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Potentials of Genotype, Varied Levels of Roxazyme G® Enzyme and their Interaction on Two Genetic Stocks of Commercial Broiler Chickens, I: Growth Performance and Carcass Traits

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Target audience: *Researchers, animal breeders, animal nutritionists, poultry farmers*

Abstract

The growth performance and carcass traits of two commercial broiler stocks were evaluated on the basis of genotype potentials, varied levels of roxazyme G® enzyme and their interaction. A total of 240 day – old broiler chicks (120 of each of Arbor acre and Marshall birds) were used for this study. The chicks were fed on four experimental diets; 0 g/ton, 100 g/ton, 200 g/ton and 300 g/ton. Data were collected on average bodyweight, daily weight gain, daily feed intake, daily water intake, feed conversion ratio (growth performance) and liveweight, bled weight, defeathered weight, eviscerated weight, breast weight, thigh weight, wing weight, shank weight (primal cuts), gizzard, kidney, heart, liver, abdominal fat (edible visceral organs) and analysed with General Model of SAS in completely randomized designed. Results showed that Arbor acre strain was significantly ($P < 0.05$) favoured for body weight, daily weight gain, daily feed intake and daily water intake compared with Marshall birds. Birds fed diets supplemented with roxazyme G® enzyme, especially 300 g/ton gave a higher body weight, daily weight gain, daily feed intake and daily water intake. Also, for carcass traits, Arbor acre had significantly ($P < 0.05$) higher live weight, bled weight, defeathered weight, eviscerated weight, breast weight, thigh weight, wing weight, shank weight, kidney, heart and abdominal fat than the Marshall birds. It can be concluded that Arbor acre birds were better in respect of growth performance and carcass traits with enzymes interaction. Besides, enzyme inclusion levels of up to 300 g/ton made meaningful responses for growth performance and carcass characteristics.

Keywords: Genotype, roxazyme G®, broilers, growth performance, carcass traits

Description of Problem

Broilers are genetically capable of attain high rates of rapid growth at maximum feed conversion and this tremendous potential cannot be fully expressed unless the broiler diets are nutritionally adequate and the conditions in the intestinal tract enhance the maximum digestion and absorption of nutrients (1). Unless this genetic potential is fully utilized, broilers performance potentials stand to suffer retarded progress. The use of enzyme complexes is effective, since the wide range of enzymes present in this type of product allows for greater action in different types of substrates and, or, foods utilized in the process of diet fabrication. Natural commercial products such as exogenous enzymes and other products may be used to improve and maximize the genetic potential of broilers regarding feed efficiency, weight gain and carcass characteristics (2, 3). Many of feed additives such as antibiotics, steroids, vitamin, minerals and other growth promoters have been used to improve the performance of broiler growth (4). The excessive dependence on medications threatens mankind in antibiotic

resistance. However, the uses of growth promoters are also discouraged because of their residual effect in boiler meat (5).

The success of poultry meat production has been strongly related to the improvements in growth and carcass yield, mainly by increasing breast proportion and reducing abdominal fat. Nowadays, recent nutritional strategies with ultimate goal of feed cost reduction led to production of fatty broiler carcasses (6). The breeding goals variables include increased growth rate, breast muscle yield, decreased abdominal fat, improved development of the skeletal system and overall fitness (7).

It has been noted by many researchers that the supplementation of poultry diets with enzymes frequently exert beneficial effects (8, 9, 10, 11). The extent of these merit depends on a number of factors such as nature of the dietary components, whether the appropriate enzymes have been included for the substrates contained in the diets and specific factors (12). Factors that influence meat quality can mostly be controlled at various stages of setting up the chicken or during slaughter and processing. The carcass yield is closely linked to adequate food and nutrition of broilers (4). After all, animals with adequate supply of nutrients will effectively deposit muscle (13). The aim of this study was to evaluate the effect of different inclusion levels of roxazymes G® enzyme on two genetic stocks of commercial broilers for growth performance and carcass traits in Southern Guinea Savanna conditions of Nigeria.

Materials and Methods

Experimental Site

The study was carried out at the Poultry Unit of Teaching and Research Farm, Emmanuel Alayande College of Education, Oyo, Oyo state, Nigeria. Oyo lies on longitude $3^{o}5^{'}$ east of the green witch meridian and latitudes $7^{o}5'$ North eastwards from Ibadan, the capital of Oyo State. The altitude is between 300 and 600 meter above level. The mean annual temperature and rainfall are $27^{o}C$ and 1,165 mm respectively. The vegetation of the area is Southern Guinea Savanna zone of Nigeria (14).

