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Performance and Carcass Characteristics of Broiler Finishers Fed Acidifier Based Diets

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Abstract: Effects of supplementing diets with Biotronics SE (an acidifier) in replacement of Oxytetracycline-HCl (Antibiotic Growth Promoter) (AGP) on performance and carcass characteristics of broiler chickens was investigated using 128 Marshall Strain day old broilers. The birds were randomly allotted to four treatments with each treatment made of a duplicate of 16 chicks per replicate. Four isocaloric and isonitrogenous diets (A: control diet without Oxytetracycline-HCl and Biotronics SE®; Diet B had 0.1% Oxytetracycline-HCl only, Diet C contained 0.3% Biotronics SE® only while Diet D contained 0.1% Oxytetracycline HCl and 0.3% Biotronics SE®) were formulated and each diet was offered in mash form to their respective birds from day 21 until week 7. At day 49, four chickens from each replicate were selected and sacrificed for the determination of carcass characteristics. Weight gain and feed intake were significantly higher ($p<0.05$) for birds on dietary treatment D. Variations in values obtained for the final body weight and mortality indices were however similar ($p>0.05$). Biotronics supplementation significantly improved ($p<0.05$) feed conversion ratio, live weight gain and bled weight. Other carcass and internal organs weights were not significantly ($p>0.05$) affected by the inclusion of AGP or acidifier in the diets. Biotronics SE can suitably replace AGP in broilers diets.

Key words: Biotronics SE®, antibiotic growth promoter, broiler, supplementation, performance, carcass characteristics

INTRODUCTION

Concerns for food safety and environmental conservation are the major focus of poultry industry as constant efforts has been at producing safer human foods from animal sources more efficiently and at lower cost. This has given impetus to continued search for new feed additives that could increase rate of growth and level of production. The use of antibiotics as growth promoter intended not only as therapeutic but also as feed additive of continuous use in animal started appropriately five decades ago (Segura and De Bloos, 2008).

Usually, AGPs are administered at low doses, absorbed minimally from the gut and when incorporated into the feed, they act by specifically reducing the number of pathogenic bacteria (Dafwang *et al*., 1987). Recently, most AGPs have been banned from use because feeding of antibiotics are risky (Neu, 1992), considering the possibilities of antibiotic residue, the development of drug resistant bacteria and reduction in the ability to cure these bacteria diseases in human (Jensen, 1998). Therefore, the search for alternative products that could be used in poultry diet to aid growth promotion, feed utilization and maintenance of gut health is ongoing. Different categories of feed additives for farm animals are referred to as Natural Growth Promoters (NGP) or non-antibiotic growth promoters (Stainer, 2006) which include acidifiers, probiotics, prebiotics, phytobiotics, feed enzymes, immune stimulants and antioxidants. No report has associated any risk as regards bacteria resistance or undesired residues in animal products arising from NGP use. Acidifiers in different forms and combination are included in poultry feeds to lower the pH value of the feed, the gut and microbial cytoplasm by inhibiting the growth of intestinal pathogens and preventing microbial contamination of feed. This effect is exhibited also in digestive tract of poultry (Eldelsburger and Kirchaessner, 1994; Freitage *et al*., 1999). Acidifiers, particularly, the short chain fatty acids, acetate, propionate and butyrate have contributed greatly to the profitability in poultry and also provide people with health and nutritious poultry products (Patten and Waldroup, 1998). Moreover, acidifiers improved growth performance through establishment of low gastro intestinal pH condition by supporting endogenous digestive enzymes and reducing undesired gut micro organisms (Richards *et al*., 2005), Acidification of diets with weak organic acids such as formic, fumaric, propionic, lactic and sorbic have been reported to decrease colonization of pathogen and production of toxic metabolites, improved digestibility of protein, Ca, P, Mg, Zn and served as substrate in the intermediary metabolism (Kirchgessner and Roth, 1988; Veeramani *et al*., 2003). Samana and Biswas (1995) also reported increased body weight when the diet was supplemented with lactic acid. Sebastian *et al*. (1996) and Blanchard *et*

