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Modulatory effects of fermented maize supernatant as an organic liquid feed additive on the growth performance, intestinal microflora ecology, carcass yield, and meat sensory profile of broiler chickens

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ABSTRACT

The global pressure to eliminate synthetic Antibiotic Growth Promoters due to antimicrobial resistance has accelerated the search for sustainable, natural alternatives. This study evaluated the modulatory effects of fermented maize supernatant (FMS) as an organic liquid feed additive on the growth performance, intestinal microflora ecology, carcass yield, and meat sensory profile of broiler chickens. A total of two hundred and fifty one- day-old chicks (Hubbard) were randomly assigned to five treatments in a Completely Randomized Design (CRD), with each treatment comprising five replicates of ten birds each. The birds were reared in environmentally controlled deep litter pens for 42 days. Treatment 1 (T1, negative control) received a basal diet and un-supplemented drinking water; T2 (positive control) received the basal diet with the synthetic antibiotic neomycin at 20 g/L of water; while T3, T4, and T5 received the basal diet supplemented with FMS via drinking water at 10, 20, and 30 mL/L, respectively. The results demonstrated that growth performance indices, including cumulative feed intake, final body weight, and average daily gain, were significantly highest ($P<0.05$) in the FMS-supplemented groups (T3–T5), intermediate in T2, and lowest in T1. Conversely, the feed conversion ratio (FCR) was significantly lower ($P<0.05$) in T3–T5 than in the control groups. Microbiological profiling of intestinal flora revealed that beneficial Lactic Acid Bacteria (LAB) populations were maximized in T3–T5, while pathogenic *Salmonella spp*, *Streptococcus spp* and *Escherichia coli* counts were significantly suppressed through competitive exclusion and organic acidification. Furthermore, birds in T3–T5 exhibited the highest dressing percentages, superior primal cut weights (breast, back and thigh), and sensory evaluation scores for juiciness, tenderness, and flavor profile. In conclusion, spontaneous fermentation of maize supernatant creates a probiotic and acidifier environment. The addition of up to 30 mL/L of fermented maize supernatant (FMS) resulted in an enhanced gastrointestinal (GI) status associated with increased nutrient content in broiler chickens without any observed side effects, making it a promising alternative for organic production

without the addition of antibiotics.

Keywords: Fermentation, byproducts, growth, performance, feed efficiency, Chemical residues.

1. INTRODUCTION

The growth of the global production of broilers has led to poultry meat becoming an essential and inexpensive source of animal protein (Emmanuel and Alagbe, 2026a, 2026b, & 2026c). In order to meet the demands of the poultry industry for a constant supply of high-yield broiler breeds, the application of low-dose synthetic Antibiotic Growth Promoters (AGPs) has become common practice (Alagbe, 2025 & Alagbe et al., 2025; Zubairu et al., 2025). The beneficial effect of AGPs is due to their ability to modulate the subclinical infection process and prevent damage to the mucous membrane, thereby reducing the consumption of nutrients for the immune system (Shittu et al., 2024). However, the prolonged use of antibiotics as growth promoters can have negative implications for human health, such as the development of antibiotic resistance, the accumulation of toxic residues in poultry meat, and the transfer of antimicrobial resistance (AMR) genes from animals to humans, posing a serious threat to public health (Hernandez and Alagbe, 2025a). Therefore, the search for alternative resources that imitate the effects of synthetic antibiotics on livestock and are safe for human health and the environment is relevant in modern poultry farming (Alagbe, 2026a; Ojediran et al., 2024).

Among emerging sustainable strategies, the manipulation of the gastrointestinal ecosystem via organic acidifiers and live probiotic drenches has shown significant promise. A novel, underutilized resource in this class is Fermented Maize Supernatant (FMS), traditionally known in West Africa as omidun or omi ogi. FMS is the aqueous, acidic liquid byproduct generated during the anaerobic lactic acid fermentation of soaked maize (Zea mays) (Ibitoye, 2021). Rather than being treated as processing waste, FMS represents a complex, bioactive compounds teeming with wild-type Lactic Acid Bacteria (LAB) and a high concentration of metabolized organic acids (Adenrele et al., 2021).