Experimental Animals and Management

A total bird of 240 day-old chicks of two commercial broiler strains (120 Marshall and 120 Arbor acre strain) was used. Both Marshall and Arbor acre broiler chicks were purchased from a Zartech Farm in Ibadan with all necessary vaccination administered. The pens were constructed with planks, well netted and covered with nylons to reduce cold and its effect during brooding stage. The pen were thoroughly cleaned with detergent and water, disinfected with morigad and then left to dry for seven days. The pen's floor spacing of 0.14 m^2 per bird was covered with fresh wood shaving to a thickness of 7 cm. All the equipment such as drinkers, feeders and wire separators were thoroughly cleaned and disinfected. The pens were heated before the arrival of the birds with charcoal pot as source of heat with electric bulbs. The birds were randomly distributed into 4 treatments with 3 replicates of 10 birds each of the strain. Each strain was identified by assigning to a separate pen in an environmentally controlled brooder house with a floor covered with wood shavings which was kept dry throughout the experimental period by replacing spoiled litter when required. Water and feeds were given to the birds *ad libitum* throughout the experimental period.

Experimental diets

Chicks within each strain were fed four experimental diets; one of them was used as a control diet (0 g/ton), the other three groups were fed the same basal diets supplemented with roxazyme G® enzymes (100, 200 and 300 g/ton). Therefore, there were 4 experimental

treatments (T1 contain diet without enzyme, T2 contain diet with 100 g/ton enzyme, T3 contain diet with 200 g/ton enzyme and T4 contain diet with 300 g/ton enzyme. Each treatment was replicated three times, each having 10 chicks for each strain, distributed in a completely randomized experimental design. Birds were fed *ad libitum* on a broiler starter diet containing 24 % Crude Protein and 2900kcalkg/Metabolizable Energy from day old to 4th week of age followed by a finisher diet of 21 % Crude Protein and 2800kcalkg/Metabolizable Energy to 8th week of age and the composition of the experimental diets is indicated in Table 1.

Data Collection

i. *Growth performance traits*

Data were collected on growth performance traits (body weight, weight gain, feed intakes and feed conversion ratio) on both genetic stocks of broilers using the procedures of (15). At the beginning of the study, all day-old chicks were weighed with the use of an electronic kitchen scale with maximum capacity of 5 kg and initial body weight recorded on the first day after delivery. The birds were regularly weighed at the end of each week individually since each chicken were properly identified with an industrial galvanized aluminum tags attach to wing web to obtain their weekly body weight gain. The weekly average body weight gain of birds was obtained by difference between previous week average body weight and the present week average body weight. Feed consumption was obtained by the feed left over subtracted from feed given and the value divided by total number of birds daily while feed conversion ratio was obtained by the ratio of daily weight gain to daily feed intake within each measurement period on weekly basis during the whole experiment.

ii. Carcass Characteristics

Eighty - four (84) of each genetic stocks of the birds comprises of seven (7) birds per replicate were randomly selected at the end of the experiment (8 weeks) totally one hundred and sixty eight (168) birds and the carcass traits were monitored by starving the birds selected of feed overnight and individually weighed to obtain starved live body weight. The birds were stunned and bled by severing the blood vessels and the nerve trunks at the roof of the mouth with a sticking knife. Thereafter the birds were scalded, deplumed manually and eviscerated through a slit made between the end of the keel bone and rectum. The liveweight, bled weight, defeathered weight, eviscerated weight, breast weight, thigh weight, wing weight and shank weight were recorded. The visceral organs recorded were gizzard, kidney, heart, liver and abdominal fats. The parameters were measured as described by (16).

Statistical Analysis

The data collected were subjected to one-way Analysis of Variance using the General Linear Model of (17) and Duncan Multiple Range Test (18) of the same software were used to separate the means with significant differences. The model below was used;

$Y_{ijk} = \mu + G_i + Z_j + (G \times Z)_{ij} + e_{ijk}$

Where

Y_{ijk} = The individual measurement on each bird

μ = The overall mean

G_i = Effect of the i^{th} genotype (i =1, 2)

Z_j = Effect of the j^{th} enzyme (j = 1, 2, 3, 4)

