Global Scientific and Academic Research Journal of Multidisciplinary Studies
ISSN: 2583-4088 (Online)
Frequency: Monthly
Published By GSAR Publishers
Journal Homepage Link- https://gsarpublishers.com/journals-gsarjms-home/

Growth Performance, Carcass Traits, and Haematological Responses of Broiler Chickens Fed Diets Containing Maize Stover and Faczyme® Supplement

By

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Article History

Received: 01/08/2025
Accepted: 04/08/2025
Published: 06/08/2025

Vol – 4 Issue –8

PP: - 21-27

Abstract

*A 49-day feeding trial was conducted to evaluate the effects of maize stover supplemented with **Faczyme®** as a partial replacement for yellow maize on the performance, carcass yield, organ weights, and haematological indices of broiler chickens. A total of 144 day-old Abor Acre broiler chicks were randomly assigned to six dietary treatments in a Completely Randomised Design, with three replicates of eight birds per treatment. The experimental diets included 0% (control), 5%, 10%, 15%, 20%, and 25% maize stover supplemented with **Faczyme®**, replacing equivalent proportions of yellow maize. Birds were fed and watered **ad libitum** on wood-shaving litter. Growth performance parameters such as feed intake, weight gain, and feed conversion ratio (FCR) were monitored. Blood samples were analysed using standard laboratory procedures. The final body weights across treatments were: 1969.17 g, 2027.46 g, 1922.92 g, 1867.92 g, 2020.49 g, and 1917.60 g, respectively, with no significant differences (P > 0.05). However, birds fed the 15% maize stover diet showed a more favourable FCR. Carcass characteristics varied significantly (P < 0.05) among treatments, except for thigh weights (14.83%, 14.76%, 13.42%, 16.09%, 15.60%, and 14.53%) and drumstick weights (14.49%, 14.32%, 14.37%, 14.66%, 15.90%, and 14.94%). Most internal organs showed significant differences (P < 0.05) except the gallbladder, which recorded values of 0.17%, 0.14%, 0.07%, 0.10%, 0.09%, and 0.15%. Haematological indices showed significant variations (P < 0.05) except white blood cell (WBC) count and mean corpuscular hemoglobin concentration (MCHC). Notably, hemoglobin (Hb) increased from 11.34% in the control to 14.74% in the 20% treatment group, while packed cell volume (PCV) rose from 26.00% to 31.00%. In conclusion, maize stover supplemented with **Faczyme®** can effectively replace 15–20% of dietary yellow maize in broiler diets without adverse effects on performance, carcass traits, or blood parameters.*

Keywords: *Broilers, Maize stover, Faczyme, Carcass Characteristics, Organ Proportions, Haematology*

Target Audience*: Poultry Farmers, Animal Nutritionists*

Introduction

The escalating cost and scarcity of maize for livestock feed in Nigeria have become major constraints to the sustainable production of affordable and high-quality animal protein—an essential component of the average Nigerian's diet. Although maize is the second most cultivated crop after cassava in Nigeria, it remains in high demand across virtually all sectors of the economy, particularly for human consumption and industrial use (FAOSTAT, 2014). Maize has been described as indispensable to both food security and commercial viability in the country (Sahel Reports, 2014; Tang et al., 2006). Between 2005 and 2010, reports from the USDA indicated that approximately 50% of the maize produced in Nigeria was consumed by the animal feed sector, with poultry alone accounting for up to 98% of the total feed consumed.

Despite its strategic importance, maize production in Nigeria faces numerous challenges that plague the value chain. These include poor access to finance, weak market linkages, climate variability, and fluctuating commodity prices. Compounding these issues is the growing insecurity in key maize-producing states—such as Kaduna, Borno, Niger, and Taraba—resulting from activities like banditry, terrorism, and kidnapping. These

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factors have significantly disrupted maize production and supply, necessitating the urgent search for cheaper, locally available, and nutritionally viable alternative energy sources that can replace maize without competing directly with human food needs.

According to Akinfemi et al. (2009), agricultural industries generate substantial quantities of crop residues that hold potential as livestock feed resources. In Nigeria, these residues include sheath and stover from cereals like maize, millet, sorghum, and wheat. Unfortunately, such by-products are commonly underutilized—often burned, used as mulch or staking material, or fed in limited quantities to ruminants. The growing demand for alternative feed resources that require minimal processing has highlighted the need for more efficient utilization of these crop residues.

