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Effects of feeding four varieties of Sorghum supplemented with Maxigrain® enzyme on haematology and carcass characteristics of broiler finishers

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Target Audience: *Poultry farmers, Animal nutritionist and Researchers.*

Abstract

A study was carried out to evaluate the effect of feeding four varieties of Sorghum bicolor supplemented with Maxigrain ® enzyme on haematology and carcass characteristics of broiler chickens in Kaduna state, Northern guinea Savannah of Nigeria. Five diets were formulated for the broilers at both the starter and finisher phases namely T_1 – Maize without 0.01 % Maxigrain ® enzyme supplementation, T_2 –Samsorg-14 supplemented with 0.01 % Maxigrain ® enzyme, T_3 –Samsorg-40 supplemented with 0.01 % Maxigrain ® enzyme, T_4 –Samsorg-17 supplemented with 0.01 % Maxigrain ® enzyme and T_5 –KSV-15 supplemented with 0.01 % Maxigrain ® enzyme in replacement for maize (T_1) on the performance of broiler chickens. Two hundred and twenty five (225), day old Arbor acre chicks were used and placed on a common diet and were randomly distributed on the fifth day into five dietary treatment groups in a completely randomized design (CRD) with each treatment group having forty-five (45) birds per treatment and birds were allotted into three (3) replicates of 15 birds in each replicate for eight weeks. At the end of the feeding trial, 9 birds per treatment were selected based on the average weight per treatment for hematological and carcass assay. The results showed that feeding different dietary treatments supplemented with or without 0.01 % Maxigrain ® enzyme to broiler chickens had no significant ($P > 0.05$) effects on haematological parameters and did not compromise the health as values were within normal range. Result showed that birds fed T_1 and T_4 were not significantly ($P>0.05$) different in terms of final body weight, daily weight gain, daily feed intake, feed conversion ratio and major carcass characteristics were significantly ($P<0.05$) different and had higher values than birds fed T_2, T_3 and T_5 supplemented with Maxigrain ® enzyme.

Key words: Sorghum, enzyme chicken, blood

Description of Problem

Cereal grains are the major sources of energy in poultry diets in the tropics (1) and form the largest part of energy source and inclusion level in a standard poultry diet (2). Maize which used to be the major source of energy in poultry diets is now very expensive due to low production in the drier areas of the tropics and the intense competition between man and livestock (3). One important measure that can be taken to alleviate this situation is the use of alternative energy sources such as sorghum and millet (3). Sorghum varieties in Nigeria have been reported to contain tannin in a range of 0.012 to 0.215 % (4). In poultry, tannins are known to reduce feed intake, feed efficiency, growth rate, egg production, protein utilization and damaged the mucosal lining of the digestive tract (5), reduce palatability and digestibility which had adverse effects on metabolism and toxicity of livestock (6;7;8). Sorghum contains anti- nutritional factors such as phytate, oxalate, saponins and tannin. Sorghum grains contain large amount of karfirins which is a protein fraction that places it as a constraint as its protein is inaccessible

by digestive enzymes of birds and secondly because it has imbalance amino acid profile (9).

However, exogenous enzymes have been used extensively in the diets of poultry to improve productive performance and nutrient utilization especially from cereal grains (10; 11; 12).

One important means of assessing the clinical and nutritional health status of animals in feeding trials is blood. Haematological parameters commonly used in nutritional studies include the packed cell volume (PCV), red blood cell (RBC), white blood cell (WBC), haemoglobin (Hb) as reported by (13). Haematological examinations provide valuable information on the metabolic profile, support objective assessment of the state of health, and are often helpful in the revelation of health disorders already at the preclinical stage (14). The blood picture changes with the advancement of an animal's age and also varies with certain conditions as stress, bacteria or viral infections and intoxication (15). The evaluation of the levels of total protein and its fractions supply the information required to interpret the occurrence of dehydration, infections, immune diseases, and inflammatory responses (16).

A few authors have reported that sorghum had no negative effects on blood parameters in turkey and broilers respectively (17, 18), these authors also reported that total replacement of maize with sorghum grains had no apparent effect on the health of poults and finishing broiler chickens. It has been reported that sorghum varieties such as Samsorg-17 and ICSV400 (Samsorg-40) could completely be used to feed local turkeys without any deleterious effects on the haematological and serum biochemical parameters (17). A study revealed that maize could be completely replaced with low-tannin sorghum in broiler diets without adverse effects on their carcass and blood components (18). For the above reasons the objective of this research was designed to determine the effect of feeding four sorghum varieties supplemented with Maxigrain ® enzyme on haematological and carcass characteristics of broiler chickens at the finisher phase.

