Comparative Growth Performance of Arbor Acre and Ross Broiler Breeds under Different Lactobacillus Supplementation Levels

Victor Chukwunonso Nwankwo[1*]; C. I. Ebenebe[2]; E. C. Nwankwo[3]

[*1]Nnamdi Azikiwe University, Awka
[2]Department of Animal Science and Technology, Faculty of Agriculture, Nnamdi Azikiwe University, Awka, Nigeria
[3]Department of Soil Science and Land Resources Management, Faculty of Agriculture, Nnamdi Azikiwe University, Awka, Nigeria
*Corresponding Author

Received:- 01 January 2025/ Revised:- 12 January 2025/ Accepted:- 19 January 2025/ Published: 31-01-2025
Copyright @ 2025 International Journal of Environmental and Agriculture Research
This is an Open-Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (https://creativecommons.org/licenses/by-nc/4.0) which permits unrestricted Non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Abstract— *The experiment was designed to verify how supplementation chicken feed with Lactobacillus would affect the performance of Arbor Acre and Ross broilers. In total, 240-day-old chicks of both sexes were randomly allotted to four groups that had different Lactobacillus supplementation levels of 0%, 5%, 10%, and 15% for eight weeks, during which time all the performance parameters were measured, including initial and final body weight, total weight gain, feed intake, and feed conversion ratio. Results have shown that breeds are significantly different and so are the supplementation levels. The 10% Lactobacillus supplementation level proved the best, improving final body weight by 16.36%, average daily weight gain by 16.83%, and hence optimized feed conversion ratio by 17.65%. Arbor Acre always had higher initial body weight and feed intake compared to Ross breeds. Generally, the study has shown that targeted probiotic supplementation could serve as a viable alternative to antibiotic use in poultry besides determining an optimum inclusion level of Lactobacillus to enhance performance in broilers Light.*

Keywords— Lactobacillus, broiler breeds, probiotics, growth performance, feed efficiency.

I. INTRODUCTION

Broiler chicken production continues to evolve with increasing demands for efficient meat production and improved animal health (Maharjan *et al.,* 2021). Genetic variations between breeds (like Arbor Acre and Ross), combined with nutritional interventions such as probiotic supplementation, offer potential strategies to optimize growth performance (Khomayezi & Adewole, 2022). Lactobacillus probiotics have demonstrated promising effects on gut microbiota, nutrient absorption, and immune function in poultry (Kabir, 2009).

Probiotics have emerged as a promising alternative to antibiotics in poultry production, offering potential improvements in growth performance and overall bird health (Jha *et al.,* 2020). The use of Lactobacillus as a dietary supplement has garnered increasing attention due to its potential to enhance nutrient utilization, protect intestinal integrity, and stimulate animal growth (Kabir, 2009; Wu *et al.,* 2019).

Previous studies have demonstrated varied responses to probiotic supplementation, with some researchers reporting significant improvements in broiler performance (Ramlah and Tan, 1995; Uzabaci & Yibar, 2023), while others observed inconsistent results (Blajman *et al.,* 2014). The variability in outcomes has been attributed to factors such as probiotic strain, administration method, chicken genotype, and experimental conditions (Mountzouris *et al.,* 2007; Patterson & Burkholder, 2003).

Limited research exists on the comparative response of different broiler breeds to varying levels of Lactobacillus supplementation (Mountzouris *et al.,* 2007). This study aims to address this knowledge gap by systematically evaluating growth parameters across two prominent broiler breeds (Arbor Acre and Ross) under controlled probiotic interventions, thus addressing the existing knowledge gaps in probiotic application in poultry production.

II. MATERIALS AND METHODS

2.1 Experimental Site and Design:

The study was conducted at the Poultry Unit of the Teaching and Research Farm, Department of Animal Science and Technology, Nnamdi Azikiwe University, Awka (Latitude 6°12'25" N, Longitude 7°04'04" E, altitude 9 meters). A total of 240 day-old mixed-sex chicks from two broiler breeds (Arbor Acre and Ross) were sourced from Agrited Farms and CHI Farms in Ibadan, Nigeria.

2.2 Experimental Animals and Housing:

The chicks were delivered overnight and brooded for one week in deep litter. Houses were cleaned with detergent and Izal disinfectant, and space allowance was 0.05 m^2/bird (0-3 weeks) and 0.11 m^2/bird (4-8 weeks). Wood shavings were spread to a height of 5 cm, and heat was provided by 100-watt bulbs.

2.3 Lactobacillus Preparation:

Lactobacillus was isolated by fermentation using water yam wash water and raw cow milk. Isolation and identification were done using Bergey's Manual of Systematic Bacteriology, while confirmation was based on colony morphology, gram staining, biochemical tests (catalase, oxidase) and carbohydrate fermentation profiles.

