Effect of adding different levels of the compound berberine to the diet on the carcass quality parameters of broiler (Ross 308)

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Abstract

This experiment was conducted at the poultry farm of the Department of Animal Production, College of Agriculture, Al-Qasim Green University, from 13/11/2025 to 17/12/2025. The study aimed to investigate the effect of adding different levels of the compound berberine (Berberis vulgaris L.) to the broiler diet on the relative weights of main and secondary cuts and the physical and chemical characteristics of the meat. In the experiment, 225 unsexed Ross 308 broiler chicks were used, randomly distributed into 15 (cans) with 5 experimental treatments of 45 birds each, and each treatment included three replicates of 15 birds each. The experimental treatments were as follows: Treatment 1: Control (basic diet without any additives). Treatment 2: Addition of 1 gram of berberine/kg to the basic diet. Treatment 3: Addition of 2 grams of berberine/kg to the basic diet. Treatment 4: Addition of 3 grams of berberine/kg to the basic diet. Treatment 5: Addition of 4 grams of berberine/kg to the basic diet. The main findings of the study can be summarized as follows: A significant improvement ($p\leq0.05$) was achieved in the relative weight of the thigh of birds in treatments 2, 3, 4 and 5 compared to treatment 1 (control). As for the relative weight of the wings, birds in treatment 5 recorded a significant improvement ($p\leq0.05$) compared to treatments 2 and 3. Regarding the percentage of weight lost upon thawing, birds in treatment 5 recorded the lowest percentage of loss with a significant difference ($p\leq0.05$) compared to the rest of the experimental treatments. As for the concentration of cholesterol in the meat, birds in treatments 2, 3, 4 and 5 recorded a significant decrease ($p\leq0.05$) compared to treatment 1 (control), which recorded the highest concentration of cholesterol in the meat.

Key words: Berberine compound, relative weights of primary and secondary cuts, broiler meat, physical and chemical properties.

Introduction

The poultry industry has witnessed remarkable development in recent years, both in egg and meat production worldwide. The increasing demand for poultry products has led to efforts towards developing antibiotic-free products, especially with the European Union's ban on the use of many antibiotics as animal feed additives or growth promoters [1,2]. Broiler chickens, characterized by rapid growth rates and high metabolism, are more susceptible to oxidative stress and free radical formation [3,4] and experience a significant decrease in their immunity [5,6]. As a result of the increased production of free radicals within the body, which leads to oxidative stress, a concern in modern meat production systems, researchers have been encouraged to add natural antioxidants derived from medicinal plants to poultry feed for their role in

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removing free radicals and their effective role in reducing oxidation reactions, whether within the body or in meat during storage, as they are safer and cheaper, and thus a good alternative to chemical antibiotics, thereby improving production performance, maintaining high growth levels, and increasing immunity for broiler chickens [7,8,9]One of the natural antioxidants derived from medicinal plants is berberine, a yellow, basic alkaloid compound extracted from the roots of *Berberis vulgaris L*. [10]. Berberine is characterized by its effective role in enhancing antioxidant defense mechanisms by activating the Nrf2 pathway. This protein translocates to the nucleus and binds to the Antioxidant Response Element (ARE), thereby stimulating gene expression of the antioxidant enzymes Superoxide dismutase, Catalase, and Glutathione , In addition, berberine significantly reduces the production of free radicals in mitochondria and enhances the activity of antioxidant enzymes in the liver and plasma, which contributes to relieving oxidative stress and reducing lipid oxidation, thus protecting cell membranes. Berberine also shows an inhibitory effect on the NF-kB inflammatory pathway associated with increased reactive oxygen species [11,12,13]. Berberine is an anti-inflammatory and antimicrobial compound that regulates the immune system and improves lipid metabolism disorders [14,15].

