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Growth performance, carcass characteristics and internal organ weight of broilers fed probiotics.

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Target Audience: *Animal scientists and farmers*

Abstract

The basis of broiler productivity is in nutrient utilization and effective growth performance. In this study we evaluated the effect of different levels of probiotics on the growth performance, carcass characteristics and internal organ weight of broilers because of their ability to influence gut health and digestion. A total of 120 unsexed Day-Old Ross 308 chicks were randomly subdivided into four treatment groups in a Completely Randomized Design (CRD). Each treatment was replicated three times with each containing 10 birds. The experiment lasted for 8 weeks. Both the starter and the finisher rations were formulated with inclusion of different levels of probiotics for the four treatments. The control group formed the treatment one (T1) while T2, T3 and T4, contained 12.5g, 25g and 37.5g of probiotics/100kg of feed respectively. Data for growth performance were collected at day 1, day 28 and day 56 of the experiment. The result showed no statistical difference ($p<0.05$) in the weight gain and final weight but showed improved feed conversion ratio (FCR) in T3. A significant difference was also observed in the dressed weight and percentage dressed weight in which, T3 recorded the highest. Under the internal organs, a significant difference ($p<0.05$) was also observed in the weight of the abdominal fat, heart, intestine, and liver. In conclusion, the inclusion of probiotic especially at 25g was able to increase the broiler's dressed weight and feed conversion ratio (FCR) hence it can be used as a replacement for antibiotic growth promoters (AGP) in broiler production.

Keywords: Broilers, Probiotics, Antibiotics, Growth Performance, carcass, organ weight.

Description of Problem

The demand for livestock products, especially poultry, is steadily increasing in Nigeria and across Africa because of population growth and increased urbanization [1]. The increasing population means increase in the need for food security. The poultry production has therefore become an important economic activity in many countries. In large-scale rearing facilities, where poultry are exposed to stressful conditions, problems related to diseases and deterioration of environmental conditions often occur and result in serious economic losses]2]. The productivity of the poultry industry has been combated by various factors, including emergence of a large variety of pathogens and bacterial resistance. These impacts are in part due to the indiscriminate use of chemotherapeutic agents because of management practices in rearing cycles [2].

According to Kabir [2], prevention and control of diseases during recent decades have led to a substantial increase in the use of veterinary medicines. However, the utility of antimicrobial agents as a preventive measure has been questioned, given extensive documentation of the evolution of antimicrobial resistance among pathogenic bacteria [2]. So, the use of antibiotics as growth stimulants for poultry of their use as therapeutic agents and this has produced a climate in which both consumer and manufacturer are looking for alternatives [2]. In view of the severe restriction or total ban on the use of antibiotics as growth promoters in poultry production, probiotics have been suggested as an alternative to antibiotics. Probiotics have been defined as viable microorganisms (bacteria or yeasts) that exhibit a beneficial effect on the health of the host when they are ingested [3]. Several studies have shown that the addition of probiotics to the diets of broilers leads to improved performance. [4, 5, and 6,]

According to refer to Kabir [2], and Rajesh *et al*. [3] Probiotics have been evaluated for their potential to improve growth performance in commercial poultry production since the phasing out of antibiotic growth promoters (AGPs) in poultry feed [4]. Antibiotics growth promoters (AGPs) work by inhibiting the production and excretion of catabolic mediators by intestinal inflammatory cells, which, in turn, results in reduced intestinal micro flora [2]. By contrast, probiotics promote growth by modulating the gut environment and enhancing gut barrier function via the fortification of beneficial intestinal micro flora, the competitive exclusion of pathogens, and the stimulation of the immune system [4]. The aim of this study, therefore, is to observe how the dietary inclusion of probiotic affect the growth performance carcass characteristics and internal organ weights of broilers.

