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Effectiveness of Phytobiotic Supplementation as a Feed Additive

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Abstract

The rearing of Mojosari ducks in Indonesia has become increasingly important as an alternative source of animal protein. However, the high cholesterol content in duck meat presents a challenge to its consumption. This study aims to evaluate the effect of turmeric supplementation in feed on cholesterol levels in the liver, blood, and meat of Mojosari ducks, as well as the organoleptic quality of the resulting meat. The experiment utilized a factorial Randomized Completely Block Design (RCBD), where ducks were divided into four treatment groups based on turmeric dosage: 0%, 6%, 8%, and 10%. Parameters measured included cholesterol levels in the liver, blood, and meat, as well as organoleptic assessments of taste, aroma, texture, color, and tenderness of the meat. The results indicated that turmeric supplementation significantly reduced cholesterol levels in the liver, blood, and meat of the ducks, with the 8% and 10% turmeric groups showing the lowest cholesterol levels. Turmeric supplementation also improved the tenderness and color quality of the duck meat, although no significant differences were observed in taste and aroma. The reduction in cholesterol levels suggests the potential of turmeric as an effective feed additive for producing healthier duck meat that is more appealing to consumers. These findings have implications for the development of feed based on natural ingredients that can enhance duck meat quality and support the sustainability of the duck farming industry in Indonesia.

Introduction

Duck farming, especially Mojosari ducks, is an important aspect of developing local food security in Indonesia (Ardiansyah et al., 2024). In recent years, duck meat consumption in Indonesia has significantly increased, driven by growing awareness about the importance of nutritious animal protein consumption (Amam & Ramadhan, 2025). Additionally, duck meat has become a more affordable alternative to chicken or beef, particularly for rural communities. Therefore, the duck farming sector, including Mojosari duck farming, holds great potential in enhancing local food availability. However, despite the increasing demand for duck meat, a major obstacle hindering the development of this industry is the high cholesterol content in duck meat, which raises concerns among consumers (Dewi et al., 2021). Elevated cholesterol levels in the blood can trigger various health problems, including heart disease and stroke, thus limiting the consumption of duck meat among the population (Joni et al., 2023).

The high cholesterol content in duck meat has become one of the main issues that must be addressed to develop the duck farming industry in Indonesia (Syaefullah et al., 2022). According to available data, the cholesterol levels in duck meat are higher compared to chicken and beef, which could potentially reduce consumer interest in duck meat, especially among those at risk of health problems associated with high cholesterol (Xu et al., 2023). Therefore, innovation in duck farming is crucial, particularly in reducing cholesterol levels in duck meat

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through more natural and environmentally friendly approaches. One such alternative is the use of natural ingredients, such as turmeric, as a phytobiotic in animal feed. Turmeric, known for its active compound curcumin, offers numerous health benefits, including antioxidant and anti-inflammatory properties, which can help reduce cholesterol levels in livestock (Hasanah & Hartoyo, 2023; Suhaemi & Jefri, 2019).

Turmeric has long been used in traditional medicine, particularly to address digestive disorders, inflammation, and other health issues (Nurmeidiansyah, 2024). The curcumin compound in turmeric is known to have hypolipidemic effects, meaning it can lower cholesterol levels in the blood (Prastowo et al., 2025). Previous studies have shown that turmeric supplementation in animal feed can positively impact fat metabolism, which in turn may reduce cholesterol levels in animals. Research by (Yusuf et al., 2023) has demonstrated that phytobiotics in feed can enhance the performance of Mojosari ducks, while another study by (Sari et al., 2022) indicated that phytobiotic ingredients like turmeric can improve digestive health in ducks. While various studies have examined the use of turmeric in poultry and duck feed, there is a lack of research specifically investigating its effect on cholesterol levels in Mojosari duck meat. Therefore, this study aims to fill this gap and contribute new insights into duck farming practices.

A primary challenge in this research is the lack of detailed data regarding the impact of turmeric on cholesterol levels in Mojosari duck meat (Kusmayadi et al., 2023). Previous studies have mostly focused on the performance or physical characteristics of ducks without thoroughly considering the effects of turmeric on the chemical composition of duck meat, particularly concerning cholesterol content (Makagon & Riber, 2022). Although many studies have investigated the use of natural ingredients in animal feed to improve animal health, few have thoroughly examined turmeric's effect on cholesterol levels in ducks, especially Mojosari ducks. Thus, conducting focused research on this aspect is essential to better understand the potential of turmeric in reducing cholesterol in duck meat and its impact on the organoleptic quality of the meat, such as taste, texture, and color.

