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Growth Performance and Carcass Characteristics of Broiler Chickens Fed Diets Supplemented With Probiotics and Organic Acid as Alterative to Antibiotics

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ABSTRACT

In a study to evaluate the use of probiotics as alternative to antibiotics on the growth performance and carcass characteristics of broiler chicken, 150 day-old Marshall strain of broiler chicks with an average weight of 50.47±1.76 g were randomly allotted into five (5) dietary treatments replicated thrice in a completely randomized design (CRD). Diet T1, T2, T3 and T4 contained RE3-Enhancer®, Oxytetracycline, 4-Bac-Extra® and Salmo-Nil® supplementation respectively. Diet T5 (Control) contained neither probiotics nor Antibiotics. The study lasted four (4) weeks at the starter phase and five (5) weeks at the finishers. Data were collected on feed intake, weight gain, feed conversion ratio and carcass characteristics. Results revealed that no significant (p>0.05) difference exist in the final body weight and weight gain among the treatments for both the starter phase and the finisher phase. The weight gain ranged from 319.97 g in T1 fed RE3-Enhancer® to 379.87 g in T5 fed basal diet only at the starter phase and 1559.50 g in T5 to 1850.90 in T4 fed the organic acid at the finishers phase. Similarly, the total feed intakes were not significantly different among the treatments at the two phases of the study. The FCR were 2.24, 2.39, 2.30, 2.44 and 2.46 in T1, T2, T3, T4 and T5 respectively at the finisher phase. The carcass indices measured were similar (p>0.05) among the treatments except for percentages of neck and empty-gizzard. It could be concluded that the performance characteristics of the broiler chicken were not significantly influenced by the inclusion of probiotics and organic acid.

Keywords: *Antibiotics, Broiler, Performance, Probiotics*

INTRODUCTION

The inadequate consumption of animal protein in developing countries have been well documented (Gaytán-González *et al.*, 2020). Broiler production is one of the acceptable ways of solving the world's protein +nutrition needs because of its short generation interval and fast growth (Vaarst *et al.*, 2015). For instance, the World Health Organization recommended the consumption of a minimum of 0.8 g of protein per kg body weight per adult daily (WHO, 2007). It is important to note that the average daily consumption in Nigeria is 0.46 g per kg body weight per adult.

Advancement in broiler chicken production have been hinged on improved performance in feed efficiency or reduced mortality. Some producers have engaged in the use of antibiotics in chicken feed or their water as growth promoter. Overtime, the practices have resulted in negative consequences for the chicken and human consumers. This is because such chickens carry residue of antibiotics in their meat when processed. The consumption of such meat has been identified as one of the causes of antibiotic resistance infection which has resulted in many fatalities worldwide (Muaz *et al.,* 2018). It is for these reasons that the European Union banned the use of antibiotics as feed constituents in livestock production (WAP, 2022).

Sequel to the above, researches have intensified on alternatives to the use of antibiotics as growth promoters. Probiotics is an alternative that have been studied to provide safety as well as reduce the risk of disease outbreak (Doreau and Jouany, 1998). For many centuries, probiotic foods have been consumed as a natural feed component without knowing. Probiotics' products contain bacterial culture (Diereck, 1989), yeast cell which help to increase the water holding capacity, carcass output and meat hardness as reported by Ceslovas *et al.* (2005). Prebiotics on the other hand are set of non-digestible feed ingredients such as organic acids, that are advantageous to the host by stimulating the activities of beneficial microbes in the gastro-intestinal tracts. They are largely used as alternatives to anti-biotics in the diets of chickens. Some of the commonly used alternative products to antibiotics by poultry farmers in Lagos and Ogun States of Nigeria are 4-Bac-Extra - containing *Lactobacillus acidophilus,* RE_3-Enhancer which contains *Lactobacillus* spp and Salmo-Nil® (organic acid). This study evaluated the influence of use of probiotics and organic acid as alternative to antibiotics on the growth performance and carcass characteristics of broiler chicken.

MATERIALS AND METHODS

Study Location

The study was carried out at the poultry unit of the Department of Animal Production, Lagos State University of Science and Technology (former Lagos State Polytechnic), Ikorodu, Lagos State which shares boundary with Sagamu Local Government in Ogun State, Nigeria.

