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Review Article

Impact of Dietary Supplementation of Home-Produced Lactobacillus serum on growth performance, Carcass characteristics, Sensory evaluation, Microbial population and Haematological Indices of Broiler chicken

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Abstract

This study was designed to evaluate the effects of varying concentrations of home-produced Lactobacillus serum administered via drinking water on growth performance, carcass characteristics, sensory evaluation, microbial population and haematological indices of broiler chickens. A total of 250 – 1day old broiler chicks (Ross 307) were randomly assigned to five treatments in a Completely Randomized Design. Each treatment consisted of five replicates with ten birds each. The treatments included: Treatment 1 (T1: control, basal diet + plain water) T2, T3, T4 and T5 which received basal diet supplemented with Lactobacillus serum at 5, 10, 15 and 20 mL/L of drinking water, respectively. The trial lasted for 42 days and the formulation of basal diet followed nutritional recommendation by NRC (1994). The Lactobacillus serum was produced by the fermentation of polished rice water and skimmed milk. Result obtained revealed that birds in T4 (15 mL/L) and T5 (20 mL/L) achieved significantly ($p<0.05$) higher body weight gain, feed consumption, dressing percentage and overall meat acceptability compared to other groups. Furthermore, T4 and T5 exhibited the best feed conversion ratio compared to the control. Pack cell volume, haemoglobin concentration, red blood cell, mean corpuscular volume, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration and white blood cell counts remained within the physiological ranges for healthy broilers across all treatments ($p>0.05$). Intestinal microbial population of Escherichia coli, Salmonella sp and Staphylococcus sp was depressed ($p<0.05$) as the administration of serum Lactobacillus in drinking water increased from 5 – 20 mL/L while Lactobacilllus sp count increased as the level of serum Lactobacillus increases across the treatments. In conclusion, supplementation of drinking water with Lactobacillus serum at 15 – 20 ml/liter effectively enhances broiler growth and feed efficiency without compromising the bird's physiological health. It is recommended as a safe, low cost natural alternative to synthetic growth promoters. .

Keywords: Lactobacillus, Broilers, Growth Performance, Fermentation, Haematology, Milk.

Introduction

The global poultry sector is experiencing a significant transformation, driven by a rising demand for animal protein and a worldwide initiative to eliminate the use of sub-therapeutic antibiotic growth promoters (AGPs) [1, 2]. Previously, AGPs played a crucial role in enhancing growth and controlling diseases in animals; however, their connection to antimicrobial resistance has prompted the exploration of organic or natural alternatives that are safe, environmentally friendly, and do not require a withdrawal period [3, 4]. Among these alternatives, lactic acid bacteria, such as lactobacillus, have proven to be effective biological agents for promoting gut health through competitive exclusion, thereby inhibiting pathogens

like Escherichia coli, Staphylococcus spp., and Salmonella spp., while also enhancing nutrient absorption by increasing villi height [5, 6].

Despite the documented benefits of probiotics, high quality commercial formulation remain prohibitively expensive and inaccessible to small holder farmers in developing countries [7, 8]. This economic barrier often forces producers to rely on cheaper conventional antibiotics or face high mortality rates and poor feed efficiency [9]. While home produced lactobacillus solution derived from fermentation of rice wash water and skimmed milk – often offers low cost alternative, it lacks standardized inclusion protocols [10, 11]. There is critical gap regarding the optimal dosage required to achieve growth benefits without inducing stress or metabolic imbalances in the birds [12].

Previous studies have shown that the supplementation of probiotics in the diet of broilers demonstrated positive impact on body weight gain, feed intake and feed efficiency [13, 14], modulate the secretion of digestive enzymes, reduce mortality down to 0 – 3 % [15], neutralize the activities of free radicals [16, 17], improves blood parameters and increase the concentration of polyunsaturated fatty acid in the meat [18].

This research is warranted due to the pressing demand for affordable, accessible biotechnologies in sustainable poultry farming. By offering a straightforward dose-response model, farmers will be equipped to lower production expenses, eradicate antibiotic residues in meat, and enhance global food security through organic-compliant practices.