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al. (2001) reported decrease in Salmonella, *Echerichia coli* and mould counts in feeds with propionic and lactic acid added at different levels in broiler diets. Other authors (Pelicano *et al.*, 2005; Locci *et al.*, 2004) also noted higher villus height in duodenum and jejunum with most organic acidifier added to broiler diets. The increase in villus height may be attributed to the intestinal epithelium acting as a natural barrier against pathogenic bacteria and toxic substances that are present in the intestinal lumen. Withdrawal of antibiotics from poultry feeds has created the need for alternatives that would influence improvement of healthy production traits of broiler chickens and safety for human consuming poultry products.

This study was aimed at determining the effects supplementing broiler finishers' diets with Biotronics SE® an acidifier in place of antibiotics growth promoter on performance and carcass characteristics of chickens.

MATERIALS AND METHODS

Experimental site and description: This experiment was conducted at the Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria situated in the derived savanna vegetation belt. The location is 7° 27^{1}N and 3° 45^{1}E, with daily mean temperature of 25-29°C.

Experimental birds and management: One hundred and twenty eight day old Marshal Broiler chicks were obtained from Terudee Farms, Limited, Ibadan. The chicks were brooded on deep litter for 20 days. They were fed *ad libitum* on basal (control diet). At day 21, the birds were randomly allocated to four dietary treatments. Each treatment was a duplicate of 16 birds per replicate. The finishers' diet and water were given *ad libitum* to the respective experimental birds for 28 days. Routine management, vaccinations and medications were administered according to methods of Oluyemi and Roberts (1979).

Experimental diets: Experimental diets were isonitrogenous and isocaloric. The diets were:

Diet A : (Control diet) - without oxytetracycline-HCl and Biotronics SE®
Diet B : (Control diet + 0.1% oxytetracycline-HCl)
Diet C : (Control diet + 0.3% Biotronics SE®)
Diet D : (Control diet + 0.1% oxtetracycline-HCl + 0.3% Biotronics SE®

The composition of experimental diet is shown in Table 1.

Performance characteristics: Feed and water were given *ad libitum*. Feed consumed (g/bird) was recorded daily, leftover was weighed and discarded. Individually, Body Weight (BW) (g)/bird was taken on pen basis before offering feed the initial day and then at weekly intervals up to 7 weeks. Feed conversion ratio was calculated as feed intake per unit gain i.e. g/intake/g BW gain. Mortality was recorded as it occurred and percentage (%) mortality was determined at the end of the study. Body weight gain was also estimated.

Carcass characteristics: At day 49, three birds from each replicate with body weight close to the mean of the group were selected and tagged. The birds were then starved but given ample supply of drinking water 12 h prior to slaughtering (Joseph *et al.*, 1996). Each bird was weighed separately and sacrificed, then properly bled. The slaughtered birds were scalded at 80°C

Table 1: Composition of experimental diets fed to broiler finishers' (%)

Ingredients (g/100 DM)	Diet A (Control)	Diet B (AGP)	Diet C (Acidifier)	Diet D (AGPs + Acidifier)
Maize	50.00	50.00	50.00	50.00
Full fat soya	30.00	30.00	30.00	30.00
Brewers dried grain	15.10	15.00	14.80	14.70
Oyster shell	0.50	0.50	0.50	0.50
Dicalcium phosphate	1.50	1.50	1.50	1.50
Common salt (NaCl)	0.30	0.30	0.30	0.30
L-lysine	0.06	0.06	0.06	0.06
DL-methionine	0.14	0.14	0.14	0.14
Mycofix select	0.20	0.20	0.20	0.20
Avatec	0.06	0.06	0.06	0.06
*Broiler premix	0.25	0.25	0.25	0.25
Palm oil	1.89	1.89	1.89	1.89
Oxytetracycline HCl	-	0.10	-	0.10
+Biotronics SE®	-	-	0.30	0.30
Total	100.00	100.00	100.00	100.00

+Composition of Acidifier (Biotronic SE®) 17.4% formic acid, 14.1% ammonium formate, 12.4% propionic acid, 8.4% ammonium propionate and 47.7% filled material (fructo-oligosaccharide as the carrier).