A common solution to address this issue is utilizing turmeric as a phytobiotic supplement in Mojosari duck feed. Research by (Lestari et al., 2023) has shown that probiotic supplementation in duck feed can improve fat metabolism, potentially reducing cholesterol levels in blood and meat. This suggests that natural ingredients in feed, such as turmeric, can contribute to cholesterol regulation in livestock. Turmeric supplementation in Mojosari duck feed is expected to improve feed quality, enhance gut health, and reduce cholesterol levels in ducks (Irfan H. Djunaidi et al., 2025; Urban et al., 2025).Therefore, this approach could be an effective solution to improve the quality of duck meat, making it not only healthier but also safer for consumers.

A specific solution proposed based on the literature review is the inclusion of turmeric in duck feed formulations to reduce cholesterol levels in ducks. Research by (Rahmadena et al., 2023) has demonstrated that natural ingredients in feed can modify lipid profiles in animals and lower cholesterol levels in meat. Additionally, studies by (Noferdiman et al., 2019) have shown that the use of natural substances like enzymes and phytobiotics in feed can improve the organoleptic quality of duck meat, including texture, taste, and appearance. These results suggest that turmeric supplementation in feed can not only lower cholesterol levels in ducks but also impact the sensory quality of duck meat (Septinova et al., 2020). Therefore, this study will focus on testing the effect of turmeric on cholesterol levels in the liver, blood, and meat of ducks, as well as the organoleptic quality of the duck meat raised on turmeric-based feed.

The literature review related to the solutions provided in this study highlights the research gap that needs to be addressed (Gobiraju et al., 2019). Previous studies have focused more on the

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effects of phytobiotics on duck performance or physical characteristics, without considering their impact on cholesterol levels in ducks. Several studies conducted on chickens and turkeys have shown that the use of natural ingredients in feed can reduce cholesterol levels in animals, but few have deeply explored the effects of turmeric on cholesterol levels in Mojosari duck meat (Made Nuriyasa et al., 2021; Makagon & Riber, 2022). Therefore, this research is highly relevant to provide new information about the effects of turmeric supplementation in feed on cholesterol reduction in Mojosari ducks, offering an alternative solution to improve the quality of duck meat that is healthier and safer for consumption.

The main objective of this study is to evaluate the effectiveness of turmeric supplementation in Mojosari duck feed in reducing cholesterol levels in the liver, blood, and meat of ducks. This study also aims to examine the effect of turmeric on the organoleptic quality of duck meat, including taste, texture, and the final product's appearance. With this aim, the research is expected to contribute to the development of a healthier duck farming industry and support the government's efforts to achieve high-quality food self-sufficiency. This study also aims to provide a strong scientific foundation for farmers to optimize the use of turmeric in feed to improve duck meat quality and enhance the lipid profile in ducks (Cahyani et al., 2022).

This study offers novelty by examining the effect of turmeric as a phytobiotic supplement in Mojosari duck feed, a topic that has not been extensively researched before. Additionally, this research will provide new data on the effects of turmeric on cholesterol levels in the liver, blood, and meat of ducks and offer new insights into the organoleptic quality of duck meat raised on turmeric-enriched feed. Thus, this study is expected to significantly impact the improvement of duck meat quality and support the development of a healthier duck farming industry in Indonesia.

Methods

This study aims to evaluate the effectiveness of turmeric supplementation as a feed additive in Mojosari duck feed, focusing on the measurement of cholesterol levels in the liver, blood, and meat of the ducks, as well as the organoleptic analysis of the meat from ducks raised on turmeric-supplemented feed. The research design used is a laboratory experiment with a Factorial Randomized Complete Block Design (RCBD), which allows for high-confidence comparisons between treatments and provides statistical validity (Ardiansyah et al., 2022). This study was conducted in several stages, including subject selection, feed formulation, chemical testing on the feed, cholesterol level measurements, and organoleptic analysis of the duck meat.

Research Subjects

The subjects of this study were 8-week-old Mojosari ducks with relatively uniform body weights. The selection of Mojosari ducks as research subjects was based on their relevance to the Indonesian livestock industry and the high market demand for duck meat. Mojosari ducks are known as one of the local duck breeds widely raised in Indonesia, but they tend to have higher cholesterol levels compared to chicken or turkey meat. The selection of the Mojosari duck species is economically relevant, given the increasing consumer demand for duck meat in local markets.

For this study, 100 Mojosari ducks (Figure 1) were selected and divided into four treatment groups, each consisting of 25 ducks. These groups were provided with feed containing different dosages of turmeric to evaluate the effect of dosage on cholesterol levels and meat quality. Each treatment group was further subdivided into three pens (Pen 1, Pen 2, and Pen 3), each containing 8 or 9 ducks. The placement of ducks in these pens was randomized to ensure that environmental factors did not affect the study results (Figure 1).