2.4 Probiotic Culture Preparation:

The isolated Lactobacillus strains were:

- Inoculated in MRS broth
- Incubated at 37°C for 48 hours
- Centrifuged at 5000 rpm
- Washed with Phosphate Buffered Solution
- Preserved in 30% glycerol at -80°C

2.5 Experimental Design:

Chicks were randomly assigned to four treatment groups per breed, with three replicates of 10 birds each:

- Treatment 1 (T1): Control
- Treatment 2 (T2): 5 mL Lactobacillus
- Treatment 3 (T3): 10 mL Lactobacillus
- Treatment 4 (T4): 15 mL Lactobacillus

2.6 Feeding and Management:

- Commercial feed (New Hope) used for starter and finisher phases
- Ad libitum feeding
- Chick trays used initially, replaced with conical feeders
- Lactobacillus supplementation via drinking water daily for 8 weeks

2.7 Data Collection:

2.7.1 Performance Parameters:

- Individual bird weights recorded weekly using Camry EK5055 scale (±0.01g)
- Daily feed intake measured
- Feed conversion ratio calculated

2.7.2 Blood Parameters:

- Blood collected from wing web 24 hours after final dosage

Samples processed for: Hematological analysis (RBC, WBC, PCV, hemoglobin) and Serum biochemistry (protein, cholesterol, liver enzymes).

2.8 Data Analysis:

Data were analysed using SPSS version 20, two-way ANOVA within completely randomized design. Significant means were separated by Least Significant Difference (LSD) test at 5% level of significance.

2.9 Ethical Considerations

The experiment was conducted with due considerations to institutional animal care, and welfare, and, as much as possible, distress during sample collection was minimized.

III. RESULTS

The mean growth performance of Arbor Acre and Ross broiler breeds and the mean growth performance of broilers injected different levels of lactobacillus bacterial are presented in Tables 1 and 2.

TABLE 1
MEAN GROWTH PERFORMANCE OF ARBOR ACRE AND ROSS BROILER BREEDS

Parameter	Breed		SEM	P-value
	Arbor Acre	Ross		
IBWT (g)	182.88a	144.12b	0.93	0
FBWT (g)	3943.2	3891.76	42.12	0.396
TWG (g)	3760.31	3747.63	41.51	0.831
ADWG (g)	67.15	66.92	0.74	0.829
ADFI (g)	124.01a	112.40b	0.47	0
TFI (g)	6944.44a	6282.25b	22.05	0

IBWT= initial body weight, FBWT= Final body weight, TWG= total weight gain, ADWG = average daily weight gain, ADFI= average daily feed intake, TFI= total feed intake, FCR= feed conversion ratio.

TABLE 2
MEAN GROWTH PERFORMANCE OF BROILERS INJECTED DIFFERENT LEVELS OF LACTOBACILLUS BACTERIAL

Parameter	Levels of Lactobacillus				SEM	P-value
	0%	5%	10%	15%		
IBWT (g)	157.36b	163.95a	167.20a	165.49a	1.317	0
FBWT (g)	3510.79b	4019.88a	4084.99a	4054.24a	59.56	0.396
TWG (g)	3353.43b	3855.93a	3917.76a	3888.75a	58.7	0.831
ADWG (g)	59.88b	68.86a	69.96a	69.44a	1.05	0.829
ADFI (g)	121.17a	116.17b	117.77b	117.72b	0.66	0
TFI (g)	6760.50a	6505.50b	6594.88b	6592.50b	32.04	0
FCR	2.04b	1.69a	1.68a	1.69a	0.04	0.003

a-b =Means on the same row with different superscripts are significantly different(P<0.05)
IBWT= initial body weight, FBWT= Final body weight, TWG= total weight gain, ADWG = average daily weight gain, ADFI= average daily feed intake, TFI= total feed intake, FCR= feed conversion ratio.

The initial body weight (IBWT) showed significant variations across different experimental conditions. In the breed comparison, Arbor Acre chickens demonstrated a significantly higher initial body weight (182.88g) compared to Ross breed chickens (144.12g), with a statistically significant difference (P=0.000) (Table 4.1). When examining the impact of

Lactobacillus supplementation, a notable trend in IBWT was observed (Table 2). The control group (0% Lactobacillus) had the lowest initial body weight (157.36g), while groups supplemented with 5%, 10%, and 15% Lactobacillus showed significantly higher initial weights (163.95g, 167.20g, and 165.49g, respectively). The 10% Lactobacillus group recorded the highest initial body weight among all treatment groups. These findings suggest that both breed type and Lactobacillus supplementation can significantly influence the initial body weight of broiler chickens, with statistically significant differences detected across groups ($P<0.05$).

