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EVALUATION OF OPTIMUM LEVELS OF BIOTRONIC® SE AS ALTERNATIVE FOR OXYTETRACYCLINE ON PERFORMANCE OF BROILER CHICKENS

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ABSTRACT

The study was conducted to evaluate the efficacy of optimum levels of Biotronic ® SE as an alternative to the use of Oxytetracycline on growth performance, carcass characteristics and digestibility of broiler chickens. A total of 396 Ross Day old broiler chicks were randomly allotted to six (6) dietary treatments with 22 chicks/replicate in a completely randomized design. Treatments were as follows: Treatment one was the negative control (NC) diet without Biotronic® SE, while treatments 2, 3, 4, 5 contained 100, 200, 300, 400 and 500g Biotronic® SE and treatment 6 positive control (PC) contained 100g Oxytretracycline. The diets were formulated to meet standard requirements for starter and finisher broiler chickens. Feed and water were given to the birds *ad libitum* for the 8-weeks experimental period. Growth parameters measured were average body weight gain, feed intake**,** feed conversion ratio, carcass characteristics and nutrient digestibility percent. The results at the starter phase showed that 500g Biotronic® SE supplementation (P<0.05) had (1.7) feed conversion ratio (FCR) and feed cost per kilogram gain (₦151.42) values. The finisher phase result showed no significant (P>0.05) difference in weight gain. Birds on 400g Biotronic® SE had a lower (P>0.05) FCR (2.02) and feed cost per kilogram gain ((₦1159.36). The dressing percentages of carcass were similar both in the 500g Biotronic® SE and Oxytetracycline treatments. Prime cuts: breast, drumstick and wings were better in birds on diets containing 400g Biotronic® SE. The crude protein values (86.54, 89.31 and 94.50 %) for nutrient digestibility was significantly (P<0.05) higher in the 200, 300 and 400g Biotronic® SE groups respectively. The crude fibre (76.43 %) and ether extract (89.82 %) values were significantly (P<0.05) lower across the treatment groups. The use of Biotronic® SE as growth promoter gave a result comparable to the antibiotic treatment and better than the negative control. Therefore, Biotronic® SE can be use at 500g /100kg at the starter phase and 400g/kg at finisher phase as an alternative to antibiotics in broiler diets.

Key words: Broiler chickens, Antibiotics, Oxytetracycline, Biotronic® SE, Organic acid and Performance parameters

INTRODUCTION

Antibiotics have been used for several decades to protect birds from pathogenic microorganisms and also as growth promoters (AGP) to enhance the performance and reduce the population of potentially pathogenic bacteria (Mohamed *et al*., 2014; Brown *et al*., 2017). The inherent dangers in the continuous use of antibiotics in poultry feeds include; residual amount in products, increased resistance by pathogens to antibiotics and these resistances are transmitted to human microbiota (Pirgozlieve *et al*., 2008; Azeem *et al*., 2014). Although the inclusion of antibiotics has been banned in the EU countries, such legislation is yet to take place in many countries including Nigeria, where antibiotics is still being used in animal feeding (Agboola *et al*., 2015). There is a dire need to find alternatives to AGPs. Many researchers have searched for potential alternatives to antibiotic growth promoters' (AGPs). Organic acids, organic minerals, bacteriophages, probiotics, and prebiotics have been suggested as useful dietary means for compensating loss in productive performance when AGPs were

banned from poultry diets (Yang *et al*., 2009; Sugiharto *et al*., 2016). Among these alternatives, dietary organic acids have gained great attention because of their antimicrobial activities against pathogenic bacteria and the fact that these compounds can induce a pH reduction in the gastrointestinal tract (GIT), which can improve nutrient utilization in poultry diets (Kil *et al*., 2011a; Cheng *et al*., 2014). Most of the researches carried out during the last decade shows that organic acids (OA) are excellent promoters of growth performance and gut health in commercial poultry production (Sohail *et al*., 2016).

