Performance characteristics and blood profile of broiler chickens fed corn-cobs based diets with or without enzyme supplementation

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Abstract

Corn-Cob Meal (CCM) is a waste product derived from maize grain shelling corn cob which constitutes nuisance to the environment and it can be included in poultry diet in order to reduce competition between man and animal. Hence, a 63-day feeding trial was conducted in a completely randomized design to determine performance characteristics and blood profile of broiler chickens fed corn-cobs based diets with or without enzyme supplementation. One hundred and sixty five (165) birds were randomly allotted into five dietary treatment groups; T₁: (0% CCM), T₂: (10% CCM without enzyme), T₃: (20% CCM without enzyme), T₄: (10% CCM with enzyme), T₅: (20% CCM with enzyme) with each treatment comprising three replicates of eleven birds per replicate. Parameters measured include performance characteristics, haematological and serum biochemical indices. The result revealed that there were no significant difference ($P>0.05$) on performance characteristics of broiler chicken observed except for Average Daily Feed Intake (ADFI) and the Feed Conversion Ratio (FCR). Birds fed 10% and 20% CCM based diet without enzyme recorded the highest value of ADFI (129.38 g/b/d and 130.85 g/b/d) while birds fed 20% CCM based diet with enzyme supplementation had the best FCR value (2.18). The haematological parameters were not significantly influenced ($P>0.05$) by the diets except for lymphocytes and heterophil count with the highest lymphocytes value in T₂ (68.00%) and the lowest value in T₅ (53.67%). Birds on T₅ had significantly ($P<0.05$) highest heterophil value (40.67%). The serum biochemical indices were not significantly influenced ($P>0.05$) by the diets except for aspartate aminotransferase. However, values obtained in this study fell within the normal range recommended for healthy broiler chicken. Based on this result, it can be concluded that CCM with enzyme supplementation can be incorporated into broiler diet up to 20% without any detrimental effect on their performance and blood profile.

Keywords: Broiler, Corn-Cob Meal, Performance, Enzymes, Blood profile.

Introduction

The high cost of feed ingredients which accounts for 60-80% of the total cost of production clearly indicates that the production of cereal grains for livestock business is grossly inadequate (Tewe *et al.*, 1976). More so, energy sources are the most important and expensive feedstuffs especially maize which accounts for the largest proportion of about 50-55% of the poultry diet (Afolayan *et al.*, 2002). This invariably has led to stiff competition

between humans and animals over the limited supply of grains therefore affecting the poultry industry in Nigeria (Ahaotu *et al.*, 2009). Thus, there is an urgent need to divert attention toward exploitation of other tropical sources. One of such potential source that has not been fully utilized is corn-cobs which are generally not used for human consumption. Corn-cob is a waste product and readily available in Nigeria which is an underutilized by product from the processing of harvested maize. The

amount of maize cob generated annually in the country increases as more people venture into the cultivation of maize, but they have low feeding value because of its poor protein content, energy, minerals and vitamins (Akinfemi *et al.*, 2009). The militating problem affecting the utilization of corn cobs in chicken diet is due to high fibre content. The roles of enzymes as additive in poultry diets is well established (Atteh, 2000; Abdulrashid *et al.*, 2007). The authors observed that enzyme addition to monogastric feed reduced viscosity of the digesta in the intestine as opposed to a situation of association with digestion of cereal grain (by-products) and showed a marked improvement on the various morphological effects of feeding fibrous materials to non-ruminant. The determination of blood component values using laboratory is an important procedure to aid the diagnosis of several diseases and dysfunctions, as they provide reliable results, and may also give inputs for research studies on nutrition, physiology, and pathology (Bounous *et al.*, 2000). Therefore, the objectives of this study were to evaluate the performance and blood profile of broiler chickens fed corn-cobs based diets with or without enzyme supplementation.

