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THE EFFECT OF TURMERIC (*CURCUMA DOMESTICA*) POWDER SUPPLEMENTATION ON *ESCHERICHIA COLI* CONTAMINATION QUANTIFICATION AND RELATIVE ORGAN WEIGHT IN NATIVE SUPER CHICKENS

Pengaruh Suplementasi Bubuk Kunyit (*Curcuma domestica*) Terhadap Kuantifikasi Kontaminasi Escherichia Coli dan Berat Organ Relatif pada Ayam Kampung Super

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Abstract

Turmeric (*Curcuma domestica*) is a phytogenic additive containing bioactive compounds, particularly curcumin, known for immunomodulatory and antimicrobial activities. This study evaluated the effects of turmeric powder supplementation through drinking water on relative visceral organ weights and cloacal *Escherichia coli* colonization in super native chickens (Ayam Jowo Super). A total of 100 chickens, aged 29 to 56 days, were assigned to five treatments in a Completely Randomized Design with four replicates of five chickens each. Treatments consisted of no additive (P0), 0.1 g/L commercial immune booster (P1), and turmeric powder at 1 g/L (P2), 3 g/L (P3), and 5 g/L (P4). At 56 days of age, chickens were slaughtered to measure relative weights of the Bursa of Fabricius, spleen, liver, and small intestine. Cloacal swabs were collected for *E. coli* enumeration using the pour plate method on TBX agar. Turmeric supplementation significantly affected the relative weights of the Bursa of Fabricius and spleen ($P<0.05$), with the highest values observed at 3 g/L: 0.1131 ± 0.028% and 0.4216 ± 0.057%, respectively. Turmeric also significantly reduced cloacal *E. coli* counts ($P<0.01$), with the lowest count observed at 5 g/L, reaching 1.25×10^4 CFU/g. In conclusion, turmeric supplementation at 3 g/L improved lymphoid organ development, while 5 g/L was more effective in suppressing enteric *E. coli* colonization. These findings suggest that turmeric

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can be used as a natural immunomodulatory and antimicrobial additive in native poultry production.

Keywords: Bursa fabricius, drinking water supplementation, *Escherichia coli*, immunomodulation; Super native chicken, Turmeric powder

Abstrak

Kunyit (*Curcuma domestica*) merupakan aditif fitogenik yang mengandung senyawa bioaktif, terutama kurkumin, yang dikenal memiliki aktivitas imunomodulator dan antimikroba. Penelitian ini bertujuan untuk mengevaluasi pengaruh suplementasi bubuk kunyit melalui air minum terhadap bobot relatif organ viseral dan kolonisasi *Escherichia coli* pada kloaka ayam kampung super (Ayam Jowo Super). Sebanyak 100 ekor ayam berumur 29–56 hari dialokasikan ke dalam lima perlakuan menggunakan Rancangan Acak Lengkap (RAL) dengan empat ulangan, masing-masing terdiri atas lima ekor ayam. Perlakuan yang diberikan meliputi tanpa aditif (P0), 0,1 g/L imunobooster komersial (P1), serta bubuk kunyit pada dosis 1 g/L (P2), 3 g/L (P3), dan 5 g/L (P4). Pada umur 56 hari, ayam disembelih untuk mengukur bobot relatif Bursa Fabrisius, limpa, hati, dan usus halus. Swab kloaka dikoleksi untuk enumerasi *E. coli* menggunakan metode pour plate pada media Tryptone Bile Glucuronide (TBX) agar. Hasil penelitian menunjukkan bahwa suplementasi kunyit berpengaruh nyata terhadap bobot relatif Bursa Fabrisius dan limpa ($P<0,05$), dengan nilai tertinggi diperoleh pada dosis 3 g/L, masing-masing sebesar 0,1131 ± 0,028% dan 0,4216 ± 0,057%. Suplementasi kunyit juga menurunkan jumlah *E. coli* kloaka secara sangat nyata ($P<0,01$), dengan jumlah terendah ditemukan pada dosis 5 g/L, yaitu $1,25 \times 10^4$ CFU/g. Dapat disimpulkan bahwa suplementasi bubuk kunyit pada dosis 3 g/L efektif meningkatkan perkembangan organ limfoid, sedangkan dosis 5 g/L lebih efektif dalam menekan kolonisasi *E. coli* enterik. Temuan ini menunjukkan bahwa kunyit berpotensi digunakan sebagai aditif alami yang berfungsi sebagai imunomodulator dan antimikroba dalam produksi unggas lokal.