Biotronic® SE is a powerful combination of synergistically acting organic acids, a combination of formic and propionic acids and their common salts combined on a Sequential Release Medium (SRM). SRM secures a slow release of organic acids in feed and gastro intestinal tract. Besides decreasing pH, the selected acids penetrate the cell wall of gram-negative bacteria. This dual mode of action inhibits bacterial proliferation (Erich, 2020). Biotronic® products are easy to handle, with no side effects or withdrawal periods (DSM). Therefore, it is important to understand and highlight their importance, impact and mode of action, to maximize the benefits when included in poultry diets. The study was therefore, designed to evaluate optimum inclusion levels of Biotronic SE (an organic acid) as an alternative growth promoter to antibiotics (Oxytetracycline) on performance of broiler chickens.

MATERIALS AND METHODS

Experimental site and location

The experiment was carried out at the Poultry Unit of the Department of Animal Science Teaching and Research Farm, Faculty of Agriculture, Ahmadu Bello University, Samaru, Zaria. The site is located in the Guinea Savannah zone of Nigeria at Latitude 11^{o} 9’ 46’’ N, Longitude 7^{o}37’45’’E and an altitude of 610m above sea level. The temperature ranges between 26-40^{o}C depending on the season while the relative humidity during the dry and wet seasons are 21 and 72% respectively. The wet period in Zaria is between May and October with annual rainfall of about 1500 mm (IAR, 2016).

Source of experimental birds, Biotronic® SE and oxytetracycline

Ross breed of broiler chicks were purchased from a reputable hatchery located in Ibadan, South Western Nigeria for the experiment. Biotronic® SE and Oxytetracycline were purchased from a commercial dealer in poultry products in Kaduna metropolis, Kaduna State. Manufacturer’s recommended doses for Biotronic® SE was 3 – 4kg/ton at starter phase and 2 – 3kg/ton at finisher phase and Oxytetracycline, 100g/100 kg feed.

Experimental diets

Six experimental diets were formulated at both broiler starter and finisher phases to meet the nutrient requirement of broiler chickens. Table 1 shows the broiler starter diet; Treatment one, without Biotronic® SE, represented the negative control (NC), while treatments 2, 3, 4 and 5 had 200, 300, 400 and 500g Biotronic® SE inclusion and treatment 6 had 100g Oxytetracycline, this represented the positive control (PC). Table 2 shows the finisher diets; Treatment one, without Biotronic® SE represents the negative control (NC), Treatment; 2, 3, 4 and 5 had 100, 200, 300 and 400g Biotronic® SE inclusion and treatment 6 had 100g Oxytetracycline which **r**epresented the positive control (PC). For the purpose of this experiment the inclusion levels were a level lower and two levels higher than manufacturer’s recommended rate of 2 – 3kg /ton for the feeding trial.

Experimental design and management of birds

A total of 396-day-old Ross broiler chicks of mixed sexes were used for this study. The chicks were randomly allotted based on an initial average weight of 46.98g, to six groups fed on isonitrogenous and isocaloric diets, each treatment with three replicates consisting of 22 birds per replicates in a completely randomized design (CRD). They were reared in deep litter pens, feed and water were provided *ad libitum* during the experimental period. The diets were formulated to meet the

nutrient requirement of broiler chickens by NRC (1994). After four weeks of starter phase, the birds were randomized and adjusted for weights within treatments, using a uniform average weight of (1300g) for the next four weeks (finisher phase) and fed the finisher diets. Twenty birds were used per replicate. Vaccines against Newcastle and Gumboro diseases were administered following the vaccination schedule of the Veterinary Teaching Hospital of Ahmadu Bello University, Zaria.