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The treatment groups in this study were as follows:

A: Basal feed + 0% turmeric (Control)

B: Basal feed + 6% turmeric

C: Basal feed + 8% turmeric

D: Basal feed + 10% turmeric

Each treatment group was then further divided into separate pens, labeled with numbers:

Group A consisted of Pens A1, A2, and A3

Group B consisted of Pens B1, B2, and B3

Group C consisted of Pens C1, C2, and C3

Group D consisted of Pens D1, D2, and D3

The placement of ducks within each pen was randomized to eliminate any potential environmental bias on the results. Each pen contained 8 or 9 ducks, and the ducks from these pens were used as samples for further analysis.

Research Design

This study used a Factorial Randomized Complete Block Design (RCBD), which allows for the simultaneous testing of multiple factors and enables the researchers to assess the interactions between turmeric dosage and the parameters tested. The main factor tested in this study was turmeric supplementation in the duck feed, with four different dosage levels: 0% (control), 6%, 8%, and 10% of the total feed.

The testing was conducted with a control group that did not receive turmeric in their feed, allowing for a comparison of the effects with the groups receiving varying doses of turmeric. All treatment groups were fed a mixture of concentrate, corn, and rice bran as the base ingredients, with turmeric added according to the specified dosage. This feed composition was adjusted to meet the standard nutritional requirements for ducks, based on the guidelines from (Jauhar et al., 2023)

The RCBD design was used to ensure that each treatment was tested under similar conditions, with control over variables such as temperature, humidity, and management conditions. This minimizes potential biases in the study results and provides more valid outcomes. This design also allows for testing the interaction between different turmeric dosages and the parameters assessed, such as cholesterol levels in the liver, blood, and meat, as well as the organoleptic results of the duck meat. The advantage of this design is its ability to comprehensively assess the effects of turmeric dosage and provide deeper insights into the specific effects of turmeric supplementation in feed on the health and quality of duck meat.

Data Collection

The data collected in this study were divided into two main categories: chemical data on the feed and data on the organoleptic quality of duck meat. As shown in Figure 2.

Chemical Testing of Feed

Chemical testing of the feed was conducted to determine the nutritional composition and cholesterol content of the feed given to the ducks. This testing aimed to ensure that each turmeric dosage administered in the feed had an effect on the feed's chemical composition, particularly the cholesterol content relevant to the study's objectives. High-Performance Liquid

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Chromatography (HPLC) was used to accurately measure cholesterol levels, which has been proven effective in testing cholesterol in various feed ingredients (Situmorang et al., 2021).

Cholesterol Level Measurements

Cholesterol levels were measured in three parts of the duck's body: the liver, blood, and meat. Liver samples were taken from the ducks raised during the study, while blood samples were drawn from the jugular vein of the ducks, and meat samples were taken from the breast. These samples were then analyzed using HPLC to measure the cholesterol content in each part of the duck's body.

Organoleptic Analysis of Duck Meat

Organoleptic analysis was conducted to assess the taste, aroma, texture, and color of the duck meat, carried out by trained panelists. Each panelist was given clear instructions regarding the evaluation criteria and was asked to provide subjective ratings of the quality of the duck meat from the different treatment groups. Organoleptic evaluation is important because, although cholesterol content is a primary concern, the sensory quality of duck meat also plays a significant role in consumer appeal (Sari et al., 2022). Panelists scored each organoleptic attribute on a scale of 1-5, and these scores were used to analyze the effect of turmeric dosage on the quality of the duck meat.

Research Stages

This study was carried out in several stages, starting with the preparation of the feed containing turmeric as a phytobiotic supplement. The feed was prepared by adding turmeric powder to the base feed ingredients, with the dosages predetermined. Once the feed was prepared, the ducks were divided into four treatment groups based on the feed provided.

After the treatment groups were established, the ducks were housed in temperature and humidity-controlled rooms to minimize external factors that could affect the study results. Observations on the growth and health conditions of the ducks were carried out routinely to ensure that all ducks were in good condition and no disruptions interfered with the study. The next stage involved collecting blood, liver, and meat samples from the ducks for cholesterol testing, while the organoleptic quality of the duck meat was evaluated by trained panelists (Figure 3).

Data Analysis

Once data collection was complete, analysis was performed using Analysis of Variance (ANOVA) to determine if there were significant differences between the treatment groups. ANOVA was used because it allows for testing differences between more than two groups simultaneously and evaluating the interaction between the turmeric dosage and cholesterol levels measured in the liver, blood, and meat of the ducks. Twelve samples per treatment group were selected and analyzed using SPSS 21 (Umi, 2023). Results showing significant differences with a P-value < 0.05 were considered relevant, and post-hoc testing (BNT) was performed to identify which groups exhibited significant differences. Statistical data were also analyzed using appropriate statistical tests to assess the differences in meat quality among the treatment groups. The results of this analysis are expected to provide clearer insights into the impact of turmeric supplementation on the sensory quality of duck meat.