Materials and Methods

This study was conducted at the poultry farm of the Animal Production Department, College of Agriculture, Al-Qasim Green University, from November 13, 2025, to December 17, 2025. The experiment used 225 one-day-old, unsexed Ross 308 broiler chicks, randomly distributed into 15 cages, resulting in 5 experimental treatments of 45 birds each. Each treatment included three replicates of 15 birds each. The chicks were raised in the coops on a 7 cm layer of white wood shavings. Free-range feeding was provided to the birds, consisting of a starter diet from 1 to 10 days of age, a grower diet from 11 to 21 days of age, and a finisher diet from 22 to 35 days of age (Table 1). The experimental treatments were as follows: The first treatment was the control (basic ration without any additives). The second treatment added 1 gram of berberine/kg to the basic ration. The third treatment added 2 grams of berberine/kg to the basic ration. The fourth treatment added 3 grams of berberine/kg to the basic ration. The fifth treatment added 4 grams of berberine/kg to the basic ration. The experiment included studying the following characteristics: dressing percentage with edible offal, dressing percentage without edible offal, percentage weights of main and secondary cuts, and the physical and chemical properties of the meat. The averages of these characteristics were estimated for each of the five weeks of the experiment. The Completely Randomized Design (CRD) was used to study the effect of different treatments on the studied traits. Differences between means were compared using Duncan's multiple range test [16], and the ready-made statistical software SAS [17]was used to analyze the data.

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Image No. 1: Berberine compound used in the experiment

Table 1 shows the proportions of feed ingredients used in the starter, grower, and finisher diets used in the experiment, along with the calculated chemical composition.

ingredients %	Diet types		
	Starter 1-10 day	Growth 11-21 day	Final 22-35 day
yellow corn	52.8	58.65	62.4
Wheat	10	10	10
protein concentrate*	5	5	5
Soybean meal 48% **	29.8	24	20.5
Sun flower oil	0.3	0.3	0.3
Dicalcium and phosphorous	0.5	0.35	0.2
Limestone	1.14	1.21	1.22
Methionine	0.17	0.17	0.13
Lysine	0.19	0.22	0.15
Salt	0.1	0.1	0.1
Total	100	100	100
Chemical Analysis in Calculated***			

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Represented energy (Kio calories / kg of feed)	2940	2995	3035
Crude protein %	21.94	19.66	18.29
Methionine + Cystine (%)	1.03	0.97	0.9
Lysine (%)	1.39	1.26	1.11
Calcium(%)	0.9	0.88	0.83
Available phosphorous(%)	0.44	0.41	0.38
Crude fiber(%)	2.73	2.64	2.58

*The animal-based protein concentrate used is a product of the Dutch company Brocon (imported). It contains 40% crude protein, 2017 kcal/kg protein metabolizable energy, 5% crude fat, 2.20% crude fiber, 5% calcium, 4.68% phosphorus, 3.85% lysine, 4.12% methionine, 4.12% methionine + cysteine, 0.42% tryptophan, and 1.70% threonine. It also contains a blend of vitamins and trace minerals that meet the bird's needs for these elements. The soybean meal used is from an Argentinian source and has a protein content of 48% and a metabolic rate of 2440 kcal/kg.

***Construction based on NRC ، (1994) [18].

Results and Discussion

Table 2 shows the effect of adding different levels of berberine compound to broiler chicken feed on the dressing percentage (%) at 5 weeks of age (arithmetic mean ± standard error), indicating no significant differences between all experimental treatments.

Table 2. Effect of adding different levels of berberine compound to broiler feed on dressing percentage (%) at 5 weeks of age (arithmetic mean ± standard error).