However, most alternative ingredients contain high levels of non-starch polysaccharides (NSPs), which are poorly digested by poultry due to their monogastric digestive system (Dalibord, 2006). The high fibre content of such feedstuffs impairs digestive efficiency, disrupts enzymatic activity in the gastrointestinal tract, and ultimately reduces nutrient absorption and animal performance (Jozefiak et al., 2004).

To address this challenge, the use of feed enzymes has gained prominence in recent decades. Supplementing livestock diets with exogenous enzymes—typically of fungal or bacterial origin—has been shown to enhance the digestibility of fibrous diets, reduce nutrient loss in excreta, and improve overall feed efficiency. Enzymes such as phytases, carbohydrases, lipases, and proteases are now commonly employed to increase the nutritional value of unconventional feed ingredients by breaking down anti-nutritional factors and enhancing nutrient availability.

Maize stover, which comprises the stalks, leaves, husks, and cobs left in the field after harvesting maize for grain (Zea mays L.), is one such crop residue with significant feed potential. It is widely considered the best among cereal stovers due to its relatively high energy and protein content, as well as its palatability and availability wherever maize is cultivated. According to Lizotte et al. (2015), the composition of maize stover typically includes 40–60% stalk, 15–20% cobs, 20–30% leaves, and 10–15% husks. Its nutritional profile includes crude protein (2.5–6.3%), crude fibre (18.3%), ether extract (3.83%), and a metabolizable energy value of approximately 9 MJ/kg dry matter (Tona et al., 2013). Nevertheless, less than 50% of maize stover is utilized for feeding livestock (Munthali et al., 2000), with the remainder often lost to trampling, soiling, and termite damage.

Enhancing the utilization of maize stover through appropriate processing techniques or enzyme supplementation could therefore provide a sustainable solution to the feed maize shortage. Based on this premise, the present study was designed to evaluate the effects of partially substituting yellow maize with maize stover, supplemented with **Faczyme®**, on the growth performance, carcass yield, organ development, and haematological parameters of broiler chickens.

Materials and Methods

Experimental site

The experiment was carried out at the Poultry Unit of the Teaching and Research Farm, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. The area falls within the tropical rain forest zone with an annual rainfall of 2177mm, a temperature range between 20-30^{o}C °C, with relative humidity of 50-59%, depending on season (NRCRI, 2020).

Source and processing of maize stover

Maize stover was collected from a maize farm in Isiala Ngwa North L.G.A. of Abia State after harvesting was concluded. The stover was chopped into smaller sizes (2-4cm) and sundried. It was taken to the local mill, where it was ground for incorporation in the diets for experiments. Ingredients such as maize, soyabean meal, groundnut cake, fish meal (Danish), palm kernel meal, bone meal, oyster shell, vitamin/mineral premix, salt, methionine, lysine and Faczyme® were procured from a commercial dealer. The Faczyme®is aproduct obtained from Spain. It is powdery and yellowish in colour. It is a complex enzyme. Its composition includes: phytase, cellulose, xylanase, beta-glucanase, amylase, mannanase, pectinase, neutral protease, acid protease and glucose oxidase, and the inclusion level was 0.1%.

Experimental birds and management

A total of 144-day-old Abor Acre broilers were procured from Amo Byng® farms for the experiment. The initial weight of the birds was taken and randomly divided into 6 treatment groups with 8 birds per replicate, comprising 24 birds in each group, and the birds were brooded together with a 60W bulb. Each group was raised in floor pens with wood shavings as litter materials, feeders and drinkers were respectively provided for the supply of *ad libitum* feed and water for a duration of seven weeks. The birds were vaccinated against Gumboro disease at 10th and 18th days of life, while the Newcastle vaccine was administered at the 28th day. Coccidiostat was administered in drinking water during the second and third weeks of the experiment.