Previous studies have shown that addition of fermented maize supernatants at 10 mL/litre does not influence the average feed intake, feed intake and feed to gain of broiler chickens (Ibitoye, 2021). Zolotukhin et al. (2018); Chorawala et al. (2021) also reported that dietary supplementation of commercial strain probiotics at 300 mg/kg significantly improved feed intake, body weight gain, carcass characteristics, immune response and oxidative stress indices of broilers. However, there is need to establish a standardized level of inclusion FMS that could positively growth, internal gut architecture and health status of birds. This will help in addressing the global threat of antimicrobial resistance and promote food security. Therefore, this study was carried out to examine the modulatory effects of fermented maize supernatant as an organic liquid feed additive on the growth performance, intestinal microflora ecology, carcass yield, and meat sensory profile of broiler chickens.

2. MATERIALS AND METHODS

Location of the Experimental Site

The experiment was conducted at the Faculty of Agriculture, Gandhi College of Agriculture, Rajasthan, India. The research site is located in the north-western semi-arid region of India between 23°30′ to 30°11′ N and 69°29′ to 78°17′ E latitude and longitude (Yadav et al., 2023).

Ethical Approval and Pre-Experimental Operations

Prior to commencement, the experimental protocol was approved by the Institutional Animal Ethics Committee of Gandhi College of Agriculture, Rajasthan India. Two weeks before the commencement of the trial, thorough pre-experimental biosecurity and sanitation operations were carried out. The poultry house was swept, washed with water and liquid detergent, and disinfected using a broad-spectrum disinfectant comprising Aquaclean + Supermorigad + Salt combined in ratio 3:3:1. The deep litter pens were lined with clean, dust-free wood shavings to a depth of 5 cm. Infrared brooder lamps and 100 W electric bulbs were installed to supply adequate heat during brooding and provide illumination, plastic feeding and drinking troughs were washed, disinfected, and positioned at different positions within each pen.

Animals and Their Care

A total of 250 one-day-old Hubbard broiler chicks, averaging an initial body weight of 55.11 ± 0.21 g, were allocated at random to five dietary treatment groups using a completely randomized design (CRD). The experiment was set up with five replicates per treatment,

and each replicate included 10 chicks, resulting in the total number of 250 birds (5 treatments × 5 replicates × 10 birds each). The dietary treatments were organized as follows:

T1 (Negative Control): Basal diet + un-supplemented drinking water.

T2 (Positive Control): Basal diet + Neomycin administered at 20 g/L of drinking water.

T3: Basal diet + Fermented Maize Supernatant (FMS) administered at 10 mL/L of drinking water.

T4: Basal diet + FMS administered at 20 mL/L of drinking water.

T5: Basal diet + FMS administered at 30 mL/L of drinking water.

The broilers were managed in environmentally controlled deep litter pens. The ambient temperature was initially maintained at 34◦C during the first week and gradually decreased by 2◦C weekly until a stable temperature of 22 ◦C was attained. All birds were vaccinated against New Castle Disease (Lasota) and Infectious Bursal Disease (Gumboro) according to the standard veterinary vaccination schedule of the region. Feed and water were offered ad libitum throughout the 42-day trial. The basal diets was formulated to meet the nutritional requirements of broiler as recommended by the Indian Council of Agricultural Research nutrient standards (ICAR, 2013) as presented in Table 1.

Table 1. Ingredient and chemical composition of experimental diet at starter and finisher phase

	Starter phase (0-3 weeks)	**Finisher phase (4-6 weeks)**
Feedstuffs	Quantity	Quantity
Maize	51.00	55.39
Wheat bran	2.00	4.00
Soybean meal	35.00	29.00
Fish meal	4.89	3.05
Limestone	2.05	2.50
Di-calcium Phosphate	4.00	5.00
DL-Methionine	0.25	0.25
L-Lysine HCl	0.25	0.25
*Mineral-Vitamin Premix	0.25	0.25
Salt	0.20	0.20
Toxin binder	0.11	0.11
Total	100	100
Analyzed values (%)		
Crude protein	23.07	21.22
Crude fibre	3.91	4.18
Ether extract	4.11	3.98
Calcium	1.18	1.21
Phosphorus	0.65	0.71
ME (kcal/kg)	2923.1	3008.5