Treatments	Dressing percentage with light edible offal (%)	Dressing percentage excluding edible offal (%)
T1	0.44 77.28±	72.49± 0.33
T2	78.58 ± 0.58	73.78± 0.55
T3	78.04± 1.40	73.30± 1.12
T4	77.81± 2.47	72.64± 2.23
T5	77.73± 1.33	73.32± 1.36
significance level	N.S	N.S

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NS: Not significant.
T 1 = Control treatment with no additions
T 2 = Addition of 1 g Berberine/kg of the basal diet
T 3 = Addition of 2 g Berberine/kg of the basal diet
T 4 = Addition of 3 g Berberine/kg of the basal diet
T 5 = Addition of 4 g Berberine/kg of the basal diet

Table 3 shows the effect of adding different levels of berberine compound to the broiler chicken diet on the relative weight of the main and secondary cuts (arithmetic mean ± standard error). The results indicate that there are no significant differences in the relative weight of the breast between all the experimental treatments. As for the relative weight of the thigh, the second, third, fourth and fifth treatments recorded a significant improvement (P≤0.05) compared to the first treatment (control). As for the relative weight of the back, the results indicated that there are no significant differences between all the experimental treatments. As for the relative weight of the wings, the birds in the fifth treatment showed a significant improvement (P≤0.05) compared to the second and third treatments. As for the first treatment (control), it did not differ significantly from the rest of the experimental treatments, and the fourth treatment did not differ significantly from the birds in the first, second, and fifth treatments. Regarding the relative weight of the neck, the results indicated that there were no significant differences between all the experimental treatments.

Table No. 3 Effect of adding different levels of berberine compound to broiler chicken feed on the relative weight of main and secondary cuts (arithmetic mean ± standard error).

Treatments	Main segments			Secondary segments	
	Breast(%)	Thighs(%)	Back(%)	Wings(%)	Neck(%)
T1	39.18±1.67	23.84±0.67 b	20.34±0.79	9.49±0.49 abc	5.10±0.22
T2	37.02±0.95	27.24±0.79 a	18.80±0.99	9.35±0.22 bc	6.19±0.20
T3	38.67±0.95	26.50±0.50 a	18.83±1.22	8.75±0.19 c	5.75±0.18
T4	38.63±0.56	26.50±0.50 a	18.26±0.52	9.91±0.02 ab	5.37±0.58
T5	38.16±1.25	26.70±0.40 a	17.97±1.67	10.24±0.06 a	5.84±0.68
significance level	N.S	*	N.S	*	N.S

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*Means with different letters within the same column indicate differences at a significance level of P≤0.05. NS: Not significant.

T 1 = Control treatment with no additions

T 2 = Addition of 1 g Berberine/kg of the basal diet

T 3 = Addition of 2 g Berberine/kg of the basal diet

T 4 = Addition of 3 g Berberine/kg of the basal diet

T 5 = Addition of 4 g Berberine/kg of the basal diet

The significant improvement in relative thigh weight in berberine treatments compared to the first treatment (control) can be explained by the fact that thigh muscles have high metabolic activity and contain a higher proportion of oxidized muscle fibers, and are therefore more sensitive to oxidative stress. Therefore, enhancing antioxidant systems with berberine maintains the integrity of cell membranes and reduces lipid peroxidation, which supports better growth of these muscles [11]. As for the significant improvement in the relative weight of wings in the fifth treatment (4 g berberine/kg feed) compared to the second and third treatments, this may indicate that the high levels of berberine enhanced the efficiency of amino acid and energy utilization, since berberine improves intestinal morphology and absorption efficiency, which is reflected in the development of some muscle segments [1]. Table 4 shows the effect of adding different levels of berberine compound to broiler chicken feed on the physical and chemical properties of meat (arithmetic mean ± standard error). The results indicate that there are no significant differences between all experimental treatments in hot carcass weight, exudate, water retention capacity, myoglobin pigment concentration, and meat pH. As for the percentage of weight lost upon thawing, the fifth treatment recorded the lowest percentage, reaching 0.89%, with a significant difference (P≤0.05) compared to the other treatments. As for cholesterol concentration (mg/100g meat), The second, third, fourth and fifth treatments recorded a significant decrease (P≤0.05) compared to the first treatment (control), which recorded the highest cholesterol concentration of 68.38 mg/100 g of meat.

