JOURNAL OF VETERINARY AND APPLIED SCIENCES
2019 VOL. 9 (2): 70 - 76
Manuscript No. JVAS/2018/047; Received: 05/06/2018; Accepted: 22/09/2019
Published by: Faculty of Veterinary Medicine, University of Nigeria, Nsukka, Nigeria

RELATIVE ORGAN WEIGHTS OF FOUR-WEEK OLD BROILERS FED LOW ENERGY AND LOW PROTEIN DIETS SUPPLEMENTED WITH MULTI-ENZYME IN THE HUMID TROPICS

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ABSTRACT

A total of 600 day-old Abor Acre mixed sex broiler were used to evaluate the physiological response of starter broiler organs to low energy and low protein diets supplemented with multi-enzyme in the humid tropics using four low energy and four low protein treatment levels; each treatment level replicated three times. Each treatment level had eleven birds per replicate with a 4 x 4 factorial experimental in a completely randomized design. Energy level of 3000 kcal and protein level of 23 % was used as the control diet. Multi-enzyme was supplemented at 1g/kg of the experimental diet. Results revealed no significant difference on the liver and kidney of broilers fed low energy level diets, 2800 kcal metabolizable energy level and 18 % CP level significantly (P<0.05) decreased the weights of the gizzard, heart and small intestine of starter broilers. Interaction of 3000 kcal metabolizable energy x 18 % CP dietary level significantly (P<0.05) reduced the weight of the liver, lungs and small intestine of four-week old broilers. It was therefore concluded that low energy and low protein diets with multi-enzyme supplementation reduced organ weight of four-week old broilers, especially the 300 Kcal metabolizable energy with crude protein of 18 % diet, in a humid tropical environment.

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

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INTRODUCTION

One of the major challenges of livestock farmers in Sub-Saharan Africa appears to be the provision of adequate feed for animals [1]. Protein and energy are two important components of feed that are determinants of the performance and productivity of farm animals [2]. Protein sources for animal feeding are generally more expensive than energy sources such that their reduced inclusion level in diets could save the cost of feeds and that of animal production [3].

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For broiler production, the regime of dietary protein and energy has been established both in the tropics and temperate climates [4]. The performance of broiler chicks were evaluated by Olomu and Offiong, who reported that 23% crude protein (CP) with either 2800 or 3000 kcal/kg metabolizable energy (M.E.) was adequate as the requirement for starter broiler birds [5], while Onwudike [6] recommended 22% CP and 2900 kcal/kg M.E. Fetuga [7] in his own report recommended a range of 23 - 24% CP and 2800 – 3000 kcal/kg M.E for starter broiler chicks and 19 - 21% CP with same energy level for the finisher phase. On the other hand, Ojewola and Longe [4] reported that the feeding of 27% crude protein (which is considered high) in the broiler chicks' starter diet did not support good performance of the birds.

Recently, lower energy and low protein diets have been tried in an attempt at resolving such problems of high nutrient density diet, and it has been revealed that overall performance is not totally affected. This has led to the inclusion of exogenous enzymes in poultry diets to improve nutrient digestibility. With the use of enzymes, it is possible to reduce nutrient levels in diets in order to maximize profit and reduce amount lost in faecal matter. In addition nitrogenous compounds (proteins) in feeds can be reduced in diets to reduce environmental pollution [8].

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 as well as increase the choice and contents of ingredients which are acceptable for inclusion in diets [9]. Therefore, this study was aimed at determining the physiological response of starter broiler organs to low energy and low protein diets supplemented with multi-enzyme in the humid tropics.

