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Carcass characteristics and serum metabolites of finishing broiler chickens fed 8% crude fibre diets at three energy levels with or without enzyme

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ABSTRACT

This study evaluated the carcass characteristics and serum metabolites of broiler finishers fed 8% CF diets with or without Roxazyme®G²G inclusion at three energy levels maintained at constant, calorie: protein ratio, for 56 days. One hundred and forty-four unsexed Obamarshal day-old broiler chickens were allotted to six dietary treatments at 24 birds per treatment of three replicates. The six treatments diet were produced from three basal diets for each phase at caloric concentrations of 2600, 2800 and 3000 ME (kcal/kg) to which 0 and 200 mg of Roxazyme®G²G were added per kg diet. Each replicate group was provided feed and water *ad libitum* in the deep litter and battery cage cells during the starter and finisher phases each of 28-day period respectively. Carcass parameters, gut length, organ weights and serum metabolites were measured according to established standard methods. Data were subjected to one-way analysis of variance in accordance with 2x3 factorial arrangement and means separated by Duncan Multiple Range Test (DMRT) at $P < 0.05$. Results showed that carcass yield of the birds fed 8% CF diet at 2600 ME (kcal/kg) diet with enzyme was comparable to those on 2800 and 3000 ME (kcal/kg) diets with or without enzyme. Gizzard fat, abdominal fat, serum glucose and cholesterol were also minimized in birds fed 2600 ME diet in addition to enzyme. Serum total protein, albumin, urea and creatinine were not significantly ($P > 0.05$) affected by treatment diets. It was therefore, concluded that higher dietary ME levels with or without enzyme increased carcass fat, blood glucose and cholesterol levels which must be considered in broiler chicken production for the health benefit of broiler consumers. Thus, it is recommended to produce broiler chickens on 8% CF diet at 2600 ME (kcal/kg) diet with the supplemental Roxazyme®G²G in order to reduce carcass fat, blood cholesterol and glucose without compromising carcass yield.

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Introduction

Traditionally broiler chicken is commonly raised in the tropics on dietary Metabolisable Energy (ME) and Crude Fibre (CF) levels ranging from 2800 to 3000 ME (kcal/kg) and 3 to 5% CF respectively (Aduku, 2004; NRC, 1994). Owing to its genetic potential, broiler chicken raised on high- energy diet has propensity to deposit fat because of the tendency to over consume such diet. (Tion *et al.,* 2005; Udedibie *et al.,* 2015).

For healthy living, consumers' preference is currently shifting to low-cholesterol or low-fat animal products such as table meat and egg (Shang *et al.,* 2010; Udedibie *et al.,* 2015). This consumers' preference therefore calls for adoption of management strategies by the broiler farmers to produce lean or fat-free table meat to avoid health risks associated with the consumption of animal fat. Meanwhile, quantitative and qualitative feed restriction procedures have been carefully employed to utilize the feature of compensatory growth in the broiler chicken in order to reduce carcass fat (abdominal fat) and feed cost without adverse effects on performance (Oyedeji *et al.,* 2003; Udedibie *et al.,* 2015). For the same reasons, the use of low energy-low protein (LELP) diet has also been recommended (Dairo *et al.,* 2010). Earlier reports indicated that the lower the dietary ME level, the lower the broiler carcass fat. Likewise, the higher the dietary CF level, the lower the broiler carcass fat and vice versa (Salami & Odunsi, 2017b). However, 2600 ME (kcal/kg) diet at three CF levels without enzyme did not support optimum biologic performance in the broiler chicken (Salami & Odunsi, 2017c,d). In another study by Salami & Odunsi (2018b), it was shown that Roxazyme®G^{2}G-treated 2600 ME (kcal/kg) diet at 8% CF level sustained optimum growth performance which was comparable to those raised on optimal ME levels at the same CF level with or without enzyme. However, the effect of Roxazyme®G^{2}G supplementation of 8% CF diet at the three ME levels on carcass characteristics and serum metabolites of broiler finishers has not been reported.

Based on the previous report (Salami & Odunsi, 2017a), haematological indices in the finishing broiler chickens were not significantly affected by the varying levels of CF and ME and likewise their interaction. Similarly, serum metabolites except cholesterol and glucose in the broiler finishers were also not affected by the variable factors of CF, ME and likewise their interaction (Salami & Odunsi, 2017a). The varying levels of CF, enzyme and their interaction in sub-optimum energy diets did not adversely affect serum metabolites except cholesterol and glucose in the broiler finishers (Salami & Odunsi, 2017e).