Materials and methods

Ethical approval and experimental location

The trial was conducted at the Poultry Section Gandhi College of Agricultural Research Farm located between latitude 23° 03 N to 30° 012 N and longitude 69° 30 E to 78° 17 E. The mean annual rainfall and humidity of 575 mm and 55 % respectively. All experimental procedures were approved by the Institutional Animal Care and Ethics Committee (AFS/304/2026) ensuring adherence to compliance with standard poultry welfare standards over the 42 days study.

Preparation of Lactobacillus serum

500 g of polished rice was manually washed in 1000 mL of water for 5 minutes, the cloudy rice water was drained into a clean jar covered with clean breathable cotton cloth and kept at room temperature for 5 days. On the 6th day, 100 mL of the polished rice water was added into 1000 mL skimmed milk in another clean jar covered with a paper towel secured with rubber band and stored under room temperature for 7 days until a small amount of sediment was formed. The sediment was passed through a cheese cloth into a clean bottle to obtained Lactobacillus serum followed by the addition of molasses (1:1 ratio) to keep the bacteria alive and kept under room temperature.

Animal Care and experimental design

250 –one day old broiler chicks (Ross 308) were randomly assigned to five treatments in a completely randomized design. Each treatment consisted of five replicates with 10 birds each. Birds were housed in battery cages which have been thoroughly cleaned and disinfected with FIO® Avian disinfectant concentrate (10 ml to 1 liter of water). After the arrival of birds, average initial body weight was measured using a digital sensitive scale. Brooding temperature was maintained at 37°C for the first week and gradually reduced by 2°C weekly until a temperature of 27°C was attained. Vaccines were administered according to the prevailing disease condition in the environment and strict biosecurity was maintained. Treatment 1 (Control): basal diet only which was compounded according to the requirements for broilers by NRC [19] + plain water, treatment 2 to 5 received basal diet + 5 ml, 10 ml, 15 ml and 20 ml / liter of Lactobacillus serum in water. The experiment lasted for 42 days and daily feed intake was calculated as the difference between feed offered and left overs. Body weight gain was estimated as the difference between the final body weight and the initial body weight. Feed to gain ratio was calculated as the total feed consumed to the total weight gain.

Nutrient digestibility trial

At the end of the 42 days, ten birds were randomly selected per treatment for digestibility trial. Selected birds were housed individually in a battery cage which has been previously disinfected two weeks before the commencement of the trail. Birds were acclimatized for 3 days and fed basal diet. On the 4th day, birds were fed experimental diet and collection of faecal output lasted for 7 days, clean water was made available at all times and daily feed intake was recorded. Collected faecal samples were oven dried at 65°C for 24 hours and kept in a labeled polythene bag. At the end of the trial, faecal output from each treatment was weighed, bulked together and 10 % of the total feacal sample and experimental was sent to the laboratory for further analysis. Proximate analysis was carried out using Foss Near Infra-Red Feed analyzer (Model 3200 BC, Netherlands) calibrated at a wavelength between 400 – 2500 nm and its silicon and lead sulfide detector was maintained between 400 – 1100 nm and 1100 – 2500 nm to ensure clear precision in results.

Nutrient digestibility was estimated using the formula below:

$$\% \text{ Nutrient digestibility} = \frac{\text{Ingested Nutrient} - \text{Nutrient voided}}{\text{Ingested Nutrient}} \times 100$$

Carcass and organ evaluation

On day 42, 5 birds were randomly selected per treatment for carcass evaluation. Live weights of birds were recorded individually, feed was withdrawn for 12 hours while water was made available to prevent dehydration. Birds were slaughtered manually with a sharp knife through neck cut-

ting, de-feathered. Weight of cut parts were recorded with high precision digital weighing scale (Ghusp® digital scale, Model XC3100, China). Dressed weight was recorded after removing feathers, head, thigh, neck, head, drumstick, wing and shanks. Dressing percentage was computed using the formula below:

$$\text{Dressing percentage} = \frac{\text{Live body weight}}{\text{Dressed weight}} \times 100$$