$(G \times Z)_{ij}$ = Interaction effect of strain i^{th} and enzyme j^{th}

e_{ijk} = The random errors

Results and Discussion

The gross composition of experimental diets (starter and finisher phases) are shown in Table 1 while the means and standard errors of average body weight, daily weight gain, daily feed intake, daily water intake and feed

conversion ratio as affected by genotype, enzymes levels and their interaction are indicated in Table 2. The results revealed that body weight, daily weight gain, daily feed intake, daily water intake and feed conversion ratio were significantly affected by genotype, enzymes levels and their interaction are indicated in Table 2. Arbor acre were significantly higher in terms of body weight (kg), daily weight gain (g), daily feed intake (g) and daily water intake (litre) compared with Marshall birds while birds fed diets supplemented with roxazyme G® enzymes (especially 300 g/ton) obtained a higher body weight (2.20 kg), daily weight gain (40.00 g), daily feed intake (80.28 g) and daily water intake (20.97 litre). No significant ($P>0.05$) effect was observed for feed conversion ratio. These observations that favoured genotype and enzymes supplementation were in accordance with the reports of (19) and (20) that strains and enzymes inclusion with their interaction significantly affected the growth performances of broiler chickens and (15) reported that broiler strains differed in efficiency of feed utilization. This current study however disagreed with the findings of (21) on growth performance of Hubbard and Cobb broiler chickens and (22) on Cobb and Ross broiler chickens. These workers claimed that no significant effect and interaction existed among the strains, enzymes supplementation and their interactions and this non-significant variation might be attributed to different environmental factors where these animals are reared. The results also showed that increases in the enzymes inclusion levels, gave better response in both genetic stocks and their interaction and this agreed with the opinion of (23) on effect of feed restriction and enzyme supplementation on performance and carcass characteristic which stated that as the levels of enzymes increases the better the variables measured.

The means and standard errors of some primal cut weights as affected by genotype, enzymes levels and their interaction is presented in Table 3. Significant ($P<0.05$) effects were recorded by the genetic stocks for live weight, bled weight, defeathered weight, eviscerated weight, breast weight, thigh weight, wing weight and shank weight. The Arbor acre had significantly heavier live weight (2.20 kg), bled weight (2.08 kg), defeathered weight (2.03 kg), eviscerated weight (1.93 kg), breast weight (0.93 kg), thigh weight (1.03 kg), wing weight (0.65 kg) and shank weight (0.65 kg) in than the Marshall birds. Thus, the present findings agreed (16) and (24) that carcass indices were genetically dependents and were significant between the strains of broilers and the variables measured for carcass indices. However, the levels of inclusion of roxazyme G® enzymes that were significant affected the primal cuts with highest influenced on 300 g/ton for all the traits measured. These results are similar to the findings of (5) who noted that as the supplementation of enzymes increases, the heavier the parameters measured on carcass traits. On the other hand, (12) and (9) reports of non - significant enzymes inclusion levels effects in the diet of broiler chickens contradicted the findings of this study.

The means and standard errors of some edible visceral organs weights as affected by genotype, enzymes levels and their interaction are shown in Table 4. Significant ($P <0.05$) effects were detected among the genotypes, enzymes inclusion levels and their interactions. The Arbor acre broiler chickens had higher kidney (11.53 g), heart (8.89 g) and abdominal fat (28.90 g) weights than the Marshall birds. Contrarily, non- significant enzyme inclusion effects were recorded for gizzard and liver for both genotypes. Similar observations were earlier reported by (16) for Marshall and Cobb broiler chickens in derived savanna zone of Nigeria and (15) for Anak and Ross broiler chickens respectively that carcass traits were

under the influenced of genetic make-up of individual birds. The significant enzymes supplementation effects on visceral organs corroborated the reports of (25) that enzymes supplementations significantly affected the visceral organs of broiler chickens fed corn-soybean basal meal with different metabolizable energy levels. The findings of this study were also in line with the observations of (26) on carcass characteristic of broiler finisher fed rice offal based diets supplemented with exogenous enzymes, with the author noticed that enzymes supplementations significantly affected the visceral organs of broiler chickens. Meanwhile, the present findings were not in agreement with the works of (27) who observed non- significant effects between the groups of diets and some intestinal functions of broiler chickens fed diets with different inclusion levels of meals supplemented with enzymes.

Table 1: Gross composition of experimental diets (starter and finisher phases)