Experimental diets

Six (6) experimental broiler diets were formulated for the experiment such that the control diet (T_1) did not contain Faczyme® and maize stover, while Diets T_2-T_6 contained maize stover at 5%, 10%, 15%, 20% and 25% and Faczyme® at 0.1% across board. The composition of broiler chickens' diets and calculated analysis are shown in Table 1.

Table 1:Dietary Composition of Broiler Diets showing percent substitution of maize stover for yellow maize in Faczyme supplemented diets (0-7 weeks)

Ingredients (%)	T_1(0%)	T_2(5%)	T_3(10%)	T_4(15%)	T_5(20%)	T_6(25%)

Yellow Maize	52.20	49.59	46.98	44.37	41.76	39.15
Maize Stover	0.00	2.61	5.22	7.83	10.44	13.05
Soyabean Meal	15.00	15.00	15.00	15.00	15.00	15.00
Groundnut Cake	15.00	15.00	15.00	15.00	15.00	15.00
Fish Meal (Danish)	4.00	4.00	4.00	4.00	4.00	4.00
Palm Kernel Meal	10.00	9.90	9.90	9.90	9.90	9.90
Bone Meal	2.00	2.00	2.00	2.00	2.00	2.00
Oyster Shell	1.00	1.00	1.00	1.00	1.00	1.00
Premix	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Methionine DL	0.15	0.15	0.15	0.15	0.15	0.15
Lysine	0.15	0.15	0.15	0.15	0.15	0.15
Enzyme	-	0.10	0.10	0.10	0.10	0.10
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis						
Crude protein %	21.00	20.80	20.60	20.40	20.20	20.00
ME Kcal/Kg	3000.08	2910.32	2820.55	2730.79	2641.02	2551.25
Analyzed composition						
Dry matter %	91.95	91.80	91.80	91.75	91.75	91.68
Crude protein %	22.65	22.15	21.65	21.30	21.00	20.85
Crude fibre %	4.25	4.68	5.38	5.98	6.87	7.18
Ether extract %	4.10	3.80	3.60	3.40	3.20	3.10
Moisture %	8.05	8.20	8.20	8.25	8.25	8.32
NFE %	55.36	55.28	54.60	52.18	51.11	50.07
Ash	5.59	5.89	6.57	8.89	9.57	10.48
ME Kcal/kg	2912.45	2884.55	2854.37	2775.18	2747.03	2713.70

Vitamin-mineral premix supplied the following: Vitamin A 8,000,000 iu, Vitamin D_3 2,000,000, Vitamin E 5,000mg, Vitamin K_3 2,000mg,

Folic acid 500mg, Niacin 15,000mg, Vitamin B_2 8,000mg, Vitamin B_{12} 10,000mg, Vitamin B_1 1,500mg, B6 1,500mg, Biotin 20mg, Calpan 5,000mg.

Table 2: Determined Proximate composition of maize stover

Parameters	% Composition
Dry matter	92.9
Crude protein	6.48
Crude fat	0.50
Crude fibre	31.73
Ash	23.33
Moisture	8.02
Metabolizable energy (Kcal/kg)	972.72

Data Collection

Growth performance

Data on performance characteristics such as average initial weight, average weight, and average feed intake were collected, while average weight gain, feed conversion ratio, daily protein intake and protein efficiency ratio were calculated.

Carcass evaluation

At the end of the experiment, two (2) birds of similar body weight were selected from the treatment groups, fasted, weighed and slaughtered by severing the jugular vein. They were thoroughly bled and scalded by dipping in hot water of 60 ° C and defeathered. The carcass values from head, shank, neck and visceral were removed in order to determine the dressed weight as described by Ojewola and Longe (1999).

Dressing % = Dressed weight x 100

$$\text{Organs} = \frac{\text{Live weight}}{\text{Heart/liver/kidney/intestine/proventriculus}} \div \frac{\text{Live weight}}{1} \times \frac{100}{1}$$

Haematological indices

Blood samples (10mls) were taken from the jugular vein of each of the birds under each of the treatment diets at the end of the experiments using a sterile needle and syringe to withdraw the blood; from which 5mls each were kept in a sample containing Ethylene Diamine Tetra Acetic Acid (EDTA), an anti-coagulant to prevent blood clotting. Each of the blood samples collected was put into a properly labelled and sterilised tube and taken to the laboratory for haematological assessment. The following were determined: Packed Cell Volume (PCV), Red Blood Cells (RBC), White Blood Cells (WBC), Haemoglobin (Hb), Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Haemoglobin Concentration (MCHC).