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Table 4: Effect of adding different levels of berberine to broiler feed on the physical and chemical properties of meat (arithmetic mean ± standard error).

Treatments	Weight of the hot carcass (gram)	Percentage of fluid (%) Excreted	Water Holding Capacity (%)	Myoglobin pigment concentration (mg/g of meat(	Ph level	Percentage of weight lost upon melting(%)	Cholesterol concentration in meat (mg/100g of meat(
T1	630.00±20.81	2.09 ±0.15	37.99± 2.05	0.97±0.30	5.70±0.10	2.03± 0.07 a	68.38±1.42 a
T2	1668.33± 57.03	1.93±0.38	38.47± 3.06	1.91±0.30	5.60±0.05	1.82± 0.03 a	61.28±0.69 b
T3	1687.67±51.72	1.89 ± 0.02	40.85± 1.41	1.60±0.40	5.60±0.11	1.85± 0.15 a	61.19±0.67 b
T4	1725.00± 48.56	1.59±0.19	40.95± 2.14	1.82±0.43	5.70±0.05	1.85±0.05 a	61.78±1.18 b
T5	1732.67±40.39	1.40± 0.07	41.42± 7.05	2.00±0.29	5.70±0.05	0.89± 0.05 b	60.96±0.55 b

*Means with different letters within the same column indicate differences at a significance level of P≤0.05.
NS: Not significant.
T 1 = Control treatment with no additions
T 2 = Addition of 1 g Berberine/kg of the basal diet
T 3 = Addition of 2 g Berberine/kg of the basal diet
T 4 = Addition of 3 g Berberine/kg of the basal diet
T 5 = Addition of 4 g Berberine/kg of the basal diet

The significant decrease in the percentage of weight loss upon solubility (%) recorded by treatment 5 compared to the other treatments reflects an important result: improved stability of cell membranes and reduced damage to proteins and lipids during storage. It is known that oxidative stress causes oxidation of lipids and proteins, leading to deterioration of cell structure and water loss [13]. Since berberine reduces the production of reactive oxygen species and inhibits the inflammatory NF-κB pathway, it maintains the integrity of muscle proteins and their ability to retain water, thus explaining the reduced loss upon solubility [11]. As for the significant decrease in cholesterol concentration in meat (mg/100g meat) in the berberine treatments compared to the first treatment (control), this may be due to berberine's role in regulating lipid metabolism and reducing cholesterol synthesis by activating the AMPK (Adenosine Monophosphate-Activated Protein Kinase) pathway, which inhibits lipid synthesis by inhibiting the enzyme Acetyl-CoA Carboxylase, which inhibits fatty acid synthesis and thus reduces cholesterol synthesis. This explains the decrease in meat cholesterol when berberine is added [14,15].

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Conclusion

The addition of berberine to broiler feed showed a significant positive effect on the relative weight of thighs and wings, the percentage of weight lost when thawed, and the concentration of cholesterol in meat. The improvement in these characteristics can be attributed to the antioxidant and antimicrobial properties of berberine, which help improve intestinal health and increase the utilization of nutrients in the feed.

References

[1]Yuan, L., Li, M., Qiao, Y., Wang, H., Cui, L., and Wang, M.(2021). The impact of berberine on intestinal morphology, microbes, and immune function of broilers in response to necrotic enteritis challenge. *BioMed Research International*, 2021(1), 1877075.

[2]Ali NA-L, Al-Nasrawi MAM, Al-Kassie GA (2021). Investigation on the effect of adding diverse concentrations of aqueous extract of oregano leaves (Origanum vulgare) on physiological and immunological behaviors of broiler. Biochem. Cell. Arch., 21: 2657–2661.

[3]Manju ,D.K., A. Thangavel, V. Leela and J. Kalatharan (2010). Effect of dietary supplementation of Amla and Grape Seed on Semen Characterstics of Broiler Breeder Cocks. Tamilnadu J. Veterinary and Animal Sciences 6 (2):65-70.