	Dietary levels of Roxazyme G®							
	Starter phase				**Finisher phase**			
Ingredients(%)	**T1**	**T2**	**T3**	**T4**	**T1**	**T2**	**T3**	**T4**
Maize	43.00	43.00	43.00	43.00	49.00	49.00	49.00	49.00
Soybean meal	22.00	22.00	22.00	22.00	8.50	8.50	8.50	8.50
Groundnut cake	13.50	13.50	13.50	13.50	19.50	19.50	19.50	19.50
Palm kernel cake	6.50	6.50	6.50	6.50	8.50	8.50	8.50	8.50
Fish Meal	2.50	2.50	2.50	2.50	2.00	2.00	2.00	2.00
Wheat offal	7.50	7.50	7.50	7.50	6.50	6.50	6.50	6.50
Bone meal	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Roxazyme G ®	0.00	0.10	0.20	0.30	0.00	0.10	0.20	0.30
Lysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Methonine	0.20	0.20	0.20	0.20	0.25	0.25	0.25	0.25
Oyster shell	1.50	1.50	1.50	1.50	2.50	2.50	2.50	2.50
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100	100	100
Calculated Analysis								
Crude protein (%)	23.00	23.00	23.00	23.00	21.39	21.39	21.39	21.39
Metabolizable energy (kcal/kg)	2712.8	2712.8	2712.8	2712.8	2759.43	2759.43	2759.43	2759.43

% = Percent, Kcal/ka; Kilocalories/kg = kilogramme,T1 = 0 g/ton of enzyme diet, T2 = 100 g/ton of enzyme diet , T3 = 200 g/ton of enzyme diet , T4 = 300 g/ton of enzyme diet

Table 2: Means and standard errors of growth performance as affected by genotype, enzyme levels and their interaction.

Parameters	Genotype	Treatment				Interaction effect		
		Roxayzme G® levels of inclusion						
		0 g/ Ton	100 g/ Ton	200 g/ Ton	300 g/ Ton	G	Z	G*Z
Body weight (kg)	Marshall	1.58±0.05[b]	1.70±0.02[b]	1.75±0.20[b]	1.86±0.08[b]	0.02	0.01	Sig
	Arbor acre	1.75±0.04[a]	1.80±0.05[a]	1.95±0.60[a]	2.20±0.23[a]	0.01	0.02	Sig
Daily weight gain (g)	Marshall	35.42±0.06[b]	36.43±0.99[b]	37.05±0.90[b]	38.00±0.89[b]	0.02	0.01	Sig
	Arbor acre	36.82±0.89[a]	37.25±0.67[a]	38.02±0.57[a]	40.00±1.67[a]	0.01	0.02	Sig
Daily feed intake (g)	Marshall	75.83±9.99[b]	76.45±5.69[b]	77.22±9.98[b]	78.68±6.90[b]	0.02	0.01	Sig
	Arbor acre	76.64±8.89[a]	78.45±9.62[a]	78.48±5.78[a]	80.28±9.45[a]	0.01	0.02	Sig
Daily water intake (L)	Marshall	17.22±0.56[b]	17.77±0.47[b]	18.16±0.56[b]	19.89±0.99[b]	0.02	0.01	Sig
	Arbor acre	17.78±0.87[a]	14.83±0.89[a]	19.02±0.78[a]	20.97±0.22[a]	0.01	0.02	Sig
FCR	Marshall	2.14±0.03	2.09±0.05	2.08±0.01	2.07±0.02	NS	NS	NS
	Arbor acre	2.08±0.04	2.11±0.03	2.06±0.02	2.01±0.01	NS	NS	NS

[ab]Means along the column row at with different superscripts are significantly different at $P < 0.05$
FCR = Feed conversion ratio, Sig = Significant ($P<0.05$), NS = Non-Significant ($P>0.05$), G = Genotype, Z = Enzyme, G*Z = Interaction between genotype and enzyme

Table 3: Means and standard errors of some primal cut weights as affected by genotype, enzyme levels and their interaction.