Mean Corpuscular Haemoglobin (MCH)

$$\frac{\text{Hb} \times 10}{\text{RBC}}$$

Mean Corpuscular Volume (MCV)

$$\frac{\text{PCV} \times 10}{\text{RBC}}$$

Mean Corpuscular Haemoglobin Concentration (MCHC)

$$\frac{\text{Hb}\times 100}{\text{PCV}}$$

Statistical Analysis

All data generated were statistically analysed using the Analysis of Variance (ANOVA) procedure described by Steel and Torrie (1980) in a Completely Randomised Design (CRD), and significant means were separated using Duncan Multiple Range Test (Duncan, 1995), taking P<0.05 as significance level.

Results and Discussion

The proximate composition of maize stover used in this study is presented in table 2. It includes the dry matter 92.9%, crude protein 6.48%, crude fat 0.50%, crude fibre 31.73%, ash 23.33%, moisture 8.02% and metabolizable energy 972.72Kcal.kg.

Growth Performance

The result showed that there was no significant difference (P>0.05) across the treatment group on final weight, total weight. Average daily weight followed the same pattern of significance on birds fed 5%-15% Maize stover diets supplemented with an enzyme. Birds fed 5% maize stover had higher numerical values but showed no significant difference (P>0.05) when compared with other means. The observed higher weight gain values in birds fed 5% maize stover are related to the studies of Makinde *et al.* (2013), while they observed that lower body weight (1867.92g and 1917.60g) was recorded in 15% and 25% respectively, which may be attributed to high fibre content in maize stover. The observed higher numerically weight gain value (2027.46g) in birds fed 5% maize stover showed that enzyme supplementation in the diet helped in nutrient digestibility due to cleavage of Non-Starch Polysacharides (NSPs) and that of anti-nutritional factors (Carsten, 2013). This corroborated the results observed by Rahman *et al.* (2003) and Chuka (2014), who found a significant increase in broiler birds fed enzyme-supplemented diets. Enzyme-supplemented diets enhanced weight gain in broiler chickens without any adverse effects.

Total feed intake was highest (4672.92%) at 5% inclusion level of maize stover (4672.92g), followed by diet 6 at 25% and this concurs with the results of Makinde *et al.* (2013), which stated that birds eat to satisfy their energy requirement. The results of feed intake showed there was a drastic decrease as the level of maize stover increased in the treatment groups. It is related to what was observed by Alabi *et al.* (2014). Feed conversion ratio did not show any significant difference (P>0.05) but was optimal for birds fed 20% maize stover diets supplemented with enzyme, which had the lowest total weight of 1867.92g among the treatment groups. This is because a good FCR value by birds implies that the diet was better utilised. This was observed by Kehinde (2012), who observed and reported a significant (P<0.05) increase in FCR in enzyme-supplemented cassava meal in broiler diets. Daily protein intake showed a significant difference(P<0.05) with the highest value of 19.83g at 5% inclusion of maize stover, and was least at birds fed 15% and 25% maize stover, respectively. Protein efficiency ratio showed significant differences (P<0.05) but birds fed 25% maize stover supplemented with enzyme had the highest value of 2.33 in Diet 6 (25%) followed by birds fed maize stover at 15% which had 2.21 while birds fed maize stover diets at 0 and 5% showed the least numerical values of 2.07 and 2.08 respectively and this agrees with the report of Gunal and Yasar (2004) that feed enzymes have the ability to alter the bacterial population by digesting the long chain carbohydrate molecules utilized by some bacteria to colonize the tract and this increases the quantity of protein and amino acid digested in the precaecal section of the tract.