Sensory evaluation

On the last day of the experiment, samples of meat from the breast muscle of 5 birds were randomly selected per treatment for organoleptic evaluation (from the same birds used for carcass evaluation). Meat samples were diced into small pieces, tied in a polythene bag and cooked at a temperature of 70°C for 10 minutes without salt or spices. The evaluated parameters by panelist include; juiciness, flavour, tenderness, colour and overall acceptability. Before the commencement of the sensory quality, each meat sample was assigned a code for easy identification and presented one after the other to each member of the panel. Each member rinsed his or her mouth with warm water after assessing each meat sample to avoid carry-over effect. The panelists rate the meat based on 9 point Hedonic scale of (i) Dislike extremely (ii) Dislike very much (iii) Dislike moderately (iv) Dislike slightly (v) Intermediate (vi) Like slightly (vii) Like moderately (viii) Like very much (ix) and Like extremely [20].

Evaluation of Intestinal microbial population

5 birds were randomly selected per treatment for intestinal microbial population on the last day of the experiment from the same birds used for carcass evaluation. 10 g intestinal content was collected into sterile labelled sample bottles containing 0.2 mL pepetone solution. Collected samples were stored under -20°C and transferred to the laboratory for further evaluation. Samples were analyzed using BacT® Virtuo Microbial Analyzer (Model 3140 C, USA) which operates via Colorimetric/Turbidimetric Technology set at a repetition rate of 200 Hz to ensure precision in results. Population of Escherichia coli, Salmonella sp, Staphylococcus sp and Lactobacillus sp were expressed as Log10 (106/Cfu/ml)

Blood collection and analysis

On the last day of the study, 5 birds were randomly selected per treatment for haematological studies, blood sample were collected from each bird (2.5 mL) via wing vein puncture using sample bottles containing ethylene diamine tetra acetic acid (EDTA) for the determination of hematological parameters (Pack cell volume, haemoglobin, red blood cell, white blood cell, mean corpuscular volume, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration). Collected samples were placed in an ice pack to prevent deterioration of samples and shipped immediately to the laboratory for analysis. Blood samples were analyzed with Automated Haemo-Sysmex Analyzer (XN-2000 Series, Japan) which operates via fluorescence flow cytometry technology. Kit was operated at an optical density of 30 nm and sample volume 165 µL to generate precise result/output.

Data analysis

Data obtained were subjected to analysis of variance (ANOVA) for a completely randomized design using Statistical Package for the Social Sciences (version 27). When the ANOVA was significant, means were separated using Duncan's multiple range test at the level of $p< 0.05$. The statistical model is shown below:

$Yij = \mu + Ci + eij$

Where Yij = dependant variables; µ = population mean; Ci = effect of different dose on the growth performance, nutrient digestibility carcass characteristics, organoleptic qualities and haematological components and eij = random error assumed to be normally and independently distributed.

Results and Discussion

Composition of the experimental diets for broiler starter (0 – 28 d) and finisher (29 – 42 d) is presented in Table 1.

Materials	Starter diet (0- 28d)	Finisher diet (29-42d)
Maize	50.00	55.00
Wheat bran	4.20	7.65
Soybean meal	25.00	20.00
Groundnut meal	9.00	5.00
72 % Fish meal	3.00	2.00
Bone meal	5.00	6.00
Limestone	2.50	3.00
Methionine	0.25	0.25
Lysine	0.25	0.25
Min-Vit Premix	0.25	0.25

Toxin binder	0.20	0.20
Salt	0.35	0.40
Total	100.0	100.0
Determined values (%)		
Crude protein	23.41	21.09
Crude fibre	3.94	4.02
Ether extract	3.63	3.76
Calcium	1.76	1.82
Phosphorus	0.75	0.89
Energy (Kcal/Kg)	3006.1	3200.5

