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ORGAN CHARACTERISTICS OF FINISHER BROILERS FED LOW ENERGY AND LOW PROTEIN DIETS SUPPLEMENTED WITH MULTI-ENZYME

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ABSTRACT

A total of 600 day-old Abor Acre mixed sex broilers were used to investigate the organ characteristics of finisher broilers fed low energy and low protein diets supplemented with multi-enzyme in a humid tropical environment, using a 4 x 4 factorial experimental in a completely randomized design. Each dietary treatment was replicated three times with eleven birds per replicate. Diet of 3200 kcal metabolizable energy level and 21 % crude protein level served as the control. Each dietary level was supplemented with multi-enzyme at 1 g/kg of experimental diet. Results showed that the 2400 kcal/kg energy level diet reduced the weight of the kidney of finisher broilers while the 2600 kcal ME energy level significantly (p < 0.05) reduced the weight of the lungs and heart of the finisher broilers. Low protein levels significantly (p < 0.05) reduced the entire organ weight measured. Energy: protein interactions effect showed that the 2500 kcal ME x 18 % CP diets significantly (p < 0.05) reduced weight of liver and kidney, the 2600 kcal ME x 18 % CP significantly (p < 0.05) reduce weight of gizzard and heart while the 2400 kcal ME x 18 % CP significantly (p < 0.05) reduced weight of small intestine. It was therefore concluded that feeding low energy and low protein diets with multi-enzyme supplementation to finisher broilers, especially at 2500 and 2600 kcal ME x 18 % CP reduced organ weights.

Keywords: Finisher Broilers, diets, energy, protein, multi-enzyme, organ characteristics.

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INTRODUCTION

Broiler requires adequate energy and protein for proper and efficient performance by promoting efficient feed utilization, and maximizing growth rate [1]. In Nigeria, the dietary energy level of 2800-3000kcal/kg metabolizable energy (ME) and corresponding crude protein (CP) level of 22-24% have been established for broilers (1-56 days) [2,3,4]. Also, lower energy and protein diets have been evaluated in an attempt at resolving such problems of high nutrient density diet, and it has been revealed that overall performance was not generally affected [4].

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The digestive system plays a significant role in supplying nutrients to all other organs; they also ensure that nutrient requirement for maintenance is met. Physiological studies have shown that a functional gastrointestinal tract (GIT) is vital for the digestion and absorption of nutrients required for growth and maintenance of birds [5].

The addition of exogenous enzymes to low energy and protein diet could be a potential tool for improving feed efficiency and thus increase the use of low cost, high fiber and proteinaceous feedstuffs. In view of this, several authors have canvassed for the dietary inclusion of growth promoters like multi-enzyme to poultry feeds, which may reduce production cost by reducing the growth phase duration [6].

Low metabolizable energy (ME) and low protein diets supplemented with enzyme has been reported to increase nutrient digestibility [6]. Similarly, enzyme supplementation to diets has been reported also to increase pancreatic lipase and pepsin activity in broilers fed low energy diet [7]. Exogenous enzyme supplements are now widely used in poultry diets in an attempt to improve nutrient utilization, health and welfare of birds, product quality and to reduce pollution a s well as increase the choice and contents of ingredients which are acceptable for inclusion in diets [8]. In practical poultry feeding, the choice of appropriate enzymes for a particular diet is important [9]. It is also an important considerable factor in nutrition and nutritional physiology.

Marquardt reported that the degree of improvement obtained by adding enzymes to a diet depends on many factors which include; type and quantity of cereals in the diet, the spectrum and concentration of enzyme used, specie and age of animal [10]. Therefore, this study was aimed at investigating the organ characteristics of 49-day old broilers fed low energy and low protein diets supplemented with multi-enzyme.

