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Effects of Turmeric Rhizome Powder (*Curcuma longa*) on Growth Performance and Carcass Characteristics of Broiler Chickens

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ABSTRACT

This study sought to evaluate the effect of turmeric rhizome powder on growth performance and carcass characteristics of broiler chickens. A total of one hundred and twelve (112) day-old Ross 308 broiler chicks were purchased and brooded for two weeks. After brooding, the birds were randomly allocated to two dietary treatments (T1 and T2), with each group having four replicates of 14 birds, based on an average body weight of 0.57 kg (± 0.0017), in a completely randomized design. The two treatments were T1 – basal diet without turmeric rhizome powder (control) and T2 – basal diet supplemented with turmeric rhizome powder at 0.5 kg/100 kg of basal diet. Data on growth performance, carcass and organs characteristics, as well as feed cost per kg weight gain were recorded. Student T-test was conducted to separate means using GenStat at p<0.05. The diets had no significant (p>0.05) effect on growth performance. The feed cost per kg weight gain of T2 significantly increased (p<0.05) and was higher than chickens in T1, indicating that the supplementation of turmeric rhizome powder in the feed raised the cost of feed for farmers. In addition, no significant difference (p>0.05) was observed between the treatment groups for all the carcass and internal organs characteristics. Based on the results, it can be concluded that supplementation of turmeric rhizome powder at the rate of 0.5 kg/100 kg basal diet has no significant effect on the growth performance and carcass characteristics of broiler chickens.

Keywords: *birds, carscass, feed additives, feed conversion ratio, weight gain,*

INTRODUCTION

The interest in feed additives in poultry production grew over the last decade of the past century. These additives have received close attention as feed supplements for various purposes in poultry production during recent years (Zhang *et al.,* 2009; Wang *et al.,* 2024). Beneficial effects of bioactive plant substances in animal nutrition may include the stimulation of appetite and feed intake, the improvement of endogenous digestive enzyme secretion, activation of immune responses, and antibacterial, antiviral, and antioxidant actions (Dorman and Deans, 2000; Brugalli, 2011; Hosseini-Vashan *et al.,* 2012; Wang *et al.,* 2024).

Turmeric (*Curcuma longa*) is an indigenous herb of southern and south-eastern Asia of the ginger family – *Zingiberaceae* (Kennedy *et al.,* 2020). Turmeric rhizome is an extensively used spice, food preservative, and colouring material that has biological actions and medicinal applications (Chattopadhyay *et al.,* 2004; Akbarian *et al.,* 2012; Jikah and Edo, 2024). Curcumin is the

most important bioactive ingredient responsible for the biological activity of *Curcuma longa* (Nouzarian *et al.,* 2011). Curcumin has been shown to have several biological effects, exhibiting anti-inflammatory (Holt *et al.,* 2005), antifungal (Wuthi-udomler *et al.,* 2000), and antioxidant properties (Hosseini-Vashan *et al.,* 2012; Karami *et al.,* 2011; Osawa *et al.,* 1995). It helps in preventing gastrointestinal and respiratory disorders (Anwarul *et al.,* 2006). Apart from Curcumin, turmeric rhizome powder (TRP) also contains several other bioactive compounds such as tetrahydrocurcuminoids, demethoxycurcumin, and bisdemethoxycurcumin (Jurenka, 2009) that exhibit anticarcinogenic (Amalraj *et al.,* 2017), digestive, and antimicrobial properties which are required to produce healthy poultry and safe animal products (Kermanshahi and Riasi, 2010). Turmeric rhizome powder has been reported to contain 60 – 70% carbohydrate, 6 – 8% protein, 5 – 10% fat, 2 – 7% fibre, 6 – 13% water, 3 – 7% dietary minerals, 3 – 7% essential oils, and 1 – 6% curcuminoids, making turmeric a potential alternative growth promoter in livestock feeds (Kilany and Mahmoud, 2014).

Several studies have been conducted to evaluate its effect on the performance of broiler chickens, laying hens, quails, and rabbits (Suvanated *et al.,* 2003; Samarasinghe *et al.,* 2003; Sultana et al., 2024). Additionally, the effect of turmeric rhizome extract supplementation has been found to improve weight gain, feed intake, and feed conversion ratio, meat quality in Wenchang broiler chickens mainly produced and consumed in Asia (Wang *et al.,* 2015; Ogbuewu et al., 2022; Razib and Salisu, 2026). However, the results have been inconsistent, and in effect, the use of turmeric powder as a bioactive plant extract in animal nutrition has not been extensively explored. It will therefore be prudent to explore the effect of turmeric rhizome powder on our chicken breeds raised in Ghana, such as Ross 308 broiler chicken.