*Supplied per kg of diet: Vitamin A: 12,000 IU; Vitamin D3: 3,000 IU; Vitamin E: 30 mg; Vitamin K: 2 mg; Thiamine: 2 mg; Riboflavin: 6 mg; Pyridoxine: 4 mg; Vitamin B12: 0.02 mg; Niacin: 40 mg; Pantothenic acid: 15 mg; Iron: 40 mg; Copper: 8 mg; Manganese: 60 mg; Zinc: 50 mg; Iodine: 1 mg; Selenium: 0.2 mg.

Production of Fermented Maize Supernatant (FMS)

The FMS was processed traditionally using standard anaerobic steep fermentation. Clean, whole grains of yellow maize (Zea mays) were sorted to remove debris and washed thoroughly. The grains were steeped in distilled water within airtight, high-density polyethylene vessels at ambient room temperature (32±2◦C) for 72 hours to encourage fermentation. Following steeping, the softened maize grains were wet milled into a thick slurry using an attrition mill. The slurry was then filtered using a muslin cloth (200 µm) to remove the fibrous fraction. The filtrate was left undisturbed for 24 h. Starch grains started to settle down as a thick layer leaving

behind clear and acidic supernatant. The supernatant was siphoned off and subjected to pH measurement using a digital pH meter and stored in a refrigerator at 4∘C until further analysis.

Evaluation of Microbial Strains in Fermented Maize Supernatant (FMS)

Microbial strains in FMS was carried out using VITEK 2 Compact Automated System (BioMérieux, Marcy-l'Étoile, France). 0.8 mL FMS was vacuum-transferred automatically into specific VITEK 2 test cards (VITEK 2 GN for Gram-negative enterics and VITEK 2 GP for Lactic Acid Bacteria). The analytical data generated through kinetic colorimetric changes inside the card micro-wells were processed by the onboard VITEK 2 software database version 8.01, confirming species level identity with a confidence threshold greater than 99%. Final bacterial population data were calculated and log-transformed as log10 Colony Forming Units per gram (log10 CFU/g) of wet digesta.

Growth Parameters

Feed Intake (FI): was determined by calculating the difference between the total feed allocated (served) to each replicate pen and the leftover feed recovered from the troughs. Body Weight Gain: Birds was determined as the difference between the final body weight and the initial body weight. Average daily body weight was estimated by dividing the body weight gain by the experimental duration (in days).

Average daily weight gain was computed mathematically as:

$$\frac{\text{Body weight gain}}{\text{Experimental period in days (42 d)}}$$

Feed Conversion Ratio (FCR): was calculated by dividing the average daily feed intake by the average daily feed weight gain.

Assessment of Carcass characteristics

On day 42, two birds per replicate were randomly chosen for carcass assessment. The selected broilers were subjected to a 12-hour fasting period, while water was available throughout the process. First, the bird weight was determined by removing the individual bird from the pen. The animals were then slaughtered manually with a sharp knife and allowed to bleed. Afterwards, the carcasses were scalded, plucked, and washed in running water. Removal of the gastrointestinal tract and internal organs was achieved by hand-deboning and evisceration. The weight of the obtained carcasses was then measured to calculate the dressing percentage:

Dressing Percentage (%) = Eviscerated Weight (g) / Live Weight (g) × 100%

The primal cuts of chicken, including breast, thighs, drumsticks, backs, and wings, were separated manually. Each part was weighed using a sensitive scale, and the results were then expressed as a percentage of the bird's live weight. Additionally, the weights of the internal organs (liver, gizzard, and heart) were measured.

Intestinal Microbiology

To determine cecal and intestinal bacterial populations, digesta samples were harvested immediately following evisceration. One gram of content from the cecum of each slaughtered bird was collected under aseptic conditions, transferred into sterile tubes containing 9 mL of 0.1% w/v peptone water, and homogenized thoroughly according to the recent procedure published by Musa et al. (2020). For the quantitative isolation and enumeration of targeted microbial populations Gibbs Microbial Auto Analyzer (Model VB2300N, China) and adjusted to the specification of manufacturers to ensure precision in result.