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Table 3: Growth Performance of broiler chickens fed maize stover diets supplemented with Faczyme (0-7 weeks)

Parameter (g)	T_1(0%)	T_2(5%)	T_3(10%)	T_4(15%)	T_5(20%)	T_6(25%)	SEM
Initial W	39.58	41.67	47.08	46.67	45.00	40.00	0.96 NS
FW	2008.75	2069.13	1970.00	1914.58	2065.49	1957.60	21.71 NS
TW	1969.17	2027.46	1922.92	1867.92	2020.49	1917.60	22.02 NS
ADW	40.19	41.38	39.24	38.12	41.24	39.14	0.45 NS
TFI	4516.42^{a}	4672.92^{a}	4411.67^{ab}	4143.33^{b}	4641.59^{a}	4462.18^{ab}	55.54
ADFI	92.17^{a}	95.37^{a}	90.03^{ab}	84.56^{b}	94.73^{a}	91.07^{ab}	1.13
FCR	2.29	2.31	2.29	2.21	2.29	2.32	0.02 NS
DPI	19.35^{ab}	19.83^{a}	18.54^{abc}	17.25^{c}	19.13^{ab}	18.21^{bc}	0.25
PER	2.07^{b}	2.08^{b}	2.11^{ab}	2.21^{ab}	2.15^{ab}	2.33^{a}	0.03

^{aa,b,c,} Means within the rows with different superscripts are significantly different (P<0.05); SEM=Standard error of mean. FW: Final Weight; TW: Total Weight; ADW: Average Daily Weight; ADFI: Average Daily Feed Intake; TFI: Total Feed Intake; FCR: Feed Conversion Ratio; PI: Protein Intake; PER: Protein Efficiency Ratio

Carcass Characteristics

The result of the carcass characteristics of broilers fed maize stover diets supplemented with Faczyme is presented in Table 4. Statistically, live weight, defeathered weight, dressed weight and dressing percentage differed significantly (P<0.05). The results on live weight, defeathered weight, dressed weight showed that broiler chickens fed 5% maize stover diets supplemented with enzyme had the highest values (2100%, 1846.67% and 1326.27%) respectively compared to the remaining treatment groups as this could be attributed to the addition of enzymes to the diet which helped to break down fibre content of maize stover and added the positive conversion of feed to meat efficiently, whereas the lowest dressed weight recorded by the remaining treatment groups showed poor feed utilization (Makinde *et al.*, 2013). Tuncer (2011) found that dressing yields were higher in enzyme enzyme-supplemented diet in poultry. Dressing percentage was highest (73.61%) at the 10% level of inclusion of maize stover than in the other treatment groups. High dressing yield may be due to better fleshing and favourable meat in the treated group. The primal cuts (backcut, thigh, drumstick, wings, breastcut) had higher values (20.74%, 16.09%, 15.90%,12.95%, 29.08%) in birds fed 20%, 15%, 20%, 20% and 15% maize stover respectively and this is in accordance with the report of Kehinde (2012) as this was a function of the dressed weight. Although Mohammed *et al.*(2009) in their studies reported that enzyme supplementation had no effect on different meat yields and characteristics but there was an increased dressed yield, drumstick, thigh, and breast meat reported for enzyme supplementation. Nduka (2006) reported that more meat is produced in broiler chickens when supplemented with an enzyme.

Table 5: Carcass characteristics of broiler chickens fed diets containing maize stover diets supplemented with enzyme (0-7 weeks).

Parameters (%)	T_1(0%)	T_2(5%)	T_3(10%)	T_4(15%)	T_5(20%)	T_6(25%)	SEM
Live Weight (g/b)	1916.67^{bc}	2100^{a}	1800^{c}	1816.67^{c}	1866.67^{bc}	1956.67^{b}	28.17
Defeathered Weight (g/b)	1720^{b}	1846.67^{a}	1690^{b}	1660^{b}	1743.33^{ab}	1703.33^{b}	19.16
Dressed Weight (g/b)	1256.67^{ab}	1326.27^{a}	1316.67^{a}	1126.67^{b}	1106.67^{b}	1186.67^{ab}	28.73
Dressing %	65.29^{ab}	63.42^{ab}	73.61^{a}	62.03^{ab}	59.29^{b}	60.57^{ab}	1.77
Back cut	22.06^{a}	19.90^{ab}	18.34^{b}	20.48^{ab}	20.74^{ab}	18.05^{b}	0.50
Thigh	14.83	14.76	13.42	16.09	15.60	14.53	0.41 NS
Drumstick	14.49	14.32	14.37	14.66	15.90	14.94	0.36 NS
Wings	12.12^{ab}	11.30^{ab}	10.18^{b}	12.93^{a}	12.95^{a}	11.97^{ab}	0.33
Breast	30.07^{a}	28.78^{a}	22.23^{b}	29.08^{a}	15.60^{c}	14.53^{c}	1.60