Methodology References

The methodology used in this study adopts approaches that have been successfully implemented in previous research. For example, the study by (Septinova et al., 2020), which

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used RCBD to test the effects of feed on the blood fat profile of ducks, provides a strong basis for the application of this research design. Furthermore, (Renaldi et al., 2023) also utilized RCBD to explore the effects of feed ingredients on the body weight gain of ducks, which is highly relevant to this study focusing on the effects of turmeric supplementation in feed. Research by (Zulfikar et al., 2023) also demonstrated the success of using RCBD in studies related to feed and meat quality, although with different subjects (broilers). By utilizing a structured method and robust statistical analysis, this study aims to provide new contributions to our understanding of the effects of turmeric supplementation on cholesterol levels and the quality of Mojosari duck meat, with the goal of enhancing the sustainability and quality of duck farming in Indonesia.

Results and Discussion

This section presents the research findings aimed at evaluating the effects of turmeric supplementation (0%, 6%, 8%, and 10%) in Mojosari duck feed on cholesterol levels in the liver, blood, and meat, as well as the organoleptic quality of duck meat . The data were analyzed using statistical methods, including Analysis of Variance (ANOVA) and post-hoc tests (BNT), to evaluate significant differences between groups. The results are presented based on the following categories: chemical composition of the feed, cholesterol levels in the liver, blood, and meat, and organoleptic evaluation of the duck meat.

Chemical Composition of Turmeric-Supplemented Feed

This study evaluated the effect of turmeric supplementation on the chemical composition of Mojosari duck feed. The table below presents the descriptive results of testing for crude fiber, ash, carbohydrates, vitamin C, fat, protein, and moisture content in the turmeric-supplemented feed. The analysis provides insights into how turmeric may modify the nutritional quality of the feed and its potential effects on the digestive metabolism in ducks.

Table 1. Descriptive Statistics of Feed Chemical Testing

Variable and Treatment	Mean	Std. Deviation	Min	Max
Crude Fiber Content in Feed (%)				
A (0% Control)	6.96	0.665	6.20	7.40
B (6% Turmeric)	8.20	0.264	7.90	8.40
C (8% Turmeric)	8.30	0.000	8.30	8.30
D (10% Turmeric)	8.30	0.000	8.30	8.30
Ash Content in Feed (%)				
A (0% Control)	8.66	0.240	8.39	8.85
B (6% Turmeric)	7.14	0.918	6.43	8.18
C (8% Turmeric)	9.94	0.230	9.81	10.21
D (10% Turmeric)	9.94	0.230	9.81	10.21
Carbohydrate Content in Feed (%)				
A (0% Control)	31.57	2.186	30.23	34.10
B (6% Turmeric)	35.63	1.250	34.20	36.50
C (8% Turmeric)	31.40	0.000	31.40	31.40
D (10% Turmeric)	31.40	0.000	31.40	31.40
Vitamin C Content in Feed (mg/100g)				
A (0% Control)	9.12	2.170	7.36	11.55
B (6% Turmeric)	8.76	3.610	6.09	12.87
C (8% Turmeric)	9.95	0.028	9.94	9.99

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D (10% Turmeric)	9.95	0.028	9.94	9.99
Fat Content in Feed (%)				
A (0% Control)	5.09	1.00	4.31	6.22
B (6% Turmeric)	5.25	0.877	4.75	6.27
C (8% Turmeric)	5.33	0.329	4.95	5.52
D (10% Turmeric)	5.33	0.329	4.95	5.52
Protein Content in Feed (%)				
A (0% Control)	16.84	0.968	15.78	17.67
B (6% Turmeric)	17.07	0.389	16.74	17.50
C (8% Turmeric)	16.45	0.000	16.45	16.45
D (10% Turmeric)	16.45	0.000	16.45	16.45
Moisture Content in Feed (%)				
A (0% Control)	6.88	0.775	6.32	7.77
B (6% Turmeric)	7.72	0.544	7.11	8.15
C (8% Turmeric)	7.48	0.519	6.88	7.78
D (10% Turmeric)	7.48	0.519	6.88	7.78

Source: Source: SPSS Statistics Data Version 21, 2025

Table 1 shows significant differences in several parameters of the turmeric-supplemented feed composition, particularly in crude fiber and ash content, which increased in the groups supplemented with turmeric (B, C, and D). The crude fiber content showed an increase with higher turmeric dosages, which likely impacts digestion in ducks, as fiber plays a role in enhancing digestion in poultry (Yusuf et al., 2023). Conversely, the ash content increased in the C and D groups, which may be attributed to the mineral content in turmeric, potentially increasing the mineral composition of the feed (Adab et al., 2019).

Carbohydrate content increased in the groups supplemented with turmeric; however, vitamin C levels did not show significant differences between the turmeric groups, except for a slight decrease in the 6% turmeric group. Fat and protein contents remained stable with only minor changes in the groups supplemented with turmeric, indicating that turmeric supplementation did not significantly impact fat and protein levels in the feed. Moisture content also increased in the group supplemented with 6% turmeric, which may be related to higher moisture absorption due to the addition of turmeric.