MATERIALS AND METHODS

A total of 600 Abor Acre mixed sex day-old broilers from Nastech hatchery, Ibadan, 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 (3000, 2800, 2700 and 2600 kcal ME/kg) and 4 levels of crude protein (23, 20, 19 and 18 % CP). The same level of Maxi-Grain^{R} multi-enzyme (Polchem Hygiene Laboratories Pvt. Ltd India) was added at 1g/kg of the experimental diets. Diet of 3000 Kcal X 23% C.P served as 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. Water and experimental diets were provided *ad libitum*. Routine vaccination against common diseases including Newcastle disease, Gumboro, and Fowl Typhoid and medications were administered to the birds during the experiment. The layout of the experimental diets is presented in Table 1. At the end of week 4 (28 days), 3 birds per replicate were randomly selected, starved over-night but allowed access to drinking water, weighed and humanely slaughtered by severing the jugular vein. They were thoroughly bled and the internal organs and intestine were dissected out through a slit made between the end of the keel bone and the cloacae.

The weights of the heart, liver, kidney, gizzard, spleen and lungs were determined using electronic sensitive scale and expressed as percentage of live weight.

Table 1. Layout of broiler starter diets.

CP/Energy	(A)3000Kcal	(B)2800Kcal	(C)2700Kcal	(D) 2600Kcal
(W) 23 %	AW	BW	CW	DW
(X) 20 %	AX	BX	CX	DX
(Y) 19 %	AY	BY	CY	DY
(Z) 18 %	AZ	BW	CZ	DZ

Statistical Analysis

Data collected were subjected to analysis of variance (ANOVA) for a 4 x 4 factorial experiment in a completely randomized design [10]). Differences among treatment means ± Standard Error of means were separated using Duncan's Multiple Range Test at 5 % level of significance [11].

RESULTS

Effect of energy level

The effect of low energy on the relative weights of the digestive organs of the broilers is shown in Table 2. The liver and kidney of broilers fed low energy diet showed no significant differences between the treated and control groups. The lungs, spleen and small intestine of broilers fed control diet (3000 kcal/kg diet) were significantly ($p < 0.05$) lower than those fed lower ME diets (2600, 2700 and 2800 kcal ME). Lower values were however recorded in the gizzard and heart of broilers fed low energy diets than those fed the control diets.

Protein Effect

Effect of low protein diet on digestive organs of the broilers is also shown in Table 2. Kidney of broilers fed 19 % CP and 20 % CP were significantly ($p < 0.05$) lower in weight than those of broilers fed 18 % CP diet and control diet fed broilers. A similar trend was noted with the spleen. gizzard, heart and small intestine of broilers fed low protein diets had significantly ($p < 0.05$) lower weights than those fed the control diet.

Table 2. Relative organ weights of starter broilers fed low energy diets.

Parameters	3000 kcal	2800 kcal	2700 kcal	2600 kcal	SEM
Liver (%)	1.67	1.64	1.88	1.94	0.10
Kidney (%)	0.48	0.56	0.50	0.52	0.02
Lungs (%)	1.36^{b}	1.64^{ab}	1.88^{a}	1.94^{a}	0.10
Spleen (%)	0.37^{b}	0.56^{a}	0.50^{a}	0.52^{a}	0.02
Gizzard (%)	0.86^{a}	0.49^{b}	0.48^{b}	0.46^{b}	0.03
Heart (%)	0.77^{a}	0.07^{b}	0.08^{b}	0.09^{b}	0.02
Small Intestine (%)	2.89^{ab}	2.62^{b}	3.07^{ab}	3.28^{a}	0.20

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

Effect of interaction between energy and low Protein

The results of low energy and low protein interaction with multi-enzyme supplementation on the internal organs of four week old broilers are presentenced in Table 2. The liver of broilers fed 3000 kcal/kg x 18 % CP and 2800 kcal/kg x 19 % CP diet had significantly ($p <$ 0.05) lower weights than those fed 2600 kcal/kg x18 % CP diet, as were those of broilers fed 2600 kcal/kg x