Materials and Methods

Experimental site

The experiment was carried out at a poultry farm located at Nnung Ette, Shelter Afrique Extension in Ibesikpo/Asutan Local Government Area, Akwa Ibom State. The area falls within the tropical rainforest zone of Nigeria, with two distinct seasons, rainy season (March – Mid November) and dry season (November - March) it has an average rainfall of 2200mm to 3500mm. The temperature of the area ranges from 26 to 28 [7]

Experimental Diets

Four (4) experimental broiler diets were formulated for both broiler starter (first 28 days) and finisher phases (last 28 days). The diets were formulated with the inclusion of probiotics at different inclusion levels for both phases. It was designed such that diet 1 (T1, control) had no probiotics, diet 2 (T2), diet 3 (T3) and diet 4 (T4) had Lactic Dry probiotics inclusion levels of 12.5g, 25g and 37.5g per kg or 100kg respectively. The Lactic Dry is a probiotic/antistress powder containing 5000 billion cells of *Saccharomyces cerevisiae*, 77 billion CFU of *Lactobaccilus acidophilus*, 44 billion CFU of *Streptococcus faecium*, 2.2 billion CFU *Bacillus subtilis* and enzymes. The other ingredients were added to meet the nutrient requirement of broilers for both starter and finisher phases. The ingredient composition and the calculated chemical composition of both the starter and finisher diets are presented in Table 1 and 2.

Experimental birds and Design

A total of 120 unsexed day-old chicks was used for the research, they were bought from a vendor in Uyo. The birds were managed in a deep litter system with wood shavings as the liter material during the brooding and rearing phases. The experiment lasted eight (8) weeks between 8th February and 5th May 2022. The starter phase was made up of the first four (4) weeks and the last four weeks as the finisher phases. The chicks were randomly divided into four (4) treatment groups (T1, T2, T3, and T4), with thirty (30) birds each per treatment. Each of the four treatments was further divided into three (3) replicates with ten (10) birds randomly assigned to each of the replicates in a Completely Randomized Design (CRD).

Experimental Animal management

Prior to stocking/arrival of the chicks, the pen for brooding and rearing was thoroughly swept, washed, disinfected, and allowed to dry. Preparation of the brooding house followed immediately in which black polythene bags were used to create a microclimate that would conserve and maintain heat to the requirement of the birds in their first week. Proper electrical connections were done to provide enough light supply as well as heat, when the brooding house was ready, wood shavings was poured on the floor to serve as the litter material.

Glucose was added to their drinking water to ease the stress of transportation on arrival of the chicks. Feed and water were provided *ad-libitum* with the inclusion of vitamins in their drinking water from the second day, vaccines and other medications were given as at when due.

The birds were weighed at the beginning and at the end of the experiment to determine their body weight changes.

Table 1: Composition of experimental diet (starter phase)

Ingredients	T1 (0g Probiotics)	T2 (12.5g probiotics)	T3 (25g probiotics)	T4 (37.5 probiot
Maize	53.11	53.10	53.09	53.08
Soybeans	21.89	21.89	21.91	21.90
Blood Meal	3.00	3.00	3.00	3.00
Fish Meal	3.00	3.00	3.00	3.00
Wheat Offal	10.00	10.00	10.00	10.00
Palm Kernel Cake	5.00	5.00	5.00	5.00
Bone meal	3.00	3.00	3.00	3.00
Common salt	0.25	0.25	0.25	0.25
L-lysine	0.25	0.25	0.25	0.25
L-Methionine	0.25	0.25	0.25	0.25
Vit Premix*	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Calculated Proximate composition (%DM)				
Crude Protein	22.00	22.00	22.00	22.00
Ether extract	16.07	16.07	16.07	16.07
Crude Fibre	4.48	4.48	4.49	4.48
Ash	3.40	3.40	3.40	3.40
NFE**	54.05	54.05	54.03	54.05
Phosphorus	0.51	0.51	0.51	0.51
Calcium	0.17	0.17	0.17	0.17
ME (Kcal/kg)***	2663.38	2662.69	2662.86	2661.90