Table1: Ingredient composition of experimental broiler starter diets supplemented with varying inclusion levels of Biotronic® SE (0 – 4weeks)

	Levels of Inclusion (g/100kg) Biotronic® SE / Oxyt.					
Ingredients	**0**	**200**	**300**	**400**	**500**	**100g**
Maize	56.00	56.00	56.00	56.00	56.00	56.00
Soya bean cake	29.70	29.70	29.70	29.70	29.70	29.70
Groundnut cake	10.00	10.00	10.00	10.00	10.00	10.00
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00
Limestone	0.50	0.50	0.50	0.50	0.50	0.50
Common salt	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.20	0.20	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10	0.10	0.10
Vitamin premix[A]	0.25	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis						
ME Kcal/kg	2902	2902	2902	2902	2902	2902
Crude protein (%)	23.19	23.19	23.19	23.19	23.19	23.19
Crude fibre (%)	3.59	3.59	3.59	3.59	3.59	3.59
Ether extract (%)	3.16	3.16	3.16	3.16	3.16	3.16
Calcium (%)	1.32	1.32	1.32	1.32	1.32	1.32
Phosphorous (%)	0.87	0.87	0.87	0.87	0.87	0.87
Lysine (%)	1.46	1.46	1.46	1.46	1.46	1.46
Methionine (%)	0.56	0.56	0.56	0.56	0.56	0.56
Cost/ kg diet(₦)	83.82	83.88	84.00	84.06	84.12	91.32

[A]Biomix Broiler starter premix provides per kg diet Vit. A, 10,000 I.U; Vit D_3, 2000 I.U; Vit E 23mg; Vit. K, 2mg; Calcium, Pantothenate, 7.5mg B12, 0.015mg; Folic acid, 0.75mg; Choline, Oxyt.: Oxytetracycline

Table 2: Ingredient composition of experimental broiler finisher diet supplemented with varying inclusion levels of Biotronic® SE (5 – 8 weeks)

	Levels of Inclusion (g/100kg) Biotronic® SE /100g Oxyt.					
Ingredients	**0**	**100**	**200**	**300**	**400**	**100g**
Maize	58.00	58.00	58.00	58.00	58.00	58.00
Soya bean cake	20.00	20.00	20.00	20.00	20.00	20.00
Groundnut cake	13.00	13.00	13.00	13.00	13.00	13.00
Maize offal	4.70	4.70	4.70	4.70	4.70	4.70
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00
Limestone	0.50	0.50	0.50	0.50	0.50	0.50
Common salt	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.20	0.20	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10	0.10	0.10
Vitamin premix[A]	0.25	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis						
ME Kcal/kg	2929	2929	2929	2929	2929	2929
Crude protein (%)	20.54	20.54	20.54	20.54	20.54	20.54
Crude fibre (%)	4.11	4.11	4.11	4.11	4.11	4.11
Ether extract (%)	3.35	3.35	3.35	3.35	3.35	3.35
Calcium (%)	1.32	1.32	1.32	1.32	1.32	1.32
Phosphorous (%)	0.85	0.85	0.85	0.85	0.85	0.85
Lysine (%)	1.27	1.27	1.27	1.27	1.27	1.27
Methionine (%)	0.50	0.50	0.50	0.50	0.50	0.50
Cost/ kg diet(₦)	79.44	79.50	79.56	79.62	79.68	79.68

[A]Biomix Broiler Finisher premix provide per kg diet Vit. A, 10,000 I.U; Vit D_3, 2000 I.U; Vit E 23mg; Vit. K, 2mg; Calcium, Pantothenate, 7.5mg B12, 0.015mg; Folic acid, 0.75mg; Choline Chloride, 300mg; Vit B_1 1,8mg, Vit. B_2, 5mg; Vit B_6, 3mg; Manganese, 40mg; Iron, 20mg; Copper, 3mg; Iodine, 1mg; Cobalt, 0.2mg; Selenium, 0.2mg' Zinc, 30mg Bio: Biotronic, Oxyt: Oxytetracycline

Data collected / Parameters measured

Growth Performance

The initial body weights of the day-old chicks were taken, and then subsequently body weights of the birds and feed intake were recorded weekly at both starter and finisher phases. Body weight gain was calculated as the difference between final and initial weight, while feed to gain ratio and feed cost per kg gain were calculated from the values obtained from weight gain, feed cost and feed intake at both phases. Mortality was recorded as it occurred.

