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Original Article

Effect of Adding Different Levels of Therapeutic Curcuma on Productive Traits in Broiler Chickens

Al-Muhammadawi, N. A[1, 2 *], Jassim Hammoudi, S[1]

1. Department of Animal Production, College of Agricultural Engineering Sciences, University of Baghdad, Baghdad, Iraq
2. Wasit Agriculture Directorate, Baghdad, Iraq

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Corresponding Author: aimanmohaldhalimy@yahoo.com

Abstract

Given the significant evolution in the global food consumption pattern, animal protein needs have increased. This pattern has been leading to intensified efforts to develop the poultry industry that adopts scientific methods and advanced technologies since poultry meat is an important source of animal protein. Therefore, this study aimed to use different levels of therapeutic Curcuma in the diets provided to broilers and its role in production traits. This study was conducted at the University of Baghdad / College of Agricultural Engineering Sciences. This experiment used 315 unsexed Ross 308 chicks one day old. The chicks were randomly distributed into seven treatments, with three replicates per treatment, at a rate of 15 chicks for each replicate. The treatments were T_1, which represents the control treatment without any addition, and T_2 added 0.3% of Therapeutic Curcuma powder, while T_3 added 0.6% of Therapeutic Curcuma powder). Moreover, T_4 represents adding 0.9% of Therapeutic Curcuma powder, and T_5 includes adding 1.2% of Therapeutic Curcuma powder. Finally, T_6 was characterized by adding 1.5% of Therapeutic Curcuma powder, while T_7 added 1.8% of Therapeutic Curcuma powder. The effect of using Therapeutic Curcuma powder in the above treatments showed that the use of Therapeutic Curcumapowder in broiler diets significantly increased (P<0.05) in the productive traits represented by body weight, weight gain, feed consumption, and feed conversion ratio. Moreover, it is possible to use Therapeutic Curcuma powder with a percentage of 0.9%, which improves the production traits.

Keywords: Therapeutic Curcumapowder, Broiler, Productive traits

1. Introduction

Given the significant evolution in the global food consumption pattern, animal protein needs have increased. This pattern has been leading to intensified efforts to develop the poultry industry that adopts scientific methods and advanced technologies since poultry meat is an important source of animal protein. Therefore, numerous researchers in the field of feeding poultry are working hard to find advanced methods to obtain the highest production at the lowest possible costs through the increase in metabolizable energy by the bird (1). Researchers have thus turned to the introduction of natural plants in the diets of domestic birds, including the (Therapeutic Curcuma). The Curcuma is a plant belonging to the *Zingiberaceae* family and is a tropical plant that contains the compound curcumin, which is one of the most important active compounds in it. However, the plant cultivation areas extend from India to Indonesia, and turmeric is considered one of the perennial plants with red tuberous roots, about 28 cm long (2). Turmeric is characterized by active substances that have an antioxidant, anti-fungal, and anti-coccidial effect (3).

Compared to commercially available antibiotics, turmeric is natural, non-toxic, and an ideal food additive commonly used in the normal diet (4, 5).

Turmeric consists of 69.4% carbohydrates and 6.3% Protein, 5.1% fat, 3.5% minerals, and 13 moisture (6). Adding turmeric powder effectively enhances the growth of broilers (7), where the turmeric stimulates the digestive system of bowel activities, including Intestinal Lipase, Maltase, and Sucrase. In addition to stimulating the pancreatic enzymes, Anyloase, Lipase, Chemotrypsine, and Trypsin (8, 9). Moreover, using turmeric powder at a concentration of 10 g / kg increased body weight and improved feed conversion ratio with a decrease in the feed consumption for broilers (10). Therefore, this study aimed to use different levels of therapeutic Curcuma in the diets provided to broilers and its role in production traits.