*Vitamin Premix supplied the following per kg of diet, vitamin A 10,000 i.u., vitamin D3 12,000 i.u., vitamin E 20 i.u., vitamin K 2.5mg, thiamin 2.0mg, riboflavin 3.0mg,
**NFE-Nitrogen Free Extract.
***ME-Metabolizable Energy

Table 2: Composition of experimental diet (finisher phase)

Ingredients	T1 (0g Probiotics)	T2 (12.5g probiotics)	T3 (25g probiotics)	T4 (37.5g probiotics)
Maize	60.80	60.79	60.77	60.76
Soybeans	14.20	14.20	14.21	14.21
Blood Meal	3.00	3.00	3.00	3.00
Fish Meal	3.00	3.00	3.00	3.00
Wheat Offal	10.00	10.00	10.00	10.00
Palm Kernel Cake	5.00	5.00	5.00	5.00
Bone meal	3.00	3.00	3.00	3.00
Common salt	0.25	0.25	0.25	0.25
L-lysine	0.25	0.25	0.25	0.25
L-Methionine	0.25	0.25	0.25	0.25
Vit Premix*	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Calculated Proximate composition (%DM)				
Crude Protein	19.00	19.00	19.00	19.00
Ether extract	4.03	4.03	4.03	4.03
Crude Fibre	4.19	4.19	4.19	4.19
Ash	3.04	3.04	3.04	3.04
NFE**	69.74	69.74	69.74	69.74
Phosphorus	0.48	0.48	0.48	0.48
Calcium	0.16	0.16	0.16	0.16
ME (Kcal/kg)***	2862.70	2862.70	2662.86	2661.90

*Vitamin Premix supplied the following per kg of diet, vitamin A 10,000 i.u., vitamin D3 12,000 i.u., vitamin E 20 i.u., vitamin K 2.5mg, thiamin 2.0mg, riboflavin 3.0mg,
**NFE-Nitrogen Free Extract; ***ME-Metabolizable Energy

Data Collection

The data collected for the experiment included initial body weight, weekly weight gain, final weight, feed intake and mortality. Feed conversion ratio was also calculated. The birds were weighed at beginning of the research to obtain their initial body weight and weekly body weight thereafter, and at the end of the research for their final body weight. Body weight gain was determined by subtracting the initial body weight from the final body weight. Daily weight gain was determined by dividing the body weight gain by the number of days the research lasted. Feed conversion ratio was determined by dividing daily feed intake by daily weight gain. Daily, feed intake per replicate was recorded, and it was determined by subtracting the weight of the left-over feed from the weight of the feed that was given the previous day. This was usually carried out at 8am every day. The average feed intake was also determined by dividing the feed intake by 10 birds. The analysis for the carcass and internal organ weight was conducted on the 56th day of the experiment. Three (3) birds each was selected from the four (4) treatment groups and slaughtered after mechanical stunning. The slaughtered birds were defeathered, eviscerated and weighed. Internal organs were also weighed, and their different weight were recorded accordingly.

Data Analysis

Data generated from the experiment

were subjected to analysis of variance (ANOVA) according to Steel and Torie [8]. ANOVA detected the treatment effects while means were compared using the Duncan New Multiple Range Test as designed by [9].

Results

Growth performance of the experimental birds

The result of probiotics inclusion at the four experimented levels on the growth performance of broiler is presented in Table 3. The result shows no significant difference (p>0.05) in the weight gain (WG), final body weight (FBW) and mortality. There was a significant difference (P<0.05) in the Feed intake and feed conversion ratio (FCR). The T3 had the high feed intake but at the same time also recorded the lowest value of feed conversion ratio.