Carcass Analysis

At the end of the 8th week, six chickens were randomly selected from each treatment, which

represented the average weights of the group for carcass evaluation. The birds were fasted of feed overnight, weighed and slaughtered by severing the jugular vein to bleed. The birds were then scalded in hot water to remove their feathers. Live weight was taken before slaughtering, the dressed weight, cut parts (breast, thigh, drum stick, back, wings, neck and head) were measured and expressed as percent dressed weight while dressing percentage was calculated as live weight divided by dressed weight multiplied by 100. The organs were measured and expressed as percent of their live weights.

Nutrient Digestibility Trial

At the end of the finisher phase, six (6) birds were selected from each treatment, which had representative weights of the group and kept in individual metabolic cages for total fecal collection. The birds were allowed a period of three days to adjust to the cage environment. Thereafter, a known quantity of the experimental feed was weighed and given daily for 5 days with water. Trays were placed under each cage to enable daily fecal collection. Total fecal droppings were collected for five consecutive days, weighed and oven-dried at 65^0C for 24 hours. The dried samples were then assayed for their nutrient contents using methods described by AOAC (1995) at the Biochemistry Laboratory of the Department of Animal Science, Ahmadu Bello University Zaria. Nutrient digestibility was determined for crude fibre, crude protein, ether extract, ash and nitrogen free extract using the formula below:

$$\% \text{ Digestibility of Nutrient} = \frac{\text{Nutrient in feed} - \text{Nutrient in faeces}}{\text{Nutrient in feed}} \times 100$$

Statistical Analysis

Data collected from the experiment were subjected to analysis of variance (ANOVA) using General Linear Model of Statistical Analysis System (2003) Software package. Significant differences between means were compared using Dunnett's Test.

RESULTS AND DISCUSSION

Growth Performance of broiler starter chicks fed diets containing levels of Biotronic® SE and Oxytetracycline

The growth performance of broiler chicks fed diets containing varying levels of Biotronic® SE is shown in Table 3. Significant ($P<0.05$) differences were observed in final weight, weight gain, feed intake, FCR and feed cost per kg gain. Birds on 500g Biotronic® SE diet and 100g Oxytetracycline diets had the highest ($P<0.05$) weight gains (1337.7 and 1288.14g), feed intake was higher in 100g Oxytetracycline treatment (2507.10g) compared to the other treatments. A better FCR (1.70) and least feed cost per kilogram gain (151.42 ₦/kg) was recorded in birds fed 500g Biotronic® SE diet.

In general, the growth performance of birds in the study tends toward the dose used, with higher levels of inclusion of organic acid there was increased weight gain. This effect could be due to proper utilization of nutrients by the chicks since organic acids aids in maintaining a balance in the population of the gut microorganisms in favour of the commensal microflora thereby reducing competition for host nutrients. The use of organic acids has been reported to protect the young chicks by competitive exclusion of pathogenic microorganism (Mansoub *et al*., 2011), enhancement of nutrient utilization, and growth and feed conversion efficiency. Lückstädt *et al.*, (2011) noted similar increase in feed intake when lactic acid was included in broiler ration. This contrasted the earlier remarks of Cave (1987) that high levels of organic acid in broiler ration depressed feed intake. Cumulative feed intake was observed to be higher in the PC when compared with the experimental groups, which agrees with the report of Paul *et al*. (2007), who observed that feed intake after the 3rd and 6th weeks were significantly ($P<0.05$) higher in the antibiotic group than the acidifier treated groups. Findings on feed intake in this study however, disagrees with the findings of Sultan *et al*. (2015) who reported that feed intake was not significantly affected by different levels of

acid flex which is an organic acid used during the finisher phase in broiler chickens.

The feed conversion ratio of birds fed 500g Biotronic® SE diet was the best compared to the other treatment groups. Better feed conversion ratio was also reported by Vogt *et al*., (1982) and Veeramanin *et al*. (2003) in broilers given diets with propionic acid. In a similar experiment conducted with different levels of organic acid treatments, Hedayati *et al*. (2014) reported a significant decrease in FCR of broilers fed different levels of acidifier when compared with their respective control groups. Feed cost per kilogram gain was least in the different levels of organic acid groups with 500g Biotronic® SE as the best. Biotronic® SE at an inclusion level of 500 g/100kg diet reduced the cost of production by 9.52% or ₦15.94. This indicates that the use of organic acids did not only result in better growth performance alone, but could be a strategy to improve the cost effectiveness of broiler production.

