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EFFECTS OF DIETARY INCLUSION OF VARIED LEVELS OF BUTYRIC ACID AS ANTIBIOTIC ON THE PERFORMANCE OF TURKEY POULTS

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ABSTRACT

The effects of butyric acid supplemented diets on growth performance of turkey poults were examined in a 49-day experiment using one hundred and sixty (160) (one-day old) Nicholas turkey poults. The experimental design was a Completely Randomized Design. Poults were brooded for 7 days, after which they were allotted to 4 dietary treatments with 5 replicates of 8 birds per replicate. Treatment 1(T1) was the basal diet with no supplement while treatments 2 (T2), 3 (T3), and 4(T4) were supplemented with antibiotics, 0.2% butyric acid and 0.4% butyric acid respectively. Feed was offered ad-libitum. Final weight and weight gain of poults fed control, antibiotics and 0.2% butyric acid supplemented diets were similar but significantly ($p<0.05$) higher than birds fed 0.4% butyric acid diet. Significant higher feed intake was observed in birds fed control and antibiotics diets while the least was recorded in birds fed 0.4% butyric acid diet. It was observed that 0.2% butyric acid appears to be a viable alternative to antibiotics growth promoter in turkey diets without any detrimental effect on the productive performances.

Keywords: Butyric acid, Growth performance, Turkey poults

INTRODUCTION

Antibiotics, since their discovery, have been used at therapeutic levels for the treatment of diseases, and at sub-therapeutic levels as growth promoters in animal feed to improve production. Antibiotics have indeed been effectively used in containing infectious diseases and increasing feed utilization (Engberg *et al.,* 2000). However, the continued use of antibiotics in both man and birds posed the challenge of antibiotic resistance caused by antibiotic residues in meat and milk. This led to a ban on antibiotics use in feed formulation in Europe and in Nigeria recently. This ban has brought about the need for researchers to find alternatives to antibiotics for poultry production. Several feed additives such as organic acids, probiotics, prebiotics, symbiotics, and phytobiotics were used as alternative growth promoters in poultry (Agboola *et al.,* 2014; Omidiwura *et al.,* 2018). Short-chain fatty acids (acetic, butyric and propionic acids) have been reported (Agboola *et al.,* 2015; Agboola *et al.,* 2018) to have positive impact on broiler growth (Hassan *et al.* 2010). It has been documented that these acids exhibit antimicrobial properties when dissociated by reducing intestinal pH (Van Immerseel *et al.,* 2006). The target of organic acids tends to be healthy microflora. Microflora has been shown to have a significant effect on host nutrition, health and growth performance by interacting with the nutrients consumed and also playing a role in the development of the host intestinal system (Garrido *et al.*, 2014)

Despite the progress made, there has been diverse recommended levels of organic acids that would successfully replace antibiotics. Therefore, the purpose of this study was to determine the potency of butyric acid when supplemented in turkey poults.

MATERIALS AND METHODS

Experimental Site

This study was carried out in the Poultry Unit of the Teaching and Research Farm, University of Ibadan, Oyo State in the South West geopolitical zone of Nigeria, within the tropical rain forest region.

One hundred and sixty (160) one-day old unsexed Nicholas turkey poults were obtained from a reputable commercial hatchery and kept in a deep litter system. The poults were mass brooded for seven (7) days after which they were weighed, tagged and randomly allotted to four dietary treatments. Each dietary treatment had five (5) replicates of eight (8) poults per replicate. The birds were reared in a well-ventilated and illuminated standard poultry house. Experimental diets and water were provided *ad libitum* in a feeding trial that lasted for 8 weeks.

Experimental Design

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

Experimental Diets

The experimental diet were; treatment 1 (T1) was the Corn-SBM diet (basal diet/negative control); treatment 2 (T2) was the positive control, consisting of the basal diet and antibiotics (Oxytetracycline hydrochloride at 0.02g/100g feed); treatment 3 (T3) had the basal diet and 0.2% butyric acid, while treatment 4 (T4) was the basal diet and 0.4% butyric acid. The basal diet was a corn-soyabean diet formulated to meet the nutrient requirements (NRC, 1994) for starter phase 1(0 to 4 weeks) and starter phase 2 (5 to 8 weeks) as shown in Table 1.