[4]Hammod AJ, Ali NA, Alkassar AM, Jameel YJ (2018). Theeffect of partial replacement of maize by date pits on broilerperformance. J. Pure Appl. Microbiol., 12(2): 807–813.

[5]Deif, E. A., A., Galal, M. M. Fathi,, and A. Z. El-Dein. (2007). Immunocompetence of two broiler strains fed marginal and high protein diets. International Journal of Poultry Science, 621, 901-911.

[6]Abbas, R.J., Ali, N.A.-L., Alkassar, A.M., Jameel, Y.J.(2018). Haematological and Biochemical Indices of Broiler Chicks Fed at Different Levels of Moringa Oleifera Leaf Meal. Biochemical and Cellular Archives Open source preview, 18(2), pp. 1931–1936 .

[7]Ali, **N.A.-L., Jameel, Y., Abbas, R.J.(2019).** Effects of dietary prebiotics (Safmannan) and local iraqi prebiotic on some blood biochemical parameters of broiler chickens. Pakistan Journal of NutritionOpen source preview, 18(1), pp. 80–85 .

[8]Merzah, L. H., and Ali, N. A. L. (2023). Different Diets of Maca Roots (Lepidium meyenii) Affect Several Physiological Blood Characteristics of Broiler Chickens Under Oxidative Stress. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1259, No. 1, p. 012071). IOP Publishing.

[9]Abbas, N. K., & Ali, N. A. L. (2023). Physiological Changes Caused by Dietary Proanthocyanidin Supplementation at Varying Doses in Laying Hens. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1262, No. 7, p. 072040). IOP Publishing.

[10]Zhu, C., Huang, K., Bai, Y., Feng, X., Gong, L., Wei, C., and Zhang, H. (2020). Dietary supplementation with berberine improves growth performance and modulates the composition and function of cecal microbiota in yellow-feathered broilers. *Poultry Science*, 100(2), 1034-1048.

ISSN 2072-3857

[11]Yang, L., Liu, G., Liang, X., Wang, M., Zhu, X., Luo, Y., and Gu, X. L. (2019). Effects of berberine on the growth performance, antioxidative capacity and immune response to lipopolysaccharide challenge in broilers. Animal science journal, 90(9), 1229-1238 .

[12]Ghavipanje, N., Fathi Nasri, M. H., Farhangfar, S. H., Ghiasi, S. E., and Vargas-Bello-Pérez, E. (2021). Pre-and post-partum berberine supplementation in dairy goats as a novel strategy to mitigate oxidative stress and inflammation. *Frontiers in Veterinary Science*, 8, 743455

[13]García-Muñoz, A. M., Victoria-Montesinos, D., Ballester, P., Cerdá, B., and Zafrilla, P. (2024). A descriptive review of the antioxidant effects and mechanisms of action of berberine and silymarin. Molecules, 29(19), 4576.

[14]Cheng, X., Hu, Y., Kuang, J., Guo, X., Cao, H., Wu, H., ... and Zhuang, Y. (2024). Berberine alleviates high-energy and low-protein diet-induced fatty liver hemorrhagic syndrome in laying hens: insights from microbiome and metabolomics. *Poultry Science*, 103(8), 103968.

[15]Beyazgül, D., and Aksakal, N. E. (2024). Exploring the relationship between berberine and the gut microbiome: A closer look at recent studies. *Anatolian Clinic the Journal of Medical Sciences*, 29(3), 372-386.

[16]Duncan , D.B. , (1955) . Multiple range and multiple Ftes . Biometrics , 11,1-42

[17]SAS. (2012) . Statistical Analysis System, User's Guide. Statistical. 1Versio 9.1th ed. SAS. Inst. Inc. Cary. N.C. USA.

[18]NRC , (1994) . Natonal research council. Nutrient Requirements of poultry , 9 th revised edition , Academy press, Washington . DC

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