2. Materials and Methods

The field experiment was conducted in the poultry field at the Department of Animal Production in Agricultural Engineering Sciences, University of Baghdad from 22-11-2020 to 3-1-2021. Three hundred fifteen unsexed Ross-308 chicks one day old, with an average initial weight of 42 g, were used in the experiment, brought from one of the commercial sector hatcheries in Abu Ghraib district. Chicks were raised on a bed of sawdust, they were randomly distributed into seven treatments in pens by three replicates per treatment (15 birds in each replicate), and the provision of water and fodder was free. The chicks were fed on a starter diet from one day to 10 days, containing the metabolizable energy 3005.3 kcal/kg feed and crude protein 23.0. Then, a grower diet from day 11-24 contains the metabolizable energy of 3105.0 kcal/kg feed and crude protein of 21.5, and a finisher diet from day 25-42 contains the metabolizable energy of 3180.3 kcal/kg feed and crude protein of 20.2 as shown in table 1. The experiment lasted for 42 days, and the productive traits were measured for each week of the experiment, which included body weight, weight gain, feed consumption, and feed conversion ratio. The complete randomized design (CRD) was used, and a significant comparison was conducted between the averages using the Duncan Multiple Range test (1995), and the statistical program (SAS 2010) was used for the statistical analysis.

Table 1. Ingredients and chemical composition (%) of the diets used in the experiment (1-42 days)

Feed material	Starter diet 1-10	Grower diet 11-24	Finisher diet 25-42
Crushed yellow corn	43.8	44.5	47.6
Crushed wheat (local)	14	15.9	15
Soybean meal 48%	32.7	29	26
Protein Concentrate(1)	5	5	5
Sunflower oil	2.2	3.4	4.2
Limestone	1.1	1.1	1.1
DCP Dicalcium Phosphate	0.7	0.6	0.6
Salt	0.3	0.3	0.3
Mix vitamins and minerals(2)	0.2	0.2	0.2
Total	100	100	100
Calculated Chemical Analysis(3)			
Crude protein (%)	23.0	21.5	20.2
Metabolizable energy (kcal/kg feed)	3005.3	3105.7	3180.3
Lysine (%)	1.32	1.21	1.13
Methionine (%)	0.50	0.48	0.47
Methionine + Cysteine (%)	0.83	0.80	0.77
Calcium (%)	0.92	0.89	0.89
Available phosphorous (%)	46	0.44	0.43

(1) Protein Concentrate: BROCON-5 SPECIAL W, of Dutch origin. Each kg of it contains: 40% crude protein, 5% fat, 2.18% fiber, 5.14% calcium, 2.65% phosphorous, 2.50% sodium, 3.88% chloride, 3.85% lysine, 3.70% methionine, 4.12% methionine + cysteine, 2107 Kcal/kg Metabolizableenergy, 20,000 IU Vitamin A, 80,000 IU, D3 600 mg Vitamin E, 50 mg Vitamin B1, 140 mg Vitamin B2, 80 mg Vitamin B6, 700 mcg B12, 20 mg Folic Acid, 5 mg Citric Acid , 2 mg biotin, 800 mg niacin, 1 mg iron, 200 mg copper, 1,600 mg manganese, 1,200 mg zinc, 20 mg iodine, 5 mg selenium, 6 mg cobalt, 33.50 mg antioxidant (BHT).
(2) A mixture of vitamins and minerals, each kg of which contains: 5000 IU vitamin A, 600 IU vitamin D3, 10 mg vitamin E, 2 mg K3, 2 mg B1, 2 mg B2, 2 mg B6, 5 µg B12, 10 mg C, 15 mg niacin, 500 mcg folic acid, 5 mg di-calcium phosphate, 40 mg zinc, 100 mcg cobalt, 150 mg niacin.
(3) The calculated chemical composition: The chemical analysis of the feed materials included in the composition of the diet was carried out according to what was mentioned in the N R C (11).