This study, therefore, is aimed at evaluating the carcass characteristics and serum metabolites of finishing broiler chickens raised on 8% CF diets at three ME levels with or without supplemental Roxazyme®G^{2}G. The intent is to produce wholesome broiler carcass to meet consumers' choice.

Materials and methods

Experimental site

The study was conducted at the Poultry unit of the Teaching and Research farm, Emmanuel Alayande College of Education, Oyo, Nigeria. Oyo is 850 m above the sea level and is located approximately along latitude 7^0 51^1 North of the equator and longitude 3^0 57^1 East of the Greenwich meridian. The annual mean rainfall, temperature and relative humidity in Oyo are 1163 mm, 27^0C and 82% respectively (Iwena, 2012).

Experimental diets

Three 8% CF basal diets each for the starter and finisher phases (Table 1) were formulated to contain 2600, 2800 and 3000 ME (kcal/kg). From these basal diets were produced six treatment diets labeled A, B, C, D, E and F in 2 by 3 factorial arrangement in ascending order of ME level with or without enzyme supplementation. Diets B, D and F were supplemented with 200 mg of Roxazyme®G^{2}G/kg of the diets as per the recommendations of the manufacturer of

the enzyme (DSM Nutritional Products Limited, Switzerland) while the rest of diets were not supplemented with the enzyme. The entire treatment diets maintained similar calorie: protein ratios (based on calculated percent CP and ME values) in accordance with the recommendation of Olomu (1995) and Aduku (2004) for the broiler starter (123:1) and finisher phases (140:1).

Experimental Protocol

One hundred and forty-four day-old unsexed Obamarshal broiler chicken were divided into six treatment groups of 24 birds per treatment and three replicates (of 8 birds each) per treatment. Treatment diets were allocated in Completely Randomised Design (CRD) to the replicate groups. During the starter phase from day-old to 4 weeks of age, the birds per replicate were housed and brooded in the deep litter pen partitioned into units or cells, each of them measuring 45 x 75 cm for breadth and length respectively as described by Salami & Odunsi (2017d). Dried fine water erosion sand was used as the litter material and at a depth of 4 to 5 cm instead of wood shavings to prevent the birds from picking fibre from wood shavings (Esmail, 2012). Each cell was equipped with a 100 watts electric bulb to provide light and heat for the birds. In the event of electric power failure, burning charcoal pots were used and positioned in the brooder pen to provide adequate heat for the birds.

At 5 weeks of age, birds on the respective treatment diets in the starter phase were transfered into two tier battery cage with 2 birds per cage compartment cell measuring 30 x 38 x 43 cm^3 for length, breadth and height respectively (Salami & Odunsi, 2017c). The birds were vaccinated against Newcastle, Gumboro and fowl pox diseases and also protected from bacterial and coccidial infections accordingly (Salami, 2009). The study was conducted in the dry season of the year 2013.

TABLE 1
Formulation and chemical composition of 8% Crude Fibre Basal Diets

	Starter Diets			*Finisher Diets*		
	2600	*2800*	*3000*	*2600*	*2800*	*3000ME*
Feed ingredients						*(Kcal/Kg diet)*
Maize	33	32	24	39	38	30
Rice Offal	12	11	11	12	10	10
Palm Kernel Cake	2	10	10	2	10	10
Wheat Offal	18	10	10	19	12	12
Groundnut Cake	17	15	15	15	12	12
Blood meal	6	8	10	4	6	8
Danish Fish meal	3	4	5	2	3	4
Palm oil	3	5	10	2	4	9
Sterilised sand	1	-	-	-	-	-
[a]Fixed ingredients	5	5	5	5	5	5
Total	100	100	100	100	100	100
Calculated Chemical Fractions:						
Metabolisable energy (Kcal/kg)	2628.3	2820.3	3029.1	2621.9	2806.9	3015.0
Lysine (%)	1.10	1.20	1.31	0.90	1.00	1.06
Methionine (%)	0.30	0.48	0.54	0.31	0.39	0.45
Calorie : Crude Protein	123.2	123.3	124.1	140.0	139.6	139.3
[c]*DeterminedChemical Fractions (%)*						
Crude fat (%)	7.17	10.23	12.57	4.63	7.51	11.62
Dry matter	89.77	89.64	89.26	90.03	90.26	88.27
Crude Protein (%)	20.45	21.72	23.50	17.59	19.30	20.65
Crude fibre (%)	7.80	7.88	7.75	7.75	7.68	7.60
Phosphorus (%)	0.69	0.77	0.76	0.68	0.70	0.69
Calcium (%)	2.15	2.20	2.25	1.88	1.93	1.85

[a]Made up of 2.5% bone meal, 2% oyster shell, 0.25% salt, and 0.25% broiler premix

[c]Means of triplicate determinations.

