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RESPONSE OF BROILER CHICKENS FED LOW CRUDE PROTEIN, LOCAL GROUNDNUT CAKE BASED DIETS WITH THREONINE SUPPLEMENTATION

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ABSTRACT

A 28-day study was carried out to determine the effect of increasing levels of threonine (Thr) in low crude protein (CP), local groundnut cake based diet of broiler chickens on carcass characteristics. A total of 200, three weeks old broilers were randomly allocated to five treatments of four replicates of 10 birds each. Two basal diets comprising of 21% and 18% CP levels as positive (PC) and negative (NC) control diets, respectively, were formulated. The remaining three diets comprised of NC diet containing supplemental Thr at 0.2, 0.4 and 0.6%. On day 28, three birds per replicate were selected for carcass and organ evaluation, data collected were statistically analyzed using one-way ANOVA in completely randomized design. Results showed that birds fed PC diet had higher (P < 0.05) live weight followed by those on 0.4 and 0.6% Thr supplemented NC diets than those fed NC diet. The breast and drumstick yield of birds fed PC, 0.4 and 0.6% Thr-NC diets were heavier (P<0.05) than those on NC and 0.2% Thr-NC diets. Abdominal fat yield increased (P<0.05) in birds fed NC diet than those fed PC, 0.4% and 0.6% Thr-NC diet. Decreasing dietary protein content from 21 to 18% reduced the live weight and carcass prime cut-parts of broilers from 21 to 49 days of age. Therefore, Thr supplementation at minimum level of 0.4% is required to improve carcass attributes of broiler chickens fed low protein, local groundnut cake based diets.

Keywords: broilers, carcass attributes, internal organs, low-protein diets; threonine

INTRODUCTION

Globally, protein nutrition represents a major challenge to poultry production; and to reduce the feed cost, the protein content of the diets can be reduced with an appropriate amino acid supplementation, giving positive effects also on environment (Attia *et al*. 2006). However, the use of low-crude protein (CP) diet leads to a decrease of body weight gain, increase of fat deposition and impairs feed:gain according to the level of protein reduction (Namroud *et. al*., 2008; Attia *et al*. 2017; Belloir *et al*., 2019). The growth rates of chickens depend on the availability of adequate amount of amino acids that can be used to synthesize proteins for optimum growth of body tissues and organs particularly muscle growth (Nasr and Kheiri, 2012; Chen *et al*., 2016). As dietary crude protein decreases, essential amino acids also decrease. Supplemental amino acids other than methionine and lysine may be required to support optimal growth, thereby increasing the degree of limitation of other indispensable amino acids. In addition to methionine and lysine, the aliphatic amino acid threonine is an important growth factor in broilers and is one of the basic amino acids needed for growth of domesticated birds (Dozier *et al*., 2000). Moreover, threonine helps maintain the integrity of the intestinal mucosal barrier and thus can enhance nutrient uptake by broiler chickens (Rezaeipour *et al*., 2012; Helal *et al*., 2020). Meeting the optimum dietary Thr levels with L-Thr supplementation allows poultry nutritionists to reduce dietary crude protein (CP) level

while improving growth rate. Information regarding use of alternative protein source that is locally available and cheap compared to soybean in low protein formulation with threonine supplementation has been scanty. The present study was conducted to evaluate the effect of feeding low crude protein, local groundnut cake based diets with graded levels of threonine supplementation on live weight, carcass yield, prime cut-parts and internal organs of broiler chickens from 21 to 49 days of age.

MATERIALS AND METHODS

This experiment was conducted at the Poultry Unit of Teaching and Research Farm of the Department of Animal Production Technology, Federal College of Wildlife Management New Bussa, Niger State is located on longitude 9° 81' 95"N and 9° 49' 10" N and latitude 4° 58' 05" N and 4° 34' 49" N (Aguihe *et al*., 2020). A total of 200, three weeks old broiler chicks were used for this study. Completely Randomized Design (CRD) was adopted and birds were randomly allotted to five treatments with each treatment having 4 replicatescomprising 10 birds each. The chicks were housed in an open - sided and well - ventilated pens and wood shavings was used as litter materials. A continuous lighting system was used to ensure that experimental feed and water were provided *ad-libitum*. Two iso-caloric basal diets were formulated to serve as positive (T_1, corn-soybean based) and negative (T_2, local groundnut cake) control as basal diets having 21% and 18% CP level respectively (Table 1). T_2, T_3 and T_4 diets were obtained by adding supplemental threonine to T_2 diet at 0.20, 0.40 and 0.60 %, respectively. On day 28 of the experiment, three birds per pen were chosen, weighed, and slaughtered by cervical dislocation to evaluate carcass, prime cut-parts and internal organ traits. All data were analyzed using one-way ANOVA, means were compared using Turkey test (SPSS 16.0 for Windows, SPSS Inc., Chicago, IL, USA.). A P-value of 0.05 or less was declared significant.