3. Results and Discussion

Table 2 showed the effect of adding different levels of therapeutic Curcuma on the average body weight (g) of broilers during the experiment weeks. No significant differences in body weight were recorded between the experimental treatments during the first, second, third, and fourth weeks. In contrast, the treatment T_4 recorded

the highest significance (P<0.05) in body weight during the fifth and sixth weeks of age, this treatment did not differ from all the additional treatments for all levels of Therapeutic Curcuma, but it differed significantly from the control treatment that recorded the lowest body weight at these two weeks. The experiment results indicated no significant differences (P<0.05) in the weight gain trait between the experimental treatments for all weeks, as shown in table 3. When calculating the cumulative weight gain, the fourth treatment recorded the highest weight gain (2597.05 g), which did not differ from treatments T_2, T_3,T_5, T_6, and T7, while treatment T_1 recorded the lowest weight gain. On the other hand, the amount of feed consumption (Tables 4 and 5) during the first and second weeks experiment did not show significant differences between the different experimental treatments. In contrast, at three weeks, there was a significant increase in the average feed consumption for treatment T_1 compared to the experimental treatments T_2, T_3, T_4, T_5, and T_7. Although a significant increase (P<0.05) was observed in the average feed consumption for treatment T_6 in the fourth week of age, this treatment did not differ significantly from the experimental treatments T_1, T_2, T_4, T_5, and T_7, but it differed from treatment T_3. In the fifth week of age, treatment T_7 recorded the highest significant increase (P<0.05) in the average feed consumption compared to the control treatment, which had the lowest average feed consumption. As for the rest of the experimental treatments, they did not differ significantly from the two treatments, the control treatment and treatment T_7. In the sixth week of age and the cumulative period of 1-6 weeks, there were no significant differences between the experimental treatments in the average feed consumption. Similarly, it was observed from the calculation of feed conversion that there are no significant differences between the experimental treatments in the first week of the birds' age. In contrast, treatment T_3 recorded a significant improvement in the feed conversion ratio compared to treatments T_2, T_4, T_5, and T_6; it did not differ significantly from the two treatments T_1 and T_7 in the second week of age. Upon reaching the third week of age, which witnessed a significant improvement (P<0.05) in the feed conversion ratio for all the experimental treatments compared to the control treatment. Thus, treatment T_3 returned to a significant improvement (P<0.05) in the feed conversion ratio compared to treatment T_6, which recorded a deterioration in the feed conversion ratio; these two treatments did not differ from the rest of the experimental treatments. The remaining weeks of the experiment, represented by the fifth and sixth weeks and the cumulative period (1-6), did not show any significant differences between the experimental treatments in the feed conversion ratio. Gouda and Bhandary (12) pointed out turmeric's role in containing the active compounds that include Curcumin, Demethoxy curcumin, and Bisdemethoxy curcumin, as it is non-toxic and a natural antibiotic. Besides, it increases the growth rate and creates a healthy metabolism in poultry, in addition to its role as an antioxidant, antimicrobial and anti-inflammatory. Scientific references have proven its validity and usefulness as an alternative to antibiotics in poultry fields due to its wide range of biochemical activities and effect on growth performance and weight gain in addition to improving health status, metabolism, immune and antimicrobial action. The positive role of turmeric may be due to its anti-inflammatory, antioxidant, and antibacterial activity (6), or it may be due to the prebiotic-like effects of Curcumin, as mentioned by Niamsa and Sittiwet (13). Else, the improvement in weight and FCR may be due to the enhancement of secretion of the Amylase, Lipase, Trypsin, and Chymotrypsin enzymes (14). Moreover, Curcumin reduced harmful bacteria communities and inhibited their effect on various pathogenic bacteria (13). The improvement in growth performance due to turmeric added to broiler diets may be due to the environment and function of the digestive system in chickens (15). Also, Roughley and Whiting (16)

indicated that the effects shown by turmeric might be due to its containing curcuminoids (5-3% in turmeric powder), bisdemethoxycurcumin, and dimethoxy curcumin, which are the main active compounds in turmeric. These compounds showed a wide range of biological activities, including antioxidant, antibacterial, anti-fungal, antiparasitic, antiviral, anti-coccidial, and anti-inflammatory, promoting digestion and absorption and having protective effects against toxins and coccidiosis (17-19). Al-Sultan (20) showed that turmeric improves liver and bile functions by increasing bile secretion, protecting the stomach from ulcers, and reducing liver toxins. These improvements can enhance digestion, metabolism, and nutrient consumption for growth by stimulating protein synthesis through the enzymatic system.

