Growth performance and protein utilization efficiency of broiler finisher chickens fed low-protein diets with acidifier supplementation

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Abstract
An experiment was conducted to investigate the effect of graded levels of acidifier supplementation to low crude protein diet (LCPD) on growth performance, and efficiency of protein utilization by broiler finisher chickens (28 to 56 days old). A total of 240, 28-day old Arbor acre broilers chicks were randomly distributed into five dietary treatments of 4 replicates with 12 birds each in a completely randomized design. Five isocaloric diets were formulated to comprise T_1: positive control (20% CP), T_2: negative control (LCPD of 17% CP), T_3, T_4 and T_5 contained LCPD + 100, 200 and 300 g/kg acidifier supplementation, respectively. The result showed that average weight gain (AWG), feed conversion ratio (FCR) and protein efficiency ratio (PER) were significantly affected ($p<0.05$) by acidifier supplementation to LCPD but no significant difference ($p>0.05$) was found in average feed intake and nitrogen retention of the birds. The AWG and FCR of the birds were improved ($p<0.05$) among the groups fed acidifier supplemented LCPD and control diets than the birds fed LCPD without acidifier supplementation. The PER was higher ($P<0.05$) in birds fed diet T_4 and similar with those on diet T_3 and T_5 than those fed positive control diet and LCPD. In conclusion, dietary reduction of CP level from 20% to 17% with acidifier supplementation up to 300 mg/kg improved performance and protein utilization in broiler finisher chickens.

Keywords: Broiler finisher, low-protein, acidifier, performance, protein utilization.

Description of Problem

Recently, due to global warming and the climate crisis, many efforts have been made to reduce greenhouse gases (GHGs; carbon dioxide, nitrous oxide, methane, etc.) generated from livestock farming, transportation, and slaughter, which account for 18% of total GHG production [1]. In this regard, studies has been intensified to reduce the CP content in broiler feed to prevent nitrogen (N) excretion and environmental pollution (2, 3, 4). However, decreasing dietary protein level is apprehensive about insufficient protein supply for broiler, and it would be more pronounced when low-protein is provided at the late stage of finisher phase (5, 6). Therefore, to overcome the negative impact of feeding low dietary protein, the strategy would be possibly beneficial when it combined with non-interfere supplemental substance such as acidifier (7, 8). Acidifier is an organic acid of either natural or synthetic that can have beneficial effect on increasing nutrient digestibility via decreasing intestinal pH and reduction of pathogen microorganism and/or gram negative bacteria (9). As it has been described previously that the positive effect of feeding acidifier is in relation to controlling the balance of microorganism in the digestive tract which further can help to stimulate digestive enzymes work for the increase in nutrients digestibility and performance of poultry (10, 11, 12). Furthermore, supplementing acidifier in low nutrient diets may compensate for the performance losses of broilers (13). Any tool therefore, that aims to enhance the productivity of broiler chickens must have the potential to increase the protein efficiency ratio and nitrogen retention, while reducing production costs, and negative effects of production on the environment (14). Based on the above, it is hypothesized that acidifier could probably improve the performance, thereby promoting the wide

application of low-protein diets in broilers. Therefore, the current study aimed to determine the effects of reducing dietary CP levels with acidifier supplementation on growth performance and efficiency of protein utilization in broiler finisher chickens.

Materials and methods

Experimental site: The experiment was conducted at the Poultry Unit of the Teaching and Research Farm of Department of Animal Production Technology, Federal College of Wildlife Management, New Bussa, Niger state.

Experimental birds, design and management: A total of 250 day-old Arbor Acres broiler chicks were purchased from a reputable hatchery in Ibadan, Oyo state and were raised on commercial starter feed (23% CP and 3000 kcal ME/kg) for the first 28 days. Thereafter, 240 birds were randomly allocated into five dietary treatments and each treatment replicated four times with 12 broilers per replicate in a completely randomized design. The birds were housed in an open-sided pen facility under deep litter management system. Feed and water were made available *ad libitum* for a period of 28 days of the experimental period.

Experimental Diets and acidifier composition: The dietary treatments were formulated to be isocaloric according to NRC (1994) recommendation to comprise the following T1: Positive Control (20% CP) diet, T2: Negative Control (Low crude protein diet (LCPD), 16% CP), while T3, T4 and T5 contained LCPD with 100, 200 and 300 g/kg acidifier supplementation, respectively (Table 1). The acidifier used in the study is a commercial product from CIFEK INTERNATIONAL, Lagos, Nigeria and the ingredient composition of acidifier feed additive are citric acid, lactic acid, calcium formiate, calcium propionate, and caprylic acid.