Table 1: Composition of the experimental basal diets

Ingredients	PCD	NCD	0.2% Thr+NCD	0.4% Thr+NCD	0.6% Thr+NCD
Maize	59.10	68.90	68.90	68.90	68.90
Soybean meal	30.10	0.00	0.00	0.00	0.00
Local GNC meal	0.00	22.80	22.60	22.40	22.20
Vegetable oil	3.50	2.00	2.00	2.00	2.00
Fish meal	3.00	2.00	2.00	2.00	2.00
DCP	2.00	2.00	2.00	2.00	2.00
Limestone	1.50	1.50	1.50	1.50	1.50
Salt	0.25	0.25	0.25	0.25	0.25
Vitamin-Premix	0.25	0.25	0.25	0.25	0.25
DL-Methionine	0.20	0.20	0.20	0.20	0.20
L-Lysine	0.10	0.10	0.10	0.10	0.10
L-Threonine	0.00	0.00	0.20	0.40	0.60
Total	100.00	100.00	100.00	100.00	100.00
Crude protein, %	21.12	18.36	18.31	18.27	18.19
ME, Kcal/kg	3104.17	3198.53	3196.43	3191.37	3190.15
Lysine, %	1.24	1.18	1.12	1.11	1.10
Methionine, %	0.46	0.42	0.41	0.40	0.40
Threonine, %	0.87	0.71	0.73	0.76	0.80

PCD: Positive control diet (21% CP), **NCD:** Negative control diet (18% CP)

RESULTS AND DISCUSSION

Table 2 shows the effect of dietary treatments on carcass traits of broilers. No differences ($p>0.05$) were recorded among the dietary treatments on carcass yield, relative back, wing

and all organ parameters evaluated. The live weight was the highest ($p<0.05$) in broilers fed the PC diet, followed by those fed 0.6% Thr-NC diet. The percentage of breast and thigh yield were higher ($p<0.05$) in the PC and 0.6% Thr-NC diet groups than the other dietary treatment groups. The abdominal fat percentage was lower ($p<0.05$) in birds offered PC diet ,0.4% and 0.6% Thr+NC diets compared to those fed NC and 0.2% Thr+NCdiets. Our results indicated that the reduction of protein level in a maize-local groundnut cake based diet decreased the live weight and carcass prime cut-parts of broiler birds.. In general, lower Thr amino acid supplementation is not able to recover the performance losses, but 0.6% Thr addition gave better results indicating that higher supplementation of Thr is very important to sustain chick growth when protein level is reduced. This is similar to the report of Attia et al., (2017) that amino acids requirements of poultry are higher when fed low protein diets. Breast and thigh meat yield are the most desired part in the carcass of birds. In addition to lysine and methionine, threonine plays a key role in the development of breast muscles in birds and optimal supply of dietary threonine has been reported to increase the breast meat yield in birds fed low protein diet (Dozier *et al*., 2000; Ciftci and Ceylan, 2004; Rasheed *et al.,* 2018), which is in line with the current findings. The function of threonine in improving muscle growth and mass was evidenced by the significant improvement in relative breast and thigh weight through increased absorption of digestive enzymes in the small intestine as well as increased availability of amino acids that can be used for protein synthesis and rate of absorption of feed through the small intestine (Kidd and Kerr, 1997; Rezaeipour et al., 2012). Chicks fed low-protein diets had shown a concomitant increase in carcass fat deposition and the results on abdominal fat deposition are in line with the findings of Widyaratne and Drew (2011). This significant increase in abdominal fat with reduced CP content is in agreement with could be explained by the increase of the dietary ME:CP ratio when reducing CP (Namroud *et. al*., 2008; Belloir *et al*., 2019). Increasing level of threonine resulted in decrease in relative weight of abdominal fat which is an indication of improved protein accretion (Dozier et al., 2001; Rezaeipour and Gazani, 2014). The development of internal organs is closely linked to growth, development, and health of animals (Steczny *et al*., 2017). In line with the present study, some researchers had earlier reportedhat dietary Thr levels had no significant effects on the weights of organ of broilers fed low protein diets (Azzam and El-Gogary, 2015; Helal *et al*., 2020).

Table 2: Live weight, carcass yield, prime cut-parts and internal organs of broiler chickens fed low-protein local GNC based diets with graded levels of supplemental threonine

Parameters (%)	Positive Control diet (PCD)	Negative control diet (NCD)	0.2% Thr-NCD	0.4% Thr-NCD	0.6% Thr-NCD	SEM	P-value
Live weight	2593.63^{a}	1990.08^{d}	2190.73^{cd}	2200.93^{c}	2440.57^{b}	27.65	0.26
Carcass yield	88.86	84.93	85.51	87.35	87.71	0.89	0.32
Breast	21.52^{a}	12.09^{b}	13.81^{b}	15.48^{a}	18.55^{a}	1.74	0.08
Thigh	26.22^{a}	16.21^{b}	16.49^{b}	17.00^{a}	24.02^{a}	2.04	0.01
Abdominal fat	0.55^{b}	1.05^{a}	0.88^{a}	0.63^{b}	0.58^{b}	0.03	0.12
Back	4.47	5.77	4.88	4.21	3.32	0.41	0.49
Wing	2.99	4.24	3.23	2.86	2.94	0.21	0.23
Liver	0.71	0.87	0.83	0.61	0.72	0.05	0.26
Kidney	0.03	0.02	0.02	0.01	0.01	0.03	0.6
Gizzard	0.72	0.71	0.83	0.63	0.7	0.03	0.7

Heart	0.21	0.28	0.23	0.22	0.23	0.01	0.7
Bile	0.04	0.04	0.05	0.04	0.04	0.01	0.91

CONCLUSION AND RECOMMENDATION

Reduction in dietary crude protein content from 21 to 18% negatively affected the live weight and carcass prime cut-parts of broilers from 21 to 49 days of age. However, supplementation of Thr at a minimum level of 0.4% level to low protein diet resulted in an improved live weight and carcass prime cut-parts of the birds. Use of threonine in broiler diets at a level not lower than 0.4% is recommended. Future studies should explore the effects of threonine supplementation above 0.6% in low protein diet formulation on the expression of carcass growth.

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