Table 1: Gross Composition (g/1000gDM) of Experimental Diets (7-28 days)

INGREDIENTS	T1	T2	T3	T4
Corn	410	410	410	410
Soyabean meal	480	480	480	480
Fish meal	40	40	40	40
Wheat offal	6	6	6	6
Dicalcium phosphate	20	20	20	20
Premixes	2.5	2.5	2.5	2.5
Limestone	10	10	10	10
DL-methionine	2.5	2.5	2.5	2.5
L-lysine	3.5	3.5	3.5	3.5
Salt	2.5	2.5	2.5	2.5
Butyric acid	0	0	20	40
Antibiotics	0	20	0	0
Soya oil	23	23	23	23
TOTAL	**1000**	**1000**	**1000**	**1000**
Calculated Nutrients				
Crude protein g/kg	260.12	260.12	260.12	260.12
ME Kcal/kg	2811.23	2811.23	2811.23	2811.23
Fat g/kg	35.264	35.264	35.264	35.264
Crude fibre g/kg	43.41	43.41	43.41	43.41
Calcium g/kg	11.6283	11.6283	11.6283	11.6283
Total phosphorus g/kg	8.9417	8.9417	8.9417	8.9417
Non-phytate P, g/kg	5.0627	5.0627	5.0627	5.0627
Ca:NPP	2.29808	2.29808	2.29808	2.29808

Composition of premix per kg of diet: Vitamin A, 12500 I.U; vitamin D3, 255000 I.U; vitamin K3, 2mg; vitamin B1, 3mg; vitamin B2, 5.5mg; calcium pantothenate, 11.5mg; vitamin B12, 0.025mg; choline, chloride, 500mg; folic acid, 1mg; biotin, 0.08mg; manganese, 120mg; iron, 100mg, zinc, 80mg; copper, 8.5mg; iodine, 1.15mg; cobalt, 0.3mg; selenium, 0.12mg; anti-oxidant, 120mg. Over the top inclusion of 0.2, 2 and 4 were added for antibiotics, 0.2% butyric acid and 0.4% butyric acid respectively.

Table 2: Gross Composition (g/1000gDM) of Experimental Diets (29-56 DAYS)

INGREDIENTS g/kg	T1	T2	T3	T4
Corn	383	383	383	383
Soyabean meal	485	485	485	485
Fish meal	40	40	40	40
Wheat Offal	6	6	6	6
Dicalcium phosphate	20	20	20	20
Premixes	2.5	2.5	2.5	2.5
Limestone	10	10	10	10
DL-methionine	3.5	3.5	3.5	3.5
L-lysine	4.5	4.5	4.5	4.5
Salt	2.5	2.5	2.5	2.5
Butyric acid	0	0	20	40
Antibiotics	0	20	0	0
Soya oil	43	43	43	43
TOTAL	**1000**	**1000**	**1000**	**1000**
Calculated Nutrients				
Crude protein g/kg	260.33	260.33	260.33	260.33
ME Kcal/kg	2906.08	2906.08	2906.08	2906.08
Fat g/kg	34.359	34.359	34.359	36.847
Crude fibre g/kg	43.166	20	43.166	39.39
Calcium g/kg	11.6374	11.6374	11.6374	9.9209
Total phosphorus g/kg	8.9094	8.9094	8.9094	7.6951
Non-phytate P, g/kg	5.0627	5.0627	5.0627	5.0627
Ca:NPP	2.298655	2.298655	2.298655	1.959607

Composition of premix per kg of diet: Vitamin A, 12500 I.U; vitamin D3, 255000 I.U; vitamin K3, 2mg; vitamin B1, 3mg; vitamin B2, 5.5mg; calcium pantothenate, 11.5mg; vitamin B12, 0.025mg; choline, chloride, 500mg; folic acid, 1mg; biotin, 0.08mg; manganese, 120mg; iron, 100mg, zinc, 80mg; copper, 8.5mg; iodine, 1.15mg; cobalt, 0.3mg; selenium, 0.12mg; anti-oxidant, 120mg. Over the top inclusion of 0.2, 2 and 4 were added for antibiotics, 0.2% butyric acid and 0.4% butyric acid respectively.

Parameters Measured and Calculated

The growth performance parameters calculated include feed intake and body weight gain. Feed conversion ratio was calculated using the weight gain and feed intake values.

Feed Intake

The weekly feed intake was determined by giving a known quantity of feed to the birds and collecting the leftovers. Feed remnants were weighed and subtracted from the weight of feed offered to determine the feed intake per replicate per week.