Kata kunci: Ayam super lokal, Bubuk kunyit, Bursa fabricius, *Escherichia coli*, immunomodulasi, suplementasi air minum

INTRODUCTION

The poultry industry in tropical developing regions has experienced a significant transition toward local indigenous chicken breeds, notably due to rising consumer preferences for leaner, more flavorful, and organic meat products (Nur *et al.*, 2023a). In Indonesia, the super native chicken, locally designated as *Ayam Jowo Super* or *Joper*, has emerged as a premier commercial local breed (Nur *et al.*, 2023b). This crossbreed typically derived from local cocks and high-performing laying hens, retains the superior meat texture and environmental resilience of native chickens while exhibiting improved growth rates and feed conversion ratios (Nur *et al.*, 2023a). Despite these genetics, tropical smallholder production systems face significant biosecurity and health challenges, particularly enteric disease outbreaks caused by opportunistic bacterial pathogens like Avian Pathogenic *Escherichia coli* (APEC) (Hartady *et al.*, 2025)

Historically, intensive poultry production managed these microbial pressures through the routine use of subtherapeutic Antibiotic Growth Promoters (AGPs) (Fouad *et al.*, 2025)). However, the global ban on AGPs, driven by the critical threat of multidrug-resistant pathogens and toxic chemical residues in human food chains, has forced a major shift toward natural, organic phytobiotic feed additives (Aderemi & Alabi, 2023). Phytobiotics encompass plant-derived secondary metabolites, including essential oils, tannins, and polyphenols that exert

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direct antimicrobial activity in the gut lumen while supporting host physiological functions (Cojocariu *et al.*, 2026).

Among the botanical species of the family Zingiberaceae, turmeric (*Curcuma domestica*, syn. *Curcuma longa*) represents a widely accessible and biologically active phytobiotic (Nur *et al.* 2023b). The therapeutic properties of turmeric are primarily attributed to curcuminoids, a group of hydrophobic polyphenols consisting of curcumin, demethoxycurcumin, and bisdemethoxycurcumin, alongside volatile essential oils such as xanthorrhizol, turmerone, and zingiberene (Morsy *et al.*, 2023). When administered in poultry diets, these bioactive compounds stimulate mucosal digestive enzymes, improve intestinal barrier integrity, and exert potent systemic antioxidant and immunomodulatory effects (Cojocariu *et al.*, 2026).

Evaluating the systemic physiological impact of phytobiotic feed additives requires a comprehensive assessment of internal organs, particularly lymphoid tissues. The Bursa of Fabricius, a primary lymphoid organ, regulates B-lymphocyte maturation and humoral immunity, while the spleen, a secondary lymphoid organ, coordinates cellular immune responses and monitors bloodborne pathogens (Nur *et al.*, 2023a). Concurrently, changes in the relative weights of metabolic and digestive organs, such as the liver and small intestine, provide insights into nutrient absorption efficiency and potential metabolic workloads (Osman *et al.*, 2017)

This research report evaluated the effects of graded levels of turmeric powder supplementation via drinking water on the relative visceral organ weights and cloacal *Escherichia coli* colonization in super native chickens. Rearing was carried out at the native chicken farm of PT Surya Pangan Indonesia, Bollangi, Gowa Regency, South Sulawesi, from May to June 2022. Laboratory diagnostic analyses, including cloacal swab bacteriology, differential leukocyte counts, and Newcastle Disease (ND) and Avian Influenza (AI) antibody titers, were conducted at the Maros Veterinary Center Laboratory, South Sulawesi.