Table 2. Effect of adding different levels of Therapeutic Curcuma to the diet on body weight (g/bird) (mean ± standard error) for broilers from one day to 6 weeks old

Treatments **	Average body weight (g) for weeks					
	First	Second	Third	Fourth	Fifth	Sixth
T_1	8.83 ±152.20	6.69±444.33	33.50±861.97	43.52±1401.73	50.11±2005.63	26.93±2499.97^{b}
T_2	1.33± 157.40	4.41±438.97	18.09±906.93	16.17±1446.73	16.86±2056.30	5.10±2540.10^{ab}
T_3	4.26± 154.20	17.05±450.87	36.23±891.07	46.12±1438.97	77.41±2048.87	29.99±2582.50^{ab}
T_4	2.66±158.63	16.52±451.17	37.62±913.73	38.00±1468.50	38.98±2122.97	28.78±2637.53^{a}
T_5	7.96±150.96	20.52±439.43	26.23±892.07	35.05±1439.97	46.12±2071.63	48.28±2570.63^{ab}
T_6	5.85±158.30	22.79±437.07	17.70±888.63	31.69±1425.97	40.80±2031.33	40.87±2551.20^{ab}
T_7	1.45±160.96	9.58±463.10	26.60±915.07	26.76±1459.00	30.84±2080.33	18.19±2569.87^{ab}
Significant level	N.S.	N.S.	N.S.	N.S.	N.S.	*

*Different letters indicate a significant difference at the level of (P<0.05), N.S. There is no significant difference
** Treatments: T_1 is a control treatment free of any addition, T_2, T_3, T_4, T_5, T_6, T_7 adding different levels of turmeric 0.3, 0.6, 0.9, 1.2, 1.5, 1.8%, respectively

Table 3. The effect of adding different levels of Therapeutic Curcuma to the diet on the average weight gain (g/bird) (mean±standard error) for broilers from one day to 6 weeks of age

Treatments **	Average body weight (g) for weeks						Cumulative weight gain for weeks (1-6)
	First	Second	Third	Fourth	Fifth	Sixth	
T_1	8.83±109.97	5.22±292.13	27.56±417.64	13.60±539.76	14.25±603.90	28.62±494.33	26.92±2457.73^{b}
T_2	1.33±116.10	3.17±281.57	16.96±467.96	2.05±539.80	26.25±609.57	11.78±483.80	5.10±2499.62^{ab}
T_3	4.26±115.17	12.87±296.67	20.97±440.20	12.75±547.90	33.68±609.90	49.74±533.63	29.99±2542.02^{ab}
T_4	2.66±118.77	13.90±292.53	21.25±462.56	0.62±554.77	11.42±654.47	10.23±514.56	28.78±2597.05^{a}
T_5	0.95±111.00	15.38±288.63	10.08±452.64	17.03±547.90	14.26±631.66	16.74±499.00	48.28±2530.15^{ab}
T_6	5.85±118.44	19.14±278.77	9.41±451.56	16.67±537.34	9.25±605.36	22.05±519.87	40.87±2510.72^{ab}
T_7	1.45±119.86	9.96±302.14	17.14±451.97	0.86±543.93	34.07±621.33	17.51±489.54	18.19±2529.39^{ab}
Significant level	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	*

*Different letters indicate a significant difference at the level of (P<0.05), N.S. There is no significant difference
** Treatments: T_1 is a control treatment free of any addition, T_2, T_3, T_4, T_5, T_6, T_7 adding different levels of turmeric 0.3, 0.6, 0.9, 1.2, 1.5, 1.8%, respectively

Table 4. The effect of adding different levels of Therapeutic Curcuma to the diet on the average weekly feed consumption (g/bird) (mean±standard error) for broilers from one day to 6 weeks old