Materials and methods

Experimental site

The experiment was conducted at the Teaching and Research Farm of the Federal College of Animal Health and Production Technology, Moor Plantation, Ibadan. The area lies within the rain forest ecological zone, and falls within longitude and latitude 7° 27' and 3° 25' respectively at altitude 200-300m above the sea level with an annual rainfall of about 1250mm. The temperature and relative humidity ranges from 30–35°C and 76–84% respectively.

Experimental animals, management and design

A total of 165 -1- day old Cobb 500 chicks were purchased from a reputable hatchery in Ibadan and used for this experiment. They were brooded for two (2) weeks under similar managerial and hygienic conditions. All vaccination schedules and medication were followed accordingly. Birds were supplied with feed and water *ad libitum*. After one week of adaptation period, the birds were randomly allotted to five dietary treatments in a completely randomized design and the experiment lasted for nine weeks.

Preparation of experimental diet

The corn cob was obtained from Omi-Adio market, Ido local government area of Ibadan, Oyo state. The cobs were sun-dried for two days and subsequently milled to form the corn cob meal (CCM) that were later incorporated into the experimental diets as follows; T₁: control diet (0% CCM), T₂ (10% CCM without enzyme), T₃ (20% CCM without enzyme), T₄ (10% CCM with enzyme), T₅ (20% CCM with enzyme)

Data collection

Feed intake and live weight changes

The growth of the birds in response to the experimental diets was monitored by taking their pre-experimental body weights, followed by weighing on a weekly basis prior to feeding. Feed offered daily per bird was recorded and refusal was weighed and recorded to compute feed intake on daily basis.

Collection of blood samples

At the end of the experiment, blood samples of approximately 6ml were collected from nine (9) randomly selected experimental birds per treatment via the jugular vein using hypodermic needle and syringe. About 3ml of blood sample collected was released into the sample bottles containing Ethyl Diamine Tetra Acetic Acid (EDTA) as

Table 1: Gross composition and proximate analysis of the experimental diets at starter phase.

Ingredient (%)	T ₁ (0% CC)	T ₂ (10%CC ⁻)	T ₃ (20%CC ⁻)	T ₄ (10%CC ⁺)	T ₅ (20%CC ⁺)
Maize	60.00	52.23	44.50	52.23	44.50
Corn cobs	-	6.00	12.00	6.00	12.00
Soybean	30.00	31.70	33.50	31.70	33.50
GNC	7.30	8.40	8.20	8.40	8.20
Enzyme	-	-	-	0.50	0.50
*other	1.85	1.85	1.85	1.85	1.85
Total	100.00	100.00	100.00	100.00	100.00
Determined Analysis					
Dry matter	90.08	90.48	90.25	90.56	90.11
Crude protein	21.49	22.89	23.00	22.70	21.57
Crude fibre	4.54	4.03	4.06	3.98	3.89
Ether extract	3.56	3.76	3.87	3.84	3.64
Ash	5.65	5.69	5.84	6.11	5.72
Nitrogen free extract	57.07	57.01	57.51	57.79	57.16

*1.00% Fish meal (72%); 0.05% Vegetable oil; 0.25% Premix; 0.25% Methionine; 0.10% Lysine; 0.25% Salt; 1.0 % Dicalcium phosphate.

CC⁻ : Corn cob without enzyme, CC⁺: Corn cob with enzyme.

ME: Metablizable Energy; Vit. A: 10,000 iu; Vit. D: 2000 iu; Vit. E: 23 mg; Vit.K: 2 mg; Vit B₁: 1.8 mg; Vit. B₂: 5.5 mg; Niacin: 27.5 mg; Pantothenic acid: 7.5 mg; Vit B₁₂:0.015 mg; Folic acid: 0.75 mg; Biotin: 0.06 mg; Choline chloride: 300 mg; Cobalt: 0.2 mg; Copper: 3 mg; Iodine: 1 mg; Iron20 mg; Manganese: 40 mg; Selenium: 0.2 mg; Zinc: 30 mg; Antioxidant: 1.25 mg