MATERIALS AND METHODS

Experimental Method Management

The field experiment was conducted over a 30-day period from May to June 2022. Rearing operations were carried out at the native chicken farm of PT Surya Pangan Indonesia, Bollangi, Gowa Regency, South Sulawesi. A total of 100 mixed-sex super native chickens (*Ayam Jowo Super*, DKS Platinum Genetic line) aged 29 days, with an average initial body weight of 230 ± 16.37 g, were used in this study. The chickens were housed in 20 experimental bamboo cages measuring 60 x 60 x 60 cm, equipped with husks, feeders, and drinking systems. The room temperature was maintained at local ambient tropical conditions (26°C to 32°C), and a standard vaccination program was implemented. This study has approved by Hasanuddin University Animal Hospital Ethics Committee Number 00205/UN4.1.30.1.1.4/DI.05.01/2026.

Experimental Design and Dietary Treatments

The experiment followed a Completely Randomized Design (CRD) with five treatments and four replications, with each replication unit consisting of five chickens. Graded levels of Turmeric (*Curcuma domestica*) powder were supplemented daily in the drinking water. Feed (8201-Star crumble commercial ration manufactured by PT Malindo Feedmil Tbk) and drinking water were supplied ad libitum throughout the 30-day trial. The treatment groups were defined as follows:

P0: Drinking water without turmeric powder (negative control)

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P1: Drinking water supplemented with Promune C at a dosage of 0.1 g/L (positive control, a commercial water-soluble supplement containing Vitamin C, Vitamin E, and Selenium to increase immunity)

P2: Drinking water supplemented with 1 g/L of turmeric powder

P3: Drinking water supplemented with 3 g/L of turmeric powder

P4: Drinking water supplemented with 5 g/L of turmeric powder

Research Variables

The independent variable in this study is the specific drinking water additives administered to chickens. These include a plain water negative control (P0), a commercial immune booster positive control (P1), and three varying concentrations of turmeric (*Curcuma domestica*) powder: 1 g/L (P2), 3 g/L (P3), and 5 g/L (P4). The chickens' responses to these additives are measured by the dependent variables, which include the relative weights of the visceral organs, such as the Bursa of Fabricius, spleen, liver, and small intestine, as well as the levels of Escherichia coli bacteria found in the cloacal swabs. The control variables were standardized across all groups to ensure the validity and reliability of the research. In this experiment, 100 super native chickens of the same age and genetic background were housed uniformly in tropical conditions. All chickens received the same commercial feed and followed identical vaccination protocols throughout the study period.

Preparation of Turmeric Powder

Turmeric rhizomes were manually cleaned, peeled, and sliced into thin sections. The sliced rhizomes were air-dried in a controlled indoor room for 48 hours to minimize degradation of volatile oils and curcuminoids by direct sunlight. The dried rhizomes were ground using a mechanical blender to a fine flour consistency. The flour was sieved through a fine mesh, stored in airtight containers, and dissolved daily into fresh drinking water at the exact concentrations defined by the treatment protocols.

Visceral Organ Harvesting and Relative Weight Measurement

At 56 days of age, one chicken per replication (four chickens per treatment, representing average weight units) was randomly selected and humanely slaughtered via jugular venesection. Abdominal surgery was performed to harvest the internal organs: the Bursa of Fabricius, spleen, liver, and small intestine. Adhering adipose tissue and mesentery were removed, and the digestive organs were emptied of their digesta. Individual live body weight (BW) and absolute organ weights were recorded using an analytical electronic scale with a precision of 0.1 g. The relative organ weights were calculated as a percentage of live body weight according to the following formula:

$$Relative\ Organ\ Weight\ (\%) = \frac{Organ\ weight\ (g)}{Chicken\ live\ weight\ (g)} \times\ 100\%$$

Quantitative Escherichia coli Enumeration

Immediately prior to slaughter, cloacal swabs were collected from the selected chickens. Each swab was transferred into a sterile tube containing 9 mL of Peptone Saline Diluent (Maximum Recovery Diluent) to prepare a 10^{-1} homogenate. The homogenates were transported in cooler boxes to the Maros Veterinary Center Laboratory for quantitative bacterial analysis. Bacterial enumeration followed standard microbiological procedures derived from the Public Health England standard method FNES3 (F8) and BS ISO 16649-2:2001 for the enumeration of β-glucuronidase-positive *Escherichia coli*. Serial decimal dilutions were prepared, and 1 mL of

