

Effect of varying dietary energy levels supplemented with ginger or probiotics on hematology and carcass characteristics of broiler chickens in semi-arid environment

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Target Audience: nutritionists, feed millers, researchers

Abstract

High cost of feed ingredients especially energy and protein sources have been a major problem to the poultry industry. There has been increasing interest in the use of plant based feed additives and probiotics in feeds to enhance efficiency and productivity. The objective of the study was to evaluate the effect of different energy levels supplemented with ginger and probiotic on blood and carcass characteristics of broiler chickens. A total of 144 birds were weighed and randomly allotted to six (6) dietary treatments groups of 24 birds per treatment in complete randomized design (CRD), Each treatment was replicated four times with six (6) birds per replicate. Six experimental diets were fed for the starter and finisher phases respectively. The first three diets contained ginger (5g/kg) while the last three contained probiotic (0.505g/kg) at three energy levels (3100, 2900, and 2700 ME/kcal/kg) respectively. The experimental diets were fed ad libitum for eight weeks. The results for the hematological parameters revealed significant ($P \leq 0.05$) difference in packed cell volume (PCV), hemoglobin (Hb), red blood corpuscle (RBC), Neutrophil, mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH). Ginger had better influence on hematology compared to probiotics. The result for the carcass indices revealed that birds on high energy probiotic diet had significantly ($P < 0.05$) higher plucked weight, thigh, neck, breast muscle and abdominal fat weight. Low energy probiotic supplemented group had the least feed cost/kg gain. It is concluded that ginger and probiotic supplementation at different energy level did not have adverse effect on the blood constituent and carcass characteristic of broiler chicken.

Keywords: ginger; probiotics, energy level, broiler chickens

Description of Problem

Energy is the largest single dietary need of a bird. In broiler chickens the energy source constitutes between 45 and 60% of finished feeds. The incessant high prices of feed ingredients have been a major problem to the poultry industry (1). Researchers have been exploring ways to address this problem. Some of the strategies adopted include the use of non-conventional feed (NCF) ingredients and the use feed additives to maximize the utilization efficiency of existing feed ingredient (2). Many feed

additives are being researched; they include enzymes, probiotics, prebiotics, organic acids and phyto-biotics (3).

Probiotics improve growth rate, feed conversion efficiency and livability in growing chickens by improving the intestinal microbial balance (4). Phytogenic (plant based) feed additive (PFA) enhance livestock productivity through the improvement of digestibility, nutrient absorption and elimination of pathogens in the animal gut (5). Herbs and spices such as garlic and ginger appear to be the most

common PFA used in poultry nutrition. The objective of this study is to evaluate effect of supplementing ginger and probiotics at different dietary energy levels on haematology and carcass characteristics of broiler chickens.

Material and Methods

Experimental site

This study was conducted at the poultry unit of the Teaching and Research Farm of the Department of Animal Science University of Maiduguri. Maiduguri is located between Latitude 11^o.85 and 12^oN and Longitude 13^o.16 and 14^oE, and at an altitude of 325m above sea level (6). The mean temperature ranges from 33 - 40^oC (April- May) and the lowest (23 - 28^oC) during the months of December to January. The area is characterized by short duration of rainfall (June to September) which varies from minimum of 300mm to maximum of 700mm per annum (7).

Experimental Birds and Design

One hundred and forty four (144) day old chicks were randomly allotted into six (6) treatment groups. Each group was divided into four (4) replicates with six birds per replicate in a completely randomized design (CRD). The treatments were designated as T₁, T₂, T₃, T₄, T₅, and T₆. Feed and water were given *ad-libitum*. The birds were vaccinated against the common poultry diseases in the zone (Mareks at day old, gumboro at second and fifth weeks of age and new castle at three weeks of age). The experiment lasted for eight weeks.

Experimental Diets

Ginger rhizome was purchased locally,

sundried and processed by grinding with mechanical hammer mill and used as an additive in the formulated diet at 5g/kg feed for the first three diets at three energy levels 3100, 2900, and 2700 kcal/kg ME designated as T1 high energy ginger diet (HEGD), T2 medium energy ginger diet (MEGD) and T3 low energy ginger diet (LEGD) respectively. Similarly, commercial probiotic 'BIOVET-YC' manufactured by Pharmanza India Ltd containing *Saccharomyces cereavisiae* and *Saccharomyces boulradii* was purchased and added to the feed according to manufacturer's instruction at 0.505g/kg in the last three diets at three energy levels 3100, 2900, and 2700 kcal/kg ME designated as T4 high energy probiotic diet (HEPD), T5 medium energy probiotic diet (MEPD) and T6 low energy probiotic diet (LEPD). Composition and calculated analysis of the experimental starter and finisher diets are presented in Table 1.

