EFFECT OF GALLIC AND BUTYRIC ACIDS SUPPLEMENTED DIETS ON PERFORMANCE OF BROILER CHICKENS AT STARTER PHASE

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ABSTRACT
The effects of gallic and butyric acids supplemented diets on growth performance as an alternative to antibiotic growth promoters were examined in a 28-day experiment using two hundred and forty(240) one-day-old, Ross 308 strain of broiler chickens. The experimental design was a Completely Randomized Design. Broiler chickens were allotted to 10 dietary treatments with 3 replicates of 8 birds each. Treatment 1 was the basal diet with no supplements (given antibiotics), while Treatments 2, 3, and 4 were supplemented with 0.0005, 0.0010 and 0.0015% gallic acid respectively, Treatments 5, 6, and 7 were supplemented with 0.20, 0.30 and 0.40% butyric acid respectively, Treatment 8 was supplemented with 0.0005%, gallic acid and 0.20% butyric acid, Treatment 9 was supplemented with 0.0010% gallic acid and 0.30% butyric acid and Treatment 10 was supplemented with 0.0015% gallic acid and 0.40% butyric acid. The inclusion of gallic acid at 0.0015% inclusion in broilers chickens diet significantly increased the weight gain of broiler chickens and had similar feed conversion ratio when compared with the control, and the combination of gallic and butyric acids significantly influenced feed conversion ratio positively and increased weight gain of broiler chickens.

Keywords: Gallic acid, Butyric acid, growth performance, Broiler

DESCRIPTION OF THE PROBLEM

Antibiotics as feed additives have long been used in poultry feed to stabilize intestinal microbial flora, enhance overall performance, and prevent specific intestinal pathologies [1]. However, the use of antibiotics in animal agriculture has faced scrutiny [2] due to concerns regarding antibiotic resistance. Consequently, the search for alternatives to antibiotics in the poultry industry has intensified following the European Union's ban on antibiotic use in animal production [3]. Organic acids have been researched [4] and are considered promising alternatives to antibiotics due to their strong antibacterial and antifungal properties. Organic acids have been used to improve growth, nutrient digestibility [5] and improve intestinal health of poultry [6]. Notwithstanding the progress made, there have been diverse recommended levels of organic acids that would successfully replace antibiotics. Therefore, the purpose of this study is to determine the effect of gallic and butyric acid and to establish a specific level of inclusion that will guarantee optimum performance of broiler chickens at the starter phase.

MATERIALS AND METHODS

Experimental Site

The experiment was carried out at the Poultry Research unit of the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria. Ogbomoso is situated in the derived savanna zone of southwest Nigeria and lies on Latitude 8^{o} 8'31.7940"N of the equator and Longitude 4^{o} 14'42.6696"E of the Greenwich Meridian [7].

Experimental Design

The experimental design used for the study was a Completely Randomized Design (CRD).

Experimental Diets

The broiler chickens basal diet was prepared for the starter phase following NRC (1994) recommendations. Gallic acid was added at 0.0005, 0.0010 and 0.0015%, Butyric acid was added at 0.20, 0.30 and 0.40% as shown in Table 1.

Experimental Animals and Management

Two hundred and forty (240) one-day old Ross 308 strain of broiler chicks were used for the experiment. The birds were weighed and

randomly distributed into ten treatment groups of three replicates each with each replicate having eight birds. Each replicate was housed in experimental pens measuring 125 × 125 × 185 cm. The birds were raised intensively on a deep litter and wood shavings were used as litter materials with 3cm depth. Adequate feed and water were offered *ad-libitum.* Broiler starter diets were offered and the required vaccination was carried out as applicable to the environment.

Data collection

Feed given to treatments groups were recorded daily and feed intake was calculated by subtracting weight of left over feed from the feed given. Chicks were weighed on weekly basis and total weight gain was obtained by subtracting the initial weight from the final weight. The feed conversion ratio was calculated as total feed intake divided by total weight gain of birds. The feed cost per kg(₦) was calculated by dividing the price of the feed ingredients by the quantity of feed ingredients. Feed cost per kg weight gain was done by multiplying the feed cost per kilogram and the feed to gain ratio. Survivability was recorded and expressed as the percentage of the number of dead birds divided by the total number of live birds at the beginning of the experiment on a replicate basis.

Table 1: Gross Composition (kg/100kgDM) of experimental diet (Stater Phase)

	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
*Fixed ingredients(kg)	100	100	100	100	100	100	100	100	100	100
Gallic (0.0005%)	-	+	-	-	-	-	-	+	-	-
Gallic (0.0010%)	-	-	+	-	-	-	-	-	+	-
Gallic (0.0015%)	-	-	-	+	-	-	-	-	-	+
Butyric (0.20%)	-	-	-	-	+	-	-	+	-	-
Butyric (0.30%)	-	-	-	-	-	+	-	-	+	-
Butyric (0.40%)	-	-	-	-	-	-	+	-	-	+

*Fixed ingredients 100kg (maize 54.0, soybean Meal 32.7, Soybean Oil 2.0, Wheat Offal 4.0, Fishmeal 3.0, Limestone 1.5, Salt 0.25,Dicalcium phosphate 2.0, Lysine 0.12, Methionine 0.18, Premix 0.25

Results and Discussion

The result of the effect of gallic and butyric acid supplementation and its synergy on the growth performance of broilers chickens at starter phase is shown in Table 2. The final weight of the birds in Treatment 4 (0.0015% gallic acid) was highest ($p<0.05$). Treatments 3, 7, 8, 9, and 10 are similar but significantly higher than Treatments 1, 2, 5, and 6. Samuel *et al*. [8] reported that the inclusion of gallic acid of 150mg/kg similar to Treatment 4 in this study resulted in comparatively higher body weight at 21 days. Liu *et al.* [9] reported that at the finisher phase, broilers fed chestnut wood extract (hydrolyzable tannic acid which contains Gallic Acid 0.1%) had higher body weight than the control. Xiong *et al*., [10] also reported a significant increase in final weight and average daily weight gain in broilers supplemented with 150 mg/kg gallic acid in their diet compared with the control diets.

