chick were randomly assigned to five dietary treatments in a completely randomized design. The diets included 100% yellow maize (T_1), 100% white sorghum (T_2), 100% red sorghum (T_3), a 50:50 yellow maize-white sorghum mixture (T_4), and a 50:50 yellow maize-red sorghum mixture (T_5). Growth performance parameters, Feed Conversion Ratio (FCR), mortality rate, and haematology were examined. The results revealed that no significant difference ($p>0.05$) was observed in all the parameters measured for growth performance except for feed intake where all the treatments where significantly ($p<0.05$) difference from each other with T_5 (50:50 yellow maize-red sorghum mixture) recording the highest value (2443.20). Similarly, no significant ($p>0.05$) difference was observed in almost all the haematology parameters except for Red Blood Cell, where birds fed T_2 (100% white sorghum), T_4 (50:50 yellow maize-red sorghum) and T_5 (50:50 yellow maize-red sorghum) where significantly ($p<0.05$)different from birds on T_1 (100% yellow maize), while birds on T_3 (50:50 yellow maize-white sorghum) was similar ($p<0.05$) to all the other treatments. The findings suggest that sorghum can serve as a viable alternative to maize in broilers chicken diets, as no significant ($p>0.05$) difference was observed between the control and the experimental diets, particularly when balanced with essential nutrients. The study recommends further to arrive at the optimal maize-sorghum ratios and supplementation strategies to enhance the efficient use of both grains in broilers chicken nutrition.

Keywords: Maize, Sorghum, Broilers chicken, Growth performance and haematology

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INTRODUCTION

The poultry industry has been developing rapidly over the last few decades and has become a major contributor to overcoming the shortage of animal protein in human nutrition. Broilers chicken production is the quickest means of achieving high-quality animal protein in the shortest possible time. In raising poultry, however, feed expenditure

accounts for about 70% - 75% of the total cost of production [1]. High feed cost is the major constraint for further progress of the poultry industry in developing countries. Feed formulation requires the judicious use of feed ingredients to supply adequate amounts and proportions of nutrients required by poultry birds. Cereal grains such as maize, wheat and rice are the major energy sources and major components of poultry diets. Increased cost of cereal grains and competition between human beings and poultry over the consumption of cereal grains has compelled nutritionists to explore new and non-conventional foods. A cost-effective broilers chicken feed can be produced with little or no use of maize, and no consequential decrease in performance which leads to the formulation of meal diets with a less expensive energy source

Sorghum grain is an interesting energy ingredient in poultry diets due to its nutritional composition, which is very similar to maize. Sorghum has enormous potential and is particularly suited to processing for both human consumption and livestock feed. It has metabolizable energy (3310kcal/kg) and crude protein (11%) contents approaching the 3350kcal/kg and 7.5%, respectively of maize [2]. The use of sorghum (*Sorghum bicolor* L. Moench), to replace maize in feeds is economically attractive due to the recent increases in maize prices [3]. The culture of sorghum has a high potential for grain production per unit area and can be produced in hot dry environment [4]. Its usage in poultry feed is however limited, because it contains high level of tannin, which is an anti-nutritional feed component [5]. The objective of this research is to evaluate the effect of maize and maize-sorghum mixture on the growth performance and haematology of broilers chicken.

MATERIALS AND METHODS

Experimental Site

The research was carried out at the Veterinary Hospital, Ministry of Livestock and Fisheries, P.M.B 175, Bosso, Minna, Niger State, Nigeria. Bosso lies between latitude $9^0$62 and $6^0$35, east of the equator. The area falls within the Southern Guinea Savannah vegetation zone of Nigeria with annual rainfall of 1300mm, and mean temperature 25.86^{0}C and 39.18^{0}C.

Source of Experimental Birds and other Ingredients

Two-hundred-day old broiler chicks were purchased from AgriTech in Ibadan, Oyo State Nigeria for the purpose of this study. Maize, sorghum and rice offal used for diet formulation were purchased locally from Gwadabe Market, along Western by-pass, Minna. Groundnut cake, vitamin mineral premix, lysine, methionine, fish meal and di-calcium phosphate (DCP) were purchased at Farida shop adjacent Amma Plaza, Okada Road, Bosso, Minna.

Experimental Diets

Five diets were formulated which are designated as follows.

T_1: (control) contained feed with 100% yellow maize.