MATERIALS AND METHODS

A total of 600 Abor Acre day-old mixed broilers of mixed sexes (Nastech hatchery, Oyo State, Nigeria) were used for this study. The birds were randomly allocated to 16 dietary treatment groups. Each treatment was replicated 3 times with 11 chicks per replicate, the treatment groups were 4 levels of dietary energy (3200, 2600, 2500 and 2400 kcal ME/kg of diet) and 4 levels of crude protein (21, 18, 17 and 16 % CP). Each dietary ll received the same level of Maxi-Grain^{R} multi-enzyme (Polchem Hygiene Laboratories Pvt. Ltd India) supplementation at 1g/kg of the experimental diets. The dietary level of 3200 Kcal X 21% C.P without multi-enzyme supplementation served as the control diet.

Brooding was done with kerosene stoves under metal hoovers, while light was provided with 100 watt electric bulbs for additional five hours at night each day. The birds were provided with water and experimental died *ad libitum*. Routine medications and vaccination against common diseases like Newcastle, Gumboro, and Typhoid were administered to the birds during the experiment. The layout of the experimental diets is presented in Table 1. At the end of the 7th week (49 days), 3 birds per replicate were randomly selected, starved over-night but allowed access to drinking water, weighed and humanely sacrificed by cervical disarticulation. They were thoroughly bled. The internal organs and intestines were removed through a slit made between the end of the keel bone and the cloacae. Heart, liver, kidney, gizzard, spleen and lungs weights were determined using a sensitive electronic weighing balance and expressed as percentages of live weight.

Statistical Analysis Data collected were subjected to analysis of variance (ANOVA) for a 4 x 4 factorial experiment in a Completely Randomized Design [11]. Differences among treatments means were separated using Duncan's Multiple Range Test [12].

Table 1: Layout of broiler finisher diets supplemented with multi-enzyme

CP/Energy	3200Kcal	(B) 2600Kcal	(C) 2500Kcal	(D) 2400Kcal
(W) 21 %	AW	BW	CW	DW
(X) 18 %	AX	BX	CX	DX
(Y) 17 %	AY	BY	CY	DY
(Z) 16 %	AZ	BW	CZ	DZ

AW, AX, AY and AZ = Diets of 3200 Kcal metabolizable energy with corresponding percentage crude protein of 21, 18, 17 and 16 respectively; BW, BX, By and BZ = Diets of 2600 Kcal metabolizble energy with corresponding percentage cude protein of 21, 18, 17 and 16 respectively; CW, CX, Cy and CZ = Diets of 2500 Kcal metabolizble energy with corresponding percentage cude protein of 21, 18, 17 and 16 respectively and DW, DX, Dy and DZ = Diets of 2400 Kcal metabolizble energy with corresponding percentage crude protein of 21, 18, 17 and 16 respectively.

RESULTS

Effect of energy level

The effect of low energy on digestive organs weight of 49-day old broilers is shown in Table 2. Energy levels did not significantly ($p > 0.05$) influence the weights of the liver, spleen, gizzard and small intestine of finisher broilers. Kidney of broilers fed 2400 kcal ME diet was significantly ($p < 0.05$) lower than those fed with control and 2500 Kcal ME but did not vary significantly ($p > 0.05$) when compared to broilers fed 2600 Kcal ME diet. The lungs of broilers fed 2600 Kcal ME diet was significantly lower than those fed with 2500 Kcal ME diet but similar to that of broilers fed control and 2400 Kcal ME diet. Heart of broilers fed 2500 Kcal ME diet was significantly ($p < 0.05$) higher than those fed 2600 Kcal ME diet and similar to broilers fed the 2400 Kcal ME diet but compared favorably with those fed the control (3200 Kcal ME) diet.