Sensory Evaluation

Sensory profiling of the broiler meat was performed using breast muscle tissue samples collected for carcass evaluation (10 birds per treatment). The meat samples were cut into uniform cubes (2×2×2 cm), wrapped in aluminum foil, and cooked uniformly without the addition of any spices, salt, or condiments in a convection steam oven at an internal core temperature of 75∘C for 20 minutes. A trained 15-member sensory panelist were used for this examination to prevent carry-over, panelists were instructed to rinse their mouths thoroughly with warm water between successive samples. A 9-point Hedonic scale (9=Like Extremely,1=Dislike Extremely) was employed to score core sensory attributes, including color, flavor intensity, juiciness, tenderness, and overall acceptability.

Statistical Analysis

All experimental data collected were subjected to a one-way Analysis of Variance utilizing General Linear Model procedure of Statistical Software Package (Version 9.4). Significant differences between treatment means were separated using Duncan's New Multiple Range Test at P<0.05.

3. RESULTS

Microbial population of Fermented Maize Supernatant (FMS) is revealed in Table 2. The sample had a pH of 3.52 and their microbial population (Log 10 CFU/mL) contained *Lactobacillus fermentum* (4.09), *Lactobacillus acidophilus* (6.62), *Lactobacllus brevis* (5.87), *Lactobacillus acidophilus* (6.71) and *Lactobacillus plantarum* (5.63).

In Table 3, effect of feeding different levels of FMS on growth performance of broiler chickens. Average daily weight gain, average daily feed intake and feed conversion ratio were affected (P<0.05) by the treatment. Average daily weight gain and average daily feed intake follow similar patterns as their values were higher in T3-T5, intermediate in T2 and lower in T1 (P<0.05).

Effect of feeding different levels of FMS on the carcass characteristics of broiler chickens is presented in Table 4. Dressed and eviscerated weight were affected (P<0.05) by the treatment and their values varied from 1838.3 – 2320.3 g and 1538.3 – 2108.4 g. Dressing percentage was higher in T5 (83.66 %), T4 (83.60 %), T3 (83.77 %) than T2 (81.64 %) and T1 (77.37 %). Relative weight of kidney, spleen, liver, gizzard, head and neck were not significantly affected (P>0.05) except for breast, drumstick, thigh, shank and back (P<0.05).

As presented in Table 5, different levels of FMS on the intestinal microbial population of broilers had a significant effect on *Escherichia spp*, *Lactobacillus spp*, *Salmonella spp* and *Streptococcus spp* population. Microbial population of *Escherichia spp* which ranged from 2.72 – 5.71 Cfu/g, *Salmonella spp* and *Streptococcus spp* 0.57 – 1.97 Cfu/g and 0.92 – 2.08 Cfu/g was higher (P<0.05) in T1 compared to the other groups. *Lactobacillus spp* (2.39 – 6.11 Cfu/g) was higher in T3 (5.92 Cfu/g), T4 (6.07 Cfu/g), T5 (6.11 Cfu/g) than T2 (3.56 Cfu/g) and T1 (2.39 Cfu/g).

Sensory evaluation of meat from broiler chickens fed different levels of FMS is presented in Table 6. T3 – T5 had the highest score for juiciness, tenderness, flavor, colour and overall acceptability compared to T2 and T1 (P<0.05). In order of ranking: T5> T4 > T3 > T2 > T1.

Table 2. Microbial population of Fermented Maize Supernatant (FMS)

Microbial isolate	**Population (Log 10 CFU/mL)**
pH	3.52
Lactobacillus fermentum	4.09
Lactobacillus acidophilus	6.62
Lactobacllus brevis	5.87
Lactobacillus acidophilus	6.71
Lactobacillus plantarum	5.63

Table 3. Effect of feeding different levels of FMS on growth performance of broiler chickens