Table 3: Effect of probiotics on growth performance of broilers

Parameters	T1 (0g Probiotics)	T2 (12.5g probiotics)	T3 (25g probiotics)	T4 (37.5g probiotics)	SEM
Abd. Fat*	0.00^{b}	0.62^{a}	0.62^{a}	0.00^{b}	0.24
Initial body weight/bird (g)	138.80	138.10	138.50	139.80	3.13
Final body weight/bird (g)	1853.00	1820.00	2002.00	1797.00	99.40
Body weight gained/bird (g)	1714.00	1682.00	1864.00	1658.00	99.33
Body weight gained/day (g)	34.98	34.32	38.04	33.83	2.03
Total feed intake/bird (g)	4143.00^{a}	4146.00^{a}	4080.00^{b}	4198.00^{a}	27.11
Feed intake/bird/day (g)	84.56^{a}	84.60^{a}	83.27^{b}	85.67^{a}	0.55
Feed conversion Ratio	2.42^{a}	2.47^{a}	2.10^{b}	2.54^{a}	0.09
Mortality (%)	13.33	13.33	13.33	13.33	9.43

^{ab} = Means with different superscripts within a row are significantly different (P<0.005), SEM= Standard error of mean; Abd - Abdomen

Carcass Characteristics

The result of the carcass and cut parts is presented in Table 4, below. The result recorded a significant difference (p<0.05) only in the dressed weight and percentage dressed weight within the carcass table. The results showed that the T3 had the best dressed weight compared to others, its weight was significantly different (p<0.05) from the T4 but was significantly like the control and the T2. This result also shows that when cut into parts, the inclusion of probiotics doesn't affect (p>0.05) the weight of any of the meat cuts.

Table 4: Effect of probiotics on carcass characteristics (% of live weight)

Parameters	T1 (0g Probiotics)	T2 (12.5g probiotics)	T3 (25g probiotics)	T4 (37.5g probiotics)	SEM
Live weight (g)	2128	1960	2193	1592	247.56
Dress weight (g)	1467.20^{ab}	1412.17^{ab}	1593.07^{a}	1076.06^{b}	177.71
Dress %	69.09^{ab}	72.04^{ab}	72.56^{a}	67.61^{b}	1.923
Breast cut (g)	28.47	28.59	29.16	27.37	1.25
Back cut (g)	27.49	27.85	28.64	27.61	1.35
Thigh cut (g)	15.43	15.57	14.97	13.63	1.18
Wing cut (g)	10.74	10.29	9.93	11.17	0.53
Drum stick (g	15.43	15.57	14.17	13.63	1.18

ab =Means with different superscripts within a row are significantly different, SEM= Standard error of mean.

Organ weights

The result of the internal organ weights is presented in Table 5. There were significant differences (p<0.05) in the weight of the abdominal fat, heart, intestine 2 and liver. An increase in probiotics inclusion in the diets of the birds led to a concomitant increase in abdominal fat, heart, intestine without contents and liver. The probiotics effect is clearly evident in improving the weight of organs as stated by Shanmugam (4).

Table 5: Effect of probiotics on internal organ weights (% of dress weight)

Parameters	T1 (0g Probiotics)	T2 (12.5g probiotics)	T3 (25g probiotics)	T4 (37.5g probiotics)	SEM
Abd. Fat* (g)	0.00^b	0.62^a	0.62^a	0.00^b	0.24
Ceacum (g)	3.12	3.27	3.82	2.91	0.55
Crop (g)	2.54	1.48	1.70	2.30	0.72
Gizzard 1** (g)	5.68	5.51	4.93	6.27	0.66
Gizzard 2***(g)	3.35	3.64	3.87	4.02	0.42
Heart (g)	0.10^c	0.35^b	0.46^b	0.65^a	0.06
Intestine 1** (g)	10.82	9.92	8.59	10.07	2.09
Intestine 2***(g)	3.89^b	2.96^b	4.14^b	6.32^a	0.64
Liver (g)	2.68^b	2.49^b	2.77^b	4.23^a	0.53
Spleen	0.08	0.08	0.08	0.17	0.05

^{ab} =Means with different superscripts within a row are significantly different, SEM= Standard error of mean., *Abd Fat=abdominal fat **intestine 1, gizzard 1= with contents, ***intestine 2, gizzard 2=without content,