Data Collection

At the end of the eight weeks feeding trial, two chickens were randomly selected from each replicate. The birds were fasted overnight. Blood samples were collected in heparinized bottles from each chicken from the jugular vein after slaughter. Hematological parameters measured include packed cell volume (PVC), Hemoglobin (Hb) concentration, Red blood cell (RBC) count, white blood cell (WBC) count, lymphocytes, mean corpuscular hemoglobin (MCH), mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC) together with differential counts of Neutrophils, Lymphocytes and Eosinophils were determined according to (8).

Table 1: Ingredient composition and calculated analysis of experimental starter and finisher diets

Treatments	Starter						Finisher					
	T1 (3100)	T2 (2900)	T3 (2700)	T4 (3100)	T5 (2900)	T6 (2700)	T1 (3100)	T2 (2900)	T3 (2700)	T4 (3100)	T5 (2900)	T6 (2700)
ME (kcal/kg)												
Ingredients												
Maize	44.28	43.72	41.41	44.28	43.72	41.41	51.32	49.22	52.12	51.32	49.22	52.12
Wheat bran	10	10	10	10	10	10	11.67	15	15	11.67	15	15
GNC	40.11	40.11	39.21	40.11	40.11	39.21	28.67	27.43	28.53	28.67	27.43	28.53
Sesame	05.00	05.00	04.82	05.00	05.00	04.82	05.00	05.00	01.00	05.00	05.00	01.00
Bone ash	02.50	02.50	02.50	02.50	02.50	02.50	01.50	01.50	01.50	01.50	01.50	01.50
Limestone	1	1	1	1	1	1	1	1	1	1	1	1
Salt	0.35	0.35	0.35	0.35	0.35	0.35	0.3	0.3	0.3	0.3	0.3	0.3
*Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Total	100	100	100	100	100	100	100	100	100	100	100	100
Ginger (g)	500	500	500	-	-	-	-	-	-	500	500	500
**Probiotics (g)				505	505	505	505	505	505	-	-	-
Calculate analyses												
Crude protein	24.41	24.36	24.06	24.41	24.36	24.06	20.28	20.06	20.50	20.28	20.0	20.17
M.E.	3100	2900	2700	3100	2900	2700	3100	2900	2700	3100	2900	2700
Crude fibre	4.18	4.16	4.15	4.18	4.16	4.15	4.20	4.43	4.12	4.21	4.23	4.12
Calcium	0.15	0.15	0.15	0.15	0.15	0.15	0.13	0.14	0.10	0.14	0.14	0.10
Phosphorus	0.51	0.51	0.51	0.51	0.51	0.51	0.60	0.52	0.51	0.60	0.52	0.51
Lysine	0.90	0.90	0.88	0.90	0.88	0.88	0.74	0.74	0.75	0.73	0.74	0.75
Methionine	0.32	0.32	0.32	0.32	0.32	0.32	0.29	0.29	0.27	0.29	0.29	0.27

ME = Metabolizable energy

* Premix mineral-vitamin Starter Premix Supplied/kg Vitamin A 5000 iu, vitamin D, 888,000 iu, vitamin E, 12,000mg, vitamin K₃, 1500mg; Vitamin B₁, 1000mg; Vitamin B₂, 2000mg; Vitamin B₆, 1500mg; Niacin, 1200mg; Pantothenic acids, 2000mg; Biotin, 10,000mg; Vitamin B₁₂, 3000mg; Folic acid, 15000mg; Chlorine, 60,000; Manganese, 1000mg, Iron, 15000mg, Zinc, 800mg; Copper, 400mg; Iodine, 80mg; Cobalt, 40mg. Broiler finisher mineral Vitamin Premix Supplied Vitamin A, 5000iu; vitamin D₃ 888iu; vitamin E, 12,000mg, vitamin A, 5000iu; Vitamin B₁, 1000mg; Vitamin B₂, 2000mg; Vitamin B₆, 1500mg; Niacin, 1200mg; Pantothenic acid, 200mg; Biotin, 10,000mg; Vitamin B₁₂, 3000mg, Folic acid 15000mg; Chlorine 60000, Manganese, 1000mg; Iron; 15000mg; Zinc, 800mg; Copper 400mg; Iodine, 80mg; Cobalt, 40mg; selenium, 8000mg.