On the 28th day, mortality records showed that only birds on 300g Biotronic® SE diet had record of mortality. 100% survivability of broilers chickens was recorded in all other treatments. The mortality recorded was only in one treatment and could be as a result of causes not clear and not resulting from treatment effect.

Table 3: Growth performance of broiler starter chicks fed diets containing varying levels of Biotronic® SE

	Levels of Biotronic® SE inclusion (g/100 Kg diet)/ 100g Oxyt						
Parameters	**0**	**200**	**300**	**400**	**500**	**100g**	**SEM**
Initial weight (g/bird)	46.98	47.00	46.98	47.06	47.01	46.98	0.03
Final weight g/bird	875.74^{d}	1076.94^{c}	1187.50^{b}	1223.13^{b}	1335.15^{a}	1384.75^{a}	51.53
Weight gain (g/bird)	828.76^{d}	1029.94^{c}	1140.52^{b}	1176.07^{b}	1288.14^{a}	1337.73^{a}	51.52
Av. daily wt gain (g/bird)	29.60^{d}	36.79^{c}	40.73^{b}	42.00^{b}	46.070^{a}	47.78^{a}	1.84
Total feed intake (g/bird)	1660.40^{d}	1982.90^{c}	2178.70^{b}	2233.20^{b}	2307.10^{b}	2507.10^{a}	85.93
Av daily feed intake (g/bird)	48.51^{d}	69.83^{c}	77.81^{b}	79.76^{b}	82.40^{b}	89.54^{a}	3.07
Feed conversion ratio	2.00^{a}	1.90^{a}	1.90^{a}	1.90^{a}	1.70^{b}	1.80^{a}	0.05
Feed cost / kg gain ((₦/kg gain)	167.36^{a}	159.49^{a}	159.90^{a}	159.68^{a}	151.42^{b}	171.56^{a}	4.49
Mortality Percentage (%)	1.2	1.44	0.00	0.48	0.48	0.48	0.04

^{abcd} Means with different superscripts along same rows show significant differences (P < 0.05) SEM = Standard Error of Mean, Oxy= Oxytetracycline, %: percentage, Wt = weight. Av = average, kg = kilogram

Table 4 shows growth performance of broiler finisher chickens fed diets containing varying levels of Biotronic® SE. There were significant (P<0.05) differences among the different treatment groups for all the parameters measured. The results from birds in the NC and 100g Biotronic® SE treatments were similar, but were significantly (P<0.05) lower than the remaining groups (200, 300, 400g Biotronic® SE and PC) that were similar in values. The feed cost per kilogram gain was lowest for birds on 400g Biotronic® SE treatment. The similarities in values of the monitored parameters between the Biotronic® SE and the PC group indicates the positive effect of these additives on the diets and the consequential improvement in performance of the birds over the control group.

In all the performance parameters measured, final live weight, weight gain and feed conversion ratio of the organic acid groups from 200 to 400g inclusion showed similar improvements. This indicates that Biotronic® SE had a positive effect on nutrient utilization because of its pH lowering ability which has

beneficial effect on balancing the gut microflora, making nutrients available to the host. Adil *et al*. (2011a) reported that lowered pH of the gut was conducive for the growth of favourable bacteria simultaneously hampering the growth of pathogenic bacteria which grow at relatively higher pH.

Cheng *et al*. (2014), reported that dietary supplementation of organic acids increased the body weight and feed conversion ratio in broiler chicken. The result in this study agreed with finding of Azeem *et al*. (2014), who reported no significant differences in the growth performance indices namely body weight gain, feed intake and feed conversion ratio of broiler chickens fed on diets supplemented with Biotronic® SE.