Table 2: Gross composition and Proximate Analysis of the experimental diets at finisher Phase Level

Ingredient (%)	T ₁ (0% CC)	T ₂ (10%CC ⁻)	T ₃ (20%CC ⁻)	T ₄ (10%CC ⁺)	T ₅ (20%CC ⁺)
Maize	65.00	56.00	48.15	56.00	48.15
Corn cobs	-	6.00	12.00	6.00	12.00
Soybean	24.65	27.40	29.80	27.40	29.80
Enzyme	-	-	-	0.50	0.50
*other	9.96	9.96	9.96	9.96	9.96
Total	100.00	100.00	100.00	100.00	100.00
Determined Analysis					
Dry matter	90.62	90.33	90.60	90.15	90.23
Crude protein	19.72	22.89	19.68	19.52	19.69
Crude fibre	4.76	3.89	3.86	3.78	3.75
Ether extract	3.76	3.66	3.71	3.59	3.61
Ash	5.42	5.79	5.84	5.87	6.09
Nitrogen free extract	56.05	56.99	47.89	56.99	47.87

0.05% vegetable oil; 4.3%Wheat offal; 4.00% groundnut cake; 1.00% Dicalcium phosphate; 0.25% Premix; 0.10% Methionine; 0.01% Lysine; 0.25% Salt. CC⁻ : Corn cob without enzyme, CC⁺: Corn cob with enzyme. ME: Metablizable Energy; Vit. A: 10,000 iu; Vit. D: 2000 iu; Vit. E: 23 mg; Vit. K: 2 mg; Vit B₁: 1.8 mg; Vit. B₂: 5.5 mg; Niacin: 27.5 mg; Pantothenic acid: 7.5 mg; Vit B₁₂:0.015 mg; Folic acid: 0.75 mg; Biotin: 0.06 mg; Choline chloride: 300 mg; Cobalt: 0.2 mg; Copper: 3 mg; Iodine: 1 mg; Iron: 20 mg; Manganese: 40 mg; Selenium: 0.2 mg; Zir: 30 mg; Antioxidant: 1.25 mg

anticoagulant and the bottles were gently shaken to ensure proper mixing of the blood with EDTA to prevent coagulation and the remaining 3ml was poured into a plain sample bottle. Blood samples were analyzed according to routinely available clinical methods. The following parameters Packed cell volume (PCV), Haemoglobin (Hb), Red blood cell (RBC), white blood cell (WBC), Mean corpuscular volume (MCV), Mean corpuscular haemoglobin concentration (MCHC), Mean corpuscular

haemoglobin (MCH), Differential WBC namely; Monocytes, Neutrophils, Lymphocytes and heterophil. The PCV was determined using the wintrobe haematocrit method described by (Wintrobe, 1933). WBC and RBC were determined using haemocytometer after appropriate dilution (Dacie and Lewis, 1984), Haemoglobin and Mean corpuscular volume (Brown, 1976). Biochemical components of the serum samples estimated were total protein (g/dl) was determined according to Biuret

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Method (Reinhold, 1953) while albumin (g/dl) level was obtained using Bromocresol green method as described by (Peter *et al.*, 1982). Blood glucose (mg/dl) level was determined according to the method recommended by (Cooper and Daniel, 1970), urea (mg/dl), aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were determined using spectrophotometric methods. MCV, MCH and MCHC were deduced according to Jain (1986) as follows: MCV (fl) =

PCVX10/RBCX10; MCH (pg) = HbX10/RBC (10); MCHC (%) = HbX100/PCV

Chemical analysis

An aliquot of daily feed samples (concentrates) was collected, oven-dried, ground and sieved through a 2-mm sieve and stored in airtight container for proximate (AOAC, 2000). Nitrogen Free Extract (NFE) was determined by subtracting sum of (%Moisture + % Crude Protein + % Ether extract + % Crude fibre + % Ash) from 100.