The weight gain of broilers in Treatments 4, 9 and 10 are significantly higher than other treatments. This may be attributed to the beneficiary effect of organic acids on the gut flora by lowering the PH [11]. Biswas *et al*. [12], reported significant increase in weight gain of broiler chickens fed gallic acid at 0.02% - 0.06% compared with the control diet at starter phase. Lan *et al*. [13] reported an increase in body weight of broilers fed 600 mg/kg of sodium butyrate compared with the control diet at starter phase. The increased weight gain may also be due to the decreased level of toxic bacteria metabolites as a result of reduced bacterial fermentation causing an improvement in the protein and energy digestibility, thus enhancing the weight gain and performance of experimental birds [11].

The feed-to-gain ratio of treatment 6 (0.30% butyric acid) is significantly lower than that of the

other treatments then followed by Treatments 3,4,5,8,9and10. Tomar *et al*. [14] reported an improved feed-to-gain ratio of 1.40 with the inclusion of butyric acid at 1%, compared to the other treatments, similar to the 1.39 FCR in broilers fed 0.3% butyric acid in this study. Lakshmi and Sunder [16] also noticed significantly better cumulative feed conversion efficiency with diets incorporated with different levels of organic acid and this may be due to the addition of organic acid in the diet which maintains a better microbial environment in the digestive tract of birds by reducing the number of pathogenic microbes which enhanced the digestion, absorption and efficiency of feed utilization [17].

Table 2: Main effect of Organic acids supplementation on growth performance of broiler chickens at starter phase

Parameters	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	SEM	P-value
Initial weight (g)	42.08	42.64	42.36	43.40	43.17	42.23	43.13	43.77	43.39	43.00	0.94	0.35
Final weight (g)	705.08^{b}	641.27^{c}	704.57^{b}	809.60^{a}	647.91^{c}	616.08^{c}	715.93^{b}	735.23^{b}	785.23^{b}	770.14^{b}	55.61	0.03
Daily weight gain (g)	23.68^{b}	21.38^{c}	23.65^{b}	27.36^{a}	21.60^{c}	20.70^{c}	24.03^{b}	24.70^{b}	26.50^{a}	26.00^{a}	1.97	0.03
Daily feed intake (g)	34.57^{c}	41.24^{a}	39.00^{a}	37.72^{b}	35.91^{b}	32.48^{c}	38.35^{a}	38.25^{a}	39.52^{a}	36.50^{b}	1.62	0.02
FC/KG feed (₦)	926.00^{b}	926.00^{b}	926.00^{b}	927.00^{b}	950.00^{b}	888.00^{c}	974.00^{a}	950.00^{b}	962.00^{b}	975.00^{a}	22.84	0.03
Feed: Gain	1.56^{b}	2.10^{a}	1.79^{b}	1.48^{b}	1.72^{b}	1.39^{c}	2.02^{a}	1.60^{b}	1.60^{b}	1.53^{b}	0.91	0.03
FC/KGWT	1447.79	1950.65	1654.81	1369.72	1633.11	1332.43	1963.19	1518.94	1524.77	1487.60	183.67	0.08
Mortality (%)	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.0.	0.00	0.03	0.06

^{abc} Means on the same row with different superscripts are significantly different ($p<0.05$), S.E.M: Standard Error of Mean, T1 - Control (basal diet); T2 – basal diet +0.0005% gallic acid,T3 –basal diets + 0.0010% gallic acid, T4 – basal diet + 0.0015% gallic acid, T5- basal diet +0.2% butyric acid, T6 – basal diet+ 0.3% butyric acid, T7- basal diet + 0.4% butyric acid, T8 – basal diet + 0.0005% gallic acid and 0.2% butyric acid, T9 – basal diet + 0.0010% gallic acid and 0.3% butyric acid, T10 - 0.0015% gallic acid and 0.4% butyric acid.

The daily feed intake of Treatment 6 (0.3% butyric acid) is significantly lower than other treatments but similar to the control, which is against Dolan *et al.* [18] and Kamal and Ragaa [19], who observed no significant differences when diets are supplemented with different level of coated sodium butyrate in broilers. The daily feed intake of Treatments 4, 5 and 10 are similar and significantly higher than Treatment 6 and the control, which correlates with the report of Tomar *et al.* [14] who reported a daily feed intake of 37.60g in broiler chickens fed 0.50% butyric acid. Treatments 2 ,3,7,8 and 9 have significantly higher feed intake than other treatments, which correlates with Ogunwole *et al*. [21] who reported increase in feed intake following acidifier supplementation in broiler diets. Samuel *et al*. [8] also reported daily feed intake of 46-49g across treatments with 25mg-150mg gallic acid. Treatments 2 and 8 had inclusion levels of 0.0005% gallic acid and Treatments 3 and 9 had 0.0010% gallic acid which is lower than Treatments 4 and 10 with inclusion level of 0.0015% gallic acid but significantly higher in feed intake than treatments 4 and 10.

CONCLUSION AND APPLICATION

It can be concluded that supplementation of gallic acid at 0.0015% and the combination of butyric and gallic acids in broiler chickens' diet improved weight gain and feed conversion ratio.

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