VOL. 12 NO. 1,
MAY, 2026
E-ISSN 3027-0995
P-ISSN 3026-8265

African Scholar Publications & Research International
www.africanscholarpub.com

Journal of Biotechnology and Agricultural Research (JBAR)

Performance and Nutrient Digestibility of Broiler Chickens Fed Graded Levels of Dietary Supplementation of *Lactobacillus acidophilus*

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DOI: https://doi.org/10.70382/ajbar.v12i1.032

Abstract

This study was carried out to evaluate the effects of graded levels of *Lactobacillus acidophilus* as growth promoting agent on growth performance and nutrient digestibility of broiler chickens. 240-day old Arbor Acre broiler chicks were allocated to four treatments; each treatment had six replicates with ten birds per replicate. The experimental diets were: Treatment 1- basal diet (control), Treatment 2- basal diet + 1 x 10^8 CFU *Lactobacillus acidophilus*/kg, Treatment 3- basal diet + 2 x 10^8 CFU *Lactobacillus acidophilus*/Kg, and Treatment 4- basal diet + 3 x 10^8 CFU *Lactobacillus acidophilus*/kg. There were no significant differences in the body weight gain of the groups fed lactobacillus acidophilus supplemented diets, but their values were higher ($P<0.05$) than the value observed for the control. Feed intake followed the same pattern with body weight gain with the values got in the supplemented groups higher ($P<0.05$) than the control. Feed conversion ratio values obtained in the groups fed the treated diets were statistically similar ($P<0.05$), but better ($P<0.05$) than the value got in the control. The result of nutrient digestibility shows that the treatment had no effect on metabolizable energy digestibility, while crude protein, ether extract and crude fibre digestibility followed the same pattern, with the values derived in T2, T3 and T4 statistically similar ($P>0.05$), but higher ($P<0.05$) than the observation in T1. It is therefore inferred from this study that *Lactobacillus acidophilus* is a good growth promoter than can always be used to improve broiler chickens' performance and digestibility.

Keywords: Performance, Nutrient Digestibility, *Lactobacillus acidophilus,* Broiler Chickens, Feed.

Introduction

Broiler chicks are exposed to considerable stress during their lifetime immediately after post hatch. The gastrointestinal tract of newly hatched chicks is immature and sterile. It begins to develop function and its microflora when it starts to ingest feed, this time; the chick is very susceptible to pathogenic microorganisms (El-Sabry and Yalcin, 2023). To reduce these pathogenic microorganisms in the intestinal tract of the broiler chicks, a lot of efforts have been embarked upon by both researchers and producers in the area of the usage of antibiotics as growth promoters in broiler chicken production. The demand for higher and safer protein source, free of infections is on the increase, as well as concern about the effects of antimicrobial on human health (Al-Khalaifah, 2018). The increasing antimicrobial resistance in livestock and poultry has become a problem in animal nutrition. Therefore, alternatives to improve growth performance in high intensity food animal production are necessary.

Nutritional strategies and some feed additives such as organic acids, acidifiers, probiotics, oligosaccharides, herbs and essential oils were used as alternatives to antibiotics to provide gut health and enteric disease resistance (Apata, 2008; Hung *et al.,* 2012, Adeosun *et al*., 2023). Among these, the probiotics proved to be the most promising alternatives to antibiotics in broilers (Apata, 2008). The beneficial effects of probiotics microbes on gastrointestinal health are attributed to their ability to produce antimicrobial substances such as lactic acid and bacteriocins, competitive adherence of probiotic strains to the intestinal mucosa, which prevents colonization by pathogens, strengthening of the gut epithelial barrier and modification of the gut microbiota. The effectiveness of probiotics resides on factors such as microbial species composition (e.g., single or multiple strains) and viability, application method and frequency, administration level, diet composition, bird age and environmental stress factors (Bajagai *et al*., 2016).

*Lactobacillu*s species have been reported to have potential to modulate the composition of microbial communities in the gut. In the gut, bacterial probiotic forms a physical obstruction on the binding sites of intestinal mucosa by their own attachment causes blockage to pathogenic bacteria (Apata, 2008). *Lactobacillus acidophilus* is a normal component of the healthy intestinal microflora. Various effects of *Lactobacillus acidophilus* as a probiotic have been described in animals, which depend on strain, host, dose, timing and viability of the strain (Hung *et al.,* 2012). These properties may potentially improve broiler intestinal integrity and eventually performance. The use of *Lactobacillus acidophilus* creates an acidic environment with the production of lactic acid in the gut, which favours the

multiplication of lactobacilli and inhibits the replication of *Escherichia coli*, *Salmonella*, and other gram-negative bacteria. To provide health benefits, the suggested concentration for *Lactobacillus acidophilus* is 10^8cfu/kg of product (Hung *et al.,* 2012). *Lactobacillus acidophilus* is found to have several positive effects on broilers, such as improving protein digestion (Markowiak and Slizewska 2018), feed conversion ratio (FCR), growth performance, immunity (Markowiak and Slizewska 2018) and enhancing mineral absorption (Nourmohammadi *et al*., 2012; Wu *et al.,* 2014).