Data collection

Blood samples were drawn from 3 birds per treatment diet (i.e one bird per replicate) at 50 days of age. The blood (3 mls) was collected asceptically from the neck veins of the sampled birds into non-heparinised sample bottles. The blood samples were immediately centrifuged to separate and decant serum for deep freezing until needed for serum analyses. Serum analyses were subsequently carried out in triplicate to measure total protein, albumin, urea, creatinine, glucose and cholesterol using the established standard procedures outlined in Salami & Odunsi (2017e).

Four sampled birds (comprising two males and two females per treatment and each serving as a replicate) whose pre-slaughter weights were close to the treatment mean were sacrificed at 56 days of age. Carcass and organ evaluation were carried out according to the procedures described by Salami & Odunsi (2017b). The carcass parameters measured included pre-slaughter, post slaughter, plucked and eviscerated weights. Length of the gut sec-

tions determined were those of the small and large intestines, paired caeca and colorectum. Weight of the visceral and digestive organs were also measured and expressed in relation to the pre-slaughter weight of the slaughtered birds.

Chemical analysis

Basal diets for the starter and finisher phases were analysed according to AOAC (2000) for dry matter, crude protein, crude fibre, crude fat, calcium and phosphorus.

Statistical Analysis

Data were subjected to one-way analysis of variance (ANOVA) in accordance with 2 x 3 factorial arrangement comprising 2 levels of Roxazyme®G²G inclusion (0 and 200 mg/kg diet/energy level and 3 levels of ME (2600, 2800 and 3000 ME (kcal/kg) using SAS (2000) statistical package. Means were separated using Duncan's Multiple Range Test of the same package at 5% probability level.

Results

Superior ($P < 0.05$) pre- and post- slaughter weights as well as plucked and eviscerated weights were attained by birds fed 2800 and 3000 ME (kcal/kg) diets in comparison with the values recorded for birds on 2600 ME (kcal/kg) diet (Table 2). However, there was no consistent effect of dietary energy levels on gut length of the sacrificed birds. Inclusion of Roxazyme®G²G in the broiler finisher diets did not significantly affect the pre-and post-slaughter, plucked and eviscerated weights as well as the gut length of the birds (data not presented).

TABLE 2

Effect of varying levels of dietary energy of 8% crude fibre diets on carcass parameters and gut length of broiler finishers at 56 days of age

Carcass parameters:	*2600*	2800	3000	± SEM
Pre-slaughter weight at 56 days (kg/b)	2.14^{b}	2.39^{a}	2.31^{a}	0.05
Post-slaughter weight (kg/b)	2.02^{b}	2.27^{a}	2.18^{a}	0.05
Plucked weight (kg/b)	1.95^{b}	2.17^{a}	2.13^{ab}	0.03
Eviscerated weight (kg/b)	1.48^{b}	1.59^{a}	1.60^{a}	0.03
Gut length (cm/kg):				
Small intestine	82.77^{a}	76.34^{b}	84.09^{a}	0.79
Large intestine	22.42^{a}	19.22^{b}	20.57^{ab}	1.88
Combined caeca	17.17^{a}	15.31^{b}	16.72^{ab}	0.61
Colo-rectum	5.08	4.41	4.47	0.20

^{a,b,}Means within the same row bearing identical or no superscript are similar ($P > 0.05$) while those with unidentical superscripts differ. ($P < 0.05$).

However, interaction effect showed that the pre - and post – slaughter weights as well as the plucked and eviscerated weights of the birds fed Roxazyme®G²G supplemented 2600 ME (kcal/kg) diet were better ($P < 0.05$) than those fed with unsupplemented 2600 ME (kcal/kg) diet. The carcass parameters of the birds on the enzyme-supplemented 2600 ME (kcal/kg) diet were comparable with those on the other energy levels with or without enzyme inclusion (Table 3). Interaction effects of enzyme and energy levels (Table 3) on the gut length was also inconsistent as observed in the main effect of energy level.