Discussion

Growth Performance of the Experimental Birds

The reports on effect of probiotics on body weight of broilers is conflicting, while several researchers like [7, 12, 13], have claimed a significant improvement in body weight of broilers following probiotic supplementation in broiler diet, there are others like [9, 10], who have concluded based on their studies that addition of probiotics did not significantly affect the body weight of broilers. In this study once again, the growth performance was not consistent in all the measured parameters. This study also shows that inclusion of probiotic at 25g per 100kg yielded the highest final liveweight in all the treatments. Probiotics are noted to promote growth by modulating the gut environment thereby enhancing gut barrier function via the fortification of beneficial intestinal micro flora, the competitive exclusion of pathogens, and the stimulation of the immune system [4]. The beneficial effect of probiotic supplementation to broiler diet in terms of increasing body weight and body weight gain has also been documented in the study of [13]. They also ran a cost analysis and figured that feeding probiotics to broilers brought about increased profitability especially in the group fed 75g per 100kg of feed thus concluded that probiotics given at 75 g/100 kg feeds improves growth, feed efficiency, carcass yield and profitability. Results of feed intake obtained in this study is in line with the report of Abdel-Raheem et al [14] who observed that feed intake was improved by the supplementation of probiotics. [14, 15] holds that the supplementation of probiotics decreased gastric emptying time, which leads to higher feed intake. In contrast to [16] who reported that the use of probiotics in broiler diet did not affect FCR, the treatment fed 25g of probiotics had the best FCR of (2.10) and was significantly different ($p<0.05$) when compared with T1 (2.42), T2 (2.47) and T4 (2.54). In this study, T3 represent the inclusion of probiotics at 25g per 100kg of feed and it has consistently shown a better performance in comparison with the other levels of inclusion. There were no significant differences between treatments regarding mortality which also conforms to the findings of [17]. Other researchers, also found no or minimal effect of probiotics on the mortality of broilers [18, 19 and 20]. This inconsistency might be attributed to the strains of probiotic, method of preparation, administration dosage, diet composition, bird age, and hygiene status etc. [19, 21].

Carcass Characteristics

As revealed in the result, the dressed weight and percentage dressed weight was significantly affected by feeding probiotics to the broilers as the group treated with 25g/100kg of feed had the highest dressed weight. They also recorded the highest percentage dressed weight. This implies that 25g inclusion of probiotics increases the quantity of edible meat in broilers. When the chicken was cut however, there was no significant difference in the weight of their cut parts. That was also the case in the studies of [22, 23, 24, 25 and 26] who reported no significant effect of dietary inclusion of probiotic on, breast, thigh weights, abdominal fat. This is, however, awkward and can be attributed to absence of a significant difference in the final liveweight and the narrow difference in the dressed weight.

Organ weights

The use of probiotics did not significantly affect the weight of the gizzard, caecum, and intestine 1. However, a significant difference was observed in the abdominal fat where the T1 and T4 did not have any abdominal fat content. There was also a significant difference in the weights of the heart, liver, and intestine. The latter is in line with the findings of [27] where the use of probiotics and prebiotics had a profound effect on the weight and development of the liver and heart. In support of this, [14] reported that the relative weights of proventriculus, gizzard, heart, colon, cecum, thymus, and bursa remained unaffected by adding probiotics to feed. The divergent result might be influenced by strain, level of treatment, and basal composition [19]

Conclusion and Application

1. The use of probiotics found its way into poultry nutrition because of its expected positive digestive actions in the alimentary canal, making digestion easier and improving nutrient utilization thus growth performance. In this study, we have found that:
2. The use of Lactic Dry Probiotics influenced feed intake but did not influence the growth performance of broilers. However, it showed an effect in the carcass characteristics as the group fed 25g had the highest edible meat.
3. The probiotics had a limited effect on only the gizzard, intestine, and heart.
4. The best level of probiotic supplementation is 25g/100kg of feed.
5. There is need to study the effect of the different probiotics on the microbiome of the broilers to better understand how it can affect broiler productivity.

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