Therefore, this study was planned to investigate the potential of *Lactobacillus acidophilus* as growth promoters in broiler chicken production especially in areas of growth performance and nutrient digestibility.

Materials and Methods

The experiment was carried out at the Teaching and Research Farm, University of Ibadan, Nigeria, and lasted for a period of 6 weeks. Birds were allocated to four treatments; each treatment had six replicates with ten birds per replicate making a total of 240 birds. The experimental diets are as follows: Treatment 1- basal diet only (control), Treatment 2- basal diet + *Lactobacillus acidophilus* at $1.0x10^8$ CFU/Kg feed, Treatment 3- basal diet + *Lactobacillus acidophilus* at $2.0x10^8$ CFU/Kg feed, Treatment 4- basal diet + *Lactobacillus acidophilus* at $3.0x10^8$ CFU/Kg feed.

Table 1: Gross composition of diets fed to broiler chicken

Ingredients	Composition (%) broiler starters	Composition (%) broiler finishers
Maize	56.00	61.00
Soya bean meal	35.00	29.00
Soya oil	2.70	3.50
Wheat bran	2.55	1.00
Salt	0.25	0.25
***Vitamins/mineral premix**	0.25	0.25
Methionine	0.20	0.30
Lysine	0.10	0.10
Di Calcium Phosphate	2.00	2.70
Limestone	1.00	1.65
Total	100.00	100.00
Calculated Analysis		
Crude Protein (%)	22.39	19.61
Metabolisable Energy (kcal/kg)	2930.19	3113.70
Crude fibre	3.28	4.10
Calcium(%)	1.05	1.03
Total Phosphorus (%)	0.67	0.53
Calcium: Phosphorus	1.57	1.95
Energy: Protein	130.87	161.83

*2.5kg of Micro-Mix broilers premix containss, Vit. A 10,000,000 IU; Vit.D3 2,000,000IU; Vit.E 8,000IU; Vit.K 2,000 mg; Vit.B1 2,000 mg; Vit.B2 5,500 mg; Vit.B6 1,200 mg; Vit. B12 12 mg; Biotin 30 mg; Folic acid 600 mg; Niacin 10,000 mg; Panthothenic acid 7,000 mg; Choline chloride 500,000 mg; Vit. C 10,000 mg; Fe 60,000 mg; Mn 80,000 mg; Cu 8,000 mg; Zn 50,000 mg; I 2,000 mg; Co 450 mg; Se 100 mg; Mg 100,000 mg; Antioxidant 6,000mg

Data collection:

Chickens were weighed on day 42 to determine average body weight (BW). Feed intake (FI) per pen was recorded on the same date and feed conversion ratio (FCR) was calculated as feed to gain ratio for all periods.

To determine the digestibility of diet and excreta, samples were analyzed for ash, crude protein, ether extract, metabolisable energy, using established protocols (AOAC, 2000).

The digestibility experiment had a four-day adjustment period as well as three days of excreta sample collection. Throughout the three-day collection period, excreta samples of broilers from each of the replicates were collected at six-hour intervals, i.e., 4 times a day and put away in preserved bags at 20°C. Left over feed in the feeder trough and in the faeces were collected and weighed. For the total tract digestibility, faeces collected per cage during the period of the three-day collection were pooled together, with each treatment having six replicates.

Statistical analysis:

Data were analyzed as a completely randomized design using the ANOVA. Procedures of Statistical Analysis System software (SAS, 2005) were used and means were compared using Duncan's multiple range tests. A single pen represented the experimental unit (replicate) for all measured parameters. The results were presented as means and SEM calculated by standard procedures. Differences among treatments were considered significant when $p< 0.05$.

Results and Discussion

The results of *Lactobacillus acidophilus* on broiler chickens' performance are presented in Table 2.