Parameters	T1	T2	T3	T4	T5	SEM
Initial body weight (g/b)	55.36	55.12	55.18	55.11	55.08	0.01
Final body weight (g/b)	1772.1^{c}	2000.5^{b}	2412.3a	2420.9a	2420.6a	71.21
Body weight gain (g/b)	1716.74^{c}	1945.38^{b}	2357.12a	2365.79a	2365.52a	68.09
Average daily weight gain (g/b)	40.87^{c}	46.32^{b}	56.12a	56.32a	56.32a	0.02
Cumulative feed intake (g/b)	4181.2^{c}	4600.2^{b}	5000.1a	5003.4a	5005.1a	106.1
Average daily feed intake (g/b)	99.55^{c}	109.5^{b}	119.1a	119.1a	119.2a	0.06
Feed conversion ratio	2.44^{a}	2.36^{b}	2.12c	2.11c	2.11c	0.001

^{abc} Means on the same row having different superscripts are significantly different (P < 0.05)

T1 (Negative Control): Basal diet + un-supplemented drinking water.

T2 (Positive Control): Basal diet + Neomycin administered at 20 g/L of drinking water.

T3: Basal diet + Fermented Maize Supernatant (FMS) administered at 10 mL/L of drinking water.
T4: Basal diet + FMS administered at 20 mL/L of drinking water.
T5: Basal diet + FMS administered at 30 mL/L of drinking water.

Table 4. Effect of feeding different levels of FMS on the carcass characteristics of broiler chickens

Parameters	T1	T2	T3	T4	T5	SEM
Live weight (g)	1988.3c	2291.2b	2507.6a	2516.9a	2520.3a	76.03
Dressed weight (g)	1838.3c	2093.0b	2307.6a	2316.9a	2320.3a	72.07
Eviscerated weight (g)	1538.3c	1870.6b	2100.7a	2104.1a	2108.4a	62.55
Dressing percentage (%)	77.37c	81.64b	83.77a	83.60a	83.66a	0.02
Organ weight (% Live weight)						
Liver (%)	3.00	3.01	3.03	3.08	3.13	0.01
Kidneys (%)	0.21	0.23	0.27	0.25	0.28	0.01
Spleen (%)	0.11	0.13	0.15	0.15	0.17	0.02
Heart (%)	0.41	0.44	0.46	0.48	0.51	0.01
Gizzard (%)	2.23	2.91	3.51	3.66	3.97	0.03
Cut parts (% Live weight)						
Head (%)	3.51	3.62	3.77	3.69	3.91	0.01
Neck (%)	3.01	3.13	3.35	3.31	3.31	0.02
Wing (%)	6.34	8.08	8.67	8.82	8.94	0.02
Breast (%)	15.92c	17.23b	20.81a	20.97a	21.19a	0.03
Drumstick (%)	9.22c	11.21b	14.67a	14.88a	14.91a	0.03
Thigh (%)	10.19c	13.53b	16.94a	17.13a	18.02a	0.02
Shank (%)	4.83c	5.91b	6.78a	6.91a	7.02a	0.01
Back (%)	11.24c	14.11b	17.93a	18.78a	20.72a	0.03

[abc] Means on the same row having different superscripts are significantly different ($P < 0.05$)
T1 (Negative Control): Basal diet + un-supplemented drinking water.
T2 (Positive Control): Basal diet + Neomycin administered at 20 g/L of drinking water.
T3: Basal diet + Fermented Maize Supernatant (FMS) administered at 10 mL/L of drinking water.
T4: Basal diet + FMS administered at 20 mL/L of drinking water.
T5: Basal diet + FMS administered at 30 mL/L of drinking water.

Table 5. Effect of feeding different levels of FMS on the intestinal microbial population of broilers

Microbes (Cfu/g)	T1	T2	T3	T4	T5	SEM
Escherichia spp	5.71a	4.81b	2.92c	2.88c	2.72c	0.02
Lactobacillus spp	2.39c	3.56b	5.92a	6.07a	6.11a	0.03
Salmonella spp	1.97a	1.01b	0.83c	0.62c	0.57c	0.01
Streptococcus spp	2.08a	1.51b	1.02c	0.95c	0.92c	0.01

[abc] Means on the same row having different superscripts are significantly different ($P < 0.05$)
T1 (Negative Control): Basal diet + un-supplemented drinking water.
T2 (Positive Control): Basal diet + Neomycin administered at 20 g/L of drinking water.
T3: Basal diet + Fermented Maize Supernatant (FMS) administered at 10 mL/L of drinking water.
T4: Basal diet + FMS administered at 20 mL/L of drinking water.
T5: Basal diet + FMS administered at 30 mL/L of drinking water.