Table 4: Growth performance of broiler finisher chickens fed diets containing varying levels of Biotronic® SE

	Levels of Biotronic® SE inclusion (g/100 Kg diet) /100g Oxyt.						
Parameter	**0**	**100**	**200**	**300**	**400**	**100**	**SEM**
Initial weight (g/bird)	1296.68	1300.02	1300.01	1300.03	1300.02	1300.02	1.08
Final weight (g/bird)	2385.58^{b}	2364.58^{b}	2843.75^{a}	2851.39^{a}	3062.50^{a}	2927.08^{a}	69.05
Weight gain (g/bird)	1085.42^{b}	1064.58^{b}	1543.73^{a}	1551.39^{a}	1762.50^{a}	1627.08^{a}	69.05
Av. daily wt gain (g/bird)	51.69^{b}	50.70^{b}	73.51^{a}	73.88^{a}	83.93^{a}	77.48^{a}	3.29
Total feed intake (g/bird)	2972.90^{b}	2821.92^{b}	3446.91^{a}	3540.00^{a}	3556.30^{a}	3503.10^{a}	143.65
Av daily feed intake (g/bird)	141.57^{b}	134.37^{b}	164.14^{a}	168.57^{a}	169.35^{a}	166.82^{a}	6.84
Feed conversion ratio	2 .74^{b}	2.65^{b}	2.23^{a}	2.28^{a}	2.02^{a}	2.15^{a}	0.06
Feed cost/gain (₦/kg gain)	214.49^{c}	206.70^{c}	175.03^{b}	175.16^{b}	159.36^{a}	187.50^{b}	5.20
Mortality (%)	0.00	0.00	0.00	0.24	0.00	0.00	5.20

^{abdc} Means with different superscript along the same rows shows significant differences ($P < 0.05$) SEM = Error, Oxyt. = Oxytetracycline

Table 4: Growth performance of broiler finisher chickens fed diets containing varying levels of Biotronic® SE

	Levels of Biotronic® SE inclusion (g/100 Kg diet) /100g Oxyt.						
Parameter	**0**	**100**	**200**	**300**	**400**	**100**	**SEM**
Initial weight (g/bird)	1296.68	1300.02	1300.01	1300.03	1300.02	1300.02	1.08
Final weight (g/bird)	2385.58^{b}	2364.58^{b}	2843.75^{a}	2851.39^{a}	3062.50^{a}	2927.08^{a}	69.05
Weight gain (g/bird)	1085.42^{b}	1064.58^{b}	1543.73^{a}	1551.39^{a}	1762.50^{a}	1627.08^{a}	69.05
Av. daily wt gain (g/bird)	51.69^{b}	50.70^{b}	73.51^{a}	73.88^{a}	83.93^{a}	77.48^{a}	3.29
Total feed intake (g/bird)	2972.90^{b}	2821.92^{b}	3446.91^{a}	3540.00^{a}	3556.30^{a}	3503.10^{a}	143.65
Av daily feed intake (g/bird)	141.57^{b}	134.37^{b}	164.14^{a}	168.57^{a}	169.35^{a}	166.82^{a}	6.84
Feed conversion ratio	2 .74^{b}	2.65^{b}	2.23^{a}	2.28^{a}	2.02^{a}	2.15^{a}	0.06
Feed cost/gain (₦/kg gain)	214.49^{c}	206.70^{c}	175.03^{b}	175.16^{b}	159.36^{a}	187.50^{b}	5.20
Mortality (%)	0.00	0.00	0.00	0.24	0.00	0.00	5.20

^{abdc} Means with different superscript along the same rows shows significant differences (P < 0.05) SEM = Error, Oxyt. = Oxytetracycline

Table 5 shows the carcass characteristics of broiler finisher chickens fed diets containing four levels of Biotronic® SE. There were significant (P<0.05) differences in most of the parameters measured. Live weight was significantly (P<0.05) higher in the Oxytetracycline fed bird than the others. Carcass weight was similar in birds fed 400g Biotronic®SE and Oxytetracycline birds. The dressing percentage values were similar for birds on Biotronic and Oxytetracycline but significantly higher than (P<0.05) those in the control group. The cut parts were significantly (P<0.05) higher in birds fed 500g Biotronic diet for breast, drumstick and wings across the treatment groups and control. Organ weights showed no significant difference in all the parameters measured except the gizzard that recorded higher value (P<0.05) in the control group.