Table 2: Effect of low energy diets on organs weight of 49-day old broilers fed low energy diets supplemented with multi-enzyme

Parameters	3200 kcal	2600 kcal	2500 kcal	2400 kcal	SEM
Liver (%)	1.85	1.72	1.84	1.67	0.07
Kidney (%)	0.52^{a}	0.47^{ab}	0.52^{a}	0.43^{b}	0.02
Lungs (%)	0.46^{ab}	0.41^{b}	0.48^{a}	0.46^{ab}	0.02
Spleen (%)	0.12	0.11	0.11	0.09	0.01
Gizzard (%)	2.09	1.85	2.17	2.06	0.13
Heart (%)	0.43^{a}	0.38^{b}	0.43^{a}	0.42^{ab}	0.01
Small inte. (%)	3.52	3.25	3.35	3.06	0.19

^{ab}Means on the same row with different superscripts differ significantly ($p < 0.05$);
SEM = standard error. of mean

Table 3: Effect of low protein diets on organs weight of 49-day old broilers fed low protein diets supplemented with multi-enzyme

Parameters	21% CP	18% CP	17% CP	16% CP	SEM
Liver (%)	1.98^{a}	1.74^{b}	1.62^{b}	1.74^{b}	0.07
Kidney (%)	0.53^{a}	0.46^{b}	0.46^{b}	0.49^{ab}	0.02
Lungs (%)	0.43^{b}	0.46^{b}	0.41^{b}	0.51^{a}	0.02
Spleen (%)	0.14^{a}	0.10^{b}	0.09^{b}	0.10^{b}	0.01
Gizzard (%)	2.34^{a}	1.97^{ab}	1.93^{b}	1.91^{b}	0.13
Heart (%)	0.45^{a}	0.41^{b}	0.41^{b}	0.39^{b}	0.01
Small inte. (%)	3.52	3.25	3.30	3.28	0.19

^{ab}Means on the same row with different superscripts differ significantly ($p < 0.05$);
SEM = Standard error of means.

Effect of protein level

The effect of low protein on digestive organs weight of 49-day old broilers is shown in Table 3. Liver of broilers fed 16 %, 17 % and 18 % crude protein (CP) were significantly ($p < 0.05$) lower than those fed the control diet (21 % CP). Broilers fed with the 17 % and 18 % CP diet had significantly ($p < 0.05$) lower kidney weight than broilers fed the control diet but were similar to those fed the 16 % CP diet. Lungs of broilers fed the 16 % CP diet had significantly ($p < 0.05$) higher weight than those fed the 17 %, 18 % and control (21 %) diets. Spleen and Heart of broilers fed low protein diets maintained the same liver trend. Significantly lower gizzard weights were observed in broilers fed the 16 % and 17 % CP diets than those fed the control diet but similar with the gizzard of those fed the 18 % CP diet.

Table 4: Interaction effect of low protein and low energy diets supplemented With multi-enzyme on organs weight of 49-day old broilers.