** Probiotic 'BIOVET-YC' manufactured by Pharmanza India Ltd containing *saccharomyces ceravisiae* and *saccharomyces bouladii*

Carcass Parameters

At the end of the feeding trial, two birds were randomly selected from each replicate. The chickens were weighted, slaughtered and plucked after steeping in hot water at 80⁰ C for 2-5 minutes. Each carcass was divided into the following anatomical parts: shanks, drumsticks, thighs, back, thorax, wings, breast, neck and head. The visceral components which include heart, crop, gizzard, liver, spleen, intestines and abdominal fat were removed from individual carcasses. The Cut-up parts and visceral

organs were individually weighed using electronic sensitive balance and expressed as percentage (%) of the plucked weight.

Feed cost per kilogram was calculated from the cost of ingredients used in the feed preparation. Feed cost per kilogram live weight gain was determined using prevailing market prices of each ingredient at the time of the study.

Statistical Analysis

All data obtained from the study were subjected to analysis of variances (ANOVA)

of the completely randomized design (CRD). Significant differences obtained, were separated using Duncan's multiple range test (9).

Result and Discussion

Hematological Parameters

The results for the hematological parameters are presented in Table 2. Packed cell volume (PCV) showed significant ($P < 0.05$) difference. Chickens on high energy ginger diet (HEGD) group had higher PVC value (32.5 %) which is similar to values obtained for low energy ginger diet (LEGD) and low energy probiotic diet (LEPD) groups. On both ginger and probiotic groups the medium energy group had lower PCV

values (28.5, 29.00 %). All values however, fall within the range of 25-45% reported by (10). Hemoglobin (Hb) followed similar trend with PCV, where chickens on medium energy diets had lower ($P \leq 0.05$) values ($P < 0.05$) than other groups. The range of Hb value in this study (9.45-10.80) fell within normal range of 7 – 13g/dl reported by (10).. Higher ($P \leq 0.05$) red blood cell count (RBC) (2.85) count were recorded in chickens on HEGD, HEPD and MEPD compared to 2.30 – 2.45 observed in MEGD, MEPD and LEPD groups. It was also noted that the values followed the trend of Hb and PCV. The range of RBC (2.30 - 2.85) values in this study fall within the range ($2-4 \times 10^6/\text{mm}^3$) given by (11).

Table 2: Hematological parameters of broiler chickens fed with varying dietary energy levels supplemented with ginger and Probiotics

Treatments	Ginger			Probiotics			SEM
	T1 (3100)	T2 (2900)	T3 (2700)	T4 (3100)	T5 (2900)	T6 (2700)	
Energy(kcal/kg)							
Parameters							
PCV (%)	32.5 ^a	28.5 ^b	32.00 ^a	28.5 ^b	29.00 ^b	32.00 ^a	1.12*
HB (g/100ml)	10.80 ^a	9.45 ^b	10.65 ^a	9.45 ^b	9.65 ^b	10.65 ^a	0.38*
WBC ($10^3/\text{mm}^3$)	14.00 ^a	15.00 ^a	15.50 ^a	19.50 ^a	17.00 ^a	17.50 ^a	2.44
RBC ($10^6/\text{mm}^3$)	2.85 ^a	2.45 ^b	2.30 ^b	2.60 ^{ab}	2.35 ^b	2.55 ^{ab}	1.29*
MCV (fl)	114.00 ^b	117.00 ^b	139.50 ^a	111.50 ^b	123.50 ^{ab}	125.50 ^{ab}	8.16*
MCH (pg)	38.00 ^b	38.00 ^b	46.50 ^a	36.00 ^b	41.00 ^{ab}	41.00 ^{ab}	2.75*
MCHC (g/dL)	33.23	33.15	33.28	33.15	33.27	33.28	0.09
Neutrophil (%)	19.50 ^b	31.00 ^{ab}	28.50 ^{ab}	19.00 ^b	24.50 ^{ab}	39.00 ^a	6.67*
Eosinophil (%)	2.50	2.00	0.00	2.00	0.00	2.00	2.17
Lymphocyte (%)	76.50 ^a	67.00 ^{ab}	70.50 ^{ab}	79.00 ^a	75.50 ^{ab}	59.00 ^b	6.87*
Monocytes (%)	0.00	0.00	0.50	0.00	0.00	0.00	0.28
Neutrophil (%)	19.50 ^b	31.00 ^{ab}	28.50 ^{ab}	19.00 ^b	24.50 ^{ab}	39.00 ^a	6.67*
Eosinophil (%)	2.50 ^a	2.00 ^a	0.00 ^a	2.00 ^a	0.00 ^a	2.00 ^a	2.17
SRBC	6.01 ^{ab}	5.98 ^{ab}	7.57 ^a	4.50 ^b	3.77 ^c	5.50 ^b	2.07*