The dressing percentage recorded were similar for birds on Biotronic® SE and Oxytetracycline treatments but significantly (P<0.05) higher than those in the negative control group. This result disagrees with report of Brzoska *et al*. (2013) that better dressing percentage was obtained when 0.06% Galli acid was used with 0.02% Enramycin in broiler diets.

This showed that organic acids have the potentials to be used as growth promoter since it improved growth rate and nutrient utilization efficiency which resulted in higher carcass yield. This result disagrees with report of Mohamed *et al*. (2014) that better dressing percentage was obtained when 0.06% Galli acid was used with 0.02% Enramycin in broiler diets. Panda *et al*. (2009) and Hossain *et al*. (2016, reported that organic acids (0.3 – 0.9%) had no significant influence on carcass yield or proportion of individual carcass parts. The findings of this study agree with Saki *et al*. (2012) and Tabidi *et al*. (2016), who reported that supplementation of organic acids increased carcass, breast, thigh and drumstick meat yields when activated liquid organic acid blend composed of propionic acid, formic acid and hydroxy-4-methylthio-butanoic acid were used in diets of broilers. Hassan *et al*. (2010),

reported an increase in breast and thigh meat yields at 21 days, an effect not observed at 42 days. Increased dressing yield upon organic acid supplementation could be attributed to higher live weight.

Table 5: Carcass evaluation of broiler finisher chickens fed diets containing varying levels Biotronic ® SE

	Levels of inclusion of Biotronic ® SE g/100kg /100g Oxyt						
Parameters	**0**	**100**	**200**	**300**	**400**	**100g**	**SEM**
Live weight (g)	2258.33^{d}	2273.33^{d}	2783.33^{c}	2762.67^{c}	3008.33^{b}	3100.00^{a}	42.85
Carcass weight (g)	1454.00^{c}	1536.83^{c}	1935.17^{b}	1987.33^{b}	2179.83^{a}	2194.00^{a}	53.47
Dressing percentage (%)	64.41^{b}	67.66^{a}	69.54^{a}	71.86^{a}	72.44^{a}	70.77^{a}	0.29
Cut parts expressed as percentage of carcass weight (%)							
Back	18.16	18.69	18.59	18.76	19.26	18.86	0.79
Breast	30.42^{b}	30.05^{b}	31.58^{b}	29.17^{b}	34.44^{a}	31.88^{b}	1.27
Thigh	15.25^{b}	15.13^{b}	16.03^{b}	16.28^{b}	17.11^{b}	18.78^{a}	0.92
Drum stick	8.90^{d}	8.96^{d}	10.09^{c}	9.86^{c}	13.43^{a}	12.71^{b}	0.29
Wings	908^{d}	9.70^{c}	9.70^{c}	10.05^{b}	11.38^{a}	10.22^{b}	0.25
Organs expressed as percentage of live weight (%)							
Heart	0.41	0.53	0.50	0.44	0.51	0.41	0.03
Full gizzard	3.14^{a}	2.72^{b}	2.75^{b}	2.71^{b}	2.69^{b}	2.47^{b}	0.18
Empty gizzard	2.32^{a}	2.02^{b}	2.11^{b}	2.27^{b}	1.95^{b}	2.47a	0.30
Liver	1.71	1.97	1.80	1.75	1.66	1.95	0.12
Lungs	0.48	0.62	0.66	0.43	0.55	0.59	0.08
Kidneys	0.34	0.38	0.52	0.38	0.41	0.37	0.08
Spleen	0.14	0.16	0.14	0.13	0.18	0.13	0.02
Abdominal fat	0.56	0.74	1.09	1.05	1.54	1.09	0.25
Intestinal weight	5.13	4.09	3.51	4.09	4.09	3.35	0.51
Intestinal length (cm)	85.17	76.83	87.00	90.67	100.33	102.5	7.77

^{abcd} Means with different superscripts along same rows show significant differences ($P < 0.05$), SEM= Standard error mean, Oxyt = Oxytetracycline

