

The influence of turmeric powder (*Curcuma longa*) supplementation to broiler diets on productive performance and economic efficiency First Author^{1*}, Second Author², and Third Author^{3*}

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Abstract

The abstract is a digest of the entire paper and should be given the same consideration as the main text. It does not normally include any reference to the literature. Abbreviations or acronyms must be preceded by the full term at the first use. An abstract should be between 150-200 words. It includes a brief statement of problem, a concise description of the research method and design, a summary of major findings, including their significance or lack of it, and conclusions.

Keywords: Component; Formatting; Style; Styling; Insert (6-8 words)

تأثير إضافة مسحوق الكركم (*Curcuma longa*) لعلائق دجاج اللحم على الأداء الإنتاجي والكفاءة الاقتصادية

المستخلص: هدفت هذه الدراسة إلى تقييم تأثير إضافة مسحوق الكركم في علائق دجاج اللحم على الأداء الإنتاجي والكفاءة الاقتصادية خلال فترة التسمين. تم وزن 240 كتكوت لحم (كوب 500) بعمر يوم واحد ووزعت عشوائياً على أربع مجموعات متساوية تألفت من 60 طير لكل مجموعة. تكونت كل مجموعة من أربع مكررات تحتوي على 15 كتكوت في كل منها. غذيت الطيور على عليقة أساسية أضيف لها مسحوق الكركم بنسب 0.1%، 0.2%، و 0.3%، لمجموعة الشاهد والمجموعة الثانية والثالثة والرابعة على التوالي. أشارت النتائج أن الطيور المغذاة على عليقة تحتوي على 0.2% و 0.3% من مسحوق الكركم أظهرت زيادة معنوية ($P < 0.05$) في الزيادة الوزنية للجسم وتحسن في كفاءة التحويل الغذائي مقارنة بمجموعة الشاهد والمجموعة الثانية المغذاة على 0.1% مسحوق الكركم. لم تكن هناك اختلافات معنوية ($P > 0.05$) في استهلاك العلف بين المعاملات الغذائية. تحسنت الكفاءة الاقتصادية بإضافة مسحوق الكركم بنسبة 0.3% و 0.2%، على التوالي. نستنتج أن إضافة مسحوق الكركم بنسبة 0.3% كمحفز للنمو في علائق دجاج اللحم خلال فترة التسمين أثرت بشكل إيجابي على الأداء الإنتاجي والكفاءة الاقتصادية.



INTRODUCTION

Rapid population growth has increased the demand for meat and other high protein foods of animal origin. As a means of achieving sufficient protein intake, broiler meat remains one of the a major source of protein for consumers rely on because of its availability as well as its popularity as a component of the international cuisine (Alshelmani *et al.*, 2021; Alshelmani *et al.*, 2013; Kairalla *et al.*, 2023). Public concerns regarding antibiotic resistance and the lingering detrimental effects of these medications on human health have catalyzed a transition towards sustainable and alternative methods for growth promotion in poultry (Kairalla, *et al.*, 2022; Kairalla and Alshelmani, 2025; Kairalla, *et al.*, 2022). Incorporation of medicinal plants into poultry diets has emerged as a viable method amongst these choices. Medicinal plants can safeguard poultry against numerous infections, improve health, promote growth, and are equally economic efficiency and widely accessible with minimal or no adverse effects (Kairalla and Alshelmani, 2025).Turmeric contains active phytoconstituents, and has emerged as a viable alternative to enhance growth and sustainability in the poultry industry. These plants exhibit substantial advantages, such as accelerated growth, modulation of inflammation, enhanced gut morphology and microbiota, boosted immunity, and overall improved productivity (Aburas *et al.*, 2025).Numerous natural substances can enhance poultry health through dietary formulation. Currently, the poultry industry has employed numerous natural chemicals as feed additives (Kairalla, *et al.*, 2022). Thus, the current study aimed to understand how supplementing turmeric to the diet affects the productive performance and economic efficiency of broiler chickens.

MATERIALS AND METHODS

The current feeding trial was conducted at the Faculty of Agriculture, Zintan University, Libya. The commercially tested material, turmeric (*Curcuma longa*) powder, was purchased from a local market in Zintan city. Samples of turmeric were analyzed according to the methods described by (AOAC (1995) (Table 1).

Table:(1). Proximate analysis of turmeric, (% of DM).