Table 3: Performance characteristic of broiler chicken fed Corn-Cobs based diet with or without enzyme supplementation

Parameters	T ₁ (0%CC)	T ₂ (10% CC ⁻)	T ₃ (20% CC ⁻)	T ₄ (10% CC ⁺)	T ₅ (20% CC ⁺)	SEM±
Initial Wt (g/b)	110.51	111.58	113.06	117.48	119.15	1.44
Final body wt (g/b)	2941.30	3011.30	2782.10	3116.60	2977.80	57.62
Total Wt gain (g/b)	2830.80	2899.70	2669.10	2999.10	2858.60	57.34
ADWt gain (g/b/d)	50.55	51.78	47.66	53.56	51.05	1.02
Total fd intake (g/b)	6443.70 ^b	7245.20 ^a	7327.30 ^a	6886.90 ^{ab}	6217.30 ^b	141.06
ADFI (g/b/d)	115.07 ^b	129.38 ^a	130.85 ^a	122.98 ^{ab}	111.02 ^b	2.52
FCR	2.29 ^b	2.50 ^{ab}	2.75 ^a	2.32 ^b	2.18 ^b	0.07

^{a,b,ab} Means in the same row with different superscripts are significantly different (P< 0.05).

Wt: Weight, ADWt: Average daily weight gain, fd: Feed, ADFI: Average daily feed intake, FCR: Feed Conversion ratio, CC⁻: Corn cob without enzyme, CC⁺: Corn cob with enzyme.

Haematological indices of Broiler Chicken fed corn-cobs based diet with or without enzyme supplementation is presented in Table 4. There were no significant difference (P>0.05) on the haematological indices of broiler chicken investigated except the lymphocytes and heterophil which were significantly influenced by the dietary treatment. Lymphocytes use the blood to travel round the body but can wander freely in other types of tissues using the lymphatic channels. An increase in lymphocytes number is in response to viral, parasitic and bacterial infection of the animal's body (Coles, 1986). However, lymphocytes and heterophil values obtained in this study fell within the normal range of values recommended for healthy birds (Mitruka and Rawnsley, 1977). This suggest that CCM based diet may not have

had any negative effect on haematology of birds.

Indicated in Table 5 are the Serum biochemical indices of broiler chicken fed Corn-Cobs based diet with or without enzyme supplementation. Apart from aspartate aminotransferase (AST) that was significantly (P<0.05) influenced by the dietary treatments, all other serum biochemical indices measured were not significantly (P>0.05) influenced across the dietary treatments. AST varied significantly (P<0.05) across the dietary treatment with birds fed 10% CCM based diet without enzyme supplementation recorded the highest value (234.40 iu/l) followed by those fed 20% CCM without enzyme supplementation (169.62 iu/l) and 10% CMM with enzyme supplementation (170.50 iu/l) that were statistically similar

($P>0.05$) but they were significantly higher ($P<0.05$) than those on 0% CCM (216.22 iu/l) and 20% CCM with enzyme supplementation (196.16 iu/l) that were also statistically similar ($P>0.05$). Aspartate aminotransferase (AST) differed significantly ($P<0.05$) as the inclusion level of corn-cobs with or without enzyme supplementation varies in feed. Enzymes are protein catalysts present mostly in living cells and are constantly and rapidly degraded although, renewed by new synthesis (Coles, 1986). According to (Zilva and Pannall, 1984), normal enzyme level in serum is a reflection of a balance between synthesis and their release, as a result of the different physiological processes in the body. Transaminase

enzymes are those mostly responsible for the synthesis of non-essential amino acids through the process known as transamination (Carola *et al.*, 1990). In this study, the relatively close but low mean levels observed for the transaminases could be an indication that the test diets did not differ in their effects on enzyme secretion mechanism. According to Keele and Neil (1971) serum levels of AST are significantly high under disease and morbid conditions involving injuries to large numbers of metabolically active cells. However, the result of this study suggests a contrary situation thus indicating the potential of the enzymes supplementation on the fibrous diet fed to the chicken.