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each dilution was inoculated in duplicate into sterile Petri dishes. Molten Tryptone Bile Glucuronide (TBX) agar, cooled to 44°C to 47°C, was poured and thoroughly mixed with the inoculum. The plates were allowed to solidify and incubated at 37°C for 4 hours, followed by incubation at 44°C for 18 to 21 hours. Typical blue colonies representing β-glucuronidase-positive *E. coli* were quantified. For low bacterial counts, the estimated number of *E. coli* was calculated as the arithmetic mean of the two plates:

$$N_E = \frac{\sum_a}{V \,.\, n \,.\, d}$$

Where Σα is the sum of colonies counted, *V* is the inoculum volume (1 mL), *n* is the number of plates, and *d* is the dilution factor. For high bacterial counts, the weighted mean count (*N*) was determined:

$$N = \frac{\sum_a}{V \,.\, (n1 + 0.1 \,.\, n2) \,.\, d}$$

Bacterial counts were transformed to logarithmic values ($\log_{10}$ CFU/g) prior to statistical processing.

Statistical Analysis

All data were subjected to one-way Analysis of Variance (ANOVA) for a Completely Randomized Design (CRD) using SPSS version 25. Before analysis, the homogeneity of variances was confirmed. When significant differences were detected, treatment means were compared using Duncan's Multiple Range Test (DMRT) at a significance level of 5% (α= 0.05).

RESULTS AND DISCUSSIONS

Combined Animal Growth and Visceral Organ Performance

The primary biological database generated from the 56-day-old super native chickens, integrating individual body weights, absolute organ weights, calculated relative visceral organ weights, and corresponding quantitative cloacal *Escherichia coli* loads, is presented in Table 1.

The development of primary and secondary lymphoid organs is a crucial biological indicator of systemic immune competence and developmental health in local poultry species. In this study, dietary supplementation with turmeric powder (*Curcuma domestica*) through drinking water significantly modified the relative weights of the Bursa of Fabricius and the spleen ($P<0.05$), with both parameters peaking at the 3 g/L (P3) supplementation level.

The Bursa of Fabricius is the primary site for B-lymphocyte differentiation and maturation, making its development essential for a robust humoral immune response. Supplementation with 3 g/L of turmeric powder (P3) increased relative bursa weight to 0.1131% ± 0.028%, compared to 0.0748% ± 0.011% in the negative control group (P0). This tissue hypertrophy indicates that moderate doses of curcuminoids stimulate cellular proliferation within the lymphoid follicles of the bursa, increasing B-lymphocyte density (Ismail *et al.*, 2023). These anatomical changes are supported by previous findings showing that local chickens supplemented with 3 g/L of turmeric powder exhibited significantly increased antibody titers against Newcastle Disease (ND) and Avian Influenza (AI) (Nur *et al.*, 2023a)

Concurrently, relative spleen weight reached its maximum under the P3 treatment (0.4216% ± 0.057%), representing a significant increase compared to both the negative control (P0, 0.3668% ± 0.072%) and positive control (P1, 0.3208% ± 0.063%) groups. The spleen serves

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as the primary secondary lymphoid organ in poultry, coordinating cellular immune responses and filtering systemic pathogens. An increase in relative spleen weight indicates enhanced systemic immune surveillance and active lymphopoiesis within the splenic white pulp (Nur *et al.*, 2023b). Histological evaluations have shown that turmeric active compounds help preserve splenic cell architecture and prevent lymphoid depletion during bacterial or environmental challenges, supporting these organ-level observations (Hartady *et al.*, 2025).

Notably, a slight decline in relative lymphoid organ weights was observed at the highest turmeric concentration of 5 g/L (P4) compared to the 3 g/L (P3) group, although weights remained higher than those of the negative control (P0). This response may be attributed to a physiological hormetic effect, where moderate levels of botanical active compounds stimulate positive systemic adaptations, while higher concentrations introduce a minor metabolic workload. High doses of raw turmeric powder contain secondary compounds, such as tannins and oxalates, which can limit nutrient utilization or cause minor metabolic stress when consumed in excess, plateauing further lymphoid tissue growth. Thus, a dosage of 3 g/L appears to represent the physiological optimum for supporting immune system development in super native chickens (Nur *et al.*, 2023b).

