GROWTH PERFORMANCE AND COST ANALYSIS OF BROILER CHICKS FED VARYING DIETARY LEVELS OF BENZOIC ACID

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ABSTRACT

A four-week study was conducted to evaluate the growth performance of broiler chicks fed varying dietary levels of 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 8 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 included 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 that dietary treatments had significant ($p<0.05$) effects on FBW, TWG, and DWG. The FBW, TWG, and DWG increased with increasing levels of benzoic acid in the diet. Birds fed diet containing 10g of benzoic acid per kg of feed (treatment 5) had the highest FBW, TWG and DWG values (1081.49±23.74g, 1041.19±47.20g and 37.19±1.69g, respectively). There were no significant ($p>0.05$) differences among treatments in initial body weight (IBW), TFI, DFI, FCR, cost of total feed intake (CTFI) and feed cost per kg gain. It was concluded that up to 10g of benzoic acid can be included in the diet of broiler chicks for optimum growth performance without any deleterious effect on birds.

Key words: **Broiler chicks, diet,performance, cost, benzoic acid,**

INTRODUCTION

The poultry production industry is challenged with the development of management strategies that can achieve a balance between optimizing growth performance while limiting food safety concerns (Ricke *et al.,* 2020). Poultry farming has made tremendous progress during the last decades, from a meager backyard venture to a fully-fledged well-organized scientific and commercial industry (Archana *et al.,* 2019). Traditionally, antimicrobials have been widely used for improving health and growth performance in poultry; however, increased public awareness about the risk of developing cross-resistance of pathogens to antibiotics has resulted in the gradual removal of antibiotics for therapeutic and prophylactic uses in food animals (Ricke *et al.,* 2020). The removal of antibiotic supplementation has resulted in a tremendous growth in research focusing on the implementation of effective alternative control methods, management, and dietary amendments aimed at improving animal health, welfare, and productivity (Abdelli *et al.,* 2021). A wide range of feed additives, including a broad spectrum of essential oils and related compounds from botanical sources to organic acids (Zhai *et al.,* 2018), as well as probiotics and prebiotics (Al-Khalaifah, 2018), bacteriophage (Li *et al.,* 2020), exogenous enzymes (Torres-Pitarch, 2019) and competitive exclusion products (Schneitz and Hakkinen, 2016), have been used in animal production. Among these, the organic acids (propionic acid, formic acid, citric acid, acetic acid, benzoic acid, fumaric acid) are promising alternatives. Organic acids are weak acid compounds with pH values ranging from three (carboxylic) to nine (phenolic), which are widely distributed in nature and found in animals, plants, and microbial substances (Ogwuegbu *et al.,* 2021). Their inclusion in broiler feed has been shown to enhance the feed intake, performance, and feed efficiency (Khan *et al.,* 2022). Against this backdrop this study was designed to evaluate the growth performance of broiler chickens fed varying dietary levels of benzoic acid.

MATERIALS AND METHODS

Location and duration of the Study

The study which lasted five 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 finisher broiler diet used for the experiment was 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 composition of the commercial diet is shown in Table 1.

Table 1: Nutrient composition of the experimental diet

Nutrients	Composition
Metabolizable energy(kcal/kg)	3000
Crude protein (%)	22
Calcium (%)	1.
Phosphorus (%)	0.45
Crude fibre (%)	3.5
Lysine (%)	1.25
Methionine (%)	0.55

Experimental animals and management

One hundred and twenty (120) four weeks old finisher 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. The chicks were vaccinated against Newcastle and Gumboro diseases as at 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 performance of broiler chicks 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 fed diet containing 10g of benzoic acid per kg of feed (treatment 5) had the highest FBW, TWG and DWG values (1081.49±23.74g, 1041.19±47.20g and

Table 2: Growth performance of broiler chicks fed varying dietary levels of benzoic acid