Parameter	CP (%)	3200 kcal	2600 kcal	2500 kcal	2400 kcal	Mean
Liver (%)	21	1.81^{ab}	1.85^{ab}	2.14^{a}	1.80^{b}	1.99
	18	2.06^{ab}	1.69^{bc}	1.56^{d}	1.64^{bc}	1.74
	17	1.67^{bc}	1.59^{cd}	1.62^{bc}	1.60^{bc}	1.63
	16	1.54^{d}	1.76^{b}	2.02^{b}	1.63^{bc}	1.74
	Mean	1.86	1.72	1.84	1.67	
	SEM	CP x E =	0.13			
Kidney (%)	21	0.50^{bc}	0.56^{b}	0.58^{b}	0.51^{bc}	0.52
	18	0.68^{a}	0.42^{cd}	0.38^{d}	0.36^{d}	0.46
	17	0.49^{bc}	0.48^{bc}	0.50^{bc}	0.39^{d}	0.47
	16	0.45^{cd}	0.43^{cd}	0.61^{ab}	0.46^{bc}	0.49
	Mean	0.52	0.47	0.52	0.43	
	SEM	CP x E =	2.11			
Lungs (%)	21	0.38^{de}	0.38^{de}	0.54^{ab}	0.42^{c}	0.44
	18	0.45^{bc}	0.46^{bc}	0.40^{de}	0.52^{b}	0.46
	17	0.44^{c}	0.37^{e}	0.43^{bc}	0.42^{c}	0.42
	16	0.54^{ab}	0.45^{bc}	0.57^{a}	0.48^{bc}	0.51
	Mean	0.46	0.42	0.49	0.46	
	SEM	CP x E =	0.38			
Spleen (%)	21	0.32^{a}	0.11^{bc}	0.18^{b}	0.11^{b}	0.14
	18	0.11^{bc}	0.12^{bc}	0.10^{bc}	0.06^{c}	0.09
	17	0.11^{bc}	0.10^{bc}	0.07^{c}	0.09^{b}	0.09
	16	0.09^{bc}	0.10^{bc}	0.10^{bc}	0.10^{b}	0.10
	Mean	0.12	0.11	0.11	0.09	
	SEM	CP x E=	0.02			
Gizzard (%)	21	1.95^{a}	2.41^{a}	2.28^{a}	2.30^{a}	2.34
	18	2.46^{a}	1.28^{b}	2.11^{ab}	2.06^{ab}	1.98
	17	1.81^{ab}	1.96^{ab}	2.12^{a}	1.84^{ab}	1.93
	16	1.74^{ab}	1.77^{ab}	2.17^{a}	1.96^{ab}	1.91
	Mean	2.10	1.86	2.17	2.04	
	SEM	CP x E =	0.25			
Heart (%)	21	0.44^{b}	0.42^{bc}	0.47^{ab}	0.41^{bc}	0.46
	18	0.42^{bc}	0.38^{c}	0.40^{bc}	0.46^{ab}	0.42
	17	0.38^{c}	0.39^{bc}	0.41^{bc}	0.45^{ab}	0.41
	16	0.49^{a}	0.44^{b}	0.41^{bc}	0.45^{ab}	0.45
	Mean	0.45	0.41	0.42	0.44	
	SEM	CP x E =	0.02			
Small Inte. (%)	21	3.04^{a}	3.25^{b}	3.67^{ab}	3.51^{ab}	3.36
	18	4.33^{a}	3.82^{ab}	3.26^{b}	2.79^{c}	3.55
	17	3.67^{ab}	3.22^{b}	2.88^{bc}	2.88^{bc}	3.16
	16	2.89^{bc}	2.96^{bc}	3.25^{b}	3.52^{ab}	3.15
	Mean	3.48	3.31	3.26	3.17	
	SEM	CP x E =	0.67			

^{a,b,c}Means on the same row with different superscripts differ significantly ($p < 0.05$); SEM = Standard error of means; CP x E = crude protein x energy interaction.

Energy : protein interaction

The effect of low energy and low protein diets supplemented with multi-enzyme on weight of 49-day broilers are shown in Table 4. Significantly (P<0.05) lower liver weight was observed in broilers fed the 3200 Kcal/kg ME x 16 % CP and 2500 Kcal/kg ME x 18 % CP diet, then those fed the 2500 Kcal/kg ME x 21 % CP. Broilers fed the control diet (3200 Kcal/kg x 21 % CP) had similar values as those fed the 2500 Kcal, 2600 kcal x 21 % CP and 3200 Kcal x 18 % CP diets. Kidney of broilers fed the 2400 Kcal/kg ME x 17 and 18 % CP and those fed the 2500 Kcal/kg x 18 % CP had significantly ($p < 0.05$) lower weight than those fed the 3200 Kcal/kg x 18 % CP diet.

Lungs of broilers fed the 2600 Kcal/kg x 17 % CP diet were significantly (P<0.05) lower, than those fed 2500 kcal/kg ME x 16 % CP diet, while those fed with 2500 kcal/kg x 21 % CP and 3200 kcal/kg x 16 % CP were similar to those fed 2500 kcal/kg ME x 16 % CP diet. A significantly lower weight difference was observed for spleen of broilers fed with 2400 Kcal/kg x 18 % CP and 2500 Kcal/kg x17 % CP compared to those fed the control diet. The gizzard was significantly heavier across all the broilers fed lower ME diets with 21 % CP, 3200 Kcal/kg x 18 % CP diet together with those fed the control diet, than those fed the 2600 Kcal/kg x 18 % CP diet but similar to other broilers fed lower energy and protein diets. Heart of broilers fed 2600 Kcal/kg x 18 % CP and 3200 Kcal/kg x 17 % CP diets were significantly lower than those fed 3200 Kcal/kg x 16 % CP diet.