Parameters (kg)	Genotype	Treatment Roxayzme G® levels of inclusion				Interaction effects		
		0 g/ Ton	100 g/ Ton	200 g/ Ton	300 g/ Ton	G	Z	G*Z
Liveweight	Marshall	1.58±0.05[b]	1.70±0.02[b]	1.75±0.20[b]	1.86±0.08[b]	0.01	0.01	Sig
	Arbor acre	1.75±0.04[a]	1.80±0.05[a]	1.95±0.60[a]	2.20±0.23[a]	0.01	0.02	Sig
Bled weight	Marshall	1.42±0.04[b]	1.58±0.02[b]	1.62±0.02[b]	1.75±0.03[b]	0.01	0.01	Sig
	Arbor acre	1.52±0.04[a]	1.68±0.02[a]	1.82±0.02[a]	2.08±0.03[a]	0.01	0.02	Sig
Defeathered weight	Marshall	1.40±0.04[b]	1.53±0.02[b]	1.60±0.02[b]	1.70±0.03[b]	0.01	0.01	Sig
	Arbor acre	1.50±0.04[a]	1.65±0.02[a]	1.80±0.02[a]	2.03±0.03[a]	0.01	0.02	Sig
Eviscerated weight	Marshall	1.20±0.04[b]	#1.33±0.02[b]	1.40±0.02[b]	1.50±0.03[b]	0.01	0.01	Sig
	Arbor acre	1.30±0.04[a]	1.45±0.02[a]	1.60±0.02[a]	1.93±0.03[a]	0.01	0.02	Sig
Breast weight	Marshall	0.68±0.04[b]	0.70±0.02[b]	0.73±0.02[b]	0.78±0.03[b]	0.01	0.01	Sig
	Arbor acre	0.79±0.04[a]	0.85±0.02[a]	0.89±0.02[a]	0.93±0.03[a]	0.01	0.02	Sig
Thigh weight	Marshall	0.85±0.04[b]	0.88±0.02[b]	0.90±0.02[b]	0.95±0.03[b]	0.01	0.01	Sig
	Arbor acre	0.90±0.04[a]	0.95±0.02[a]	0.99±0.02[a]	1.03±0.03[a]	0.01	0.02	Sig
Wing weight	Marshall	0.30±0.04[b]	0.35±0.02[b]	0.40±0.02[b]	0.45±0.03[b]	0.01	0.01	Sig
	Arbor acre	0.35±0.04[a]	0.45±0.02[a]	0.50±0.02[a]	0.65±0.03[a]	0.01	0.02	Sig
Shank weight	Marshall	0.30±0.04[b]	0.35±0.02[b]	0.40±0.02[b]	0.45±0.03[b]	0.01	0.01	Sig
	Arbor acre	0.35±0.04[a]	0.45±0.02[a]	0.50±0.02[a]	0.65±0.03[a]	0.01	0.02	Sig

[ab]Means along the column row at each genotype with different superscripts are significantly difference at $P < 0.05$ Sig = Significant ($P<0.05$), G = Genotype, Z = Enzyme, G * Z = Interaction between genotype and enzyme

Table 4: Means and standard errors of some edible visceral organs weights as affected by genotype, enzyme levels and their interaction.

Parameters (g)	Genotype	Treatment: Roxazyme G® levels of inclusion				Interaction effects		
		0 g/ Ton	100 g/ Ton	200 g/ Ton	300 g/ Ton	G	Z	G*Z
Gizzard	Marshall	30.25±2.35	32.78±0.02	34.05±8.29	38.89±1.08	NS	0.01	Sig
	Arbor acre	30.41±0.07	33.28±5.89	33.50±0.90	38.25±0.95	NS	0.02	Sig
Kidney	Marshall	8.38±0.35[b]	8.93±0.38[b]	8.48±0.35[b]	10.71±0.33	0.01	0.01	Sig
	Arbor acre	10.23±0.89[a]	9.17±0.89[a]	10.30±55[a]	11.53±0.67	0.01	0.02	Sig
Heart	Marshall	5.33±0.87[b]	6.45±0.35[b]	6.65±0.75[b]	7.34±0.93[b]	0.01	NS	Sig
	Arbor acre	6.50±0.67[a]	8.66±0.60[a]	7.56±0.67[a]	8.89±0.89[a]	0.01	NS	Sig
Liver	Marshall	6.93±0.35	5.14±0.47	7.89±0.39	8.42±0.35	NS	NS	NS
	Arbor acre	6.95±0.60	5.22±0.98	7.90±0.89	8.65±0.45	NS	NS	NS
Abdominal fat	Marshall	23.30±1.45[b]	22.99±0.98[b]	23.76±0.78[b]	27.23±2.63[b]	0.01	0.01	Sig
	Arbor acre	23.89±0.48[a]	23.89±2.90[a]	24.00±2.90[a]	28.90±0.69[a]	0.01	0.02	Sig

[ab]Means along the column at each genotype with different superscripts are significantly difference at $P < 0.05$ Sig = Significant ($P<0.05$), NS = Non-Significant ($P>0.05$), G = Genotype, Z = Enzyme, G *Z = Interaction between genotype and enzyme

Conclusion and Application

Based on the outcomes of this study, it can be concluded that supplementations of roxazyme G® enzyme on broiler diets up to 300 g /ton performed better in terms body weight, daily weight gain, daily feed intake and daily water intake with non - significant effects observed for feed conversion ratio. Arbor acre broiler chicken expressed significantly heavier effect on carcass traits than its counterpart Marshall broiler birds. All the enzymes inclusion levels in the diets and their interaction resulted in increases in the liveweight, bled weight, defeathered weight, eviscerated weight, breast weight, thigh weight, wing weight, shank weight, gizzard weight, kidney weight and abdominal fat. It is therefore inferred that enzyme inclusion genetically enhanced intake of the diets.

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