Composition	(%)
Dry Matter	67.99
Ash	7.57
Crude Protein	13.77
Ether extract	3.0
Crude Fiber	21.18
Nitrogen-Free Extract	54.41

Birds and diets: This study employed a completely randomized design (CRD). A total of 240 one-day-old Cobb500 broiler chicks with similar live body weights were used. The chicks were individually wing tagged and weighed. Then, the birds were allocated into four equal groups, each group consisted 60 birds per treatment. The groups were split into four replicates, each replicate consisted 15 birds. The birds were housed in ground pens measuring 1.5 × 1.5 m per replicate, equipped with wood shavings as bedding. The chicks were provided with unrestricted access to water and feed. All birds were subjected to uniform feeding and maintenance procedures as specified in the Cobb500 broiler chick manual (2022). The lighting program was 23 h light and one h dark. All

chicks were vaccinated against three prevalent infectious diseases: Newcastle disease, infectious bronchitis, and Gumboro disease.

The birds were fed their starter and finisher diets from 1 to 21 days and 22 to 42 days of age, respectively (Table 2). The diets were formulated in the farm of the Faculty of Agriculture, Zentan. Experimental diets were developed according to the calorie requirements of birds as described by the National Research Council (NRC, 1994). All diets had almost iso-nutritive value according to the purpose of the study. The experimental diets were determined as basal diet with turmeric powder supplemented in the basal diet at 0%, 0.1%, 0.2% and 0.3%.

Table:(2). Ingredients and the chemical composition of the experimental starter and finisher diets for broiler chickens (% as fed).

Ingredients	Starter diet 1 to 21 days	Finisher diet 22 to 42 days
Yellow Corn	53.40	61.00
Soybean Meal 44%	28.00	25.05
Corn Gluten Meal	10.00	6.19
Di-calcium phosphate	2.20	2.05
Lime stone	1.10	1.00
Salt (NaCl)	0.25	0.25
Vegetable oil	4.55	4.00
L-lysine	0.15	0.15
DL-Methionine	0.05	0.01
Vitamin and Mineral Premix *	0.30	0.30
Total	100	100
	Calculated analysis**	
Crude protein (%)	22.09	18.02
M. E (kcal/ kg)	2975	3161
C/P ratio	134.67	175.41
Crude fat, %	3.79	6.30
Crude fiber	2.42	2.61
Calcium %	1.05	0.99
Available phosphorus,%	0.45	0.40
Methionine %	0.52	0.41
Lysine %	1.14	0.98

* Each 1 kg Premix contained: Vit A 3350000 IU Vit D3 760 000 IU Vit E 6700 IU Vit K3 335 mg Vit B1 334 mg Vit B2 1670 mg Vit B6 500 mg Vit B12 3.4 mg Niacin 10 000 mg , Ca.D. Pantothenate 3 334 mg Biotin 16.7 mg Folic acid 334 mg, Trace minerals: Iron 13 350 mg, Copper 3 335 mg Zinc 16 700 mg Manganese 25 000 mg Iodine 500 mg Cobalt 84 mg Selenium 100 mg, Additives: Ethoxyquine 600 mg, and Carrier (Ca co3) up to 1 kg. **According to tables of NRC (1994).

Production performance:The body weight was individually measured every week and the amount of food consumed was recorded every week for all replicates, and the body weight gain (BWG) was determined. Feed conversion ratio (FCR) was calculated as feed to BWG. The equations were as follows:

BWG = Body weight at the beginning of the week - Body weight at the end of the week

FCR = Feed consumption / BWG

Economic efficiency: Bayoumi (1980) assessed the economic efficiency of dietary treatments as net revenue (NR) per unit of feed cost. The assessment utilized various indicators based on the price

of feed and live body weight in the local market at the time of the trial. The economic efficiency was assessed using the following equations as referred by Kairalla *et al.*, (2023):

$$\text{TR} = \text{FLBW} \times \text{market price of 1 kg of LBW}$$

$$\text{NR} = \text{TR} - \text{TFC}, \text{ whereas TFC} = \text{total feed intake} \times \text{price of feed}$$

$$\text{EE} = \frac{\text{NR}}{\text{TFC}}$$

$$\text{REE} = \frac{\text{EE for the treatment group}}{\text{EE for the control}} \times 100$$

Statistical analysis: The data were subjected to one-way ANOVA for statistical analysis, followed by Tukey's test which for post-hoc comparisons of treatment means, with a significance threshold set at $p < 0.05$. The analyses were conducted using the general linear model technique facilitated by SAS software (SAS, 2003).