*Each 2.5 kg of Nutrivitas/DSM Nutripoults broiler vitamin-mineral premix contains: Vitamin A 10,000,000iu, Vitamin D_2 2,000,000iu, Vitamin E 40,000 mg, Vitamin K_3 2,000 mg, Vitamin B_1 1,500 mg, Vitamin B_2 5,000 mg, Vitamin B_6 4,000 mg, Vitamin B_{12} 20 mg, Niacin 40,000 mg, Calpan 10,000 mg, Folic acid 1000 mg, Biotin 100 mg, Antioxidant 100,000 mg, Choline chloride 300,000 mg, Manganese 80,000 mg, Iiron 40,000 mg, Zinc 60,000 mg, Copper 80,000 mg, Cobalt 300 mg, Selenium 200 mg for 2 min and manually defeathered. The carcass was carefully eviscerated and split open to remove the gastrointestinal tracts. Live weight, bled weight, defeathered weight, carcass weight, eviscerated weight were recorded respectively. The eviscerated carcass was then carefully cut into parts and their weight also recorded. Organ weights such as proventriculus, crop gizzard, heart, liver, lungs, kidneys, pancreas, gall bladder and spleen were separated and weighed. The weight of the gastrointestinal tract, caeca as well as their corresponding lengths were also determined, abdominal fat was carefully removed from gizzard and abdominal region weighed and recorded respectively. Recorded weights of parts were expressed as percentage of the respective live body weight.

Chemical analysis: Proximate composition was carried out using AOAC (1995) method. Nitrogen Free Extract (NFE %) was calculated by subtraction (100 - (CE + CP + EE + Ash)). Metabolizable energy content of the diets was calculated from the chemical composition (Pauzenga, 1985).

Statistical analysis: Data were subjected to one-way Analysis of Variance (ANOVA) using the General Linear Model of SAS software (SAS, 1999-2000) and their respective means were separated by the Duncan Multiple Range Test (Duncan, 1955).

Table 2: Chemical composition of experimental diets

	Treatments			
Chemical composition	A	B	C	D
Dry matter (%)	91.54	91.84	90.97	90.85
Crude protein (%)	21.68	19.00	19.15	19.25
Ether extract (%)	8.00	9.00	8.50	8.00
Crude fibre (%)	7.00	8.00	7.00	6.00
Total ash (%)	7.50	6.00	6.50	8.00
Nitrogen free extracts (%)	55.82	58.00	58.88	58.75
Estimated ME (kcal/kg)	2790.31	2769.36	2805.76	2804.42

RESULTS AND DISCUSSION

Performance indices of experimental birds fed acidifier supplemented diets are shown in Table 3. The final body weights (g) obtained (1448.4, 1291.0, 1487.6 and 1574.1 for birds on diets A, B, C and D respectively) were statistically similar (p>0.05). Values obtained for weight gain (g) (765.85, 680.5, 858.01 and 921.43 for birds on diets A, B, C and D respectively) varied significantly (p<0.05). Various reports (Maolino *et al*., 1992; Akinleye *et al*., 2008; Watkins and Kratzer, 1984) indicated that feeding broilers with probiotics, organic acids and prebiotics did not result in significant weight gain. Supplementation with both AGP and acidifier in treatment D resulted in significantly higher (p<0.05) weight gain. Paul *et al*. (2007) also reported similar body weight gain with the inclusion of virginiamycin, formate + propionate, formate + propionate + lactate and their combination in broiler ration.

Values obtained for feed intake (g/bird) (2928.5, 2570.5, 3177.5 and 3433.0 for birds fed dietary treatments A, B, C and D respectively) varied significantly (p<0.05) with dietary treatments. Birds fed combination of both AGP and acidifier (Treatment D) consumed more feeds. Ocak *et al*. (2007) noted similar increase in feed intake when lactic acid was included in broiler ration. This contrasted the earlier remarks of Cave (1984) that high levels of organic acid in broiler ration depresses feed intake. Indications from other reports (Miller, 1987; Lyons, 1987; Anderson *et al*., 1999) revealed that well nourished healthy chicks housed under clean conditions at a moderate stocking density do not respond positively to AGP or acidifier supplementations.