TABLE 3

Interaction effects of varying levels of dietary energy and enzyme supplementation of 8% crude fibre diets on carcass parameters and gut length of broiler finishers at 56 days of age.

	2600		2800		3000 ME (kcal/kg) diet		
Carcass parameters	A	*B+e*	C	*D+e*	*E*	*F+e*	± *SEM*
Pre-slaughter weight at 56 days (kg/b)	2.04^{c}	2.24^{b}	2.45^{a}	2.33^{a}	2.31^{ab}	2.30^{ab}	0.06
Post-slaughter weight (kg/b)	1.93^{c}	2.11^{b}	2.31^{a}	2.24^{a}	2.21^{ab}	2.15^{ab}	0.06
Plucked weight (kg/b)	1.88^{c}	2.03^{b}	2.18^{a}	2.17^{a}	2.15^{a}	2.11^{ab}	0.05
Eviscerated weight (kg/b)	1.39^{c}	1.58^{b}	1.76^{a}	1.63^{a}	1.64^{a}	1.56^{b}	0.05
Gut length (cm/kg):							
Small intestine	84.78^{ab}	80.75^{bc}	72.57^{c}	80.11^{bc}	80.48^{bc}	87.69^{a}	2.53
Large intestine	23.38^{a}	21.45^{ab}	19.08^{b}	19.36^{b}	20.35^{b}	20.78^{b}	1.05
Combined caeca	17.45^{a}	16.89^{ab}	15.23^{b}	15.38^{b}	16.03^{ab}	17.40^{a}	0.81
Colo-rectum	5.29^{a}	4.87^{ab}	4.13^{b}	4.68^{ab}	4.12^{b}	4.81^{ab}	0.27

^{a,b,c}Means within the same row bearing identical or no superscript are similar (P > 0.05) while those with unidentical superscripts differ significantly (P < 0.05) .

+e = supplementation with 200mg Roxazyme®G^{2}G per kg diet.

The weight of the visceral organs except the heart and giblet as well as the colorectum of the sacrificed chickens (Table 4) were not significantly affected (P > 0.05) by the dietary energy levels. However, the weight of the digestive organs (such as the crop, proventriculus, gizzard, paired caeca and small intestine) were not affected by dietary energy levels. The abdominal fat was smaller (P < 0.05) in the birds fed 2600 ME (kcal/kg) diet as compared with those fed 2800 and 3000 ME (kcal/kg) diets.

TABLE 4

Effect of varying levels of dietary energy of 8% crude fibre diets on organ weights of broiler finishers at 56 days of age.

	Dietary energy levels (Kcal.ME/Kg diet)			
Organ (% of live weight)	*2600*	*2800*	*3000*	± *SEM*
Trachea	0.21	0.18	0.20	0.01
Heart	0.49^{b}	0.49^{b}	0.97^{a}	0.02
Lung	0.47	0.45	0.49	0.01
Spleen	0.17	0.13	0.16	0.01
Giblet (Liver and Bile)	0.97^{b}	1.69^{a}	1.72^{a}	0.04
Crop	0.44	0.46	0.41	0.02
Proventriculus	0.47	0.43	0.42	0.02
Intact gizzard	2.57	2.64	2.62	0.05
Cleaned gizzard	1.77	1.56	1.84	0.04
Gizzard fat	0.51	0.50	0.49	0.04
Abdominal fat	1.16^{b}	1.67^{a}	1.67^{a}	0.09
Colo-rectum	0.40^{a}	0.16^{b}	0.17^{b}	0.01
Combined caeca	0.63	0.51	0.53	0.02
Small intestine	3.35	3.74	3.41	0.07
Large intestine	0.81^{a}	0.77^{a}	0.69^{b}	0.02

[a,b]Means within the same row bearing identical or no superscript are similar (P > 0.05) while those with unidentical superscripts differ significantly (P < 0.05).

The weight of other organs except gizzard fat and abdominal fat was not affected (P > 0.05) by enzyme inclusion (data not presented). In line with the main effect of energy and enzyme inclusion level, there was generally no interaction effect on the visceral organs, including gizzard (Table 5). However, the weight of gizzard fat and abdominal fat tended to increase with increase in dietary energy level and reduce with enzyme inclusion in the experimental diet.