RESULTS

Productive performance: Table 3 demonstrates the impact of turmeric powder supplementation on productive performance. In the starter phase (1-21 d), the findings indicated that birds fed diets containing 0.2% and 0.3% turmeric powder showed significant ($P < 0.05$) improvement in BWG (804.39g and 850.92g) compared to those fed diets containing 0% and 0.1% turmeric powder. The FCR was significantly ($P < 0.05$) improved for those group fed diets supplemented by 0.2% and 0.3% turmeric powder (1.22 and 1.14). No significant differences were observed during finisher phase in BWG or FCR, whereas in the overall phase, BWG and FCR were significantly ($P < 0.05$) improved for those group fed diets supplemented by 0.2% and 0.3% turmeric powder (2286.52 and 2358.00; 1.68 and 1.63 in BWG and FCR, respectively). Feed consumption did not differ significantly among the experimental groups.

DISCUSSION

Productive performance: The current results are in agreement with those of Enyenihi *et al.* (2024), who indicated that supplementing turmeric rhizome powder in broiler diets led to increased live body weights relative to the control group. The improvement in broiler performance could be attributed to the medicinal benefits, anti-inflammatory, immune modulator and antioxidant, anti-coccidial effects in turmeric. Turmeric can also used as a coloring agent in food (Geevarghese *et al.*, 2023). Turmeric's excellent antioxidant activity may be responsible for the significant improvement in body weight. The increase in body weight was linked to carbohydrates sticking to bacterial fibers, which assist to prevent from harmful germs to grow in the digestive system. Therefore, it boosts the growth of broiler chickens. Turmeric extracts enhanced intestinal health and growth performance by increasing the intestinal barrier, antioxidant capacity, and modifying the intestinal microbiota of yellow-feathered broilers (Ji *et al.*, 2024). Furthermore, Fallah and Mirzaei (2016) noted that broilers administered varying levels of turmeric and thyme powders exhibited greater feed consumption compared to the control group. There are many of herbal plants and their extracts exert beneficial effects on the digestive system by functioning as laxatives and spasmolytics. Another study indicates that the majority of herbs positively influence enzyme function, control digestive enzymes, and enhances digestion (Alshelmani *et al.*, 2024).

Table(1). Impact of dietary turmeric (*Curcuma longa*) supplementation on the productive performance of broiler chickens.

Traits	turmeric Levels				SEM	P-value
	0%	0. 1%	0. 2%	0. 3%		
Overall mean body weight	2213.32 ^C	2211.66 ^C	2327.73 ^b	2399.30 ^a	15.219	<0.05
	Body weight gain (g/bird)					
1–21 d	673.60 ^C	685.40 ^C	804.39 ^b	850.92 ^a	7.6771	<0.05
22–42 d	1497.82	1486.01	1482.13	1507.08	17.191	0.724
Overall mean BWG	2171.42 ^C	2171.41 ^C	2286.52 ^b	2358.00 ^a	15.206	<0.05
	Feed consumption (g/bird)					
1–21 d	964.81	967.35	987.74	973. 53	20.577	0.833
22–42 d	2865.09	2867.93	2864.88	2886.69	28.734	0.371
Overall mean feed intake	3830.0	3835.28	3852.62	3860.22	39.937	0.390
	Feed conversion ratio (feed/gain)					
1–21 d	1.43 ^a	1.41 ^a	1.22 ^b	1.14 ^b	0.0348	<0.05
22–42 d	1.91	1.92	1.93	1.91	0.0418	0.754
Overall mean FCR	1.76 ^a	1.76 ^a	1.68 ^b	1.63 ^b	0.0232	<0.05

a, b, c Means within the same row indicated by different superscripts are substantially different at (P<0.05).

Economic efficiency: The effect of turmeric powder incorporation on economic efficiency is presented in Table 4. The total and net revenue were elevated in the group of birds fed diets supplemented with 0.3% and 0.2% turmeric powder, respectively, in comparison to the other dietary treatments. Consequently, the economic efficiency and relative economic efficiency were enhanced in the aforementioned treatments.