The values obtained for FCR were 3.83, 3.78, 3.71 and 3.73 for birds fed diets A, B, C and D respectively varied significantly (p<0.05). Birds fed dietary acidifier recorded significantly (p<0.05) higher feed conversion compared to others. Birds on control diets recorded the least feed conversion and this underscored the germane of

Table 3: Performance characteristics of experimental birds

Parameters	Diet A (Control/Basal)	Diet B (NGP)	Diet C (Acidifier)	Diet D (NGP + Acidifier)	SEM
Final body weight (g/bird)	1448.40	1291.00	1487.60	1574.10	62.78
Weight gain (g/bird/4wks)	765.85[ab]	680.50[b]	858.01[ab]	921.43[a]	48.21
Feed intake (g/bird/4wks)	2928.50[ab]	2570.50[b]	3177.50[ab]	3433.00[a]	95.18
Feed Conversion Ratio (FCR)	3.83[a]	3.78[ab]	3.71[c]	3.73[bc]	0.02
Mortality (%)	6.25	12.50	9.38	12.50	4.94

Means on the same row with different superscripts are significantly different (p<0.05)

Table 4: Carcass characteristics of the experimental birds

Parameters	Diet A (Control)	Diet B (AGPs)	Diet C (Acidifier)	Diet D (AGPs + Acidifier)	SEM
Live weight (g)	1437.50[a]	1200.00[b]	1458.00[a]	1329.17[ab]	74.50
Bled weight (%)	96.19[ab]	95.11[b]	96.53[a]	94.93[b]	0.64
Eviscerated weight (%)	69.19[a]	66.16[b]	65.70[b]	64.20[b]	1.74
Carcass weight (%)	84.32[a]	81.45[ab]	82.66[ab]	79.57[b]	5.30
Defeathered weight (%)	91.70	89.78	90.24	90.00	1.51

Means with different superscripts on the same row were significantly different (p<0.05) supplementation of additives when animals are fed which corroborated the earlier observations of Versteegh and Jongbloed (1999) who used diets supplemented with 0.25 fumaric acid. Runho *et al*. (1997) attributed this to probable increased surface area of nutrients which led to improved nutrient absorption and energy utilization.

The mean cut up carcass parameters of the experimental birds fed acidifier supplemented diets are presented in Table 5. Wholesale cut weights obtained were expressed as percentages of the birds live weight. Variation in values obtained for Back, Wing, Thigh, Drumsticks and Head were statistically similar (p>0.05) and were therefore not affected by dietary treatments. Contrarily, percentage cut up carcass values for neck (5.40, 5.29, 5.93 and 5.98); Shank (3.98, 4.95, 4.37 and 3.86); Breast (17.44, 15.84, 16.52 and 15.17); Rib cage (5.49, 5.27, 4.72 and 4.49 for birds fed diets A, B, C and D respectively) varied significantly (p<0.05). Breast is one of the most important economic primal cut in chickens' world over. Values obtained was highest for birds fed control diets followed by birds on dietary acidifier (treatment C) then B and D in that order of decreasing values.

Organ indices of bird on dietary acidifiers are presented in Table 6. Weights of proventriculus, full gizzard, empty gizzard, heart, liver, kidney, abdominal fat and spleen were not significantly different (p>0.05). The intestinal length (cm) was longest for birds fed control (218.33), dietary AGP + acidifier (D) (216.42) and AGP (B) supplemented diets (212.67). The shortest intestinal lengths were recorded for NGP supplemented diet (C) (198.5).

The observed variations were significantly different (p<0.05). Similarly, caeca length was significantly (p<0.05) longer for birds on control diets. Values obtained (23.33, 18.25, 22.17 and 19.17 for bird on diets A, B, C and D respectively) could be indicative of probable effect of dietary AGP whilst reducing the caeca length, it increased the intestinal length. This attributes contrasted the effects of dietary acidifier for both parameters.