The relative weights of metabolic and digestive organs, such as the liver and small intestine, did not differ statistically among the treatment groups ($p>0.05$), indicating that turmeric supplementation did not cause adverse physiological changes or systemic toxicity (Negari *et al.*, 2014). However, the observed trends suggest interesting physiological adaptations to the phytobiotic treatments. The mean values for relative organ weights, which express developmental and physiological variations under phytobiotic pressure, are summarized in Table 2.

Relative liver weight was lowest in the 5 g/L group (P4, 2.8599% ± 0.142%) compared to the positive control group (P1, 3.1756% ± 0.176%) and the negative control group (P0, 3.0304% ±0.063%). Curcuminoids are known to have hepatoprotective and lipid-regulating properties (Cojocariu *et al.*, 2026). They stimulate bile acid synthesis, which facilitates fat emulsification, and reduce hepatic fat accumulation, helping to maintain a healthy liver size and function under intensive rearing conditions (Oni, A and Oke, 2025)

Relative small intestine weight showed a downward trend in the turmeric-supplemented groups, with the P2 (1 g/L) and P4 (5 g/L) groups averaging 6.0256% ± 0.374% and 6.5008% ± 0.392%, respectively, compared to 7.6782% ± 0.397% in the negative control group (P0). A higher relative intestine weight in untreated chickens often indicates a thicker intestinal wall, a response to subclinical inflammation or pathogen exposure (da Rosa *et al.*, 2020). Conversely, a lower relative weight in turmeric-treated chickens suggests improved intestinal health, characterized by thinner, more efficient intestinal walls and enhanced nutrient absorption. This allows the host to allocate more energy toward growth and immune function rather than maintaining gut tissue mass (Al-Sultan, 2003)

Quantitative Escherichia coli Contamination and Morphological Observations

Quantification of cloacal *Escherichia coli* provides a direct measure of intestinal health and pathogenic colonization dynamics in poultry. The microbiological analysis revealed a highly significant, dose-dependent antimicrobial effect of turmeric supplementation on *E. coli* colonization ($p<0.01$). While low (P2, 1 g/L) and moderate (P3, 3 g/L) doses maintained high *E. coli* counts of 4.13 ± 1.38 and 5.38 ± 0.27 Log10 CFU/g, respectively, the highest dose of 5 g/L (P4) successfully suppressed the bacterial population to 2.98 ± 0.79Log10 CFU/g.

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This response demonstrates that the direct antibacterial effect of turmeric powder in the gut lumen depends on reaching a minimum inhibitory threshold (Oni, A and Oke 2025). Active compounds, such as curcumin and xanthorrhizol, must be present at high concentrations in the intestinal lumen to effectively disrupt the cell membranes of Gram-negative bacteria such as *E. coli* (Asmara *et al.*, 2018). At lower doses (1–3 g/L), these compounds support systemic immunity and digestive enzyme secretion without reaching bactericidal concentrations in the distal digestive tract (Fouad *et al.*, 2025). When the dosage was increased to 5 g/L (P4), direct bactericidal and bacteriostatic pressures were established, resulting in a significant 2.4-log reduction in cloacal *E. coli* shedding compared to the P3 group.

The negative control group (P0) exhibited a low baseline *E. coli* population (1.53 ±0.23 Log10 CFU/g), which is typical of chickens reared in clean, isolated research facilities with strict biosecurity (Nur *et al.*, 2023a). However, uncompromised control chickens remain vulnerable to rapid pathogen multiplication under standard commercial rearing conditions (Uroševic *et al.*, 2022). This is illustrated by the positive control group (P1, Promune C), which lacked direct luminal antimicrobial compounds and exhibited a high *E. coli* load of 5.55 ± 0.24 Log10 CFU/g. While P1 contains Vitamin C, Vitamin E, and Selenium to support systemic immunity, it does not exert direct antibacterial pressure in the gut lumen, leaving the chickens susceptible to enteric colonization (Morsy *et al.*, 2023). In contrast, the P4 treatment (5 g/L) successfully controlled *E. coli* shedding, demonstrating its therapeutic efficacy as a phytobiotic alternative in environments with high exposure to enteropathogens (Asmara *et al.*, 2018).The mean values of the transformed *Escherichia coli* colonization levels are summarized in Table 3.