Materials and Methods

Location of study

The experiments was conducted at the Poultry Unit, Department of Animal Science Teaching and Research farm, Ahmadu Bello University, Zaria, Kaduna State, which is within the northern Guinea savannah zone of Nigeria on latitude $11^0$14`44 N and longitude $7^0$33'65 E at an altitude of 610m above sea level. The climate is relatively dry, with a mean annual rainfall of 700-1400mm (19).

Experimental birds and feed ingredients

250 day-old Abor- acre broiler chicks were obtained from Zamfy Farms, Ilemono, Kwara State, Nigeria. Four varieties of sorghum grains were used for this study and were obtained from Samaru and Giwa open markets in Kaduna State. While other feed ingredients and Maxigrain ® enzyme were purchased in Rebson Feed Mill, Samaru, Zaria.

Experimental design and management of experimental birds

Two hundred and twenty five (225) broiler chicks of mixed sexes were randomly allotted into five dietary treatments at five days old at the starter phase, the birds were weighed at the beginning of the experiment and maintained their allocation of five different dietary treatments in a completely randomized design (CRD) till the finisher phase. The birds were housed in deep litter pens; each treatment group had total number of forty five (45) birds in three replicates of 15 birds per pen. Routine vaccination and medications were given as at when due, feed and water were provided ad-libitum.

Experimental diets

Five diets were formulated to be iso-nitrogenous (approximately 23 % CP at starter phase and 21 % at finisher phase) and iso-caloric (approximately 2900 Kcal/kg at the starter phase and 3000 Kcal/kg at the finisher phase) in order to meet the standard requirements of broiler chickens in the tropics (20, 21). Diets were formulated as follows; T_1 – Maize without Maxigrain ® enzyme supplementation, T_2 –Samsorg-14, T_3 – Samsorg-40, T_4 –Samsorg-17 and T_5 – KSV-15, T_2 - T_5 were supplemented with 0.01 % Maxigrain ® enzyme as presented in Table 1 and 2 respectively.

Data collection

Growth performance

Growth parameters were measured and calculated, these included final body weight, weight gain, feed intake, feed to gain ratio and feed cost per kg gain. Broilers were weighed at the beginning of the experiment and weekly thereafter, feed and water was provided *ad libitum* daily. Left over feed was weighed and subtracted from the total feed supplied for the week to obtain feed intake per week. The study lasted for eight weeks and mortality was recorded as it occurred and calculated in percentages at both the starter and finisher phase. Growth parameters were also measured and calculated as indicated in the starter phase.

Table1: Composition of the experimental broiler starter diets supplemented **with Maxigrain ® Enzyme (0-4 weeks)**

Dietary Treatments **Ingredients** (%)	**T_1 (Control)**	**T_2 (Samsorg-14)**	**T_3 (Samsorg-40)**	**T_4 (Samsorg-17)**	**T_5 (KSV-15)**
Maize	51.00	0.00	0.00	0.00	0.00
Sorghum	0.00	51.00	51.00	51.00	51.00
Palm oil	2.00	2.00	2.00	2.00	2.00
Soyabean cake	15.60	15.60	15.60	15.60	15.60
Groundnut cake	27.00	27.00	27.00	27.00	27.00
Limestone	0.50	0.50	0.50	0.50	0.50
Bone meal	3.00	3.00	3.00	3.00	3.00
Common salt	0.25	0.25	0.25	0.25	0.25
Vitamin premix*	0.30	0.30	0.30	0.30	0.30
Synthetic lysine	0.20	0.20	0.20	0.20	0.20
Synthetic methionine	0.15	0.15	0.15	0.15	0.15
Total	100	100	100	100	100
Calculated analysis					
Maxigrain® enzyme	0.00	0.01	0.01	0.01	0.01
ME (Kcal/kg)	2981	2952	2941	2989	2935
Crude protein (%)	23.05	23.17	23.49	23.36	23.57
Ether extract (%)	5.83	5.46	5.60	5.27	6.03
Crude fibre (%)	4.03	4.81	3.98	3.98	5.37
Calcium (%)	1.19	1.18	1.18	1.18	1.18
Available phosphorus (%)	0.58	0.59	0.59	0.59	0.59
Lysine (%)	1.20	1.25	1.24	1.26	1.24
Methionine (%)	0.50	0.48	0.48	0.48	0.48
Methionine + cysteine (%)	0.83	0.83	0.87	0.86	0.91
Cost/kg feed (₦)	78.76	76.26	76.26	76.26	89.01