Experimental Animals and Management

A total of one hundred and fifty (150) day-old Marshall strain of broiler chicks with an average weight of 50.47±1.76 g were collected from a reputable hatchery. Prior to the chicks' arrival, the pen was washed, disinfected and fumigated. Wood shavings were spread on the floor at 4 cm deep as litter material. This was followed by the installation of the feeders, drinkers, and heat source. The pen was pre-heated to about 34 ^{0}C before the arrival of the chicks and was kept likewise all through the brooding period. Glucose solution was offered to the chicks on arrival as anti-stress. Water and mash feeds were offered *ad-libitum* to the experimental birds for 63 days of the study. The gross composition of the basal diet is as presented in Table 1.

Experimental design and layout

In a completely randomized design, the 150 birds were randomly allotted to five dietary treatments with three replicates per treatment and 10 birds in each replicate. The chickens were fed either a basal diet (as a control group) or the basal diet with the additives as follows;

Treatment 1 Basal diet + RE_3 Enhancer®
Treatment 2: Basal diet + Oxytetracycline (Positive Control)
Treatment 3: Basal diet + 4 Bac-Extra®
Treatment 4: Basal diet + Salmo-Nil® Dry
Treatment 5: Basal diet alone (Negative Control).

The probiotics and the antibiotic were added to the feed as recommended by the manufacturer as follows: RE_3 Enhancer® (1.5 ml/Kg), 4 Bac-Extra® (0.5 g/Kg), Salmo-Nil® Dry (3 g/kg) and Oxytetracycline (0.5 g/kg). RE_3-Enhancer contains *Lactobacillus* spp while 4-Bac-Extra contains *Lactobacillus acidophilus.* Salmo-Nil® Dry is an organic acid.

Data collection

The birds were weighed with sensitive weighing scale at the onset of the study to determine the initial weight, they were subsequently weighed weekly till the end of the study when the final weight of the birds was determined. The weight was estimated as the difference between the final weight and the initial weight. The feed intake was measured daily as the difference between the feed offered and the leftover. The feed conversion ratio (FCR) was calculated as the ratio of feed intake to weight gain. These were determined at both the starter and finisher phases of the study.

At the end of the finisher phase of the study, two birds from each replicate (six birds per treatment) were selected for carcass analysis. Feed was withdrawn from the birds overnight, they were then weighed in the morning and slaughtered. Each carcass was dressed, weighed and the dressing percentage was evaluated as the ratio of the dressed carcass weight to live weight expressed as percentage. In addition, the weight of the liver (without gall bladder), gizzard, heart, and visible fat was recorded. Their relative weights were determined as percentage of the live weights. Percentage mortality was estimated as the ratio of number of mortality recorded to the total number of chickens per group expressed in percentage.

Data Analysis

Data collected were subjected to analysis of variance (ANOVA). Means that were significant were separated using the Duncan's Multiple Range Test. The data were tested at 95 % confidence level.

The statisitical model for this study is as follow:
$Y_{ij} = \mu + T_i + e_{ij}$

Where Y_{ij} = growth response and carcass indices of broiler chicken; μ = population mean of all observation; T_i = fixed effect of the additives in the diet (i = 1,2, 3, 4 and 5) and e_{ij} = random residual effect.

RESULTS AND DISCUSSION

The feed intake of the broiler chickens fed probiotics-supplemented diets at the starter phase (Table 2) showed that the feed intake was 1032.56 g in T1, 1048.32 g in T2, 1059.04 g in T3, 1174.48 g in T4 and 1185.00 g in T5. At the finisher's phase (Table 3), the feed intake ranged from 3836.70 g in T5 fed no additive (negative control) to 4509.50 g in chickens T4 fed (Basal diet + Salmo-Nil® Dry) The feed intake was not significantly influenced by the different dietary treatments at both the starter and finisher phases. These observations agreed with the findings of Parsa *et al.,* (2018) who found that the addition of probiotics did not significantly influence the feed intake of broiler starter chicken. Similarly, Al-Khalaifa *et al.* (2019) who assessed the effect of different probiotics and prebiotics on the feed consumption of broilers reported no significant effect through the different weeks of ages observed in the study.

