RESPONSE OF BROILER CHICKENS TO VARYING LEVELS OF DIETARY BENZOIC ACID

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ABSTRACT
An eight-week study was conducted to evaluate the response of broiler birds to varying levels of dietary benzoic acid. A total of one hundred and twenty (120) day-old unsexed "Arbor acre" strain broiler chicks were randomly assigned into five treatment groups. Each treatment group contained 24 birds replicated three times with eight birds per replicate in a completely randomized design (CRD). The treatments were designated as follows: Treatment 1,0g benzoic acid; Treatment 2, 2.5g benzoic acid per kg of feed; Treatment 3, 5.0g benzoic acid per kg of feed; Treatment 4, 7.5g benzoic acid per kg of feed and Treatment 5, 10g benzoic acid per kg of feed. Parameters assessed include final body weight (FBW), total weight gain (TWG), daily weight gain (DWG), total feed intake (TFI), daily feed intake (DFI) and feed conversion ratio (FCR). Feed and water were provided ad libitum. The results showed significant ($p<0.05$) differences among treatments in FBW, TWG, DWG, TFI, DFI and FCR values. The FBW, TWG and DWG values increased significantly ($p<0.05$) as the levels of benzoic acid in the diet increased from 0g to 7.5g. Birds fed diet containing 5g of benzoic acid per kg of diet (treatment3) had the highest ($p<0.05$) FBW, TWG and DWG values (3380.71g, 3341.50g and 59.67g, respectively) but these values were similar to the FBW, TWG and DWG values (3236.98g, 3197.27g and 57.09g, respectively) recorded for birds in treatment2 (2.5g of benzoic acid per kg of diet). Birds fed diets containing 2.5g, 5g and 7.5g of benzoic acid had better efficiency of feed utilization as shown by their FCR values (1.89, 1.86 and 1.92, respectively) as compared to the FCR value(2.15) for birds fed the control diet. It was concluded that up to 7.5g of benzoic acid can be included in the diet of broiler birds for optimum growth performance without any deleterious effect on birds.
Key words: **Broiler birds, diet, benzoic acid, growth, response.**

INTRODUCTION

The high production potential of the broiler chicken industry and supply of quality protein from its products cannot be over emphasized. Proper nutritional management is pertinent to maintaining and improving the productive capacities of broiler chickens. However, one of the challenges facing the broiler chicken industry is how to improve production without the use of antibiotics. The increasing concerns surrounding the use of antibiotic growth promoters (AGPs) in animal production have promoted the exploration of alternative strategies to promote growth and maintain animal health (Weber *et al.,* 2012). One of the alternatives that can be used to curb this problem is benzoic acid. Benzoic acid is an organic acidifier, colorless crystalline solid, and the simplest aromatic carboxylic acid (Sim. *et al.,* 2015). The salts are common food preservatives and can also be used as feed additives in animal production (Mroz *et al.,* 2010). Benzoic acid has emerged as a potential alternative to AGPs due to its antimicrobial effects, which can help mitigate the negative consequences associated with the overuse of antibiotics, such as development of antibiotic resistance (Odemoye, 2016). Benzoic acid inhibits the growth of mould, yeast, and other microorganisms, thereby reducing feed spoilage and maintaining feed quality(Gong *et al.,* 2021). Haojie *et al*. (2021) have demonstrated that the inclusion of benzoic acid can improve growth performance, carcass trait, intestinal health and the overall health of poultry. Hassan and Raheem, (2016) posited that organic acids if used correctly along with nutritional, managerial and bio-security measures can be a powerful tool in maintaining the health of the gastrointestinal tract of poultry, resulting in improved performance. Organic acids can improve protein digestion in young animal by stimulating pancreatic enzyme secretion (Vinus and Tewatia, 2017). The addition of benzoic acid to the diet of broiler chickens is known to increase growth performance of broilers, but excess benzoic acid can have a negative impact on broiler chickens (Gong *et al.,* 2021). The present study therefore was conducted to evaluate the response of broiler birds to varying dietary levels of benzoic acid.