* Biomix broiler starter premix supplied the following per kg diet: Vit. A, 1,000 I.U; Vit. D_3, 2000 I.U, Vit. E, 5.0mg; Vit. K, 2mg; Vit. $B_1$1.8mg; VitB_2, 5.5mg; Niacin, 27.5mg; Pantothenic acid, 0.5mg Vit.B_6, 0.30mg; Vit. B_{12}, 0.015mg; Folic acid, 0.75mg; Biotin 0.6mg; Choline Chloride,3000mg; Copper,3mg; Iodine, 1mg; Iron,20 mg; Manganese, 40mg; Selenium,0.2mg; Zinc,30mg; Antioxidant, 1.25mg, ME= Metabolizable Energy.

Table 2: Composition of the experimental broiler finisher diets supplemented with Maxigrain® enzyme (5-8 weeks)

Dietary Treatments **Ingredients** (%)	T_1 (Control)	T_2 (Samsorg-14)	T_3 (Samsorg-40)	T_4 (Samsorg-17)	T_5 (KSV-15)
Maize	57.00	0.00	0.00	0.00	0.00
Sorghum	0.00	57.00	57.00	57.00	57.00
Palm oil	3.00	3.00	3.00	3.00	3.00
Soyabean cake	15.00	15.00	15.00	15.00	15.00
Groundnut cake	20.60	20.60	20.60	20.60	20.60
Limestone	0.50	0.50	0.50	0.50	0.50
Bone meal	3.00	3.00	3.00	3.00	3.00
Common salt	0.25	0.25	0.25	0.25	0.25
Vitamin premix*	0.30	0.30	0.30	0.30	0.30
Synthetic lysine	0.20	0.20	0.20	0.20	0.20
Synthetic methionine	0.15	0.15	0.15	0.15	0.15
Total	100	100	100	100	100
Calculated analysis					
Maxigrain® enzyme	0.00	0.01	0.01	0.01	0.01
ME (Kcal/kg)	3085	3063	3051	3096	3044
Crude protein (%)	20.58	20.72	21.20	20.92	21.39
Ether extract (%)	6.47	6.07	6.22	5.84	5.96
Crude fibre (%)	3.28	3.23	3.57	3.23	3.51
Calcium (%)	1.18	1.17	1.17	1.17	1.17
Available phosphorus (%)	0.57	0.58	0.58	0.58	0.59
Lysine (%)	1.09	1.15	1.14	1.16	1.14
Methionine (%)	0.46	0.46	0.46	0.46	0.48
Methionine + cysteine (%)	0.76	0.76	0.80	0.81	0.86
Cost/kg feed (₦)	75.86	73.06	73.06	73.06	87.31

* Biomix broiler finisher premix supplied the following per kg diet: Vit. A, 10,000 I.U; Vit. D_3, 2000I.U; Vit. E, 23mg; Vit.K, 2mg; Vit.B_1, 1.80mg; Vit.B2, 0.0mg; Niacin, 5.5mg; Pantothenic acid, 7.5mg ; Vit.B_6, 3.0mg; Vit. B_{12}, 0.015mg; Folic acid, 7.5mg; Biotin, 0.06mg; Choline Chloride, 300mg; Cobalt, 0.2mg; Copper, 3mg; Iodine, 1mg; Iron, 20mg; Manganese, 40mg; Selenium, 0.2mg; Zinc, 30 mg; Antioxidant, 1.25mg, ME = Metabolizable Energy.

Blood samples were collected at 8th week of age from nine (9) birds per treatment which were randomly selected based on their average weight per treatment. Birds were fasted for 12hours before slaughtering, to allow the emptying of the crop and excretion of the undigested feed residues. Birds were slaughtered and blood samples were collected from the jugular vein using Bijou test tubes containing ethylene-diamine tetra-acetic acid (EDTA) an anticoagulant, at a ratio of 5 mg/ml of blood were used for blood sampling according to the procedure by (22).

The blood samples were put in an ice pack to prevent deterioration of blood samples according to the procedure by (23) and transported to the faculty of Veterinary Medicine Haematology Laboratory of the Ahmadu Bello University, Zaria to determine the Packed cell volume (PCV), Red blood cells (RBC), White blood cell (WBC), Haemoglobin (Hb), Total blood protein (TP) and differential blood counts.