Body Weight

The chicks were weighed at the beginning of the trial and subsequently weighed on weekly basis throughout duration of the experiment. The weekly weight gain was obtained by subtracting the weight of the preceding week from that of the present.

Feed Conversion Ratio

This was calculated per pen as the ratio of weight gained to the feed consumed.

$$\text{Feed Conversion Ratio (FCR)} = \frac{\text{Average feed intake(g)}}{\text{Average weight gain(g)}}$$

Chemical Analysis

The proximate composition of the diets was determined according to the methods of Association of Official Analytical Chemists (AOAC, 2000).

Statistical Analysis

Data collected were subjected to Analysis of Variance using SAS (2008). Mean differences was separated using Duncan's Multiple Range Test.

RESULTS

The effect of butyric acid supplementation on the performance of turkey poults is shown in Table 3. Final weight and weight gain of birds on the control and antibiotic supplemented diet were similar and significantly higher than those on 0.2 and 0.4% butyric acid supplemented diets. Birds on the control, antibiotic supplemented and 0.2% butyric acid supplemented diet consumed more feed than those on 0.4% butyric acid supplemented diet. Feed conversion ratio of birds in the control and antibiotics supplemented diet were similar while those in 0.2 and 0.4% butyric acid were significantly different.

Table 3: The Impact of Butyric Acid Supplementation on Growth Performance of Turkey Poults (7– 28 days)

Parameters	T1	T2	T3	T4	SEM
Initial weight(g/bird)	77.27	74.67	72.80	73.40	3.39
Final weight(g/bird)	350.27^{a}	360.07^{a}	315.41^{b}	309.71^{b}	24.22
Weight gain(g/bird)	273.00^{a}	285.4^{a}	242.61^{a}	236.31^{b}	21.75
Feed intake(g/bird)	734.58^{a}	746.07^{a}	694.76^{a}	629.64^{b}	31.25
FCR	2.69^{ab}	2.61^{ab}	2.92^{a}	2.32^{b}	0.38

Means within the same row with the same superscript are not significantly different (p>0.05). T1 – Control (basal diet); T2 – basal diet + antibiotics fed for 21 days; T3 – basal diet + 0.2% butyric acid fed for 21 days; T4-basal diet+ 0.4% FCR=Feed Conversion ratio. SEM – Standard Error of Mean

The Impact of Butyric Acid Supplementation On the Performance Characteristics of Turkey Poults (29-56 days)

The result on the impact of butyric acid supplementation on the performance of turkey poults as shown in Table 3. Similar initial weight was recorded for birds placed on the control and antibiotic supplemented diets which were significantly (p<0.05) higher than those observed in 0.2% and 0.4% butyric acid supplemented diets. Final weight, weight gain and feed intake of birds on control, antibiotic and 0.2% butyric acid supplemented diets were similar but significantly higher than those recorded for 0.4% butyric acid supplemented diet. FCR was also significantly higher in the control, antibiotic and 0.2% butyric acid supplemented diets than those in 0.4% butyric acid supplemented diet.

Table 4: The Impact of Butyric Acid Supplementation on Growth Performance of Turkey Poults (29-56 Days)

Parameters	T1	T2	T3	T4	SEM
Initial weight(g/bird)	350.27^{a}	360.07^{a}	315.41^{a}	309.71^{b}	24.22
Final weight(g/bird)	980.43^{a}	963.99^{a}	917.64^{a}	775.52^{b}	87.34
Weight gain(g/bird)	630.16^{a}	603.93^{a}	602.23^{a}	465.81^{b}	31.26
Feed intake(g/bird)	1882.61^{a}	1796.31^{a}	1705.71^{a}	1442.98^{b}	95.55
FCR	2.99^{a}	2.98^{a}	2.83^{a}	3.10^{b}	0.26

Means within the same row with the same superscript are not significantly different (p>0.05). T1 – Control (basal diet); T2 – basal diet + antibiotics ; T3 – basal diet + 0.2% butyric acid ; T4-basal diet+ 0.4% .FCR=Feed Conversion ratio. SEM – Standard Error of Means

The Impact of Butyric Acid Supplemented Diets on Performance of Turkey Poults (7– 56 Days)

The results on the influence of butyric acid supplemented diets on growth response of turkey poults are shown in Table 5.

Final weight and weight gain of birds on control, antibiotic supplemented diet and 0.2% butyric acid diets were similar and significantly higher than those observed in 0.4% butyric acid diet. Birds in the control and antibiotic supplemented

diets consumed more feed than those in 0.2% and 0.4% butyric acid supplemented diets. Least feed consumption was recorded for birds in 0.4% butyric acid supplemented diet.