	Treatments					
Parameters	**T1(0g/kg)**	**T2(2.5/kg)**	**T3(5g/kg)**	**T4(7.5g/kg)**	**T5(10g/kg)**	**P-value**
Initial body weight(kg)	39.09±1.24	39.71±0.55	39.21±0.79	39.66±1.59	40.29±1.90	0.94^{NS}
Final body weight(kg)	816.57±17.59^{c}	891.45±32.05^{bc}	922.82±11.13^{b}	949.63±23.74^{b}	1081.49±23.74^{a}	0.00*
Total weight gain(kg)	777.49±18.79^{c}	851.74±31.77^{bc}	883.61±11.73^{b}	909.97±23.00^{b}	1041.19±47.20^{a}	0.00*
Daily weight gain(g)	27.77±0.67^{c}	30.42±1.13^{bc}	31.56±0.42^{b}	32.50±0.82^{b}	37.19±1.69^{a}	0.00*
Total feed intake(g)	1752.26±92.50	1750.25±127.71	1863.93±69.10	1703.55±49.06	1735.34±69.24	0.73^{NS}
Daily feed intake(g)	62.58±3.30	62.52±4.56	66.57±2.47	60.84±1.72	61.98±2.47	0.73^{NS}
Feed conversion ratio	2.26±0.16	2.06±0.20	2.11±0.11	1.87±0.57	1.68±0.14	0.10^{NS}
Cost of total feed intake(₦)	806.04±42.55	805.12±58.75	857.41±31.79	783.64±22.57	798.25±31.86	0.73^{NS}
Feed cost per kg gain(₦)	1039.71±75.13	949.80±90.24	971.65±48.94	861.76±26.16	772.42±63.49	0.10^{NS}

^{abcd} Means on the same row with different superscripts are significantly (P<0.05) different.

37.19±1.69g, respectively). Birds fed diet containing 7.5g of benzoic acid per kg of diet (treatment 4) had similar FBW, TWG, and DWG values (949.63±23.74g, 909.97±23.00g and 32.50±0.82g, respectively) with those fed 5g of benzoic acid per kg of feed (treatment 3) and these were significantly ($p<0.05$) higher than the FBW, TWG and DWG values (816.57±17.59g, 777.49±18.79g and 27.77±0.67g, respectively) of birds that were fed the control diet (0g benzoic acid). The FBW, TWG, and DWG values (891.45±32.05g, 851.74±31.77g and 30.42±1.13g, respectively) for birds in treatment 2 (2.5g of benzoic acid per kg of diet) were similar to the FBW, TWG and DWG values (922.82±11.13g, 883.61±11.73 and 31.56±0.42g, respectively) for birds in treatment 3 (5g of benzoic acid per kg of diet). Birds in treatment 1(control) and those in treatment 2 also had similar FBW, TWG and DWG values. There were no significant($p>0.05$) differences among treatments in initial body weight(IBW), total feed intake(TFI), daily feed intake(DFI), feed conversion ratio(FCR), cost of total feed intake(CTFI) and feed cost per kg gain. As observed in Table 2, significant ($p<0.05$) differences existed among treatments in FBW, TWG, and DWG whereas there were no significant ($p>0.05$) differences among treatments in IBW, TFI, DFI, FCR, CTFI and feed cost per kg gain. The observed differences appeared to be dose dependent. The results being discussed (Table 2) clearly show that the growth performance of chicks was affected by the increasing levels of benzoic acid in their diet. The chicks optimized their rate of growth at the highest level of benzoic acid inclusion in the diet (treatment 5). Birds fed diets containing 5g and 7.5g of benzoic acid per kg of feed had superior growth performance as compared to those in the control group. The observed increase in FBW, TWG and DWG with increasing levels of benzoic acid in the diet corroborates previous reports of increase in growth performance in broilers fed diets supplemented with benzoic acid (Seifi *et al.,* 2015; Islam 2012; Esmaeilipour *et al.,* 2011; Garcia *et al*., 2007). The putative mechanism underlying the observed improvement in growth performance of birds may be attributed to benzoic acid's potentiality to stimulate appetite and enhance feed utilization efficiency (Seifi *et al.,* 2015). Earlier report by Józefiak *et al*. (2007) showed that the addition of benzoic acid to the diet of broilers increased their weight gain and enhanced their feed conversion ratio.

CONCLUSION

It is evident from the results obtained in the present study that up to 10g of benzoic acid can be included in the diet of broiler chicks for optimum growth performance without any deleterious effect on birds.

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