Statistical Analysis

All data obtained from the study were

subjected to analysis of variance (ANOVA) using general linear model procedure of SAS, 2008 (24). Significant levels of differences among treatment means were determined using the Tukey`s test as reported by (25) to separate the means.

Results and Discussion

The effect of feeding four varieties of sorghum supplemented with 0.01% Maxigrain ® enzyme on growth performance is presented in Table 3. The results showed significant (P<0.05) differences in all the growth parameters measured. Birds fed T_1 and T_4 were significantly (P<0.05) different from other birds fed different sorghum varieties supplemented with Maxigrain ® enzyme (T_2, T_3 and T_5) in terms of final body weight, daily weight gain, daily feed intake and feed conversion ratio. The result showed that birds fed T_1 and T_4 were not significantly (P>0.05) different in terms of final body weight, daily weight gain, daily feed intake and feed conversion ratio.

The effects of feeding four varieties of sorghum supplemented with Maxigrain® enzyme on the haematological parameters is presented in Table 4.

The result showed that there were no significant (P > 0.05) differences in all the haematological parameters measured indicating that feeding broiler chickens with sorghum supplemented with Maxigrain® enzyme at the finisher phase had no negative effect on the packed cell volume (PCV), haemoglobin (Hb), total protein (TP), red blood cell (RBC), white blood cell (WBC), eosinophils and monocyte as they were all within normal range for healthy chickens (12).

Table 3: Performance of broiler chickens fed four varieties of S*orghum bicolor* supplemented with Maxigrain ® enzyme (5 days - 8weeks)

Treatments Parameters	T1	T2	T3	T4	T5	SEM
Initial weight (g / bird)	102.20	102.20	102.20	102.20	102.20	0
Final weight (g / bird)	2987.20 [a]	2613.20 [b]	2142.20 [c]	3038.5[a]	2170.90 [c]	134.74
Average daily weight gain (g /bird)	51.52 [a]	44.84 [b]	36..43[c]	52.43 [a]	36.94[c]	2.41
Average daily feed intake (g / bird)	121.57 [a]	109.92[b]	98.25[c]	119.75 [a]	96.95 [c]	3.31
Feed conversion ratio	2.37[a]	2.45[a]	2.70[b]	2.28[a]	2.62[b]	0.12
Feed cost / kg gain (₦)	182.63 [a]	182.92[a]	201.58[a]	170.22 [a]	230.98[b]	16.63
Mortality (%)	13.33	15.54	17.78	13.33	17.78	2.44

[a,b,c..] Means on the same row with different superscripts are significantly (P < 0.05) different.

SEM = Standard error of means

T1- Control (0% sorghum supplemented with 0% Maxigrain ® enzyme), T2- Samsorg- 14 with 0.01g/kg Maxigrain® enzyme, T3- Samsorg-40 supplemented with 0.01g/kg Maxigrain ® enzyme, T4- Samsorg -17 supplemented with 0.01g/kg Maxigrain ® enzyme, T5- KSV-15supplemented with 0.01g/kg Maxigrain® enzyme.

Table 4: Haematological parameters of broiler chickens fed S*orghum bicolor* varieties supplemented with Maxigrain ® enzyme at 8 weeks.

	Treatments						
Parameter	T1	T2	T3	T4	T5	Normal range	SEM
PCV (%)	26.00	27.00	24.67	27.00	27.17	22-35	1.19
Hb (g/dl)	8.65	8.97	8.15	8.95	9.02	7.0-13	0.39
TP (g/dl)	4.53	4.82	4.32	4.65	4.72	3.0-4.9	1.79
RBC (x10^6/l)	2.37	2.35	2.00	2.31	2.13	2.00-4.0	0.32
WBC (x10^3/l)	10.85	12.15	11.40	13.18	13.67	9.20-31.0	0.94
Heterophils (%)	11.17	9.50	8.33	10.83	12.50	4.57-24.2	1.29
Lymphocytes (%)	88.83	90.50	91.67	89.17	87.50	40-70	1.78
Eosinophils (%)	0.00	0.00	0.00	0.00	0.00	0.0-1.8	0.00
Monocyte	0.00	0.00	0.00	0.00	0.00	0.0-1.0	0.00
Band	0.00	0.00	0.00	0.00	0.00	Rare	0.00