Treatments **	Average body weight (g) for weeks						Cumulative feed consumption rate (1-6) weeks
	First	Second	Third	Fourth	Fifth	Sixth	
T_1	8.66±136.93	6.44±344.40	13.90±638.93^{a}	13.67±813.20^{ab}	5.73±1168.00^{b}	25.71±745.07	27.40±3846.53
T_2	3.86±145.73	2.02±345.87	14.10±602.87^{ab}	19.07±830.77^{ab}	33.24±1178.10^{ab}	47.23±734.73	29.77±3838.07
T_3	4.34±141.40	7.18±332.40	23.95±600.97^{ab}	36.033±803.13^{b}	39.95±1210.10^{ab}	43.78±696.50	110.15±3784.50
T_4	5.38±140.73	3.67±355.20	28.52±600.97^{ab}	29.81±842.73^{ab}	22.84±1239.20^{ab}	39.08±773.17	30.12±3952.00
T_5	0.95±135.50	15.38±353.63	10.08±575.40^{ab}	17.03±849.73^{ab}	14.26±1225.07^{ab}	16.74±721.53	16.74±3860.87
T_6	3.78±143.43	15.20±337.97	25.84±566.63^{b}	32.64±886.83^{a}	11.33±1183.20^{ab}	20.28±709.87	34.55±3827.93
T_7	3.37±145.06	14.31±357.63	13.62±591.07^{ab}	4.54±816.77^{ab}	12.14±1253.27^{a}	5.34±745.40	25.26±3909.20
Significant level	N.S.	N.S.	*	*	*	N.S.	N.S.

*Different letters indicate a significant difference at the level of (P<0.05), N.S. There is no significant difference
** Treatments: T_1 is a control treatment free of any addition, T_2, T_3, T_4, T_5, T_6, T_7 adding different levels of turmeric 0.3, 0.6, 0.9, 1.2, 1.5, 1.8%, respectively

Table 5. The effect of adding different levels of Therapeutic Curcuma to the diet on the average feed conversion ratio (g/bird) (mean ± standard error) for broilers from one day to 6 weeks old

Treatments **	Average body weight (g) for weeks						The average cumulative feed conversion ratio for weeks (1-6)
	First	Second	Third	Fourth	Fifth	Sixth	
T_1	0.027±1.24	0.008±1.78^{ab}	0.094±1.52^{a}	0.048±1.50^{ab}	0.037±1.93	0.050±1.50	0.027±1.56
T_2	0.037±1.25	0.005±1.22^{a}	0.051±1.28^{b}	0.041±1.53^{ab}	0.044±1.93	0.073±1.51	0.018±1.53
T_3	0.012±1.22	0.026±1.12^{b}	0.029±1.36^{b}	0.031±1.46^{b}	0.055±1.98	0.169±1.30	0.018±1.48
T_4	0.025±1.18	0.058±1.21^{a}	0.010±1.29^{b}	0.051±1.51^{ab}	0.008±1.89	0.062±1.50	0.012±1.52
T_5	0.090±1.22	0.003±1.22^{a}	0.014±1.27^{b}	0.010±1.55^{ab}	0.051±1.93	0.101±1.44	0.021±1.52
T_6	0.036±1.21	0.029±1.21^{a}	0.084±1.25^{b}	0.113±1.65^{a}	0.023±1.95	0.037±1.36	0.023±1.52
T_7	0.012±1.21	0.008±1.18^{ab}	0.037±1.30^{b}	0.011±1.50^{ab}	0.115±2.01	0.061±1.52	0.015±1.54
Significant level	N.S.	*	*	*	N.S.	N.S.	N.S.

*Different letters indicate a significant difference at the level of (P<0.05), N.S. There is no significant difference
** Treatments: T_1 is a control treatment free of any addition, T_2, T_3, T_4, T_5, T_6, T_7 adding different levels of turmeric 0.3, 0.6, 0.9, 1.2, 1.5, 1.8%, respectively

Authors' Contribution

Study concept and design: S. J. H.
Acquisition of data: N. A. A.
Analysis and interpretation of data: S. J. H.
Drafting of the manuscript: N. A. A.
Critical revision of the manuscript for important intellectual content: S. J. H.
Statistical analysis: S. J. H.
Administrative, technical, and material support: N. A. A.