TABLE 5

Interaction effects of varying levels of dietary energy and enzyme supplementation of 8% crude fibre dietson organ weights of broiler finishers at 56 days of age.

Organ (% of live weight)	2600		2800		*3000 ME (kcal/kg) diet*		
	A	B+e	C	D+e	E	F+e	± SEM
Trachea	0.22	0.19	0.16	0.20	0.19	0.20	0.02
Heart	0.49	0.48	0.47	0.50	0.51	0.46	0.03
Lung	0.46	0.48	0.45	0.44	0.46	0.52	0.02
Spleen	0.13	0.20	0.12	0.14	0.18	0.14	0.01
Giblet (Liver and Bile)	2.01[a]	1.92[a]	1.58[b]	1.81[a]	1.78[a]	1.66[b]	0.06
Crop	0.40	0.47	0.45	0.47	0.40	0.41	0.04
Proventriculus	0.51[a]	0.42[b]	0.40[b]	0.45[ab]	0.40[b]	0.44[ab]	0.02
Intact gizzard	2.71	2.43	2.67	2.60	2.52	2.72	0.09
Cleaned gizzard	1.81	1.72	1.61	1.50	1.70	1.98	0.08
Gizzard fat	0.61[a]	0.40[b]	0.50[ab]	0.49[ab]	0.42[ab]	0.36[b]	0.06
Abdominal fat	0.63[b]	0.68[b]	0.77[b]	0.57[b]	0.97[ab]	1.37[a]	0.15
Colo-rectum	0.19	0.16	0.16	0.15	0.16	0.18	0.01
Combined caeca	0.65	0.61	0.51	0.50	0.51	0.54	0.03
Small intestine	3.39	3.30	3.32	3.42	3.43	3.38	0.12
Large intestine	0.84	0.77	0.68	0.86	0.66	0.72	0.03

[a,b]Means within the same row bearing identical or no superscript are similar (P > 0.05) while those with unidentical superscripts differ significantly (P < 0.05) . +e = supplementation with 200mg Roxazyme® G²G per kg diet.

Enzyme inclusion level in the diets had no significant effect on the serum metabolites of the birds (data not presented). Similarly, there was no significant effect of dietary energy levels on the serum metabolites measured except serum cholesterol and glucose (Table 6) as confirmed by interaction effect (data not presented). Serum cholesterol level was lower (P < 0.05) in the birds fed 2600 than those on the 2800 and 3000 ME (kcal/kg) diets. However, serum glucose tended to be uniform across dietary energy levels as confirmed by the inter-

action effect. This interaction effect indicated that birds fed 2800 and 3000 ME (kcal/kg) diets had higher ($P < 0.05$) serum cholesterol levels than the birds fed 2600 ME (kcal/kg) diet. Conclusively, the relatively lower ($P < 0.05$) carcass fat, serum cholesterol and glucose levels were in favour of 2600 ME (kcal/kg) diet with Roxazyme®G²G inclusion for producing lean broiler carcass without compromising optimum carcass yield.

TABLE 6
Effect of varying levels of dietary energy in 8% crude fibre diets on serum metabolites of broiler finishers at 50 days of age.

	Dietary energy levels ME (kcal/kg diet)			
Metabolites (mg/dl)	*2600*	*2800*	*3000*	*± SEM*
Total protein	3.38	4.02	3.12	0.40
Albumin	1.27	1.35	1.32	0.12
Urea	13.49	12.24	13.53	0.65
Creatinine	0.53	0.53	0.54	0.08
Glucose	219.24[b]	212.59[b]	245.85[a]	21.03
Cholesterol	84.52[b]	96.36[a]	97.09[a]	2.29

[a,b,]Mean values within the same row bearing identical or no superscript are similar ($P > 0.05$) while those with unidentical superscripts differ significantly ($P < 0.05$).