Table (4). Effect of turmeric (*Curcuma longa*) supplementation on the economic efficiency of broiler chickens.

Items	Turmeric (%)			
	0	0.1	0.2	0.3
Average Live body weight /bird (kg)	2.21	2.21	2.32	2.39
Average feed intake/bird (kg)	3.83	3.83	3.85	3.86
Price of feed (L.D./1 kg)	2.70	2.70	2.70	2.70
Total feed cost (L.D)	10.34	10.34	10.39	10.42
Price/kg body weight (L.D)	12.50	12.50	12.50	12.50
Total revenue	27.62	27.62	29.00	29.87
Net revenue	17.28	17.28	18.61	19.45
Economic efficiency	1.67	1.67	1.79	1.86
Relative economic efficiency	100.00	100.00	107.18	111.37

Regarding to feed consumption and FCR, the current study recorded the optimal FCR of 1.63 in the group of birds fed diet supplemented by 0.3% turmeric powder, followed by the group fed with 0.2%, 0.1% and 0% turmeric powder at 1.68, 1.76, and 1.76, respectively. The 0.3% turmeric was superior and statistically better ($P < 0.05$) compared to those birds fed diets supplemented with 0.1% and 0.2% turmeric. Mbachu *et al.* (2023) reported that diet supplementation with turmeric powder enhanced performance metrics such as feed conversion ratio, viability, performance index, and overall net profit in the broiler chickens compared to those fed diets without turmeric supplementation. Incorporating turmeric rhizome powder into broiler diets enhanced development and feed efficiency, while simultaneously lowering production costs and augmenting earnings (Enyenihi *et al.*, 2024). In another experiment, broiler chickens were administered ginger and turmeric powders at concentrations of 0.5% and 0.75% of their food, respectively. Both of which showed a beneficial effect on weight gain and FCR (Kafi *et al.*, 2017). The optimal FCR in broilers fed diets enhanced with turmeric powder may indicate that the influence of growth-promoting agents, including phytochemicals, on performance be associated with a more effective benefits of nutrients, resulting in a better FCR. Like antibiotics, turmeric can inhibit the growth of harmful and harmless bacteria in chickens' guts, which should be given in certain level, leading to a healthier gut environment that improves nutrient availability, which is reflected on the improvement in FCR.

Economic efficiency: There is not much research on how turmeric powder affects the costs of raising broilers. However, the present study supports the results of Kafi *et al.* (2017), who showed that supplementation of 0.75% turmeric in the diet improved the profitability and growth of broiler chickens. Ehiedu *et al.* (2024) concluded that supplementing broiler chicken diet at 0.3% turmeric and 0.2% garlic mixture resulted better economics of production with no adverse effects on their performance. Mixture of 0.3% turmeric and 0.2% garlic when supplemented in broiler chicken diets resulted to higher economics of producing broiler chickens by ensuring increased in revenue and maintaining the values of gross margin. It is proved that the supplementation of natural feed additives in the diet of poultry improves digestibility and economic efficiency (Kairalla, *et al.*, 2022; Kairalla and Alshelmani, 2025; Kairalla, *et al.*, 2022; Kairalla *et al.*, 2023). The improvement of economic efficiency and relative economic efficiency in the current study was as a result of the beneficial effect of turmeric powder supplementation on broiler diets with 0.3% and 0.2%, respectively.

CONCLUSION

In conclusion, turmeric powder into broiler diets presents a potential alternative to antibiotic growth promoters. This dietary strategy may contribute to reduce production expenses by improving growth efficiency and supporting the overall health of broiler chickens. Furthermore, advancements and research are required to use these additives and their combinations to enhance poultry performance and production. These feed additives consumption by birds also have beneficial or positive impact on humans' health by production of healthy, nutritious, safe and nontoxic meat.

Duality of interest: The authors declare that they have no duality of interest associated with this manuscript.

Author contributions: Study concept and design: A. A. A. and M. A. K. Acquisition of data: M. A. K. Analysis and interpretation of data: A. A. A. and M. A. K. Drafting of the manuscript: A. A. A., M. A. K. and M. I. A. Critical revision of the manuscript for important intellectual content: A. A. A., M. A. K. and M. I. A. Statistical analysis: A. A. A. Administrative, technical, and material support: A. A. A., M. A. K. and M. I. A.

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