Starter Min-Vitamin Premix; 2.5 kg contains—vitamin A: 10,000,000 IU; vitamin D3: 4,000,000 IU; vitamin E: 27,000 IU; vitamin K: 3,000 mg; thiamine B1: 1,800 mg; riboflavin B2: 7000 mg; pyridoxine B6: 2,800 mg; niacin: 30,500 mg; vitamin B12: 20 mg; pantothenic acid: 9000 mg; folic acid: 8000 mg; biotin: 70 mg; choline chloride: 350 g; antioxidant: 115 mg; magnesium: 100 g; zinc: 70 g; iron: 13 g; copper: 8.00 g; iodine: 1.25 g; selenium: 100 mg; cobalt: 100 mg.
Finisher Min-Vitamin Premix; 2.5 kg contains —vitamin A: 10,000,000 IU; vitamin D3: 2,000,000 IU; vitamin E: 20,000 IU; vitamin K: 2,250 mg; thiamine B1: 1750 mg; riboflavin B2: 5000 mg; pyridoxine B6: 2750 mg; niacin: 27,500 mg; vitamin B12: 15 mg; pantothenic acid: 7500 mg; folic acid: 7500 mg; biotin: 50 mg; choline chloride: 400 g; antioxidant: 125 mg; magnesium: 80 g; zinc: 50 g; iron: 20 g; copper: 5 g; iodine: 1.2 g; selenium: 200 mg; cobalt: 200 mg.

Table 1: Composition of the experimental diets for broiler starter (0 – 28 d) and finisher (29 – 42 d)

The analyzed value for starter diet contained crude protein (23.41 %), crude fibre (3.94 %), ether extract (3.63 %), calcium (1.76 %), phosphorus (0.76 %) and energy (3006.1 kcal/kg) while for finisher diet crude protein (21.09 %), crude fibre (4.02 %), ether extract (3.76 %), calcium (1.82 %), phosphorus (0.89 %) and metabolizable energy (3200.5 kcal/kg). The values obtained aligns with the recommendation for broiler by [17].

Effects of varying concentrations of Lactobacillus serum on growth performance of broiler chickens (Table 2).

Parameters	**T1 (0 mL)**	**T2**	**T3**	**T4**	**T5**	**SEM**	**P-value**
Initial body weight (g/bird)	55.81	54.98	54.94	55.11	54.88	0.02	0.06
Final body weight (g/bird)	2133.1c	2570.1b	2595.6b	3005.3a	3008.9a	45.11	0.03
Body weight gain (g/bird)	2077.3c	2515.1b	2540.6b	2950.2a	2954.0a	38.76	0.02
Daily weight gain (g/bird)	49.46c	59.88b	60.49b	70.24a	70.33a	0.03	0.01
Feed consumption (g/bird)	4992.5b	5106.1a	5108.6a	5111a	5115a	69.08	0.04
Daily feed consumption (g/bird)	118.8b	121.5a	121.6a	121.6a	121.7a	0.69	0.02
Feed conversion ratio	2.40a	2.03b	2.01b	1.73c	1.73c	0.01	0.01

Means in the same row with different superscripts differ significantly ($p<0.05$); SEM: standard error of the mean; Probability value (P-value); T1 (0 mL Lactobacillus serum); T2 (5 mL Lactobacillus serum/liter of water); T3 (10 mL Lactobacillus serum/liter of water); T4 (15 mL Lactobacillus serum/liter of water); T5 (20 mL Lactobacillus serum/liter of water)

Table 2: Effects of varying concentrations of Lactobacillus serum on growth performance of broiler chickens

Body weight gain, feed consumption and feed conversion ratio were influenced ($P>0.05$) by the treatments. Body weight gain and feed consumption were higher in treatment 4 (T4) and T5, intermediate in T2 and T3 and lower in T1. This result suggests that the administration of Lactobacillus serum at a higher concentration (15 – 20 mL/liter) was more effective than lower doses (5 – 10 mL/liter) in T2 and T3. Higher concentration of Lactobacillus serum can effectively stabilize the intestinal flora of birds giving room for efficient absorption of nutrients by increasing villi height, lowering intestinal pH which activates the activities of digestive enzymes in the gut [19]. This further shows that Lactobacillus serum is a potent natural growth promoter for broiler chickens [20]. The increase in feed consumption among birds in T2 through T5 suggests that Lactobacillus serum is capable of boosting the appetite of birds. This result aligns with the reports of [21];

[22] who reported an increase in body weight and improved feed intake of broilers when 0.5 % probiotics in their diet. The administration of serum via drinking water in T4 and T5 also produced the most efficient feed conversion ratio compared to the other treatment. Birds in this group are more efficient at converting feed to muscle. The result obtained is in consonance with the reports of [23].