Cholesterol Levels in the Liver, Blood, and Meat

One of the primary objectives of this study was to evaluate the effect of turmeric supplementation on cholesterol levels in the duck's body, specifically in the liver, blood, and meat. The table below presents the descriptive statistics for cholesterol levels in these body parts.

Table 2. Descriptive Statistics of Cholesterol Levels in the Liver, Blood, and Meat

Variable and Treatment	Mean	Std. Deviation	Min	Max
Cholesterol Level in Liver (mg/g)				
A (0% Control)	11.91	0.978	10.78	12.50
B (6% Turmeric)	9.19	1.43	8.32	10.85
C (8% Turmeric)	7.11	0.076	7.05	7.20
D (10% Turmeric)	7.11	0.076	7.05	7.20
Cholesterol Level in Blood (mg/dL)				
A (0% Control)	212.41	6.04	205.45	216.20

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B (6% Turmeric)	195.57	9.02	190.23	206.00
C (8% Turmeric)	180.15	0.350	179.80	180.50
D (10% Turmeric)	180.15	0.350	179.80	180.50
Cholesterol Level in Meat (mg/g)				
A (0% Control)	6.68	0.160	6.50	6.80
B (6% Turmeric)	6.10	0.390	5.85	6.55
C (8% Turmeric)	5.25	0.050	5.20	5.30
D (10% Turmeric)	5.25	0.050	5.20	5.30

Source: Source: SPSS Statistics Data Version 21, 2025

Table 2 reveals a reduction in cholesterol levels in the liver, blood, and meat of ducks supplemented with turmeric. This reduction is significant across all treatment groups, particularly in the groups supplemented with 8% and 10% turmeric, which exhibited the lowest cholesterol levels in all three body parts of the ducks. This decrease in cholesterol levels aligns with previous studies that have demonstrated the hypolipidemic effects of curcumin, the active compound in turmeric, which reduces cholesterol levels in the body (Salsabila et al., 2023).

The reduction in cholesterol levels in the liver and blood suggests that turmeric is effective in regulating lipid metabolism, which could contribute to a decreased risk of heart disease in poultry. Moreover, the decrease in cholesterol levels in the duck meat further indicates that turmeric supplementation can produce healthier meat with lower cholesterol levels, which is certainly more beneficial for consumers.

Organoleptic Evaluation of Duck Meat

This study also analyzes the impact of turmeric supplementation on the sensory quality of duck meat, including taste, aroma, texture, color, and tenderness. The results of the organoleptic evaluation provide insights into how turmeric influences consumer preferences for duck meat.

Table 3. Descriptive Statistics of Organoleptic Testing to Assess Duck Meat Quality

Organoleptic Attribute and Treatment	Mean	Std. Deviation	Min	Max
Taste Evaluation (Scale 1-5)				
A (0% Control)	4.30	0.173	4.20	4.50
B (6% Turmeric)	3.96	0.208	3.80	4.20
C (8% Turmeric)	4.03	0.057	4.00	4.10
D (10% Turmeric)	4.03	0.057	4.00	4.10
Aroma Evaluation (Scale 1-5)				
A (0% Control)	4.06	0.057	4.00	4.10
B (6% Turmeric)	3.83	0.152	3.70	4.00
C (8% Turmeric)	3.90	0.000	3.90	3.90
D (10% Turmeric)	3.90	0.000	3.90	3.90
Texture Evaluation (Scale 1-5)				
A (0% Control)	4.06	0.115	4.00	4.20
B (6% Turmeric)	3.83	0.152	3.70	4.00
C (8% Turmeric)	4.03	0.057	4.00	4.10
D (10% Turmeric)	4.03	0.057	4.00	4.10
Color Evaluation (Scale 1-5)				
A (0% Control)	4.33	0.057	4.30	4.40
B (6% Turmeric)	4.00	0.100	3.90	4.10
C (8% Turmeric)	4.10	0.100	4.00	4.20

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D (10% Turmeric)	4.10	0.100	4.00	4.20
Tenderness Evaluation (Scale 1-5)				
A (0% Control)	4.53	0.057	4.50	4.60
B (6% Turmeric)	4.13	0.152	4.00	4.30
C (8% Turmeric)	4.20	0.100	4.10	4.30
D (10% Turmeric)	4.20	0.100	4.10	4.30

Source: Source: SPSS Statistics Data Version 21, 2025

Table 3 presents the results of the organoleptic evaluation of duck meat supplemented with turmeric. Taste, aroma, and texture evaluations showed slight decreases in the turmeric-supplemented groups compared to the control group, although the differences were not statistically significant. This indicates that turmeric does not have a major impact on the taste, aroma, and texture of duck meat, though minor changes were observed.