Table 5: The Impact of butyric Acid Supplemented Diets on Performance of Turkey poults (7– 56 Days)

Parameters	T1	T2	T3	T4	SEM
Initial weight(g/bird)	77.27	74.67	72.80	73.40	3.39
Final weight(g/bird)	980.43[a]	963.99[a]	917.64[a]	775.52[b]	87.34
Weight gain(g/bird)	903.16[a]	889.32[a]	844.84[a]	702.12[b]	71.27
Feed intake(g/bird)	2720.00[a]	2569.05[a]	2423.57[b]	2072.62[c]	146.54
FCR	3.01	2.89	2.87	2.95	0.48

Means within the same row with the same superscript are not significantly different ($p>0.05$). T1 – Control (basal diet); T2 – basal diet + antibiotics ; T3 – basal diet + 0.2% butyric acid ; T4-basal diet+ 0.4% .FCR=Feed Conversion ratio. SEM – Standard Error of Means

DISCUSSION

The results of this present study showed that the inclusion of butyric acid to the corn-soya based diets did not positively affect the final weight and weight gain of birds at the end of the first 21 days (starter phase 1) of the feeding trial. However, at the end of the 49 days (starter phase 2) of the experiment 0.2% butyric acid produced similar outcome with the control and antibiotic supplemented diets. This agrees with the work of Adil *et al.* (2011) who reported no significant body weight gain difference between broilers fed control diet and butyric acid (2 and 3%) supplemented diets . This agrees also with the findings of Leeson *et al.* (2005) who reported that butyrate glyceride inclusion at 0.2% had no detrimental effect on feed intake and maintained optimal performance of broiler chickens. The results of this experiment are however contrary to the findings of Panda *et al.* (2009) and Taherpour *et al.* (2009). Panda *et al.* (2009) reported that butyric acid inclusion at 0.4 and 0.6% produced significant increase in body weight gain when compared to the control and 0.2 butyric acid inclusion level while Taherpour *et al.* (2009) reported that a supplementation with butyrate acid glycerides showed an increase in final body weight (42 days) of broiler chickens when compared to those on the basal diet. However, the authors also reported a lower feed intake and feed conversion ratio for birds on the butyric acid supplemented diet when compared to those on supplement-free diet. Adil *et al.* (2010), concluded that butyric acid inclusion at 2 and 3% improved body weight gain and feed conversion efficiency in birds at 42 days. Similarly, Adil *et al.* (2011) also reported a positive impact of butyric acid (2 and 3% inclusion rate) on body weight gain and feed conversion ratio with broiler chickens at 42 days, which is in line with the present findings of this study. Salmanzadeh (2013) reported a significant increase in body weight gain and feed conversion ratio in Japanese quail fed butyric acid supplemented diets (0.4, 0.5 and 0.6% inclusion rate). Agboola *et al.* (2015) reported an improved weight gain at 21 days when 0.4% organic acid (formic and propionic acids) were added to the feed. Hernandez *et al*. (2006) however reported no beneficial effect on weight gain when formic acid was fed, as feed additive to broiler chickens. Esmaeilipour *et al*. (2011) also reported a non-significance in weight gain using citric acid. Biggs and Parsons (2008) concluded fumaric acid had no beneficial effect on weight gain in broiler chicken. There appears to be much variability in various research findings when organic acid or its salts were used as feed additive in poultry production. While some researchers reported beneficial roles, others concluded that it had no beneficial effect on growth performance of birds. It can be concluded, in agreement with Yang *et al*. (2009) that the inconsistences observed from reports on the effects of these feed additives on performance can be attributed to the variation in the level of acids used, variation in specific acid form, variation in feed ingredients, management practices, bird characteristics such as species, breeds, strains and prevailing environmental conditions. It is also of note to observe the different nature of butyric acid used for the various studies. Butyric acid, salts of the acid, and butyric acid glycerides have all been used for the various experiments. This could also be a reason for variation in results.

CONCLUSION AND RECOMMENDATION

The result obtained from this study showed that butyric acid at the inclusion level up to 0.2% had no detrimental effects and can be used as a viable and possible alternative to replace antibiotics in turkey poults diets. From the findings of the present study, it

is concluded that 0.2% butyric acid could totally replace antibiotics in turkey poults diets.

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