T_2: feed contained 100% red sorghum.

T_3: contained feed with 100% white sorghum.

T_4: contained feed with 50% yellow maize and 50 % red sorghum.

T_5: contained feed with 50% yellow maize and 50 % white sorghum

The gross composition of the experimental diets fed to the broilers chicken are given in Table 1 and 2, respectively.

Table 1: Gross composition of experimental broilers chicken starter diets

Ingredients (%)	T_1	T_2	T_3	T_4	T_5
Yellow maize	49.17	-	-	-	-
White sorghum	-	49.17	-	-	-
Red sorghum	-	-	49.17	-	-
Yellow maize + white sorghum	-	-	-	49.17	-
Yellow maize + red sorghum	-	-	-	-	49.17
Wheat offal	10.00	10.00	10.00	10.00	10.00
Fish meal	5.00	5.00	5.00	5.00	5.00
Groundnut cake	20.49	20.49	20.49	20.49	20.49
Soybean cake	10.24	10.24	10.24	10.24	10.24
Bone meal	2.50	2.50	2.50	2.50	2.50
Lime stone	1.50	1.50	1.50	1.50	1.50
Methionine	0.30	0.30	0.30	0.30	0.30
Lysine	0.30	0.30	0.30	0.30	0.30
Vitamin premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated values					
Crude protein (%)	23.00	22.51	22.51	22.76	22.76
Crude fiber(%)	4.27	5.25	5.25	4.76	4.76
Metabolizable energy (kcal/kg)	2820.21	2789.73	2789.73	2805.11	2805.11

Table 2: Gross composition of experimental broilers chicken finisher diets

Ingredients (%)	T1	T2	T3	T4	T5
Yellow maize	49.37	-	-	-	-
White sorghum	-	49.37	-	-	-
Red sorghum	-	-	49.37	-	-
Yellow maize + white sorghum	-	-	-	49.37	-
Yellow maize + red sorghum	-	-	-	-	49.37
Wheat offal	15.00	15.00	15.00	15.00	15.00
Fish meal	3.00	3.00	3.00	3.00	3.00
Groundnut cake	20.49	20.49	20.49	20.49	20.49
Soybean cake	27.53	27.53	27.53	27.53	27.53
Bone meal	3.00	3.00	3.00	3.00	3.00
Lime stone	1.00	1.00	1.00	1.00	1.00
Methionine	0.30	0.30	0.30	0.30	0.30
Lysine	0.30	0.30	0.30	0.30	0.30
Vitamin premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated values					
Crude protein (%)	21.03	20.54	20.54	20.78	20.78
Crude fiber(%)	5.02	6.01	6.01	5.51	5.51
Metabolizable energy (kcal/kg)	2832.33	2801.72	2801.72	2817.17	2817.17

Experimental birds and Experimental design

Two-hundred-day old broiler chicks (Ross 308 strain) of mixed sexes were used for the experiment. The chicks were randomly allotted into five (5) nutritional treatments in a Completely Randomized Design (CRD). Each treatment had four replicates with ten (10) chicks per replicate.

Housing and Bird Management

Before the arrival of the birds, the experimental poultry house was washed, fully disinfected against parasite using Vinkokill at 150ml per 20 litres of water, and the brooding pens were hated. The birds were housed in a deep litter system during the period of the study. Litter material (wood shavings) were evenly spread on the floor to a height of 30 cm. Drinkers and feeders were also washed and disinfected with Vinkokill. Upon arrival of the chicks, they were weighed individually to obtain their initial weights and after which they were randomly distributed to the various treatment groups. They were provided with anti-stress (vitalyte) through drinking water. Each table spoon (20g) was diluted with 10 litres of water and then administered. Gumboro vaccine was administered twice at 7th and 21st days while Lasota vaccine was given at 14^{th} and 28^{th} days respectively. Two hundred doses of these vaccines was diluted into two litres of water in which a sachet of powdered milk was added in order to neutralise the presence of any trace of chlorine and administered after the birds were starved of water for 12 hours (7pm to 7am).