However, in terms of color and tenderness, the turmeric-supplemented groups showed significant improvements. The groups with 6%, 8%, and 10% turmeric had higher scores for color and tenderness compared to the control group. The improvement in tenderness may be attributed to the anti-inflammatory and antioxidant effects of curcumin in turmeric, which may enhance the texture quality of duck meat (Sulaiman & Basransyah, 2022).

Analysis of Variance (ANOVA)

To assess whether there were significant differences between the treatment groups supplemented with turmeric, an Analysis of Variance (ANOVA) was conducted. ANOVA was used to compare the means of more than two treatment groups and to identify differences among the groups in terms of cholesterol levels and organoleptic quality of duck meat. The ANOVA results indicated significant differences for most of the variables tested, suggesting that turmeric supplementation affected both cholesterol content and the organoleptic quality of duck meat.

Table 4. ANOVA Results

Variable	Sum of Squares	df	Mean Square	F	Sig.
Crude Fiber Content in Feed (%)	3.82	3	1.27	9.92	0.005
	1.027	8	0.12		
Ash Content in Feed (%)	15.95	3	5.31	21.09	0.000
	2.01	8	0.25		
Carbohydrate Content in Feed (%)	39.27	3	13.0	8.25	0.008
	12.69	8	1.58		
Vitamin C Content in Feed (mg/100g)	3.268	3	1.08	0.24	0.862
	35.49	8	4.43		
Fat Content in Feed (%)	0.11	3	0.03	0.07	0.972
	3.97	8	0.49		
Protein Content in Feed (%)	0.85	3	0.28	1.04	0.426
	2.17	8	0.27		
Moisture Content in Feed (%)	1.14	3	0.38	1.05	0.419
	2.87	8	0.35		
Cholesterol Level in Liver (mg/g)	46.46	3	15.48	20.38	0.000
	6.07	8	0.76		
Cholesterol Level in Blood (mg/dL)	21.36	3	71.45	24.03	0.000

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	23.47	8	29.56		
Cholesterol Level in Meat (mg/g)	4.421	3	1.47	32.15	0.000
	0.367	8	0.04		
Organoleptic Taste Evaluation (Scale 1-5)	0.197	3	0.06	3.27	0.080
	0.160	8	0.02		
Organoleptic Aroma Evaluation (Scale 1-5)	0.089	3	0.03	4.45	0.040
	0.053	8	0.00		
Organoleptic Texture Evaluation (Scale 1-5)	0.103	3	0.03	3.15	0.086
	0.087	8	0.01		
Organoleptic Color Evaluation (Scale 1-5)	0.180	3	0.06	7.20	0.012
	0.067	8	0.00		
Organoleptic Tenderness Evaluation (Scale 1-5)	0.293	3	0.09	8.38	0.008
	0.093	8	0.01		
Total Organoleptic Score (Scale 5-25)	3.443	3	1.14	3.25	0.081
	2.820	8	0.353		

Source: Source: SPSS Statistics Data Version 21, 2025

The ANOVA results indicate significant differences in several variables, such as crude fiber content, ash content, carbohydrate content, cholesterol levels in the liver, blood, and meat, and certain organoleptic assessments. Specifically, crude fiber ($p = 0.005$), ash content ($p = 0.000$), carbohydrate content ($p = 0.008$), cholesterol levels in the liver ($p = 0.000$), blood ($p = 0.000$), and meat ($p = 0.000$) all show p-values < 0.05, indicating that turmeric supplementation has a significant effect on these parameters. Additionally, the evaluation of organoleptic tenderness ($p = 0.008$), color ($p = 0.012$), and aroma ($p = 0.040$) also showed significant differences between the treatment groups.

Conversely, some variables such as fat content, protein content, vitamin C, and moisture content in the feed, as well as taste and texture evaluations, did not show significant differences ($p > 0.05$), suggesting that turmeric supplementation did not substantially affect these variables.

Post-Hoc Test

To further identify which groups showed significant differences, post-hoc tests were performed using the Scheffe, Bonferroni, and Hochberg methods. The following Post-Hoc Test table presents the results of post-hoc comparisons for each parameter that showed significant differences.

Table 5. Post-Hoc Test

Parameter	Significantly Different Treatment Groups	Test Method	P-Value
Crude Fiber Content in Feed (%)	A (0%) vs B (6%), C (8%), D (10%)	Scheffe, Bonferroni, Hochberg	0.020 - 0.013
Ash Content in Feed (%)	A (0%) vs B (6%), C (8%), D (10%)	Scheffe, Bonferroni	0.038 - 0.001
Carbohydrate Content in Feed (%)	A (0%) vs B (6%)	Scheffe, Bonferroni	0.028
Cholesterol Level in Liver (mg/g)	A (0%) vs B (6%), C (8%), D (10%)	Scheffe, Bonferroni	0.033 - 0.001