Apparent nutrient digestibility of broiler finisher chickens fed diets containing varying levels Biotronic® SE

Table 6 shows apparent nutrient digestibility of broiler finisher chickens fed diets containing four levels Biotronic® SE. There were no significant (P>0.05) differences observed across treatments for dry matter and nitrogen free extract digestibility. However, significant (P<0.05) differences were observed in crude protein, crude fibre and ether extract digestibility. The birds on 200, 300 and 400g Biotronic® SE had significantly (P<0.05) higher apparent crude protein digestibility when compared with negative control, 100g Biotronic® SE and Oxytetracycline groups. Birds fed the control diet, 100, 200, 300g /100kg had similar nutrient digestibility values for crude fibre and ether extract which were significantly (P<0.05) higher than for Oxytetracycline group.

The pH lowering ability of organic acid in the gut may have enhanced this effect and the reduced competition between host animal with pathogen organisms. Organic acids normally used as acidifier in poultry feeds, have been considered to be attractive alternatives for improving nutrient digestibility. Brzoska *et al*. (2013), reported that dietary level of 0.5% of either fumaric or formic acid and 0.75% of acetic or 2% citric acid improved both metabolizable energy and apparent nutrient digestibility (crude protein, ether extract, crude fibre and nitrogen-free extract) of broiler diets. Samanta *et al*. (2010) reported that organic acids improved gastric proteolysis as well as the digestibility of proteins and amino acids in broilers.

Saki *et al*. (2012) suggested that organic acids improved protein and energy digestibility by reducing microbial competition with the host for nutrients, decreasing endogenous nitrogen loss, lowering the incidence of sub-clinical infections and secretion of immune mediators, and reducing production of ammonia and other growth depressing microbial metabolites. Acidic environment favoured the production and secretion of pepsin, gastrin and cholecystokinin, which play a significant role in nutrient utilization and subsequent growth performance and feed efficiency (Ghazalah *et al*., 2011).

Table 6: Apparent nutrient digestibility of broiler finisher chickens fed diets containing varying levels of Biotronic® SE diets

	Levels of Biotronic® SE inclusion (g/100kg) diet /100g Oxyt						
Parameters	**0**	**100**	**200**	**300**	**400**	**100**	**SEM**
Dry matter (%)	84.77	85.34	82.38	86.81	90.54	76.50	3.86
Crude protein (%)	87.40^{b}	87.67^{b}	86.54^{a}	89.31^{a}	94.50^{a}	80.55^{b}	2.90
Crude fibre (%)	85.01^{a}	87.97^{a}	86.51^{a}	87.19^{a}	90.65^{a}	76.43^{b}	3.49
Ether extract (%)	93.62^{a}	93.98^{a}	93.54^{a}	94.64^{a}	96.27^{a}	89.82^{b}	1.52
NFE (%)	76.80	80.26	76.62	84.33	87.16	67.69	4.87

^{ab} : Means with different superscripts along same rows show significant differences (P<0.05), SEM= Standard Error of Means, NFE= Nitrogen free extract, Oxyt= Oxytetracycline

CONCLUSION AND RECOMMENDATIONS

The effect of Biotronic® SE (organic acids) on the performance of the birds indicated it was dose dependent; the more active ingredients reach the site of action, the better the desired effects. This was evident in higher inclusion rates giving better performance.

Biotronic® SE at an inclusion level of 500g/100kg diets reduced the cost of production by 9.52 % or ₦15.94k per bird at starter phase and 25% or ₦55.13k at finisher phase.

Dietary organic acids may be exploited as growth promoters for broiler chicken as in the present study it had positive outcome on the performance.

The Biotronic® SE at 500g inclusion for starters and 400g inclusion for finishers can be used as a replacement for oxytetracycline (antibiotic) since it gave better FCR and feed cost per kilogram gain over the negative control and Oxytetracycline groups.

Farmers can use Biotronic® SE amongst other benefits highlighted as means of keeping mortality minimal as it takes care of gram-negative microorganisms in both feed and GIT, other than the use synthetic antibiotics

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