Table 6. Sensory evaluation of meat from broiler chickens fed different levels of FMS

Parameters	T1	T2	T3	T4	T5	SEM
Juiciness	5.11c	5.62b	6.01a	6.09a	6.17a	0.02
Tenderness	4.85c	5.13b	5.97a	5.98a	6.01a	0.03
Flavour	5.33c	5.71b	6.11a	6.17a	6.23a	0.01
Colour	5.09c	6.01b	6.58a	6.67a	6.69a	0.02
Overall acceptability	5.55c	6.02b	6.69a	6.84a	6.91a	0.01

[abc] Means on the same row having different superscripts are significantly different ($P < 0.05$)

T1 (Negative Control): Basal diet + un-supplemented drinking water.

T2 (Positive Control): Basal diet + Neomycin administered at 20 g/L of drinking water.

T3: Basal diet + Fermented Maize Supernatant (FMS) administered at 10 mL/L of drinking water.

T4: Basal diet + FMS administered at 20 mL/L of drinking water.

T5: Basal diet + FMS administered at 30 mL/L of drinking water.

4. DISCUSSION

The replacement of sub-therapeutic synthetic antibiotics in the global livestock industry is triggered by antimicrobial residues and antimicrobial resistance. The fermented maize supernatants (FMS) used in the present experiment are predominantly constituted by highly acid-resistant lactic acid bacteria, including Lactobacillus spp. This finding is explained by the ability of these bacteria to colonize the mucous layer of the chicken's gastrointestinal tract epithelium via high cell-surface hydrophobicity indices (Hernandez and Alagbe, 2025a & 2025b; Singh et al., 2021). In turn, the colonization resistance mechanism is beneficial in reducing the adhesion and/or proliferation of acid-sensitive pathogens in the avian gastrointestinal tract, including pathogenic Escherichia spp., Salmonella spp., and Clostridium spp. (Omokore and Alagbe, 2019). These pathogens are able to inflame the chicken's gut tissues, cause a decrease in villus height, and even result in mortality (Hernandez and Alagbe, 2025b).

The significantly increased final body weight, average daily gain and cumulative feed intake with the lowest FCR in the FMS treated groups (T3–T5) could be explained by the chemical composition of FMS. The consumption of FMS by the broilers lowers the pH of the crop and gizzard digesta (Adewale et al., 2021). This change in the physicochemical properties of the content in the upper gastrointestinal tract promotes the secretion and activation of endogenous enzymes including conversion of pepsinogen to pepsin leading to increased hydrolysis of dietary protein and subsequent release of absorbable amino acids (Omokore and Alagbe, 2019). Moreover, the decreased pH reduces the rate of passage of the digesta in the gut which increases the exposure time of the nutrients to enzymes and transporters in the mucosa. This metabolic activity explains the increased feed intake and weight gain of T3–T5, evidenced by the highest bird weight. As a result, the supplemented groups recorded a good feed conversion ratio (FCR) compared to the unsupplemented T1, which lacked digestion promotion, and T2, which provided only antimicrobial coverage but not direct support to the digestive tract. Similar results were reported by Yang et al. (2021) and Zhong et al. (2018), who supplemented probiotics in the diet of broiler chickens. Contrary to the current findings, Ibitoye, (2021) found no significant difference in body weight gain of broilers fed 10 ml/l of fermented maize supernatant. This difference in findings could be due to the variation in the concentration of the supernatant used in the two experiments. Additionally, the two studies differ in the period of fermentation.