MATERIALS AND METHODS

Location and duration of the Study

The study which lasted for a period of eight weeks was conducted at the Poultry Unit of the Department of Animal Science Teaching and Research Farm, University of Nigeria, Nsukka. All experimental procedures in the present study were performed according to the guidelines for the use of animals in biomedical research as described by the Ethical Research Committee of the University of Nigeria, Nsukka.

Experimental materials and diet

The commercial starter and finisher broiler diets used for the experiment were procured from a dealer in Nsukka town while the benzoic acid used for this experiment was procured from Joechem Ventures, Nsukka in Enugu State, Nigeria. The nutrient compositions of the commercial diets are shown in Table 1.

Table 1: Nutrient compositions of the experimental diets

	Compositions	
Nutrients	**Starter broiler diet**	**Finisher broiler diet**
Metabolizable energy(kcal/kg)	3000	3150
Crude protein (%)	22	20
Calcium (%)	1.0	1.2
Phosphorus (%)	0.45	0.5
Crude fibre (%)	3.5	4
Lysine (%)	1.25	1.15
Methionine (%)	0.55	0.5

Experimental animals and management

One hundred and twenty (120) day-old broiler birds were used for the study. The birds were randomly allotted to five treatment groups of 24 birds each, and assigned to five treatments using a completely randomized design (CRD). The treatments were designated as follows: Treatment 1,0g benzoic acid; Treatment 2, 2.5g benzoic acid per kg of feed; Treatment 3, 5.0g benzoic acid per kg of feed; Treatment 4, 7.5g benzoic acid per kg of feed and Treatment 5, 10g benzoic acid per kg of feed. Each treatment group was replicated three times with 8 birds per replicate. The birds in each replicate were brooded in a deep litter pen measuring 1.50m x 1.50m in the experimental poultry house. The poultry house was an open-sided one; the sides and demarcations between individual pens were covered with wire gauze. The litter material was fresh wood shavings. Heat was provided with charcoal pots placed under metal hovers. Feed and water were provided to the birds *ad libitum* while additional light was provided at night using kerosene powered lamps to enable the birds eat at night. Starter broiler diet was given to the birds according to treatments from day old to four weeks of age and thereafter the birds were fed the finisher broiler diet according to treatments until they were eight weeks old. The chicks were vaccinated against Newcastle and Gumboro diseases as and when due. The birds were also vaccinated against fowl pox disease at week 5, and at weeks 6-8, Lasota vaccine was repeated because of prevalence of Newcastle disease in the farm.

Data Collection and measurements

Body weights and feed intake were measured. Feed intake was done daily by a weigh back technique, in which feed remaining at the end of the day was subtracted from the initial feed offered to the birds. The difference between the feed offered and the leftover is considered as feed consumed. Body weight of the birds were measured and recorded on a weekly basis. Data obtained were used to calculate average daily weight gain, total weight gain and feed conversion ratio (FCR). Feed conversion ratio was calculated from these data as gramme of feed consumed per gramme of weight gained over the same period.

Statistical Analysis

Data collected were analyzed using one-way analyses of variance (ANOVA) for completely randomized *design (CRD) using a Stat Graphic Computer Package (SPSS, 2007) Model. Significantly different means were separated using Duncan's New Multiple Range Test (Ducan, 1955) option in SPSS.*

RESULTS AND DISCUSSION

Table 2 shows the growth response of broiler birds fed varying dietary levels of benzoic acid.

Dietary treatments had significant (p<0.05) effects on final body weight (FBW), total weight gain (TWG) and daily weight gain (DWG). Birds in treatment 3 (diet containing 5g of benzoic acid per kg of feed) had the highest (p<0.05) FBW, TWG and DWG values (3380.71g, 3341.50g and 59.67g, respectively) but these values were similar to the FBW, TWG and DWG values (3236.98g, 3197.27g and 57.09g, respectively) recorded for birds in treatment2 (2.5g of benzoic acid per kg of diet). Birds fed the control diet had the least FBW, TWG, and DWG values (2788.04g, 2748.96g and 49.09g, respectively) but these were similar to the FBW, TWG, and DWG values (2872.72g, 2832.43g and 50.58g, respectively for birds in treatment 5(diet containing 10g of benzoic acid per kg of diet).