19 % CP significantly ($p < 0.05$) lower in weight than those of broilers fed with 2800 kcal/kg x 23 % CP. Broilers fed with 3000 kcal/kg x 18 % CP had significantly ($p < 0.05$) lower weight of lungs than those fed with 2600 kcal/kg x 18 % CP dietary composition. The spleen of broilers fed with 2600 kcal/kg x 19 % CP and 2700 kcal/kg x 20 % CP had significantly lower mean values than those fed with 2800 kcal/kg x 23 % CP diet. Gizzard of broilers fed 2600 and 2700 kcal/kg x 18 % CP dietary composition had significantly lower weight than those fed with the control diet (3000 kcal/kg x 23 % CP). Broilers fed low CP diet of 3000 kcal/kg x 19 % CP had significantly ($p < 0.05$) lower heart weight than those fed with the control diet (3000 kcal/kg x 23 % CP).

Table 3. Relative organ weights of starter broilers fed low dietary crude protein.

Parameters	23% CP	20% CP	19% CP	18% CP	SEM
Liver (%)	1.88	1.76	1.75	1.73	0.10
Kidney (%)	0.62^{a}	0.44^{b}	0.45^{b}	0.55^{a}	0.02
Lungs (%)	1.57	1.76	1.75	1.73	0.10
Spleen (%)	0.51^{ab}	0.44^{b}	0.45^{b}	0.55^{a}	0.02
Gizzard (%)	0.90^{a}	0.46^{b}	0.49^{b}	0.44^{b}	0.03
Heart (%)	0.79^{a}	0.07^{b}	0.08^{b}	0.08^{b}	0.02
Small Intestine (%)	3.32^{a}	2.86^{ab}	3.10^{ab}	2.61^{b}	0.20

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

DISCUSSION

The energy:protein ratio of diets has been found to play a prominent role in the performance of broiler chicken [12]. However, corn and soybean meals are the major ingredients respectively supplying energy and protein in commercial broiler diets because they are generally considered to be highly digestible [13]. Meanwhile, the benefit of exogenous enzyme supplementation to non-starch polysaccharides rich diets have been well documented 14]. The main effect has demonstrated that low energy and low protein diets supplemented with multi-enzyme had no effect on the liver of four-week old broilers. This could be attributed to the duration of the study and age of the birds; perhaps, the effect could be seen when extended to the overall growth phase of the broilers. This result is in line with the findings of Zhu [14] who reported that enzyme supplementation had no effect on liver of starter broilers. The broiler group fed 2600 kcal/kg ME diet and 18 % CP diet had a significant decrease in their gizzard and heart weights. This decrease could be the effect of low nutrient density of the diet, which may have resulted to low digestive activity in the small intestine and reduced intestinal surface area which affected the supply of nutrients to other parts of the body. According to Wang [15], supplementing exogenous enzyme to corn-soybean diet may hydrolyze non-starch polysaccharides, which reduces the secretory function of corresponding organs, then; the organ size may decrease. This may also have contributed to the reduced weight of the organs studied.

Interaction effect of 2600 kcal/kg x 19 and 18 % CP diets on 28-day broilers showed that the kidney, spleen and gizzard decreased significantly. However, in contrast, the weights of the liver and lungs were increased. The decreased weight of these organs could be attributed to the effect of low protein diets fed to the broilers or inability of the broilers' intestine to handle the multi-enzyme in the diets at this stage of growth. Marquardt [16] reported that the degree of improvement obtained by adding enzymes to diet depends on many factors including the type and quantity of cereals in the diet, the spectrum and concentration of enzyme used as well as the species and age of the animal. In this case, the age of the broilers may have been the factor applicable to the report of this study which agrees with that of Marquardt [16].

Table 4. Effect of interaction between low energy and low protein diets supplemented with multi-enzyme on relative organ weights of four-week old broilers.