Table 4 reveals that carcass yield, dressing percentage, and primal cut weights (breast, thigh, and drumstick) were the best in T3–T5, moderate in T2, and the lowest in T1. This reflects a linear growth performance of the birds; FMS, with its highly digestible amino acids, is used to build muscles, especially the pectoralis major (Chen et al., 2020). The lactic acid in FMS is delivered to the hepatic circulation through the portal vein and utilizes hepatic energy for lipid metabolism, inhibiting hepatic lipogenesis and redirecting energy toward protein production. This accounts for the high proportion of breast muscles recorded in the present study compared to the control. Similar results were reported by Shah et al. (2020) when probiotics were supplemented in the diets of broiler chickens. Ma et al. (2018) also recorded a positive effect on broilers fed yeast-supplemented diets.

The ecology of the gastrointestinal tract of broiler chickens is very important for the digestion and absorption of nutrients. The current study revealed that the number of intestinal beneficial bacteria was higher in the FMS-supplemented groups (T3–T5) compared to the neomycin group (T2) and the control group (T1). On the contrary, pathogenic coliform bacteria recorded the lowest population in the FMS-supplemented groups. FMS acts as a probiotic agent, delivering live colony-forming units (CFU) of Lactobacillus spp. to the gastrointestinal tract of the chickens. Probiotic bacteria such as Lactobacillus spp. rapidly colonize the intestinal mucosa, displacing the

adhesion sites occupied by pathogenic bacteria (Muritala et al., 2022; Azad et al., 2020). Additionally, they produce antimicrobial metabolites that inhibit the colonization and activity of pathogenic bacteria closely related to them (Singh et al., 2022). Although the antibiotic neomycin (T2) inhibited the proliferation of pathogens in the gastrointestinal tract of the chickens, it acted as a non-specific antimicrobial agent, killing both harmful and beneficial bacteria in the gut (Gadde et al., 2017; Chen et al., 2020). Thus, T2 had a lower number of beneficial bacteria to perform nutrient digestion and absorption efficiently compared to the other treatment groups (T3–T5) that received probiotic-supplemented diets. Hence, T2 was inferior to the other treatment groups in weight gain performance.

With respect to Table 5, the meat samples from the broiler chickens fed FMS-supplemented diets (T3–T5) recorded the highest juiciness, tenderness, flavor, and overall acceptability scores compared to the other treatment groups. This illustrates the beneficial effect of naturally produced probiotics in promoting general meat quality. This is attributed to their ability to improve the antioxidant status of the muscles, thus enhancing cellular membrane integrity. Consequently, improved meat quality promotes consumer acceptability and preference. The fermentation process of lactic acid bacteria produces aroma volatile compounds, esters, and fatty acids present in the meat as off-flavors without any harmful residues (Alagbe, 2026a; Alagbe, 2026b; Alagbe & Anorue, 2026). This accounts for the higher juiciness, tenderness, flavor, and overall acceptability scores recorded for the meat samples from the broiler chickens fed FMS. Similar findings were reported by Abdel-Wareth et al. (2019) when peppermint was supplemented in the diets of broiler chickens.

5. CONCLUSION

In conclusion, fermented maize supernatant is a highly effective organic alternative to synthetic antibiotics like neomycin. FMS contains several beneficial bacteria that creates a balanced intestinal profile and modulates the activities of endogenous enzymes especially when fed to broilers at 30 mL/litre of water. This enhancement directly translates into higher growth performance, better feed conversion efficiencies, and enhanced meat quality without causing any deleterious effect on the health status of birds.

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Author Contributions

Alagbe Olujimi John, designed the work, data collection, laboratory analysis, statistical analysis and writing of manuscript.

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Conflict of interest

The author declare that they have no conflicts of interest, competing financial interests or personal relationships that could have influenced the work reported in this paper.

Ethical approval

In this article, the animal regulations are followed as per the ethical committee guidelines of Department of Animal Nutrition and Biochemistry, Gandhi College of Agriculture, Rajasthan India; the authors observed the Modulatory effects of fermented maize supernatant as an organic liquid feed additive on the growth performance, intestinal microflora ecology, carcass yield, and meat sensory profile of broiler chickens. The Animal ethical guidelines are followed in the study for observation & identification. (Ethical approval code: GNP/20008/RC09).

Informed consent

Not applicable.

Data availability

All data associated with this study will be available based on the reasonable request to corresponding author.

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