[a,b.] Means on the same row with different superscripts are significantly ($P<0.05$) different.
SEM = Standard Error of Means.
T1- Control (0% sorghum supplemented with 0% Maxigrain® enzyme), T2- Samsorg 14 with 0.01g/kg Maxigrain® enzyme, T3- Samsorg-40 supplemented with 0.01g/kg Maxigrain® enzyme, T4- Samsorg -17 supplemented with 0.01g/kg Maxigrain® enzyme, T5- KSV-15 supplemented with 0.01g/kg Maxigrain® enzyme.
PCV =Packed Cell Volume, Hb = Haemoglobin, TP =Total Protein, RBC=Red blood cell, WBC=White blood cell.

The results agreed with the reports by (22) for PCV (22 – 35 %), Hb (7-13g/dl); TP (3.0 – 4.9 mg/dl) (26), RBC (2.0 – 4.0 x 10^6 / l) as reported by (27), WBC (9.20 – 31.0 x 10^9 / l) as reported
by (28), heterophils (4.57-24.2 %) as reported by (29), eosinphils (0.0-1.8%) as reported by (30) and monocytes (0.0- 1.0 %) and band (rare) as reported by (30). The result indicates that enzymes have positive effects on the health of the birds by reducing anti-nutritional factors and toxicity (31).

The haematology index and use of multi-enzyme were not compromised when broiler chickens were fed sorghum with Maxigrain ® enzyme, this result is similar to the reports by (32) that the use of multi enzyme in sorghum diets did not compromise the haematological index.

The lymphocyte values were not significantly different; this indicated that there was no adverse immune response in broiler chickens fed sorghum diets supplemented with 0.01% Maxigrain ® enzyme. The lymphocyte values were above the normal values when compared to the reports by (18), this indicated stressors were applied on chickens but did not exceed the threshold levels to affect birds performance (18) as the health of birds were not compromised.

The non-significant effect ($P>0.05$) of some varieties of sorghum diet supplemented with Maxigrain ® enzymes(T_2, T_3, T_4) and maize diet with 0% Maxigrain ® enzymes (T_1) on heterophils, monocytes and band showed the effectiveness of enzymes in reducing the anti-nutritional factors in sorghum (32).

The effect of feeding four varieties of sorghum supplemented with Maxigrain® enzyme on the carcass characteristics is presented in Table 5.

Table 5: Effects of feeding four varieties of S*orghum bicolor* supplemented with Maxigrain® enzyme on the carcass and organ characteristics of broiler **chickens at eight weeks**

Parameters	Treatments					SEM
	T1	T2	T3	T4	T5	
Live weight (g)	3000.00[a]	2600.00[b]	2108.30[d]	3100.00[a]	2133.30[c]	186.05
Plucked weight (g)	2866.70[a]	2458.30[b]	1908.30[c]	2916.70[a]	1991.70[c]	185.79
Dressed weight(g)	2250.00[a]	1808.33[b]	1416.67[c]	2300.00[a]	1533.33[c]	142.65
Dressing percentage (%)	75.00[a]	69.55[a]	67.19[b]	74.19[a]	71.87[a]	3.72
Major cuts expressed as percentages of carcass weight (%)						
Breast	30.22[a]	29.68[a]	25.15[b]	28.72[a]	27.85[a]	1.50
Thigh	15.18[a]	14.97[b]	16.18[a]	15.20[a]	16.45[a]	0.63
Drumstick	13.18	13.55	16.17	14.88	14.93	0.69
Wings	9.92[c]	10.60[b]	11.88[a]	10.72[b]	10.92[b]	0.47
Organs expressed as percentages of live weight (%)						
Gizzard	2.48[b]	2.62[b]	3.10[a]	2.62[b]	3.10[a]	0.21
Liver	1.78[b]	2.05[a]	2.27[a]	1.85[b]	2.07[a]	0.16
Lungs	0.57	0.67	0.73	0.67	0.70	0.07
Kidneys	0.45	0.68	0.42	0.57	0.60	0.09
Spleen	0.13	0.12	0.18	0.20	0.18	0.04
Heart	0.43	0.47	0.58	0.50	0.52	0.05
Abdominal fat	2.37	2.38	1.45	2.20	2.13	0.47

[a,b,c.] Means on the same row with different superscripts are significantly (P<0.05) different.
SEM = Standard error of means
T1- Control (0% sorghum supplemented with 0% Maxigrain® enzyme), T2- Samsorg 14 with 0.01g/kg Maxigrain® enzyme, T3- Samsorg-40 supplemented with 0.01g/kg Maxigrain® enzyme, T4- Samsorg -17 supplemented with 0.01g/kg Maxigrain® enzyme, T5- KSV- 15supplemented with 0.01g/kg Maxigrain® enzyme.