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[a,b,c,] Means within the rows with different superscripts are significantly different (P<0.05); SEM-Standard Error of the mean

Haematological Indices

The results of the carcass characteristics of broilers fed maize stover diets supplemented with Faczyme are presented in Table 5. Significant differences (P<0.05) existed in Red Blood Cell (RBC), Haemoglobin (Hb), Mean Cell Volume (MCV), Mean Cell Haemoglobin (MCH) and Packed Cell Volume (PCV). White Blood Cell (WBC) and Mean Cellular Haemoglobin Concentration (MCHC) did not show any significant difference (P>0.05). RBC values were highest 4.03µl in birds fed 10% maize stover-enzyme-supplemented diets among the treatment groups, while WBC values were highest (6.05 µl) in birds fed 5% maize stover and enzyme-supplemented supplemented, followed by the control group. Hb values were highest (14.74g/dl) in birds fed 20% enzyme-supplemented diets. When there is high Haemoglobin (Hb), it implies high oxygen carrying capacity, but when Hb is below normal, it means the oxygen carrying capacity is low and the birds can easily succumb to respiratory stress (Aderemi and Alabi, 2013). Also, Haemoglobin concentration (Hb) values were within the accepted range of 7.0-13 g/dl for broiler chickens (Bounous and Stedman, 2000). MCV values were highest, 102.67fl, at birds fed 5% maize stover-supplemented diet, followed by the 25% and MCV measures the average size of the RBC. MCH was the highest 50.67pg in birds fed 20% maize stover-enzyme supplemented diets, showing that the birds cannot easily succumb to anaemia since low levels indicate anaemia (Aster, 2004). MCHC was the highest, 50.16g/dl, in birds fed 15% maize stover-enzyme diets among the treatment groups. PCV values were the highest 31% in birds fed a 20% maize stover-enzyme supplemented diet. The haematological parameters are affected by factors such as management, environment, age, starvation, drug administration, nutrition, sex, breed, pregnancy, heat and parturition (Aderemi and Alabi, 2013).

Table 5: Haematological indices of broiler chickens fed maize stover diets supplemented with enzyme (0-7 weeks)

Parameters	T_1(0%)	T_2(5%)	T_3(10%)	T_4(15%)	T_5(20%)	T_6(25%)	SEM
RBC ($\times10^6$/ µl)	2.85^b	2.72^b	4.03^a	3.13^b	3.48^{ab}	3.35^{ab}	0.13
WBC ($\times10^3$/µl)	4.56	6.05	4.44	3.92	3.59	4.16	0.37
Hb (g/dl)	11.34^b	13.04^{ab}	13.93^{ab}	13.97^{ab}	14.74^a	14.42^{ab}	0.23
MCV (fl)	91.51^a	102.67^a	72.59^b	89.03^{ab}	90.59^a	92.02^a	2.86
MCH (pg)	40.05^{ab}	47.74^a	34.72^b	44.61^{ab}	50.76^a	43.84^{ab}	1.81
MCHC (g/dl)	43.66	46.82	47.73	50.16	47.59	47.53	0.96
PCV (%)	26.00^b	27.67^a	29.17^{ab}	28.00^{ab}	31.00^a	30.33^{ab}	0.62

[a,b] Means within the rows with different superscripts are significantly different (P<0.05); SEM-Standard Error of the mean. PCV: Packed Cell Volume; Hb: Haemoglobin; RBC: Red Blood Cell; WBC: White Blood Cell; MCV: Mean Cell Volume; MCH: Mean Cell Haemoglobin; MCHC: Mean Cellular Haemoglobin Concentration.

CONCLUSION

The present findings suggest that diets which contain 15% maize stover supplemented with Faczyme can serve as an alternative source of energy for broiler chickens and replace dietary yellow maize without adverse effects on growth performance, carcass characteristics and haematological parameters.

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