Farmers are also interested in feed additives that can simultaneously enhance bird performance and maintain health, thereby avoiding additional costs on products that improve only performance or only health. Therefore, the purpose of this study was to evaluate the effect of turmeric rhizome powder on growth performance and carcass characteristics of Ross 308 broiler chickens in Ghana.

MATERIALS AND METHODS

Experiment Site and Duration

The study was conducted at the Department of Animal Science, Kwame Nkrumah University of Science and Technology (KNUST). The area lies between longitude 01^0 034' W and latitude 06^0 40' N in a hot, humid environment. It receives annual rainfall of about 1400 mm to 1700 mm with annual temperature and relative humidity ranging from 25°C - 35°C and 74% - 85% respectively. The experiment covered a period of five (5) weeks from 5th November 2021 to 10th December 2021.

Experimental birds

A total of one hundred and twelve (112) day-old Ross 308 broiler chicks used for the experiment were procured from a reputable distributor, Chicks House Poultry Enterprise, located at Ahinsan Estate in Kumasi, Ashanti Region. Broiler chicks with an average weight of 39 ± 1.5 g were brooded together in isolated pens for a period of two (2) weeks before the commencement of the experiment. During this period, temperature and ventilation were regulated for the comfort of the birds. Also, formulated broiler starter feed (Table 1) and water were provided *ad libitum* throughout the brooding period and another formulated broiler finisher basal diet (Table 2) was fed to the chickens after week 2 to week 7 during the main experimental period. All necessary routine vaccinations and medications were strictly administered throughout the growth cycle to maintain the overall health of the birds.

Source of Turmeric and Feed Ingredients

Turmeric rhizome powder (TRP) was purchased from Asafo Market in Kumasi, Ghana, and stored in dry, air-tight containers. Proximate composition of TRP was determined in the Nutrition Laboratory at the Department of Animal Science, KNUST following procedures of AOAC (2005). Feed ingredients used in the feed formulation included maize, soya bean meal, fish meal, wheat bran, oyster shell, soya oil, lysine and methionine mix, salt, and vitamin/mineral premix. The nutrient composition of compounded feed was calculated from the litera-

ture nutrient composition of the feed ingredients as presented in Table 1. These ingredients were purchased from accredited feed suppliers in the Kumasi Metropolis.

Experimental design and Treatment diets

The experimental design used for the study was a completely randomized design (CRD). One hundred and twelve (112) experimental birds were randomly allocated to two dietary treatments with four replicates of 14 birds each based on an average weight of 0.57 kg (± 0.0017) per chick. The treatment diets consisted of Treatment 1, (T1), which served as the control diet containing 0 kg of TRP/100 kg of basal diet; and Treatment 2, (T2), which had TRP incorporated at 0.5 kg/100 kg of basal diet as an additive.

Table 1: Feed ingredients and nutrient composition of starter basal diet fed to Ross 308 broiler chicks within the brooding period of 1 - 2 weeks

BROILER STARTER*	
Ingredient	**Inclusion levels (%)**
Maize	59.42
Wheat bran	0.00
Fish meal	2.65
Soya oil	0.09
Soya bean meal	35.00
Oyster shell	2.03
Salt	0.25
Vita / Min premix	0.50
Synthetic Methionine	0.07
Synthetic Lysine	0.00
Total	**100**
Calculated Nutrient Composition	**Quantity**
Protein (%)	22.71
Energy (Kcal/kg)	2900
Methionine (%)	0.45
Lysine (%)	1.27
Calcium (%)	1.00
Crude Fibre (%)	3.31
Cyst + Met (%)	0.75

Table 2: Feed ingredients and nutrient composition of finisher basal diet fed to Ross 308 broiler chickens during the experimental period after the two weeks brooding (week 3 - 7)

BROILER FINISHER*	
Ingredient (%)	**Inclusion levels (%)**
Maize	60.00
Wheat bran	6.89
Soya oil	2.48
Soybean meal	28.11
Oyster shell	1.68
Salt	0.25
Vita / Min premix	0.50
Synthetic Methionine	0.10
Synthetic Lysine	0.00
Total	**100**
Calculated Nutrient Composition	**Quantity**
Protein (%)	19
Energy (Kcal/kg)	3000
Methionine (%)	0.4
Lysine (%)	0.97
Calcium (%)	0.75
Crude Fibre (%)	3.58
Cyst + Met (%)	0.61

**Experimental diet for treatment T1 (control). The same diet was used for T2, but it was supplemented with 0.5% Turmeric rhizome powder (TRP), as established by Dingfa et al. (2015), to achieve the optimum effect.*

Housing and Feeding Management

All birds were brooded together for 2 weeks and given the starter diet without incorporating the TRP, weighed at week two, and then randomly assigned to one of the two treatments (T1 and T2). The birds were raised for 5 weeks after brooding in floor pens (fourteen birds/pen) with wood shavings as litter under a 12-h light-dark

cycle at an ambient temperature of about 35°C during the first week, which was gradually reduced by 2°C per week to 25°C by reducing the number of bulbs in each pen. The pen had a floor space of 0.11 m^2 per bird. Relative humidity was maintained at 55%-65%. The water troughs and metallic feeders were thoroughly washed, disinfected, and allocated to each pen before the commencement of the experiment. The water troughs were washed and replaced with fresh water daily. Feed spillage was minimized by raising the feed troughs to the birds' back-cape level.