The result shows significant (P<0.05) differences across the various dietary treatments in terms of live weight, plucked weight, dressed weight, dressing percentage, breast weight, thigh, wings, head, gizzard and liver. The result for live weight and carcass weight shows that T_1 and T_4 had the highest weight with no significant (P>0.05) differences between them, but were significantly (P<0.05) different when compared with Samsorg -14(T_2), (T_3) Samsorg -14 and KSV-15(T_5) diets. The result was similar to the reports of (20; 21) that there were no significant differences in live weight for birds fed the control diet (maize) and sorghum varieties. Furthermore, the result showed that birds fed T_1, and T_4 and were significantly (P< 0.05) different in live weight and affected the carcass weight and dressed weight positively this is similar to the reports by (32; 33; 11), but when compared to other dietary treatments containing sorghum it was not in agreement, this might be due to varietal differences and high anti-nutritional factor concentration (34) which could have affected their performance.

The results showed that the dressed weight of birds fed T_2, T_5 and T_3 were low, this could be due to poor feed conversion ratio and poor digestibility as a result of γ - Kafirins present in the sorghum variety which made it difficult to degrade and access nutrients such as protein and carbohydrate, due to inability of the bird's digestive enzymes to access Kafirins (35).

The result for the breast muscle, thigh, wings showed significant (P<0.05) differences between birds fed dietary treatments. The

breast weight of birds in T_2, T_4 and T_5 were similar ($P > 0.05$) to that of birds in the control group (T_1) and the result agrees with the reports by (11; 12; 33) that enzymes improved breast weights of chickens. The wing weights were similar in birds fed T_1, T_2, T_5 and T_4. This result agrees with the findings by (12) who reported that birds fed sorghum diets with multi-enzyme were not significantly different from birds fed maize diets without enzymes in all carcass parts of broilers at eight weeks but this was not so for T_3. The multi-enzyme had no positive effect on birds fed Mori diets (T_3) as a result of which nutrient could not be released significantly in birds in T_3 to improve the breast and thigh weights.

The result for the gizzard and liver weights showed significant ($P<0.05$) differences across treatments with birds fed T_2, T_3 and T_5 having the highest values compared to birds fed T_1 and T_4.

The result shows no significant ($P>0.05$) differences in birds fed the different dietary treatments on the following carcass parameters: drum stick, lungs, kidney, spleen, heart and abdominal fat.

The result is in agreement with the findings by (11 ; 36) that using multi-enzyme in sorghum based diets improved carcass parts of broilers chickens at the finisher phase compared to birds fed maize diets without multi-enzyme and showed no significant differences

Birds in T_1, and T_4 had similar liver weights, while the kidney, spleen and heart weights were similar in all the dietary treatments which agrees with the findings by (12) that no significant differences were obtained from birds fed Kaura (T_4) supplemented with a multiple-enzyme compared to birds fed the control (T_1) on the gizzard weight. The result obtained by birds fed other dietary treatments containing sorghum did not agree with the findings by (12) that birds fed red sorghum supplemented with enzyme were similar in gizzard weights when compared with birds fed the control diet. In addition (11; 33) reported that feeding different sorghum varieties resulted in non-significant differences in gizzard weight when compared to broilers fed maize diets without enzyme supplementation as the case is for birds fed T_4 and T_5 in this study. This might be due to varietal differences and levels of anti-nutritional concentration as reported by (34).

Conclusion and Applications

1. The replacement of sorghum varieties for maize at 100 % dietary inclusion supplemented with 0.01 % Maxigrain ® enzyme did not compromise the health of broiler chickens at the finisher phase in terms of hematological indices.
2. The complete replacement of maize for sorghum varieties supplemented with Maxigrain ®enzyme at 0.01% in broiler diets improved the growth performance and carcass characteristics of Samsorg-17 but had no significant effect on other varieties of sorghum.
3. Farmers are encouraged to make use of Samsorg-17 (Kaura) in poultry diets as it is abundant in Northern guinea savannah and can totally replace maize with supplementation by Maxigrain® enzyme at 0.01%.

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