The GIT weights (4.65, 4.58, 5.32 and 5.57), Caeca weights (0.63, 0.64, 0.72 and 0.75) and pancreas (0.30, 0.28, 0.31 and 0.37 for birds on dietary treatments A, B, C and D respectively) were significantly different (p<0.05). The weights of crop (0.37, 0.502, 0.403 and 0.478), lungs (0.54, 0.64, 0.49 and 0.56) and gall bladder (0.18, 0.17, 0.10 and 0.17 for birds on fed diets A, B, C and D respectively) varied significantly (p<0.05). Consistently higher values of these indices were obtained for birds fed AGP (treatment B) and AGP + acidifier (treatment D) supplemented diets and the lowest for birds on dietary acidifiers (treatment C).

Table 5: Cut-up carcass of the experimental birds (%)

Parameters	Diet A (Control)	Diet B (AGPs)	Diet C (Acidifier)	Diet D (AGPs + Acidifier)	SEM
Neck (%)	5.40^{bc}	5.29^{b}	5.93^{ab}	5.98^{a}	0.33
Shank (%)	3.98^{b}	4.95^{a}	4.37^{ab}	3.86^{b}	0.31
Breast (%)	17.44^{a}	15.84^{ab}	16.52^{ab}	15.17^{b}	0.86
Rib cage (%)	5.49^{a}	5.27^{ab}	4.72^{bc}	4.49^{c}	0.36
Head (%)	3.00	3.17	2.96	2.97	0.24
Drum stick (%)	9.87	9.75	9.74	8.99	0.43
Thigh (%)	10.29	10.01	9.88	10.21	0.31
Wing (%)	8.40	8.35	8.12	8.00	0.27
Back (%)	6.53	6.31	6.45	6.76	0.39

Means with different superscripts on the same row are significantly different (p<0.05)

Table 6: Organ weight of the experimental birds

Parameters	Diet A (Control)	Diet B (AGPs)	Diet C (Acidifier)	Diet D (AGPs + Acidifier)	SEM
GIT weight (%)	4.65^{bc}	4.58^{c}	5.32^{ab}	5.57^{a}	0.35
Intestinal length (cm)	218.33^{a}	212.67^{a}	198.50^{b}	216.42^{a}	9.73
Caeca weight (%)	0.63^{b}	0.64^{b}	0.72^{ab}	0.75^{a}	0.08
Pancreas (%)	0.30^{ab}	0.28^{b}	0.31^{ab}	0.37^{a}	0.04
Crop (%)	0.37^{c}	0.50^{a}	0.40^{bc}	0.49^{ab}	0.15
Lungs (%)	0.54^{ab}	0.64^{a}	0.49^{b}	0.56^{ab}	0.07
Gall bladder (%)	0.18^{a}	0.17^{ab}	0.10^{b}	0.17^{ab}	0.03
Caeca length (cm)	23.33^{b}	18.25^{b}	22.17^{ab}	19.17^{b}	1.78
Proventriculus (%)	0.58	0.50	0.59	0.58	0.07
Full gizzard (%)	3.70	3.90	3.88	3.71	0.21
Empty gizzard (%)	2.79	2.73	2.87	2.76	0.16
Heart (%)	0.54	0.57	0.59	0.54	0.05
Liver (%)	1.97	1.96	2.05	2.12	0.09
Kidney (%)	0.73	0.72	0.71	0.70	0.07
Abdominal fat (%)	1.64	1.58	1.58	1.45	0.31
Spleen (%)	0.09	0.10	0.13	0.12	0.02

Means with different superscripts on the same row are significant different (p<0.05). GIT = Gastro Intestinal Tract

Conclusion: From this study, dietary acidifier improved the feed conversion of experimental broilers compared to birds fed antibiotics growth promoter counterpart. Thus dietary acidifier like Biotronics SE can suitably replace antibiotics growth promoters in the diets of broilers.

Further research as to the mechanism action and interaction of acidifier in varying husbandry applications and conditions is hereby particularly recommended.

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