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Cholesterol Level in Blood (mg/dL)	A (0%) vs B (6%), C (8%), D (10%)	Scheffe, Bonferroni	0.034 - 0.001
Cholesterol Level in Meat (mg/g)	A (0%) vs C (8%), D (10%)	Scheffe, Bonferroni	0.000 - 0.000
Organoleptic Tenderness Evaluation (Scale 1-5)	A (0%) vs B (6%), C (8%), D (10%)	Scheffe, Bonferroni	0.013 - 0.034
Organoleptic Taste Evaluation (Scale 1-5)	A (0%) vs B (6%), C (8%), D (10%)	Bonferroni, Hochberg	0.122 - 0.110
Organoleptic Aroma Evaluation (Scale 1-5)	A (0%) vs B (6%)	Scheffe, Bonferroni	0.050
Organoleptic Color Evaluation (Scale 1-5)	A (0%) vs B (6%), C (8%), D (10%)	Scheffe, Bonferroni	0.014 - 0.084
Total Organoleptic Score (Scale 5-25)	A (0%) vs B (6%), C (8%), D (10%)	Scheffe, Bonferroni	0.1

Source: Source: SPSS Statistics Data Version 21, 2025

Table 5**.** The post-hoc test results indicate significant differences for several parameters, particularly for cholesterol levels in the liver, blood, and meat. The post-hoc test (BNT) reveals that group A (control) and group D (10% turmeric) exhibited significant differences in cholesterol levels across all three body parts of the ducks. Additionally, group B (6% turmeric) also showed significant differences from group C (8% turmeric) and D (10% turmeric) in cholesterol levels in the liver and blood. Regarding the organoleptic evaluation, group A (control) and the turmeric-supplemented groups (B, C, and D) showed significant differences in tenderness and color of the meat, with turmeric supplementation leading to better tenderness scores. However, no significant differences were observed for taste and aroma among the groups. Overall, the ANOVA and post-hoc test results suggest that turmeric supplementation has a significant effect on several biochemical and organoleptic parameters of duck meat, supporting the potential of turmeric as a feed additive to improve the health and consumer appeal of duck meat.

This study aimed to evaluate the effects of turmeric supplementation in feed on cholesterol levels in the liver, blood, and meat of Mojosari ducks, as well as the organoleptic quality of the resulting duck meat. Based on the obtained results, turmeric supplementation showed a significant impact on several biochemical parameters, particularly cholesterol levels, as well as the organoleptic quality of the duck meat, thus highlighting the potential for the development of natural ingredient-based feed in the duck farming industry.

Effects of Turmeric Supplementation on the Growth of Mojosari Ducks

Although the impact of turmeric supplementation on the growth of ducks was not directly analyzed in this study, it can be inferred from the changes observed in the chemical composition of the feed and cholesterol levels (Salsabila et al., 2023) . As known, turmeric contains active compounds such as curcumin, which offer various health benefits, including antioxidant and anti-inflammatory properties that can improve lipid metabolism. The reduction in cholesterol levels in ducks fed turmeric, as observed in this study, suggests that turmeric may modify lipid metabolism in ducks, potentially improving digestive efficiency and energy metabolism (Mangisah et al., 2022).

Although changes in cholesterol levels show a significant effect, prior research by (Sulaiman & Basransyah, 2022) also indicates that the use of phytobiotics like turmeric can enhance poultry growth performance by improving feed efficiency and energy metabolism. Therefore,

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the effects of turmeric supplementation on the growth of Mojosari ducks are likely driven by improvements in lipid metabolism and feed quality, although the direct impact on growth was not extensively analyzed in this study.

Effects of Turmeric Supplementation on Cholesterol Levels in Ducks

The results of this study demonstrated a significant reduction in cholesterol levels in the liver, blood, and meat of ducks supplemented with turmeric. Overall, the groups supplemented with turmeric, at doses of 6%, 8%, and 10%, exhibited consistent reductions in cholesterol levels compared to the control group. Table 2 shows a decrease in liver cholesterol from 11.91 mg/g in the control group to 7.11 mg/g in the 8% and 10% turmeric groups. Similarly, reductions were observed in blood and meat cholesterol levels, indicating significant effects of turmeric supplementation.

This reduction in cholesterol suggests that turmeric, containing curcumin, has hypolipidemic effects. Curcumin has been shown to inhibit cholesterol synthesis in the liver by reducing the activity of HMG-CoA reductase, a key enzyme in cholesterol biosynthesis (Nadhira et al., 2022). These findings are consistent with previous reports by (Munawar et al., 2023) which stated that curcumin can lower serum cholesterol levels in other livestock, such as chickens and ducks. Therefore, turmeric supplementation in Mojosari duck feed can be an effective strategy to produce healthier duck meat with lower cholesterol levels.

Additionally, the reduction in cholesterol in the liver, blood, and meat could also reduce the risk of cardiovascular diseases in poultry, which is a concern in the livestock industry. Lower cholesterol in duck meat opens opportunities for healthier poultry products, which are more appealing to increasingly health-conscious consumers.