Data Collection

Data was collected on the following:

Initial body weight

This was the average live weight of the chicks before the commencement of the feeding trial. This parameter was calculated thus:

$$\textbf{Initial body weight} = \frac{\text{Weight of the total chicks}}{\text{Total number of the chicks}}$$

Feed intake

This was the difference between the number of feeds offered to the birds and the leftover. The difference between the known quantity of feeds which was supplied to the birds daily, and the amount that was left over after 24 hours was calculated thus:

FI= Amount of feed offered to the birds – feed left over after 24 hours

Average weight gain

This was the difference between the final body weight and the initial body weight of the birds. It was calculated thus:

AWG = Final body weight – Initial body weight

Average daily weight gain (ADWG)

This measures the amount of weight the birds added upon eating a known quantity of ration in a day. It was calculated thus:

$$\textbf{ADWG} = \frac{\text{Weight gain}}{\text{numbers of days of experimental period}}$$

Feed Conversion Ratio (FCR)

It was measured as the quantity of feed that will produce one kg body weight gain in a bird. It was calculated both weekly and at the end of the experiment using the formular given by [6] below:

$$\boldsymbol{FCR} = \frac{\text{Total feed intake}}{\text{total weightgain}}$$

Mortality

This was measured as the number of birds that died during the course of the experiment. The dead birds were recorded for each replicate and the value was expressed as a percentage of the stocked birds in each replicate. A postmortem analysis to investigate the cause of the mortality was carried out. Mortality % was calculated as:

$$\text{Mortality (\%)} = \frac{\text{Number of dead birds}}{\text{Initial number of birds}} x\ 100$$

Haematology

At the end of the 7th week of experiment, blood samples were obtained via the wing vein of randomly selected birds. Two birds from each replicate were selected for blood collection, making a total of forty (40) blood samples collected. 1ml disposable syringe and needles were used in collecting blood intravenously for laboratory analysis. The blood parameters considered include Haemoglobin concentration (Hb), White Blood Cell (WBC) count, Packed Cell Volume (PCV) and Red Blood Cell (RBC) count were analyzed by an auto haemoanaliser (BC-3000plusMindray Auto Hematology analyzer).

Data Analysis

All the data obtained were subjected to one-way analysis of variance using the Statistical Analysis System software (SAS, 2010) and significant means were separated using Duncan's Multiple Range Test of the same software.

RESULTS

Growth Performance of Broilers Chicken Fed Yellow Maize and Yellow Maize Sorghum Mixture

The growth performance of broilers, chicken yellow maize and yellow maize-sorghum mixture are presented in Table 3. There were no significant ($p>0.05$) differences in most growth performance parameters measured in this study. There was a significant ($p<0.05$) difference observed in feed intake across treatments, with birds in T_5 (mixture of yellow maize and red sorghum) recording the highest feed intake (2443.20g) and those in T_1 (100% yellow maize) consuming the least (2426.90g). No mortality (0%) was recorded in any of the treatments.

Table 3: Growth performance of broilers chicken f yellow maize and yellow maize- sorghum mixture

Parameters (g)	T1	T2	T3	T4	T5	SEM	p-value
Initial weight	31.00	30.33	30.67	31.00	32.00	1.07	0.62
Final weight	1933.30	1733.30	1766.70	1833.30	1900.00	234.75	0.89
Body weight gain	1902.30	1703.00	1736.00	1802.30	1868.00	234.63	0.89
Feed intake	2426.90^{e}	2433.30^{c}	2442.30^{b}	2437.60^{d}	2443.20^{a}	0.10	0.00
FCR	1.28	1.43	1.41	1.35	1.31	0.00	0.89
Mortality (%)	0	0	0	0	0		

Means with no superscripts in the same row does not differ significantly (P>0.05), abcde: means with different superscripts in the same row differ significantly (P<0.05). SEM = Standard error of means, T_1=treatment one (yellow maize), T_2=treatment two, (white sorghum) T_3=treatment three, (red sorghum) T_4=treatment four, (mixture of yellow maize and white sorghum) T_5= Treatment five;,(mixture of yellow maize and red sorghum)

Haematological Parameters of Broilers Chicken Fed Yellow Maize and Yellow Maize-Sorghum Mixtures

The haematological parameters of broilers chicken fed yellow maize and yellow maize-sorghum mixtures are presented in Table 4. With the exception of RBCs count and lymphocytes % which differed significantly ($p<0.05$) among treatments, all the other parameters evaluated did not show significant ($p>0.05$) differences among the treatments.