After incubation, visual examination of the TBX agar plates revealed clear differences in colony density and morphology among the treatment groups. Presumptive *Escherichia coli* colonies were identified by their characteristic dark blue to purple coloration and appeared as discrete, medium-sized, spherical colonies embedded within the agar matrix. In contrast, non-typical coliforms and other background microorganisms appeared as pale pink, red, or colorless colonies (Figure 1).

Figure 1a showed moderate to high numbers of typical blue colonies, accompanied by several pink background colonies, indicating substantial bacterial growth in the positive control and 3 g/L treatment groups. Figure 1b demonstrated moderate to high colony development, further supporting observable differences in bacterial growth among treatments. Figure 1c exhibited a lower density of typical *E. coli* colonies, suggesting partial inhibition of bacterial growth in some replicates treated with 1 g/L and 5 g/L concentrations. Overall, the colony profiles indicated treatment-dependent variation in *E. coli* growth, with some treatments showing reduced colony density compared with the positive control, whereas others maintained moderate to heavy colonization.

CONCLUSION

This study demonstrates that turmeric (*Curcuma domestica*) powder supplementation through drinking water influences lymphoid organ development and cloacal Escherichia coli colonization in super native chickens in a dose-dependent manner. A moderate dose of 3 g/L was most effective in improving immune organ development, as shown by increased relative weights of the Bursa of Fabricius and spleen, while a higher dose of 5 g/L provided stronger antibacterial effects by reducing cloacal E. coli colonization. Therefore, turmeric powder may serve as a natural alternative to synthetic antibiotics, with 3 g/L recommended for immune support and 5 g/L for controlling enteric bacterial contamination during periods of higher disease risk.

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Table 1. Compiled raw performance and microbiological colonization database of slaughtered chickens

Treatment	Repeat	Live BW (g)	Bursa Weight (g)	Spleen Weight (g)	Liver Weight (g)	Small Intestine Weight (g)	Relative Bursa (%)	Relative Spleen (%)	Relative Liver (%)	Relative Intestine (%)	*E. coli* Load (CFU/g)	Transformed Count (log10 CFU/g)
P0	1	600	0.6	2.8	18.0	50.0	0.1000	0.4667	3.0000	8.3333	$2x10^1$	1.301
	2	640	0.3	2.4	18.4	43.8	0.0469	0.3750	2.8750	6.8438	$7x10^1$	1.845
	3	530	0.4	2.5	16.8	37.9	0.0755	0.4717	3.1698	7.1509	$1x10^1$	1.000
	4	650	0.5	1.0	20.0	54.5	0.0769	0.1538	3.0769	8.3846	$9x10^1$	1.954
P1	1	540	0.3	1.2	18.8	38.7	0.0556	0.2222	3.4815	7.1667	$8x10^5$	5.903
	2	650	0.8	3.3	22.5	45.4	0.1231	0.5077	3.4615	6.9846	$7x10^5$	5.845
	3	510	0.2	1.1	15.0	34.3	0.0392	0.2157	2.9412	6.7255	$4x10^5$	5.602
	4	770	0.6	2.6	21.7	48.3	0.0779	0.3377	2.8182	6.2727	$7x10^4$	4.845
P2	1	630	0.5	1.6	19.4	38.3	0.0794	0.2540	3.0794	6.0794	$4x10^5$	5.602
	2	670	0.5	2.0	21.3	34.8	0.0746	0.2985	3.1791	5.1940	$2x10^5$	5.301