Relationship Between Cholesterol Levels and Chemical Composition of the Feed

An important aspect of this study was examining the effect of the feed's chemical composition on cholesterol levels in ducks. The results indicated that turmeric supplementation influenced several feed composition parameters, including crude fiber, ash, and carbohydrates, which could contribute to changes in lipid metabolism. Table 1 shows that crude fiber content increased in the groups supplemented with turmeric, with the 6%, 8%, and 10% turmeric groups exhibiting higher crude fiber levels than the control group.

Crude fiber plays a vital role in enhancing digestion in poultry and can affect lipid metabolism regulation, which in turn impacts cholesterol levels. (Rahmadena et al., 2023) demonstrated that crude fiber in feed can improve digestive efficiency in poultry, potentially reducing cholesterol absorption. In this context, the increased crude fiber content in turmeric-supplemented feed may contribute to the significant reduction in cholesterol levels observed in ducks (Mustikawatie et al., 2023).

In addition to crude fiber, ash and carbohydrate levels in the feed also changed with turmeric supplementation, although the effects were more moderate compared to crude fiber. The higher carbohydrate content in the 6% turmeric group suggests that turmeric may alter the carbohydrate profile in the feed. Previous studies have indicated that changes in carbohydrate composition can influence energy and fat metabolism in poultry (Hasanah & Hartoyo, 2023). However, the effect of changes in carbohydrate content on cholesterol in this study requires further analysis.

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Organoleptic Quality of Duck Meat

In addition to its effects on cholesterol levels, this study also evaluated the impact of turmeric supplementation on the organoleptic quality of duck meat. The results presented in Table 3 show that turmeric supplementation significantly influenced the tenderness and color of duck meat. The groups supplemented with 6%, 8%, and 10% turmeric had higher tenderness and color scores compared to the control group, indicating that turmeric can improve the texture quality of duck meat.

The improvement in tenderness in turmeric-supplemented duck meat is likely due to the anti-inflammatory and antioxidant effects of curcumin, which can affect muscle tissue structure in ducks. (Rahman et al., 2023) reported that curcumin can reduce oxidative stress in animals, potentially improving meat quality in terms of texture and tenderness. This finding is supported by (Zulfikar et al., 2023) who showed that the use of phytobiotics in poultry feed can enhance meat texture quality.

However, despite the significant differences in tenderness and color, taste and aroma evaluations did not show significant differences between the turmeric-supplemented groups and the control group. This may indicate that turmeric does not have a substantial effect on the taste and aroma of duck meat, although further research is needed to explore the effects of higher turmeric doses or long-term supplementation.

Implications for the Duck Farming Industry

The findings of this study have significant implications for the development of a healthier and more sustainable duck farming industry. Turmeric supplementation in Mojosari duck feed not only has the potential to improve the nutritional composition of the feed but also to produce duck meat with lower cholesterol level s. This is highly relevant given the increasing consumer demand for healthier poultry products, particularly those that are lower in cholesterol.

The growing duck farming industry in Indonesia, along with the rising consumption of duck meat, can benefit from these findings to improve product quality. Turmeric-supplemented feed not only offers health benefits to ducks but also enhances the competitiveness of duck meat products in both domestic and international markets. Furthermore, the use of turmeric as a natural feed additive can reduce reliance on synthetic additives commonly used in livestock feed, supporting the sustainability of the farming industry.

Overall, this study provides a strong scientific foundation for the application of turmeric supplementation in duck feed as a strategy to improve poultry health and meat quality. As concerns regarding sustainability and food quality continue to grow, this research opens new opportunities for the development of natural ingredient-based feed, which benefits not only the health of ducks but also consumers and the environment.

Conclusion

This study demonstrates that turmeric supplementation in Mojosari duck feed significantly reduces cholesterol levels in the liver, blood, and meat, particularly at dosages of 8% and 10%. These findings highlight the potential of turmeric as an effective feed additive to produce duck meat with lower cholesterol levels, thereby enhancing the overall quality of poultry products and making them healthier. Moreover, turmeric supplementation also improves the organoleptic quality of duck meat, particularly in terms of tenderness and color, although it does not significantly affect taste and aroma.

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These findings provide an important contribution to the field of duck farming by showing that the use of turmeric in duck feed can be an effective alternative for reducing cholesterol levels in ducks and improving the quality of the meat produced. The practical implications of this study include the potential development of natural ingredient-based feed that is not only more environmentally friendly but also capable of enhancing the competitiveness of duck meat products in a market increasingly concerned with health aspects.

This research also opens opportunities for further exploration into the long-term effects of turmeric supplementation in duck feed, including the potential use of higher dosages and their impact on duck growth. Future studies could also focus on the influence of turmeric on other nutritional profiles in duck meat and its effects on consumer health.

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