Table 4: Hematological parameters of birds fed sorghum and maize- sorghum mixture

Parameters	T1	T2	T3	T4	T5	SEM	p-value
Hb(g/dl)	8.86	9.55	9.00	9.16	9.51	0.53	0.63
PCV(%)	25.00	27.83	27.40	27.16	27.42	1.70	0.48
WBC x10^9	14.19	12.51	12.67	12.90	12.66	0.70	0.14
MCV	81.50	81.66	82.80	80.16	79.71	1.94	0.54
MCHC	28.16	29.83	30.00	28.83	28.28	0.85	0.13
MCH	28.33	28.00	28.20	27.16	28.28	0.73	0.49
RBC	3.06^{b}	3.40^{a}	3.38^{ab}	3.46^{a}	3.52^{a}	0.15	0.05
N(%)	42.66	41.66	42.80	39.66	40.28	2.04	0.46
L (%)	53.33^{ab}	53.16^{ab}	51.80^{b}	56.00^{a}	55.14^{a}	1.47	0.07
M(%)	1.83	2.66	3.20	2.00	2.83	0.75	0.44
E(%)	3.83	2.66	3.20	2.83	2.42	0.65	0.24

Means with no superscripts in the same row does not differ significantly ($P>0.05$), a, b: means with different superscripts in the same row differ significantly ($P<0.05$). SEM = Standard error of means, T_1=treatment one (yellow maize), T_2=treatment two, (white sorghum) T_3=treatment three, (red sorghum) T_4=treatment four, (mixture of yellow maize and white sorghum) T_5= Treatment five;,(mixture of yellow maize and red sorghum) Hb= Hemoglobin concentration, PCV= Packed cell volume, RBC= Red blood cell, WBC= White Blood Cell, N= Neutrophils, L= lymphocytes, M= Monocytes, MCV= Mean corpuscular volume, MCH = Mean corpuscular haemoglobin, MCHC = Mean corpuscular haemoglobin concentration.

DISCUSSION

The growth performance results presented in Table 3 suggest that the different treatments used in this study had varied effects only on the feed intake of broilers chicken. The higher feed intake that was observed for birds fed treatment 5 (50:50% mixture of yellow maize and red sorghum), suggest that the combination of these grains in the given ratio stimulated higher feed consumption. However, the lack of significant differences in the body weight gain among the treatments suggests that feed efficiency, rather than the amount of feed consumed, was the critical factor

influencing growth. This result contradicts the findings of [7] That suggested maize as an excellent source of digestible energy; thereby improving feed conversion in poultry. Evidently, it was the combination of yellow maize and red sorghum that gave the best feed intake.

Importantly, no mortality was recorded in any of the treatments, suggesting that all the diets were safe and effectively supported the health of the broilers chicken throughout the study. This is an encouraging outcome, as it highlights the potential of using yellow maize and yellow maize-sorghum mixtures as viable feed ingredients without compromising the safety or well-being of the birds.

Hematological parameters: such as Hb, PVC, WBC did not show significant differences across the treatments, indicating that the diets did not adversely affect the general health and immune status of the birds. The RBCs count did, however, differ significantly suggesting that the combination of yellow maize and red sorghum might have enhanced erythropoiesis, the production of RBCs formation. This could be due to the iron and other micronutrients present in these grains.

The lymphocyte percentage, which is an important indicator of immune function, was significantly higher in birds fed treatments 4 and 5 respectively. This suggests that these diets might have provided better support for immune responses, which is critical in poultry production, particularly in intensive systems where birds are often exposed to stress. The absence of significant differences in the neutrophils, monocytes, and eosinophils further supports the idea that these diets did not cause immune stress or infection in the broilers chicken.

CONCLUSION AND RECOMMENDATION

Based on the findings of this study, it can be concluded that feeding broilers chicken with yellow maize and yellow maize-sorghum mixtures had varying effects on feed intake, RBCs count and lymphocytes %. The combination of yellow maize and yellow maize-white and red sorghum mixtures showed promising results and as such sorghum (white or red) can be introduced alongside yellow maize in broilers chicken feed.

Authors contribution

EOO and GHI were the senior members of this research work, they both jointly helped in conceptualizing and guiding the direction of the work and ensuring that the research work is carried out to the best standard of a feeding trial while CH and ML participated in the fieldwork, data collection and interpretation. All authors contributed to the development of the manuscript and approved its submission.

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