*a, b, and c, means within the same raw bearing different superscript differs significantly ($P < 0.05$). * Significant ($P < 0.05$). SEM = Standard error of mean. SRBC = Sheep Red Blood Cell PVC = Packed cell volume, Hb = Hemoglobin concentration, RBC = Red blood cell count, WBC= white blood cell count, MCH =, mean corpuscular hemoglobin , MCV = mean corpuscular volume MCHC= mean corpuscular hemoglobin concentration*

Chickens on LEGD group had the highest (139.50 fl) mean corpuscular volume (MCV) value. The lowest value (114.00, 11.00 fl) was recorded in the HEGD and MEGD groups. The MCV can be said to be influenced by the energy levels of the diet which favors low energy groups with the high energy groups having lower values. The observations of this study fall within the normal range of 90 to 140 fl (12 and 13). Mean corpuscular hemoglobin (MCH) value was highest (46.50 pg) in chickens on LEGD. Those on high and medium energy ginger groups recorded the lowest value (36.00, 38.00 pg). The values are similar to the observation obtained for the medium and low energy probiotic groups (41.00, 41.00 pg). It can also be said that energy influences the MCH production of the birds. Generally the mean values for ginger were higher than that of probiotic group. The findings of this study (36.00 - 46.00 pg) is aligned with normal range of 33- 47pg reported by (13). Chickens on LEPD group had the highest ($P \leq 0.05$) neutrophil value, (39.00%). Those on high energy ginger and probiotic supplemented group had the least value (19.50%). Treatments with low energy level had higher values than those with high energy inclusion. Lymphocytes were higher ($P \leq 0.05$) in chickens on HEPD, the least value (59.00 %) was obtained for the low energy probiotic group. The result of this study (59.0 - 79.0 %) is higher than 55-60% reported by (10). (14) reported that the low value of lymphocyte can be as a result of disease which predisposed the animal to reduced immunological responses to infection. Higher values obtained in this study could suggest that the ginger and probiotic supplementation conferred better immunological status to the chickens. Sheep red blood cell (SRBC) was significantly

higher ($P \leq 0.05$) in chickens on LEGD group (7.57). The lowest value (3.77) was found in the MEPD group. High value of the antigen in the ginger supplemented groups could be as a result of its active ingredients such as *zingerine*, *gingerol*, *shagaol* etc which stimulate immuno-modulatory activities.

Carcass Characteristics

Significant differences ($P \leq 0.05$) existed between the groups for carcass parameters (Table 3). Chickens on LEPD group had the lowest dressing percent. Those on MEPG had the highest value which was similar ($P \leq 0.05$) to values obtained for those on HEPD and high and medium energy ginger groups. The weight of thigh and drumstick were significantly ($P \leq 0.05$) higher in chickens on HEPD. Breast muscle weight was highest in the same group, they were, however, similar ($P \leq 0.05$) to values observed for other groups. The percent weight for wings and neck were similar between the groups. Chickens fed HEPD had significantly ($P \leq 0.05$) higher crop weight compared to other groups. The least weight was found in the LEGD group. The value is similar to values obtained for chickens on MEGD, MEPD and LEPD.

Weight of the liver was lowest in chickens on MEPD, the value was similar to values recorded for chickens on LEPD and MEGD. Those on HEPD and MEGD had the highest liver weight. Similarly, chickens on HEPD had the highest gizzard, abdominal fat, small and large intestine weight compared to other groups which were statistically similar. Superiority of the carcass parameters in chickens fed HEPD compared to other groups could perhaps be related to positive interactive effect of high energy and probiotic supplementation which promoted development of the parameters.

Table 3: Carcass characteristics of broiler chickens fed diets containing different energy levels supplemented with ginger or probiotics