Table 2: Performance of broiler chicken on diets with graded levels of *Lactobacillus acidophilus*

Parameter	(T_1)	(T_2)	(T_3)	(T_4)	SEM
BWG (g)	782.48^b	1091.02^a	1136.10^a	1163.80^a	29.25
Feed intake (g)	2022.17^b	2196.33^a	2217.17^a	2196.33^a	17.45
FCR	2.59^a	2.02^b	1.96^b	1.89^b	0.04

Means with the same superscripts are not significantly different ($P<0.05$) SEM: Standard Error of Means, BWG: Body Weight Gain, FCR: Feed Conversion Ratio

Treatment 1= basal diet only (control)

Treatment 2= 1x 10^8 cfu *Lactobacillus acidophilus*

Treatment 3= 2x 10^8 cfu *Lactobacillus acidophilus*
Treatment 4= 3x 10^8 cfu *Lactobacillus acidophilus*
The result showed that the intake of feed of the broilers fed diets with graded levels of *Lactobacillus acidophilus* (La) were similar but higher (P< 0.05) than that of the birds on the control diet with the least feed intake (2022.17g). The Body Weight Gain (BWG) of birds on diets with graded inclusion levels of La were significantly (P< 0.05) higher than control. The FCR of broiler chickens on graded levels of *Lactobacillus acidophilus*) were similar (P>0.05) but better than the control. This study confirmed that *Lactobacillus acidophilus* enhance broiler chickens' performance. This study agrees with the findings of Galib and Alqeel (2009) who recorded improved weight gains in broiler birds fed probiotics. The lactic acid produced by *Lactobacillus acidophilus* reduced intestinal pH which might improve pepsin activities and other pancreatic secretions for increased protein, energy and mineral digestion and absorption. This is also in agreement with (Boling *et al*., 2000; Chowdhury *et al*., 2009, Al-Khalaifah, 2018) who observed higher weight gain in broiler chickens fed probiotics, compared with controls, considering the period between one and 42 days of age. Increase in weight gain as well as improved feed to gain ratio (FCR) in the present work may be ascribed to the ability of ileal microbes to produce exogenous enzymes, which resulted to increased endogenous enzyme activity in low pH in gastrointestinal tract stemming from increased probiotic microbe multiplication (Safamehr *et al*., 2013). The improvement in FCR might be from better utilization of nutrients in low pH medium in the ileum, resulting in additional body weight gained (Olukosi and Dono, 2014).
The results of nutrient digestibility of the broiler chicken are presented in Table 3.

Table 3: Nutrient Digestibility of broiler chicken fed diets with graded levels of *Lactobacillus acidophilus*

Parameter(%)	(T_1)	(T_2)	(T_3)	(T_4)	SEM
Crude protein	68.69 [b]	80.97[a]	78.94 [a]	80.74[a]	0.63
Metabolisable energy	74.95	76.01	76.55	75.33	0.36
Ether Extract	71.68 [b]	79.82 [a]	79.78 [a]	75.69 [a]	0.41
Crude fibre	67.88 [b]	84.23 [a]	83.44 [a]	82.78 [a]	1.28

Means with the same superscripts are not significantly different (P<0.05) SEM: Standard Error of Means,
Treatment 1= basal diet only (control)
Treatment 2= 1x 10^8 cfu *Lactobacillus acidophilus*
Treatment 3= 2x 10^8 cfu *Lactobacillus acidophilus*
Treatment 4= 3x 10^8 cfu *Lactobacillus acidophilus*
The supplementation of three levels of inclusion of *Lactobacillus acidophilus* as shown in table 3, significantly (P<0.05) influenced the digestibility of crude protein (CPD), ether extract digestibility (EED) and crude fibre digestibility (CFD) of broiler chickens, while the metabolisable energy digestibility (MED) of the broiler chickens was not affected. The crude

protein, ether extract and crude fibre digestibility of broilers on three levels of inclusion of *Lactobacillus acidophilus* were similar but higher (P<0.05) than the values obtained for broiler chickens on control. The activities of *Lactobacillus acidophilus* in *the* gut in relation to reduction of pH, increasing population of beneficial microbes, reducing pathogenic microbes may be responsible for the improved digestibility. Improved digestibility of nutrients noticed in the current study could as well be attributed to decrease in the population of pathogenic microbes, leading to good ileum integrity which encourages effective digestion and nutrients absorption (Safamehr *et al*., 2013). The improved body weight in birds supplemented with *Lactobacillus acidophilus* may be due to improved utilization of nutrients.

Conclusion and Recommendation

In conclusion, this study demonstrated the outstanding influence of *Lactobacillus acidophilus* as feed additives to improve the performance of broilers as a result of improved feed intake, good feed conversion ratio, body weight gain and the improved protein digestibility of the experimental birds. It is therefore recommended that *Lactobacillus acidophilus* can be used instead of antibiotics in chicken ration to enhance better growth of chicken.

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