Table 4: Haematological indices of broiler chicken fed Corn-Cobs based diet with or without enzyme supplementation

Parameters	T ₁ (0%CC)	T ₂ (10% CC ⁻)	T ₃ (20% CC ⁻)	T ₄ (10% CC ⁺)	T ₅ (20% CC ⁺)	SEM±
PCV (%)	25.00	28.67	25.00	25.33	23.67	0.83
Hb(g/dl)	8.30	9.53	8.33	8.43	7.90	0.27
RBC(10^{12} /L)	3.63	3.66	3.43	3.91	3.58	0.12
WBC (10^3 /L)	16.03	16.52	17.30	18.20	17.23	0.31
Lymphocyte (%)	57.00 ^{ab}	68.00 ^a	63.00 ^{ab}	65.33 ^{ab}	53.67 ^b	2.08
Heterophil (%)	39.33 ^{ab}	28.00 ^b	31.33 ^{ab}	29.00 ^{ab}	40.67 ^a	1.15
Monocytes (%)	2.00	2.00	2.67	3.67	2.67	0.31
Eosinophil (%)	1.33	3.00	2.67	1.67	3.33	0.39
Basophil (%)	0.33	0.33	0.33	0.33	0.00	0.12
MCV(pg)	69.08	80.88	72.54	66.34	67.37	3.42
MCH(fl)	22.91	26.90	24.19	22.08	22.49	1.14
MCHC(g/dl)	33.19	33.25	33.35	33.35	33.28	0.03

^{a,b,ab} Means in the same row with different superscripts are significantly different ($P<0.05$).

CC⁻ : Corn cob without enzyme, CC⁺: Corn cob with enzyme. MCV: Mean Corpuscular Volume, MCH: Mean Corpuscular Haemoglobin, MCHC: Mean Corpuscular Haemoglobin Concentration.

Table 5: Serum biochemical indices of broiler chicken fed Corn-Cobs based diet with or without enzyme supplementation

Parameters	T ₁ (0%CC)	T ₂ (10%CC ⁻)	T ₃ (20%CC ⁻)	T ₄ (10%CC ⁺)	T ₅ (20%CC ⁺)	SEM±
Total Protein (g/dl)	4.00	3.97	3.93	3.03	4.08	0.20
Albumin (g/dl)	1.80	2.02	2.01	1.83	1.94	0.05
Globulin (g/dl)	2.20	1.95	1.93	1.20	2.14	0.18
Glucose (mg/dl)	171.48	163.89	175.18	187.96	154.63	5.60
Urea (mg/dl)	4.45	4.39	3.76	4.69	3.70	0.21
Creatinine (mg/dl)	0.30	0.28	0.39	0.60	0.52	0.05
AST(iu/l)	216.22 ^{ab}	234.40 ^a	169.62 ^b	170.50 ^b	196.16 ^{ab}	9.58
ALT(iu/l)	6.45	5.28	4.64	7.16	4.69	0.43

^{a,b,ab} Means in the same row with different superscripts are significantly different ($P<0.05$).

CC⁻:Corn cob without enzyme, CC⁺: Corn cob with enzyme. AST: Aspartate aminotransferase, ALT: Alanine aminotransferase

Conclusion

The utilization of the crop residues; CCM based diet with enzyme supplementation up to 20% has no deleterious effects on the nutritional and health conditions as determined by the blood analysis of broiler chicken. Results of the haematological indices showed that lymphocyte and heterophil values were significantly different ($P < 0.05$) among the treatment groups. Serum biochemistry showed that AST values was influenced ($P < 0.05$) by the dietary. The other values of the blood biochemical indices and the parameters of hematology were similar ($p > 0.05$) among dietary groups.

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