Table 1: Gross composition of the basal diet

Ingredients	Quantity (%)
Maize	50.00
Groundnut cake	34.00
Soya beans	6.00
Fishmeal	2.00
Wheat offal	2.00
Palm kernel cake	2.00
Limestone	1.00
Bonemeal	2.10
Methionine	0.30
Lysine	0.10
Premix	0.25
Salt	0.25
Total	**100.00**
Calculated Analysis	
Crude Protein (%)	22.70
Energy (Kcal/Kg)	2900.36

The weight gains obtained at the starter phase also revealed that the inclusion of the probiotics and the organic acid in the diets of the chicken did not significantly affect the weight gains. The weight gain of 319.97 g in chickens fed RE3 (T1) did not statistically differ from 370.00 g obtained for those fed oxytetracycline in T2 (positive control) nor differ from 379.80 g in T4 fed Salmo-Nil® Dry. Similar trend was observed at the finisher phase. The weight gains were 1781.00, 1806.16, 1708.90, 1850.90 and 1559.50 in T1, T2, T3, T4 and T5 respectively. These findings agreed with Al-Khalaifa *et al*., (2019) who did not find any significant effect on the body weight when probiotics and prebiotics were fed to broiler chickens. On the contrary, Ipek *et al,* (2016) that assigned 500 day-old Cobb broiler chicks into T4 treatment groups that consisted of; control, and 3 groups of different measures of probiotics and prebiotics (PPS), which included live *Saccharomyces cerevisiae* strain observed significant difference among the treatment groups.

Table 2: Performance characteristics of broiler starter chicks fed probiotic and organic acid supplemented diets

	T1	T2	T3	T4	T5	SEM
Initial wt. (g)	50.00	53.00	49.67	52.33	47.33	0.59
Final wt. (g)	369.97	423.07	397.07	432.13	427.20	6.75
Wt. gain (g)	319.97	370.00	347.40	379.80	379.87	5.39
TFI(g)	1032.56	1048.32	1059.04	1174.48	1185.00	19.00
FCR	3.23	2.83	3.05	3.09	3.12	0.03
Mortality (%)	0.83	1.70	0.83	0.83	0.83	0.01

[1]*Means within a row with superscript are significantly different (p<0.05)*
[2]*Wt - Weight; TFI - Total Feed Intake; FCR - Feed Conversion Ratio*

The feed conversion ratio (FCR) of the chickens at the starter phase ranged from 2.83 in diet T2 (oxytetracycline-supplemented) to 3.23 in diet T1 (Basal diet + RE_3 Enhancer®). None of the dietary treatments was significantly ($p>0.05$) better than others. At the finisher phase, the FCR were 2.24 in T1 fed basal diet + RE_3 Enhancer®, 2.39 in T2 fed basal diet + oxytetracycline; 2.30 in T3 fed basal diet + 4 Bac-Extra®, .44 diet T4 (basal diet+Salmo-Nil®) and 2.46 in T5 fed only the basal diet (negative control). The FCR among the treatments were not significantly ($p>0.05$) influenced by the dietary treatments among the groups. It is noteworthy that the control chickens that were not supplemented with either probiotics or antibiotics recorded had FCR that was comparable to the diets with additives. In a similar study, Neveling *et al*. (2017) reported that the average feed conversion ratios (FCRs) of broilers in the probiotic and antibiotic treatment groups were not significantly ($p>0.05$) different from what was recorded for broilers in the untreated group on days 7, 14, 21 and 28, suggesting that neither the multi-strain probiotic, nor the antibiotics had an effect on growth performance. Similar results were published by Gheisar *et al*. (2016). The authors reported an increase in body weight of broilers that received *Enterococcus faecium* M74, but their FCRs were not significantly different from broilers in control groups on a probiotic-free diet. However, Shim *et al*. (2010), Sinol *et al*. (2012) and Chen *et al*. (2013), reported an improved growth performance in studies using different probiotics. They attributed the enhanced growth to an increase in digestive enzyme activity, coupled with additional changes, such as decrease in ammonia production and maintenance of beneficial microbiota in the GIT.