Parameter	CP (%)	3000 kcal	2800 kcal	2700 kcal	2600 kcal	Mean
Liver (%)	23	1.82^{ab}	2.09^{ab}	1.91^{ab}	1.70^{b}	1.88
	20	1.77^{b}	1.51^{bc}	1.88^{ab}	1.89^{ab}	1.76
	19	1.85^{ab}	1.26^{c}	2.01^{ab}	1.90^{ab}	1.75
	18	1.23^{c}	1.72^{b}	1.72^{b}	2.26^{a}	1.73
	Mean ±	1.66±	1.64±	1.88±	1.93±	
	SEM	CP x E =	0.21			
Kidney (%)	23	0.50^{b}	0.75^{a}	0.60^{ab}	0.62^{ab}	0.61
	20	0.45^{c}	0.50^{b}	0.38^{d}	0.45^{c}	0.44
	19	0.48^{c}	0.44^{c}	0.52^{b}	0.38^{d}	0.45
	18	0.52^{b}	0.52^{b}	0.53^{b}	0.64^{ab}	0.55
	Mean	0.48	0.55	0.50	0.52	
	SEM	CP x E =	0.05			
Lungs (%)	23	0.58^{b}	2.06^{ab}	1.91^{ab}	1.70^{b}	1.56
	20	1.77^{b}	1.51^{bc}	1.88^{ab}	1.89^{ab}	1.76
	19	1.85^{ab}	1.26^{c}	2.01^{ab}	1.90^{ab}	1.75
	18	1.23^{c}	1.72^{b}	1.72^{b}	2.26^{a}	1.73
	Mean	1.36	1.63	1.88	1.93	
	SEM	CP x E =	0.21			
Spleen (%)	23	0.06^{d}	0.75^{a}	0.60^{ab}	0.62^{ab}	0.50
	20	0.45^{bc}	0.50^{b}	0.38^{c}	0.45^{bc}	0.44
	19	0.48^{bc}	0.44^{bc}	0.52^{b}	0.38^{c}	0.45
	18	0.52^{b}	0.54^{b}	0.53^{b}	0.64^{ab}	0.55
	Mean	0.37	0.55	0.50	0.52	
	SEM	CP x E =	0.05			
Gizzard (%)	23	2.16^{a}	0.49^{bc}	0.46^{bc}	0.47^{bc}	0.89
	20	0.44^{c}	0.45^{c}	0.51^{b}	0.43^{c}	0.45
	19	0.48^{bc}	0.50^{b}	0.49^{bc}	0.50^{b}	0.49
	18	0.37^{d}	0.52^{b}	0.44^{c}	0.44^{c}	0.44
	Mean	0.86	0.49	0.47	0.46	
	SEM	CP x E =	0.06			
Heart (%)	23	2.89^{a}	0.10^{b}	0.09^{bc}	0.09^{bc}	0.79
	20	0.06^{bc}	0.05^{c}	0.09^{bc}	0.09^{bc}	0.18
	19	0.01^{d}	0.07^{bc}	0.07^{bc}	0.09^{bc}	0.06
	18	0.06^{bc}	0.07^{bc}	0.08^{bc}	0.10^{b}	0.07
	Mean	0.75	0.07	0.08	0.09	
	SEM	CP x E =	0.04			
Small int (%)	23	2.89^{bc}	3.30^{b}	3.56^{ab}	3.75^{a}	3.37
	20	3.15^{b}	2.56^{bc}	2.61^{bc}	3.11^{b}	2.85
	19	3.35^{b}	2.31^{c}	3.25^{b}	3.50^{ab}	3.10
	18	2.44^{c}	2.33^{c}	2.89^{bc}	2.78^{bc}	2.61
	Mean	2.95	2.62	3.07	3.28	
	SEM	CP x E =	0.73			

^{abc}Means on the same row with different superscripts differ significantly (P< 0.05); SEM= Standard error of mean; CP x E = Crude protein x Energy.