The small intestine of broilers fed lower energy and lower protein diet of 2400 Kcal/kg x 18 % CP had significantly ($p < 0.05$) lower value than those fed 3200 Kcal/kg x 18 % CP.

DISCUSSION

The benefit of exogenous enzyme supplementation to non-starch polysaccharides rich diets have been well documented [7]. Corn and soybean meal are highly digestible and so form the major ingredients supplying energy and protein in commercial broiler diets [1]. From the results of the present study, increased weight of broiler organs fed low energy diets of 2400 Kcal/kg and 2500 Kcal/kg supplemented with multi-enzyme compared favorably with those fed with the control diet as shown in Table 2. A possible explanation for this might be that the multi-enzyme enhanced the absorption of the nutrients there by making enough available to be utilized in the body. These showed that energy have little effect on digestive organ of broilers. From Table 3, decrease in organ weight of broilers fed low protein diet of 16 % CP and 18 % CP could be attributed to increased need for nutrient as a result of increased activities of the organs in supplying the available nutrients to other parts of the system. Interaction effect showed the weights of the kidney and small intestine of broilers fed with 2400 Kcal/kg ME x 17 and 18 % CP and those fed with 2500 and 2600 Kcal/kg x 18 % CP reduced significantly. The heart and gizzard weights of broilers fed 2600 Kcal/kg x 18% CP also reduced significantly. This could be due to increased activities of these organs brought about by the low protein in the diets. Prior studies have noted increased weight of internal organs associated with high protein dietary intake [4]. Adeyemi also reported a reduced gizzard weight in broiler diets with enzyme supplementation which agrees with the findings in the present study [14]. Dairo reported that dietary energy and protein has effect on small intestinal weight [4], which did not agree with this study, the non agreement with this study could be as a result of multi-enzyme supplementation. However, there had been previous reports that the inclusion of exogenous enzyme to broiler diets did not affect the weights of the kidney, gizzard, heart and liver which do not agree with the findings in our study [15,16].

From our results, increased digestive organ weights of broilers fed with 2500 Kcal ME diet could be attributed to increased energy density of the diet and utilization due to multi-enzyme supplementation, which in turns improved their performance. This suggests that, there is a level at which energy concentration as a nutrient is justifiable, hence a positive effect is expected in terms of performance parameters. Enzyme supplementation improves energy-utilizing efficiency in broilers fed corn-soybean diet with lower ME levels [6]; this is in line with the findings of this study. Enzyme as a catalyst, when

supplemented to low energy and protein diet, increased digestive enzyme and nutrient availability as well as secretion of endogenous enzyme to meet the nutrient requirements of the birds. Broilers fed non-multi-enzyme supplemented diet (control) showed lower relative internal organ weights when compared with those fed with lower energy and lower protein diets. This contradicts with the report of other researchers who stated that supplementing enzyme to broiler diet had no effect on their organ weights [18], which could be attributed to the enzyme type, concentration, environmental factors, management and breeds of birds used.

It was therefore concluded that: i). Main effect; low energy dietary levels of 2400 and 2600 Kcal ME have no significant effect on liver, spleen, gizzard and small intestine but reduced kidney while low protein dietary levels of 17 and 18 % CP reduced internal organ weights but without significant difference on small intestinal weight of finisher broilers with multi-enzyme supplementation. Ii). Interaction effect; low energy and low protein diets with multi-enzyme supplementation can be fed to finisher broilers especially, 2600 Kcal/kg x 18 % CP without adverse effect on digestive organ weights.

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