Effects of varying concentrations of Lactobacillus serum on nutrient digestibility of broiler chickens (Table 3).

Parameters (%)	T1	T2	T3	T4	T5	SEM	P-value
Dry matter	78.15b	89.06a	89.54a	88.93a	88.95a	0.02	0.03
Crude protein	71.13b	84.36a	84.76a	84.82a	84.89a	0.03	0.01
Crude fibre	58.18b	63.27a	64.05a	64.11a	64.52a	0.01	0.04
Ether extract	59.88b	70.18a	73.55a	73.67a	73.76a	0.02	0.05
Ash	48.73b	55.85a	55.19a	55.52a	55.63a	0.04	0.02

Means in the same row with different superscripts differ significantly ($p<0.05$); SEM: standard error of the mean; Probability value (P-value); T1 (0 mL Lactobacillus serum); T2 (5 mL Lactobacillus serum/liter of water); T3 (10 mL Lactobacillus serum/liter of water); T4 (15 mL Lactobacillus serum/liter of water); T5 (20 mL Lactobacillus serum/liter of water)

Table 3: Effects of varying concentrations of Lactobacillus serum on nutrient digestibility of broiler chickens

Digestibility of dry matter was lower ($p<0.05$) in T1 (78.15 %) than T2 (89.06 %), T3 (89.54 %), T4 (88.93 %) and T5 (88.95 %). Crude protein, crude fibre, ether extract and ash digestibility were influenced ($p<0.05$) by the treatment and values obtained ranged from 71.13 – 84.89 %, 58.18 – 64.52 %, 59.88 – 73.76 % and 48.73 – 55.63 % respectively. The result on nutrient digestibility suggests that supplementation of drinking water with Lactobacillus serum at 5 – 20 ml/liter helps to increase the surface area of villi to ensure more nutrient absorption into the blood stream of birds and also facilitates the production of exogenous enzymes to ensure breakdown of complex feed [24]. This result is in consonance with the reports of [25] when probiotics was substituted was used to substitute antibiotics at 6 % in the diet broiler chickens. [26] also recorded a positive outcome in nutrient digestibility of crude protein, dry matter and ether extracts of broilers fed diet supplemented with prebiotic, probiotic and symbiotic.

Effects of varying concentrations of Lactobacillus serum on carcass characteristics of broiler chickens is revealed in Table 4.

Parameter	T1	T2	T3	T4	T5	SEM	P-value
Live weight (g)	2300.8 c	2711.2 b	2750.2 b	3081.2 a	3095.3a	47.19	0.03
Dressed weight (g)	1830.4c	2220.1b	2231.4b	2834.1a	2840.9a	40.80	0.04
Dressing percentage	79.55c	81.88b	81.13b	91.08a	91.78a	0.74	0.02
Head (g)	42.96	43.03	43.11	43.98	44.32	0.32	0.06
Neck (g)	71.02c	88.05b	88.31b	95.71a	96.75a	0.93	0.03
Back (g)	209.1c	229.8b	231.2b	268.4a	271.6a	3.85	0.02
Breast (g)	301.5c	388.5b	387.2b	496.3a	498.1a	4.72	0.02
Thigh (g)	154.2c	190.3b	188.7b	208.6a	210.3a	2.16	0.01
Shank (g)	69.22c	76.09b	75.11b	86.23a	87.16a	0.65	0.04
Wing (g)	138.8c	146.9b	145.3b	166.5a	168.9a	1.97	0.03
Drumstick (g)	189.6c	206.3b	211.4b	230.7a	229.5a	2.05	0.01