Table 3: Performance characteristics of broiler finishers fed probiotics and organic acid supplemented diets

	T1	T2	T3	T4	T5	SEM
Initial wt. (g)	369.97	423.07	397.07	432.13	427.20	6.75
Final wt. (g)	2150.97	2229.23	2105.97	2283.03	1986.70	29.62
Wt. gain (g)	1781.00	1806.16	1708.90	1850.90	1559.50	18.85
TFI (g)	3995.75	4313.55	3924.30	4509.50	3836.70	19.00
FCR	2.24	2.39	2.30	2.44	2.46	0.19
Mortality (%)	0.00	0.71	0.00	0.00	0.69	0.01

[1]Means within a row without superscript are significantly different (p<0.05)
[2]*Wt - Weight; TFI- Total Feed Intake; FCR - Feed Conversion Ratio*

The carcass characteristics of broiler chickens fed probiotics and organic acid supplemented diets are presented in Table 4. The weights obtained were expressed as percentage live weight of the broiler chicken. The de-feathered weight, eviscerated weight, drum stick, wings, back, thigh, breast, heart, lungs, livers, abdominal fat, shank and head were not significantly (p>0.05) different among the treatment and were therefore not affected by the supplemented diets. This corroborated the findings of Hassan *et al*. (2017) that fed probiotic, prebiotic, and symbiotic to broiler chickens and reported that the feed additives did not influence (p>0.05) the carcass yield.

On the contrary, percentage values of Neck (6.43, 6.92, 5.83, 6.41, 5.82 in T1, T2, T3, T4 and T5 respectively) and that of Empty Gizzard (1.88, 1.61, 2.07, 1.73, 2.11 for birds fed diet T1, T2, T3, T4 and T5 respectively) varied significantly (p < 0.05) among the treatments. Breast meat is one of the most important economical prima cut in chicken all over the world (Endo and Nakano, 1999). The percentage of breast were 13.14 % in T1, 14.57 % in T2, 12.67 % in T3, 13.48 % in T4 and 13.11 in T5. This values were not significantly (p>0.05) different among the treatments. This result agreed with the workMoreira *et al.* (2001) where the control birds showed no significant (p>0.05) difference from those given probiotics. Similarly, Vargas *et al*. (2002) reported no differences in carcass yield between birds that were fed probiotics and control birds. Results from Sojoudi *et al*. (2012) also revealed that feeding broilers with probiotics had no significant (p>0.05) effect on some internal organs including gizzard, heart, liver, lung, testicles, pancreas, duodenum, ileum, colon and rectum.

CONCLUSION

It can be concluded from this study that with adequate bio-security and management, broiler chicken can be reared raised with no probiotics and antibiotics in the diet without negatively affecting the performance indices of the chickens. However, for preventive measures, probiot-

Table 4: Carcass evaluation of broiler chicken fed probiotics-supplemented diets

Parameters	T1	T2	T3	T4	T5	SEM
Live Weight (g)	2291.00[a]	2189.67[ab]	1967.00[c]	2294.67[a]	2045.67[bc]	26.83
De-Feather weight (%)	91.00	96.22	95.68	96.24	95.28	0.40
Eviscerated weight (%)	72.23	73.26	71.03	71.52	70.80	0.18
Drum Stick (%)	10.49	10.90	11.26	10.19	10.19	0.09
Wings (%)	10.28	12.11	10.13	10.47	9.58	0.16
Neck (%)	6.43[ab]	6.92[a]	5.83[b]	6.41[ab]	5.82[b]	0.08
Back (%)	13.14	14.57	12.67	13.48	13.11	0.13
Thigh (%)	11.06	12.10	11.22	10.30	12.29	0.15
Breast (%)	17.36	18.54	18.22	19.04	15.20	0.28
Heart (%)	0.47	0.43	0.41	0.45	0.44	0.00
Lungs (%)	0.45	0.51	0.41	0.45	0.44	0.00
Liver (%)	1.76	1.22	1.63	1.40	1.71	0.04
Abdominal Fat (%)	2.84	3.19	2.41	3.54	1.76	0.13
Empty-Gizzard (%)	1.88[ab]	1.61[b]	2.07[a]	1.73[ab]	2.11[a]	0.03
Shank (%)	4.05	3.97	4.13	3.97	4.59	0.05
Head (%)	1.94	2.09	1.91	2.02	2.04	0.01

[abcd]Means within row with different superscript are significantly different (p<0.05)

ics can be used without any adverse effects on the birds.

RECOMMENDATION

It is therefore recommended that farmers should use probiotics together with good management and bio-security measures for an optimum and efficient production of broiler chicken.

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