Data collection and statistical analysis: The birds and feed were weighed by pen at weekly intervals of 28 days for determination of growth performance, which included average body weight (ABW), average daily gain (ADG), average daily feed intake (ADFI), and the feed conversion ratio (FCR). The FCR was calculated by dividing weight gain by feed intake. The Protein efficiency ratio (PER) was calculated as g weight gain/ g protein intake while nitrogen retention was estimated according the method of Belloir *et al*. (14). Subsequently, all data were analyzed by an analysis of variance according to a completely randomized design using the PROC MIXED procedures of SAS 9.4 (SAS Institute, Cary, NC, USA). Means were compared and separated using the Tukey post hoc test at 5% probability.

Table 1: Ingredients composition of experimental diets

Ingredients	T_1	T_2	T_3	T_4	T_5
Maize	59.70	66.60	66.50	66.40	66.30
Soybean	29.00	21.00	21.00	21.00	21.00
Fishmeal	2.00	2.50	2.50	2.50	2.50
Oil	3.00	3.00	3.00	3.00	3.00
Acidifier	0.00	0.00	0.10	0.20	0.30
DCP	2.50	2.50	2.50	2.50	2.50
Limestone	1.50	1.50	1.50	1.50	1.50
Inert filler	1.00	1.00	1.00	1.00	1.00
Salt	0.30	0.30	0.30	0.30	0.30
Methionine	0.30	0.60	0.60	0.60	0.60
Lysine	0.20	0.50	0.50	0.50	0.50
Premix	0.50	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00
CP, %	19.45	16.92	16.91	16.90	16.89
ME, Kcal/kg	3052.67	3057.51	3054.29	3051.07	3047.86

Results and discussion

The response of broiler finisher chickens to graded levels of acidifier supplementation to low crude protein diets (LCPD) is presented in Table 2. The results of the statistical analysis showed that there were significant ($p<0.05$) differences in the mean values of average weight gain (AWG), FCR and PER of the birds while feed intake, and nitrogen retention were not affected ($p>0.05$) by the dietary treatments. The AWG of the birds was significantly ($p<0.05$) higher in the group fed acidifier supplemented LCPDs and control diet compared to the group fed LCPD. Lower ($p<0.05$) mean values of FCR were recorded among the groups fed acidifier supplemented LCPD and control diets than the birds fed LCPD without acidifier supplementation. The PER was higher ($P<0.05$) in birds fed diet 4 and similar with those on diet 3 and 5 than those fed control diet and LCPD. The poor performance of birds fed LCPD obtained in the present study is in line with numerous studies that have shown decreased broiler performance even though AAs were supplemented to meet requirements (14, 15, 2, 3). Meanwhile, the improvement in performance observed in birds fed LCPD with acidifier supplementation is in close agreement with the reports of Sharifuzzaman *et al*. (5) and Mahfudz *et al*. (6), which revealed that dietary acidifier can compensate the performance of broiler by reducing 2-3% protein level in diet. These data may be indicative of the superior conversion of the amino acids and energy from the acidifier supplemented diets into muscle tissues (18). Therefore, feeding management with reduction of dietary protein combined with supplemental acidifier improved growth and efficiency of protein utilization, as characterized by low FCR and higher PER in the current investigation. This improvement in performance by acidifier supplementation could be explained by its role in increasing the efficiency of amino acid utilization through acidity reduction of the diet and gut, eliminating harmful microbes that are sensitive to low pH or selectively enhancing *Lactobacillus* (6, 10, 11, 12).

Table 2: Effect of graded levels of acidifier supplementation to low crude protein diets of broiler finisher chickens on growth performance

Treatment	AWG, g/bird	AFI, g/bird	FCR	PER	NR, g/bird
PCD	720.83[a]	1870.83	2.63[b]	1.98	20.90
NCD	579.17[b]	1924.17	3.42[a]	1.79	16.80
NCD+100g/kg A	708.33[a]	1875.00	2.66[b]	2.23	20.54
NCD+200g/kg A	783.33[a]	1889.17	2.50[b]	2.47	22.72
NCD+300g/kg A	720.83[a]	1944.17	2.70[b]	2.20	20.91
SEM	29.384	14.92	0.14	0.10	0.85
P-values	0.028	0.499	0.027	0.303	0.281

[ab]Mean values in the same row with different letters are significantly different ($P<0.05$)

PCD: positive control diet; Negative control diet; A: Acidifier; AWG: Average weight gain, AFI: Average feed intake; FCR: Feed conversion ratio; PER: Protein Efficiency Ratio; NR: Nitrogen retention

Conclusion and Application

It is concluded that the minimum of 100 g/kg dietary supplementation of acidifier to low protein diet of 17% CP in finisher broiler chickens could increase performance by improving the weight gain, FCR and PER. The present findings clearly show that a reduction of the dietary CP content by 3 percentage points is possible in finishing broilers with positive implications for the sustainability of broiler production.

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