Means in the same row with different superscripts differ significantly ($p<0.05$); SEM: standard error of the mean; Probability value (P-value); T1 (0 mL Lactobacillus serum); T2 (5 mL Lactobacillus serum/liter of water); T3 (10 mL Lactobacillus serum/liter of water); T4 (15 mL Lactobacillus serum/liter of water); T5 (20 mL Lactobacillus serum/liter of water)

Table 4: Effects of varying concentrations of Lactobacillus serum on carcass characteristics of broiler chickens

Dressed weight was lower in T1 (1830.4 g) than in T2 (2220.1 g), T3 (2231.4 g), T4 (2834.1 g) and T5 (2840.9 g). Dressing percentage was higher in T4 (91.08 %) and T5 (91.78 %) intermediate in T2 (81.88 %), T3 (81.13 %) and lowest in T1 (79.55 %) ($p<0.05$). Weights of back, breast, thigh, neck, shank, wing and drumstick were significantly ($p<0.05$) influenced except the neck ($p>0.05$). This outcome suggests that administration across the treatments improved the retention of nitrogen and protein deposition in the breast and thigh muscles translating to an increase in dressing percentage. This result is in agreement with the report of [27] when organic acid was supplemented in the diet of broiler chicken. [28] recorded that the dressing percentage of broiler chickens fed diet supplemented with Lactobacillus reuteri SL001 varied from 78.91 – 93.00 %.

Effects of varying concentrations of Lactobacillus serum on sensory evaluation of broiler chickens is presented in Table 5.

Parameter	T1	T2	T3	T4	T5	SEM	P-value
Colour	5.53b	6.58a	6.61a	6.69a	6.73a	0.29	0.01
Flavour	5.64b	6.01a	6.05a	6.11a	6.15a	0.30	0.02
Juiciness	4.75b	5.87a	5.93a	6.31a	6.32a	0.33	0.01
Tenderness	5.01b	5.86a	6.51a	6.57a	6.65a	0.36	0.03
Overall acceptability	5.79b	6.37a	6.45a	6.51a	6.56a	0.31	0.02

Means in the same row with different superscripts differ significantly ($p<0.05$); SEM: standard error of the mean; Probability value (P-value); T1 (0 mL Lactobacillus serum); T2 (5 mL Lactobacillus serum/liter of water); T3 (10 mL Lactobacillus serum/liter of water); T4 (15 mL Lactobacillus serum/liter of water); T5 (20 mL Lactobacillus serum/liter of water)

Table 5: Effects of varying concentrations of Lactobacillus serum on sensory evaluation of broiler chickens

Colour, juiceness, flavor, tenderness and overall acceptability were all significantly influenced ($p<0.05$) by the treatment. Birds fed Lactobacillus serum at various concentrations had higher values compared to the control. This result suggests that administration of Lactobacillus serum influenced the biochemical environment of the muscle by improving the water holding capacity of meat, reduction in lipid peroxidation and increasing their concentration of polyunsaturated fatty acids [29]. The result obtained is in agreement with the reports of [30] when plant extracts was supplemented in the diet of broiler chickens. According to [31], dietary supplementation of probiotics can slightly lower the pH of meat which can result in a more desirable meat colour of broilers.

Effects of varying concentrations of Lactobacillus serum on intestinal microbial population of broiler chicken (Table 6).

Parameters (×106 Cfu/mL)	T1	T2	T3	T4	T5	SEM	P-value
Escherichia coli	3.92a	1.97b	1.71b	1.62b	1.51b	0.03	0.01
Salmonella sp	1.86a	0.95b	0.83b	0.75b	0.72b	0.22	0.03
Staphylococcus sp	2.44a	1.82b	1.57b	1.43b	1.41b	0.25	0.02
Lactobacillus sp	4.08b	6.72a	6.81a	6.86a	6.91a	0.18	0.03