Treatments	Ginger					Probiotic	SEM
ME (kcal/kg)	(3100)	(2900)	(2700)	(3100)	(2900)	(2700)	
Parameters							
Live weight (g)	1850.00 ^g	1975.00 ^{bc}	2515.50 ^a	2141.50 ^b	2171.50 ^b	1876.50 ^c	231.01*
Plucked weight (g)	1340.50 ^g	1792.00 ^{ab}	2334.50 ^a	1925.00 ^{ab}	2032.50 ^a	1687.00 ^{ab}	196.72*
Dressed weight (g)	1188.50 ^b	1396.50 ^b	1791.50 ^c	1529.00 ^{bc}	1632.00 ^c	773.30 ^a	342.45
Dressing %	64.31 ^b	70.69 ^{ab}	71.22 ^a	71.28 ^{ab}	75.80 ^{ac}	41.76 ^a	3.13*
Cut-up parts (%)							
Shanks	6.90 ^c	5.68 ^b	5.28 ^b	8.25 ^c	3.98 ^a	5.10 ^b	0.54*
Head	3.54 ^b	2.73 ^a	3.53 ^b	4.85 ^c	2.61 ^a	2.89 ^a	0.07*
Wings	7.17 ^a	8.81 ^b	8.35 ^b	7.83 ^{ab}	7.89 ^{ab}	8.61 ^b	2.77*
Thigh	15.12 ^{bc}	10.24 ^a	12.34 ^c	20.36 ^d	12.22 ^{bc}	10.90 ^{ab}	0.79*
Drumstick	14.75 ^b	12.07 ^{ab}	10.48 ^a	21.93	10.27 ^a	11.79 ^a	2.21*
Breast	22.93 ^b	18.43 ^a	19.39 ^a	30.75 ^c	21.23 ^{ab}	18.37 ^a	6.53*
Back	14.15 ^a	11.09 ^a	12.53 ^a	22.88 ^b	11.13 ^a	11.33	3.39*
Neck	6.84 ^{ab}	6.55 ^{ab}	6.16 ^a	10.85 ^c	7.66 ^b	7.81 ^b	0.77*
Organ weight (%)							
Crop	0.63 ^b	0.56 ^a	0.35 ^a	1.24 ^c	0.54 ^a	0.61 ^a	0.54*
Liver	3.28 ^{bc}	3.60 ^{cd}	2.51 ^{ab}	4.68 ^{cd}	1.92 ^a	2.25 ^{ab}	0.01*
Spleen	0.19 ^a	0.17 ^a	0.16 ^a	0.63 ^c	0.36 ^b	0.16 ^a	0.12*
Gizzard	4.28 ^b	3.85 ^{ab}	2.99 ^a	5.48 ^c	3.30 ^a	3.27 ^a	0.03*
Heart	0.91 ^{ab}	0.78 ^{ab}	0.99 ^{bc}	1.12 ^c	0.65 ^a	0.64 ^a	4.00*
Abdominal fat	1.90 ^{bc}	1.60 ^{bc}	3.40 ^{abc}	4.89 ^d	2.74 ^a	2.86 ^{ab}	0.04*
Small intestine	1.19 ^a	1.04 ^a	1.29 ^a	1.95 ^b	1.17 ^a	1.34 ^a	0.22*
Large intestine	4.63 ^c	3.54 ^b	3.17 ^{ab}	6.69 ^d	2.74 ^a	4.43 ^c	0.01*

*ME = Metabolizable energy a,b, c,d, means within the same row bearing different superscript differs significantly (P<0.05). * Significant (P≤0.05) NS= Not significant. (P>0.05) SEM = Standard error of mean.*

Cost per gain analysis

Chickens on LEPD had the highest feed cost and lowest feed cost per kg gain, while those on HEGD recorded the least cost per kg feed and highest feed cost per kg gain. Contrary to the findings of this study, (15,16), showed higher income and cost - benefit ratio in birds fed ginger supplemented diet compared with the control. The variation with this report may be related to feed cost and feed conversion

ratio.

Conclusions and Applications

- 1) This study shows that ginger and probiotic supplementation at low energy level had no detrimental effect on hematological and carcass parameters of broiler chickens.
- 2) High energy diet supplemented with probiotics supports better carcass development of broiler chickens.

Table 4: Economic analyses of Broiler Chicken Feed Ginger and Probiotic at different energy levels

Treatments	Ginger			Probiotic			SEM
ME (kcal/kg)	(3100)	(2900)	(2700)	(3100)	(2900)	(2700)	
Parameters							
TFI (g/bird)	4467.8 ^b	4605.8 ^b	5145.8 ^a	4910.8 ^a	4616.0 ^b	4960.6 ^a	3.37*
BWG (g/bird)	286 ^{abc}	1464 ^a	1077 ^c	1169 ^{bc}	1343 ^{ab}	1249 ^{abc}	103.22*
FCR	3.48 ^{bc}	3.17 ^c	4.91 ^a	4.34 ^{ab}	3.44 ^{bc}	4.02 ^{abc}	0.44**
Cost/kg feed(₦)	390.20	409.30	416.25	407.25	434.25	440.20	
Cost/kg gain(₦)	913.07	846.15	887.5	875.59	746.75	755.62	

a, b, and c, means within the same row bearing different superscript differs significantly (P<0.05).

** Significant (P≤0.05) SEM = Standard error f mean.*

BWG = Body Weight gain, TFI = total feed intake, FCR = feed conversion ratio

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