Table 2: Growth performance of broiler birds (day1-56days) fed varying dietary levels of benzoic acid

Parameters	Treatments T1(0g/kg)	T2(2.5/kg)	T3(5g/kg)	T4(7.5g/kg)	T5(10g/kg)	SEM
Initial body weight(kg)	39.07	39.71	39.21	39.66	40.29	0.44
Final body weight(kg)	2788.04^{c}	3236.98^{ab}	3380.71^{a}	3136.43^{b}	2872.72^{c}	63.04
Total weight gain(kg)	2748.96^{c}	3197.27^{ab}	3341.50^{a}	3096.77^{b}	2832.43^{c}	62.23
Daily weight gain(g)	49.09^{c}	57.09^{ab}	59.67^{a}	55.30^{b}	50.58^{c}	1.11
Total feed intake(g)	5919.41^{ab}	6039.57^{ab}	6226.88^{a}	5952.94^{ab}	5724.54^{b}	69.61
Daily feed intake(g)	105.70^{ab}	107.85^{ab}	111.19^{a}	106.30^{ab}	102.22^{b}	1.24
Feed conversion ratio	2.15^{a}	1.89^{b}	1.86^{b}	1.92^{b}	2.02^{ab}	0.04

^{abc} Means on the same row with different superscripts are significantly (P<0.05) different.
SEM= Standard error of the mean

Birds fed diet containing 5g of benzoic acid per kg of feed (treatment3) had the highest TFI and DFI values (6226.88g and 111.19g, respectively) and these were statistically similar to the TFI and DFI values for birds in treatment 1(5919.41g and 105.70g, respectively), treatment 2(6039.57g and 107.85g, , respectively) and treatment 4(5952.94g and 106.30g, respectively). Birds in treatment 5 had the least TFI and DFI values (5724.54g and 102.22g, respectively) but these were similar to the TFI and DFI values for birds in treatments 1, 2 and 4. Birds in treatment 1(control) had the highest FCR value (2.15) but this was similar to the FCR value (2.02) for birds in treatment 5. Birds in treatments 2, 3 and 4 had similar FCR values (1.89, 1.86 and 1.92, respectively) with those in treatment 5. Results (Table 2) show that the FBW, TWG and DWG values increased significantly (p<0.05) as the levels of benzoic acid in the diet increased from 0g to 7.5g, thus suggesting that the differences observed appeared to be dose dependent. At 2.5g to 7.5g inclusion levels, the birds were able to optimize their efficiency of feed utilization and performance. Considering all the indices of growth performance assessed in the present study, there is a clear indication that the inclusion of 7.5g of benzoic acid in the diet of the adult broiler birds enhanced their growth performance. This agrees with previous report that benzoic acid has the potential to stimulate appetite, enhance feed efficiency and birds' growth (Seifi *et al*., 2015). Ogwuegbu *et al*. (2021) had also reported the ability of organic acids to improve intraluminal digestibility of mineral, protein and energy by reducing microbial competition with the host for nutrients and endogenous nitrogen losses. Dietary benzoic acid is known to improve protein digestion in young animal by stimulating pancreatic enzyme secretion (Vinus and Tewatia, 2017). According to Gong *et al* . (2021), the addition of benzoic acid to the diet of broiler chickens could increase the weight gain and feed conversion rate of broilers, but excess benzoic acid can have a negative impact on broiler chickens. The results obtained in the present study strongly indicate that the inclusion of benzoic acid in the diets of starter and finisher broilers can enhance birds' growth performance.

CONCLUSION

It is evident from the results obtained in the present study that up to 7.5g of benzoic acid can be included in the diet of broiler birds for optimum growth performance without any deleterious effect on birds.

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