In conclusion, the results of this study showed that multi-enzyme supplementation, especially with low energy and low protein diets (3000 kcal ME x 18 % CP and 2600 kcal/kg x 19% CP) reduced the weights of the organs studied while increasing those of the liver and lungs. This suggests that multi-enzyme supplementation to low energy and low protein diet may be more effective to improving the absorption capacity and other functions of these organs.

REFERENCES

1. Onua, E. C and Okeke, G .C. (1999). Replacement value of processed cassava peel for maize silage in cattle diet. *Journal of sustainable agriculture*, 1: 38 - 41
2. Dairo, F. A. S., Adeseinwa, A. O. K., Oluwasola, T. A. and Oluyemi, j. A. (2010). High and Iow dietary energy and protein levels for broiler chickens. *African Journal of Agricultural Research*, 5: 2030 – 2038.
3. Ajayi, H. I. (2014). Ileal crude protein digestibility of feather meal supplemented with protease in broiler chickens. Ph,D. Thesis, University of Ibadan, Ibadan. Nigeria. 150pp.
4. Ojewola, G. S. and Longe, O. G. (1999). Comparative response and carcass composition of broiler chickens fed various protein concentrations. Proceedings of Animal Science Association of Nigeria Conference, Pp. 9 - 2.
5. Olomu J. M. and Offiong, S. A. (1980). The effect of different protein and energy levels and time of change from starter to finisher ration on the performance of broiler chickens in the tropics. Poultry Science, 59: 828 - 835.
6. Onwudike, O. C. (1983). Energy and protein requirements of broiler chicks in humid tropics. *Tropical Animal Production*, 8: 39 - 44.
7. Fetuga, B. L. (1994).Technique in feed formulation. Paper presented at the Feed mill Management Training Workshop. Department of Agricultural Economics. University of Ibadan, Ibadan, Nigeria. April, 1994.
8. Ajayi, H. I. and Imouokhome, J. I., (2015). Blood parameters and performance of broiler chickens fed diets containing feather meal at three crude protein levels, with or without protease supplementation *Nigerian Journal of Agriculture, Food and Environment*, 11(2): 146 – 149.
9. Acamovic, T. (2001). Commercial application of enzyme technology for poultry production. World Poultry Science Journal, 57: 225 – 243.
10. Steel, R. G. D., Torrie, J. H., and Dickey, J. D. (1997). *Principles and Procedures of statistics: A Biometrical Approach*. 3rd Edition, . McGraw Hill Book Co., New York, NY
11. Duncan, D. B. (1955). Multiple Range and Multiple F-tests. *Biometrics*, 11: 1-42.
12. Aftab, U., Ashraf, M., and Jiang Z. (2006). Low protein diet for broilers. *World Poultry Science Journal*, 62: 688 - 701.
13. Zanella, L., Sakomura, N. K., Silversides, F. J., Fiqueirdo, A. and Pack, M. (1999). Effect of enzyme supplementation of broiler diet based on corn and soybean. *Journal of Poultry. Science*,78: 561 - 568.
14. Zhu, H. L., Hu, L. L., Y. Q., Hou, Y. Q., Zhang, J and Ding, B. Y. 1. (2014). The effects of enzyme supplementation on performance and digestive parameters of broilers fed corn-soybean diets. *Poultry Science Journal*. 93: 1704–1712.
15. Wang, Z. R., Qiao, S.Y., Lu, W. Q. and Li, D. F. (2005). Effect of enzyme supplementation on performance, nutrient digestibility, gastrointestinal morphology, and volatile fatty acid profiles in the hindgut of broilers fed wheat-based diet. *Poultry Science*, 84: 875 - 881.

16. Marquardt, R. R. (1997). Enzyme enhancement of the nutritional value of cereals: role of viscous, water-soluble, nonstarch polysaccharides in chick performance. In: *Enzyme in Poultry and Swine Nutrition*. Marquardt, R. R. and Han, Z. (eds.), International Development Research entre, Ottawa, Canada. Pp. 5 – 15.