The final body weight (FBWT) and total weight gain (TWG) exhibited interesting patterns across different experimental conditions (Table 4.1 and 4.2). In the breed comparison, Arbor Acre and Ross chickens showed minimal differences in final body weight (3943.20g vs. 3891.76g, respectively), with no statistically significant variation ($P=0.396$). Similarly, total weight gain was comparable between the two breeds (3760.31g for Arbor Acre vs. 3747.63g for Ross, $P=0.831$). Lactobacillus supplementation demonstrated more pronounced effects. The control group (0% Lactobacillus) showed the lowest final body weight (3510.79g), while groups supplemented with 5%, 10%, and 15% Lactobacillus exhibited significantly higher final weights (4019.88g, 4084.99g, and 4054.24g, respectively). Correspondingly, total weight gain was significantly improved in the supplemented groups, with the 10% Lactobacillus group achieving the highest total weight gain (3917.76g). Again, these results suggest that Lactobacillus supplementation can effectively enhance broiler growth performance.

Total feed intake (TFI) and feed conversion ratio (FCR) revealed significant differences across experimental groups. In the breed comparison, Arbor Acre chickens demonstrated a substantially higher total feed intake (6944.44g) compared to Ross breed chickens (6282.25g), with a statistically significant difference ($P=0.000$). The Lactobacillus supplementation groups showed marked variations in feed intake and efficiency. The control group (0% Lactobacillus) exhibited the highest total feed intake (6760.50g), while supplemented groups showed reduced intake (6505.50g to 6594.88g). Correspondingly, feed conversion ratio was significantly improved in the Lactobacillus-supplemented groups.

The control group had the least efficient feed conversion ratio of 2.04, whereas groups supplemented with 5%, 10%, and 15% Lactobacillus demonstrated improved FCR values (1.69-1.68), with statistically significant differences ($P=0.003$). These findings still suggest that Lactobacillus supplementation can enhance feed efficiency in broiler chickens, potentially reducing overall feed consumption while maintaining growth performance.

Lactobacillus supplementation demonstrated significant improvements across various growth performance parameters. At progressive supplementation levels, notable enhancements were observed. The initial body weight increased from 157.36g in the control group (0% Lactobacillus) to a peak of 167.20g at 10% supplementation, representing a 6.26% improvement. Final body weight showed a substantial increase from 3510.79g in the control group to 4084.99g at 10% supplementation, indicating a 16.36% enhancement. Correspondingly, average daily weight gain improved from 59.88g to 69.96g, representing a 16.83% increase in growth rate. Most remarkably, feed conversion ratio demonstrated significant optimization, improving from 2.04 in the control group to 1.68 at 10% Lactobacillus supplementation. This 17.65% improvement in feed efficiency suggests that Lactobacillus supplementation can effectively enhance broiler chicken metabolism, nutrient absorption, and overall growth performance. These findings highlight the potential of targeted probiotic supplementation in poultry nutrition.

IV. DISCUSSION

The present study investigated the application of Lactobacillus on growth performance between two broiler breeds, Arbor Acre and Ross, and provided useful information regarding probiotic interventions in poultry production. The results agree and extend previous studies conducted to investigate potential benefits of probiotic supplementation in broiler nutrition.

Initial body weight and feed intake are significantly different between Arbor Acre and Ross breeds. Initial body weight was 182.88g and the total feed intake was 6944.44g for Arbor Acre chickens. These are significantly higher when compared to Ross chickens. This evidences that breed consideration is important in nutritional intervention programs. Genetic differences in broiler performance have been echoed elsewhere. Havenstein *et al.* (2003) suggested that nutritional strategies may be needed, which are tailored to a particular genetic line.

The most interesting results were obtained in the supplementation groups treated with Lactobacillus. Such probiotic supplementation with different concentrations exhibited regular enhancements regarding growth performance parameters. Thus, with a supplementation level of 10% Lactobacillus, more encouraging results may be obvious, improving initial body weight, final body weight, and feed conversion ratio. The improvement in feed conversion ratio (FCR) from 2.04 in the control group to 1.68 in supplemented groups is particularly noteworthy. This 17.65% enhancement in feed efficiency aligns with

research by Mountzouris *et al.* (2007), who highlighted the potential of probiotics to optimize nutrient utilization and metabolic efficiency in broiler chickens. The mechanism behind this improvement likely involves enhanced gut microbiota composition and improved nutrient absorption (Kabir, 2009).