Ethics

The study was approved by the Research Ethics Committee of the University of Baghdad, Baghdad, Iraq.

Conflict of Interest

The authors declare that they have no conflict of interest.

References

1. Naji SAH. Broiler Breeding Guide. Iraqi Federation of Poulter Poultry Producers and Association Poultry ScienceTechnical Bulletin. 2006.
2. Chopda M, Mahajan R. Wound healing plants of Jalgaon district of Maharashtra state, India. Ethnobot Leafl. 2009;2009(1):1.
3. Jurenka JS. Anti-inflammatory properties of curcumin, a major constituent of Curcuma longa: a review

of preclinical and clinical research. Altern Med Rev. 2009;14(2).
4. Khan RU, Naz S, Javdani M, Nikousefat Z, Selvaggi M, Tufarelli V, et al. The use of turmeric (Curcuma longa) in poultry feed. Worlds Poult Sci J. 2012;68(1):97-103.
5. Wang R, Li D, Bourne S, editors. Can 2000 years of herbal medicine history help us solve problems in the year 2000. Alltechs annual symposium; 1998.
6. Chattopadhyay I, Biswas K, Bandyopadhyay U, Banerjee RK. Turmeric and curcumin: Biological actions and medicinal applications. Curr Sci. 2004:44-53.
7. Kumari P, Gupta M, Ranjan R, Singh K, Yadava R. Curcuma longa as feed additive in broiler birds and its patho-physiological effects. Indian J Exp Biol. 2007;45(3):272-7.
8. Platel K, Srinivasan K. Influence of dietary spices or their active principles on digestive enzymes of small intestinal mucosa in rats. Int J Food Sci Nutr. 1996;47(1):55-9.
9. Platel K, Srinivasan K. Influence of dietary spices and their active principles on pancreatic digestive enzymes in albino rats. Food Nahrung. 2000;44(1):42-6.
10. Daramola O. Growth performance and serum metabolites of broiler chickens fed turmeric (Curcuma longa) powder supplemented diets. Livest Res Rural. 2020;32:12.
11. C NR. Nutrient requirements of poultry: 1994: National Academies Press; 1994.
12. Gouda MM, Bhandary YP, editors. Natural antibiotic effect of turmeric in poultry management. Annual Symposium, Nottingham (UK): Nottingham University Press; 1998.
13. Niamsa N, Sittiwet C. Antimicrobial activity of Curcuma longa aqueous extract. J Pharmacol Toxicol. 2009;4(4):173-7.
14. Platel K, Srinivasan K. Digestive stimulant action of spices: a myth or reality? Indian J Med Res. 2004;119(5):167.
15. Emadi M, Kermanshahi H. Effect of turmeric rhizome powder on the activity of some blood enzymes in broiler chickens. Int J Poult Sci. 2007;6(1):48-51.
16. Roughley PJ, Whiting DA. Experiments in the biosynthesis of curcumin. J Chem Soc Perkin trans. 1973:2379-88.
17. Abou-Elkhair R, Ahmed H, Selim S. Effects of black pepper (Piper nigrum), turmeric powder (Curcuma longa) and coriander seeds (Coriandrum sativum) and their combinations as feed additives on growth performance, carcass traits, some blood parameters and humoral immune response of broiler chickens. Asian-Australas J Anim Sci. 2014;27(6):847.
18. Eevuri TR, Putturu R. Use of certain herbal preparations in broiler feeds-A review. Vet World. 2013;6(3).
19. Masuda T, Maekawa T, Hidaka K, Bando H, Takeda Y, Yamaguchi H. Chemical studies on antioxidant mechanism of curcumin: analysis of oxidative coupling products from curcumin and linoleate. J Agric Food Chem. 2001;49(5):2539-47.
20. Al-Sultan S. The effect of Curcuma longa (turmeric) on overall performance of broiler chickens. Int J Poult Sci. 2003;2(5):351-3.