Discussion

The better carcass yield of the birds on the optimal energy diets with or without supplemental Roxazyme®G²G in this study accords with the carcass yield of birds on similar diets in the antecedent report (Salami & Odunsi, 2017b). This result revalidates the adequacy of these energy levels without enzyme inclusion for optimum growth performance in the broiler chickens as previously reported (Salami & Odunsi, 2017 c, d). Similarly, the superior carcass parameters of the birds on the Roxazyme®G²G-treated 2600 ME (kcal/kg) diet (diet B) as compared with the untreated one (diet A) also indicates its nutritional adequacy for optimum growth performance and carcass yield (Salami & Odunsi, 2018a). This further confirms the extra caloric effect of optimum CF level (8%) with enzyme inclusion via depolymerisation and microbial fermentation of depolymerisation products (Acamovic, 2001; Johnston *et al.,* 2003; Jozefiak *et al.,* 2004). However, the extra caloric effect of 8% CF level upon enzyme inclusion at the sub-optimal energy level did not manifest at the optimal energy levels in this study. This confirms the effect of dietary energy level on the beneficial effects of exogenous polysaccharidase enzymes (Acamovic, 2001; Sundu *et al.,* 2006; Salami & Odunsi, 2018a) and the need for caution in the application of enzymes in poultry diets (Khattak *et al.,* 2007; Altaf-Ur Rahman *et al.,* 2007; Salami & Odunsi, 2018b). The maximum values of evisceratаed carcass weight of the birds on diets B, C, D, E and F were comparable and ranged from 1.56 kg (diet F) to 1.76 kg (diet C). These values agree with the published data elsewhere (Odunsi *et al.,* 2005; Tion *et al.,* 2005; Isikwenu *et al.,* 2010). As previously observed by Salami & Odunsi (2017b), the non-consistent effect of the treatment diets on the gut length of the birds in this study was probably due to similar CF content

and calorie: protein ratio. Majority of the visceral and digestive organs were not affected by the treatment diets and this is in agreement with earlier findings (Salami & Odunsi, 2017b). However, the bigger size of the fat depots (adipose tissues) notably the abdominal fat, gizzard fat and heart, especially in the birds fed high-energy diets was attributed to fat deposition occasioned by excessive intake of calorie (Bartov *et al.,* 1974; Tion *et al.,* 2005; Salami & Odunsi, 2017b). Similarly, the bigger size of the giblet (liver + bile) in the birds fed high-energy diets was also probably attributed to increased metabolic activities of the organ in the regulation of stored fat via hepatic synthesis of cholesterol and bile acids and conversion of fat to glucose (Mc Donald *et al.,* 1995; Jozefiak *et al.,* 2004; Olorode *et al.,* 2007).

The values of blood cholesterol and other metabolites except glucose fell within the standard values for normal chickens as reported by Mitruka & Rawnsley (1977). This finding suggests that the protein metabolism and health status of the birds were not compromised by the treatment diets since the calorie: protein ratio of the diet was kept within the tolerance limit. Mitruka & Rawnsley (1977) quoted the values ranging from 52 to 148 mg/dl and 152 to 182 mg/dl for serum cholesterol and glucose respectively for normal chickens. However, in this study, there was tendency for increased serum cholesterol level as dietary energy level increased from 2600 to 3000 ME (kcal/kg) (Salami & Odunsi, 2017a). The 8% dietary CF level in this study might have assisted the birds to reduce their blood cholesterol level (via excretion of bound bile acids with fibre in the excreta) below the standard value (Shang *et al.,* 2010; Esmail, 2012; Salami & Odunsi, 2017a). However, the serum glucose level exceeded the standard value given by Mitruka & Rawnsley (1977) because of the glucose from the metabolic origin (gluconeogenesis) and simpler carbonhydrates of dietary origin (Salami & Odunsi, 2017a).

The findings in this study, therefore, are in favour of enzyme-treated 2600 ME (kcal/kg) diet (diet B) for producing low-fat broiler carcass to satisfy consumers' choice. This diet is also expected to be cheaper for broiler production in a tropical environment.

Conclusion and Recommendation

The objective of this study was to evaluate the carcass characteristics and serum metabolites of broiler chickens raised on 8% CF diets at three energy levels with or without Roxazyme®G²G inclusion. Carcass yield of the birds on the lowest energy level without supplemental enzyme was poorer but it was optimised with enzyme inclusion to compare with those on the higher energy levels with or without enzyme. Incremental levels of energy significantly increased carcass fat and blood cholesterol while addition of enzyme tended to reduce carcass fat and serum cholesterol. Hence, it is advantageous to produce lean broiler carcass on 8% CF diet at 2600 ME (kcal/kg) with supplemental Roxazyme®G²G. Diet B is hereby recommended to produce low fat or low cholesterol product (meat) in order to satisfy consumers' preference.

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