The significant increase in average daily gain from 59.88g in the control group to 69.96g in the 10% Lactobacillus group represents a 16.83% improvement. This result supports previous studies by Begdildayeva *et al.* (2024) showing that probiotics have the potential to enhance growth performance in broiler chickens. This increase in weight gain could partly be explained by a number of factors including gut health, increased nutrient digestion, and changes in the intestinal microbiota (Fesseha *et al.* 2021).

Interestingly, this study demonstrated a non-linear relationship in the performances due to supplementation with Lactobacillus. While 5%, 10%, and 15% supplementation groups outperformed the control group, 10% was the most effective among those, suggesting an optimal dosage range beyond which further supplementation additions do not translate into greater improvements, in a similar vein to the dose-dependent response of many probiotic intervention studies (Patterson & Burkholder, 2003).

V. CONCLUSION

The study clearly shows the most promising role of Lactobacillus supplementation in broiler chickens and an optimum inclusion level at 10% is clearly indicated. The results have showed that there is great improvement in feed conversion ratio, weight gain, and overall growth performance, which recommend probiotics as a promising substitute for conventional antibiotics in poultry nutrition. This study forms a valuable addition to already existing knowledge regarding economic and performance benefits of targeted probiotic interventions.

While encouraging, the present findings call for additional studies concerning the exact modes of action of probiotics, longer-term effects, and possible strain-specific differences. More studies will be needed altogether to explain the overall Lactobacillus supplementation effects given under variable conditions of diet and genetics.

REFERENCES

[1] Begdildayeva, N., Karahan, A. G., Kondybayev, A., Kudaibergenova, A., Nurgazina, A., Akhmetsadykov, N. and Akhmetsadykova, S. (2024). Probiotics effects on the growth performance and meat quality of broiler chickens. *Animal Production Science*, *64*(13).

[2] Blajman, J. E., Frizzo, L. S., Zbrun, M. V., Astesana, D. M., Fusari, M. L., Soto, L. P. and Signorini, M. L. (2014). Probiotics and broiler growth performance: a meta-analysis of randomised controlled trials. *British Poultry Science*, *55*(4), 483-494.

[3] Fesseha, H., Demlie, T., Mathewos, M. and Eshetu, E. (2021). Effect of Lactobacillus species probiotics on growth performance of dual-purpose chicken. *Veterinary Medicine: Research and Reports*, 75-83.

[4] Havenstein, G. B., Ferket, P. R. and Qureshi, M. A. (2003). Growth, livability, and feed conversion of 1957 versus 2001 broilers when fed representative 1957 and 2001 broiler diets. *Poultry science*, *82*(10), 1500-1508.

[5] Jha, R., Das, R., Oak, S. and Mishra, P. (2020). Probiotics (direct-fed microbials) in poultry nutrition and their effects on nutrient utilization, growth and laying performance, and gut health: A systematic review. *Animals*, *10*(10), 1863.

[6] Kabir S. (2009). Effect of probiotics on broiler meat quality. *African Journal of Biotechnology*. 8 (15): 3623–3627.

[7] Khomayezi, R. and Adewole, D. (2022). Probiotics, prebiotics, and synbiotics: an overview of their delivery routes and effects on growth and health of broiler chickens. *World's Poultry Science Journal*, *78*(1), 57-81.

[8] Maharjan, P., Martinez, D. A., Weil, J., Suesuttajit, N., Umberson, C., Mullenix, G. and Coon, C. N. (2021). Physiological growth trend of current meat broilers and dietary protein and energy management approaches for sustainable broiler production. *Animal*, *15*, 100284.

[9] Mountzouris, K. C., Tsirtsikos, P., Kalamara, E., Nitsch, S., Schatzmayr, G. and Fegeros, K. (2007). Evaluation of the efficacy of a probiotic containing Lactobacillus, Bifidobacterium, Enterococcus, and Pediococcus strains in promoting broiler performance and modulating cecal microflora composition and metabolic activities. *Poultry science*, *86*(2), 309-317.

[10] Patterson, J. A., & Burkholder, K. M. (2003). Application of prebiotics and probiotics in poultry production. *Poultry science*, *82*(4), 627-631.

[11] Ramlah, A. H. and Tan, C. K. (1995). Effects of probiotic supplementation on broiler performance. *Pertanika Journal of Tropical Agricultural Science*, *18*, 109-112.

[12] Uzabaci, E. and Yibar, A. (2023). Effects of probiotic supplementation on broiler growth performance: a meta-analysis of randomised controlled trials. *Animal production science*, *63*(7), 645-651.

[13] Wu, X. Z., Wen, Z. G. and Hua, J. L. (2019). Effects of dietary inclusion of Lactobacillus and inulin on growth performance, gut microbiota, nutrient utilization, and immune parameters in broilers. *Poultry science*, *98*(10), 4656-4663.