Means in the same row with different superscripts differ significantly ($p<0.05$); SEM: standard error of the mean; Probability value (P-value); T1 (0 mL Lactobacillus serum); T2 (5 mL Lactobacillus serum/liter of water); T3 (10 mL Lactobacillus serum/liter of water); T4 (15 mL Lactobacillus serum/liter of water); T5 (20 mL Lactobacillus serum/liter of water)

Table 6: Effects of varying concentrations of Lactobacillus serum on intestinal microbial population of broiler chickens

The intestinal microbial population of Escherichia coli, Salmonella sp, Staphylococcus sp and Lactobacillus sp recorded in this study varied from 1.51 to 3.92 (×106 Cfu/mL), 0.72 to 1.86 (×106 Cfu/mL), 1.41 – 2.44 (×106 Cfu/mL) and 4.08 – 6.91 (×106 Cfu/mL) respectively. The outcome obtained suggests that the administration of Lactobacillus serum in drinking water significantly reduced inflammation by suppressing the population of pathogenic organisms like Escherichia coli, Salmonella sp, Staphylococcus sp and promoting the activities of beneficial bacteria like Lactobacillus sp in the gut thereby promoting optimal balance (eubiosis) [32]. Several reports by [33, 34] have disclosed that probiotics can hinder the activities of pathogens in the intestinal flora by attaching itself to the intestinal epithelial walls thereby preventing their colonization and also secreting organic acid which has the capability to lower the pH of the intestinal creating a lethal environment to many pathogenic organisms.

Haematological values could serve as reference information for comparison in conditions of nutrient deficiency, physiology and health status of farm animals [33]. Haematological

studies have been reported to be useful for disease prognosis and feed stress monitoring [34]. Effects of varying concentrations of Lactobacillus serum on haematological parameters of broiler chickens (Table 7).

Variables	T1	T2	T3	T4	T5	SEM	P-value
Packed cell volume (%)	33.96	34.04	34.18	34.55	34.91		
Haemoglobin (g/dL)	11.95	12.07	12.55	12.69	12.88		
Red blood cell (x 1012/L)	3.56	3.73	3.87	3.91	3.95		
Mean Corpuscular Haemoglobin (pg)	41.27	42.44	42.53	42.64	42.83		
Mean Corpuscular Haemoglobin Concentration (g/dL)	32.14	33.45	33.56	33.72	33.85		
Mean Corpuscular Volume (fl)	29.68	30.15	30.28	31.18	31.25		
White blood cell (x 109/L)	16.64	17.08	17.23	17.35	17.56		

Table 7: Effects of varying concentrations of Lactobacillus serum on haematological parameters of broiler chickens

Pack cell volume (PCV), heamoglobin concentration (Hb), red blood cell count (RBC), mean corpuscular volume, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration and white blood cell count were not significantly ($p>0.05$) different in all the treatments. The haematological results were important as they confirm the serum's safety. PCV, Hb and RBC counts remained within the physiological ranges [(PCV; 25 – 45.00 %, 9.00 – 15.00 g/dL and 2.50 – 4.00 (x 1012/L)], reported for healthy broilers [35]. Mean corpuscular volume, corpuscular haemoglobin and mean corpuscular haemoglobin concentration obtained in this study were within 20.00 – 45.00 fl, 35.00 – 61.00 pg and 30.00 – 75.00 g/dL cited by [36]. White blood cells are responsible for the production of antibodies which protects the body's cells from damage and helps to maintain a proper immune function [36, 37]. White blood cell count was within the reference ranged reported by [36]. The absence of significant difference in haematological indices recorded in this study, suggests that the superior growth of birds in T4 and T5 were not pathological, the birds were metabolically stable and did not exhibit any signs of dehydration, infection or anaemia.

Conclusion

In conclusion, the outcome of this experiment reveals that Lactobacillus serum is an effective natural growth promoters for broilers. Administration of Lactobacillus serum in drinking water up to 15 mL per liter of water had positive effect on final body weight, feed intake and feed conversion ratio without compromising the haematological studies, intestinal microbial population and health status of birds. Therefore, it can be utilized as a sustainable alternative to synthetic growth promoter to reduce the risk of antimicrobial resistance in meat production.

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