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	3	650	0.5	3.5	24.1	44.8	0.0769	0.5385	3.7077	6.8923	$1x10^0$	0.000
	4	630	0.5	1.5	20.0	37.4	0.0794	0.2381	3.1746	5.9365	$4x10^5$	5.602
P3	1	610	0.2	1.6	18.0	40.1	0.0328	0.2623	2.9508	6.5738	$3x10^5$	5.477
	2	670	1.0	3.5	22.5	43.3	0.1493	0.5224	3.3582	6.4627	$7x10^5$	5.845
	3	670	1.0	3.2	23.1	44.2	0.1493	0.4776	3.4478	6.5970	$4x10^5$	5.602
	4	660	0.8	2.8	19.5	42.4	0.1212	0.4242	2.9545	6.4242	$4x10^4$	4.602
P4	1	750	1.0	3.3	21.5	55.3	0.1333	0.4400	2.8667	7.3733	$4x10^1$	1.602
	2	720	0.5	1.7	19.0	45.4	0.0694	0.2361	2.6389	6.3056	$5x10^1$	1.699
	3	700	0.8	3.0	22.8	47.5	0.1143	0.4286	3.2571	6.7857	$1x10^4$	4.000
	4	650	0.3	2.0	17.4	36.0	0.0462	0.3077	2.6769	5.5385	$4x10^4$	4.602

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Table 2. Mean Relative Visceral Organ Weights (%) of 56-Day-Old Super Native Chickens

Parameter	P0	P1	P2	P3	P4	SEM	P-value
Relative Bursa (%)	0.0748^{b}	0.0740^{b}	0.0776^{b}	0.1131^{a}	0.0908^{ab}	0.0102	0.041
Relative Spleen (%)	0.3668^{b}	0.3208^{b}	0.3323^{b}	0.4216^{a}	0.3531^{b}	0.0211	0.038
Relative Liver (%)	3.0304	3.1756	3.2852	3.1778	2.8599	0.0911	0.185
Relative Small Intest (%)	7.6782	6.7874	6.0256	6.5144	6.5008	0.2104	0.114

Note: Means within a row with different superscripts (a,b) differ significantly (P<0.05). SEM: Standard Error of the Mean.

Table 3. Mean Quantitative Cloacal Swab Escherichia coli Load (log_{10} CFU/g)

Parameter	P0	P1	P2	P3	P4	SEM	P-value
Cloacal *E. coli* Count	1.53^{c}	5.55^{a}	4.13^{ab}	5.38^{a}	2.98b^{c}	0.385	0.003

Figures

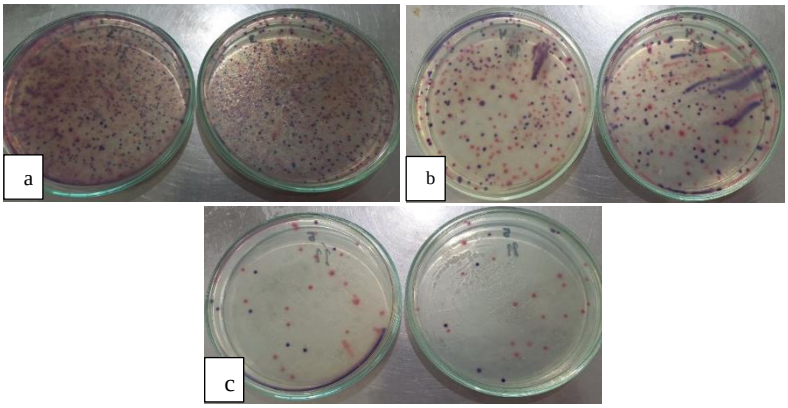

Figure 1. Representative colony morphology and distribution of Escherichia coli on differential agar across experimental treatments. (a) Plate A shows a dense distribution of characteristic dark blue to purple colonies against a prominent pink background, indicating high E. coli growth, as observed predominantly in the positive control (P1) and 3 g/L turmeric treatment (P3) groups. (b) Plate B displays moderate to heavy colony growth distributed relatively evenly across the medium, reflecting differences in bacterial survival and proliferation among the experimental treatments. (c) Plate C shows a lower density and sparser distribution of characteristic blue E. coli colonies, indicating partial inhibition of bacterial growth in selected replicates of the 1 g/L (P2) and 5 g/L turmeric treatment (P4) groups.

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