Data Collection

Growth Parameters

Data were taken based on parameters required for the assessment of the growth performance of the birds on a weekly basis, from week two to the end of the experiment (seventh week). The growth parameters included:

***Feed Intake*:** Feed intake was determined per replicate throughout the experimental period by measuring the feed given to the birds, and also the leftover daily by using a mechanical spring weighing scale, then the total quantity of leftover was subtracted from the total feed given to obtain the feed intake.

***Body Weight and Weight Gain*:** Initial mean weight of the birds was determined for each replicate prior to the commencement of the experiment. Subsequent weighing was done weekly for the duration of the experiment using a mechanical spring weighing scale. Birds were weighed per replicate every week after feed deprivation for 12 h. The average body weight for each treatment was obtained by adding up the body weight of birds in each replicate and dividing by the number of birds in the treatment. Weekly average body weight gain was obtained by subtracting the initial average body weight from the preceding body weight. The initial average weight was subtracted from the final body weight at the end of the experiment to determine the weight gain over the period of the experiment.

Body weight gain (kg) = Final body weight gain (kg) – Initial body weight (kg)

Feed Conversion Ratio (FCR): Feed conversion ratio (feed intake/weight gain) values were also calculated on weekly basis by dividing the total average feed intake by the average body weight gain for each replicate. No mortality of chickens was recorded during the 5 weeks of the experimental duration.

Carcass Parameters

All the carcass parameters were measured on the last day of the experiment. At the end of week 5, two birds per replicate were randomly chosen and weighed after feed deprivation for 12 h. Blood samples were collected from each bird through the brachial vein for laboratory analysis. After blood collection, the birds were slaughtered by exsanguination, de-feathered, and eviscerated. Live body weight (LBW), de-feathered weight, eviscerated weight, carcass weight, abdominal fat weight, and the internal organs such as heart, kidney, gizzard, intestines, liver, breast and thigh muscles were all weighed separately and recorded using digital electronic scale. Carcass weight is defined as the weight of the feather-scalded, eviscerated carcass after removal of the head, neck, blood, and hocks (Dilger *et al*., 2006).

The carcass parameters determined included live weight, bled weight, de-feathered weight, dressed weight and dressing percentage of the birds. Breast, shank, head, and liver weights were taken. Full gizzard and intestines were weighed. Empty intestines and gizzard weight was also taken and other organs such as liver, kidney, abdominal fat, spleen, neck, wing, thigh, and drumstick were all weighed and recorded.

Live weight was the weight of the birds before slaughter; the weight of the birds after they were bled out completely from the slaughter by rapture of the jugular vein as the bled weight. De-feathered weight was weight of the warm carcass after the removal of the feathers and the blood whereas dressed weight and dressing percentage (%) being the warm carcass weight measured after de-feathering and removal of the viscera including the head and the hocks. The dressing percentage was then calculated by expressing the dressed weight as a percentage of the live weight at slaughter. The other organs were professionally cut out and weighed. The

full birds and various organs were weighed using a digital electronic scale.

Economics of Production

The cost per kg of the basal diet was computed using prevailing market prices for the ingredients used and the cost per inclusion of the TRP (₵35/kg) to the finisher basal diets and used for the production economics calculation.

Data analysis and presentation

The data collected were analyzed with Genstat (2012) statistical software package. The two experimental diets were the main factors and the parameters measured being the dependent variables. Significant levels were determined at $p<0.05$ and Student T-test was performed to separate means.

RESULTS AND DISCUSSION

Growth Performance

The effects of dietary supplementation of turmeric rhizome powder on the growth performance of broiler chickens are presented in Table 3. From the results obtained, no significant differences ($P>0.05$) were observed on the measured parameters of Ross 308 broiler chickens in Ghana.

Feed intake

Birds fed the diet without turmeric had a slightly higher average total feed intake (5.41 kg) in absolute values than those fed the turmeric-based diet (5.37 kg) (Table 3). However, the difference was not statistically significant ($p > 0.05$).

The work of Sultana *et al.* (2024) showed a significantly improved feed intake in birds fed diet containing varying levels of turmeric rhizome powder (TRP). This is contrary to the current study results on feed intake which recorded slightly lower feed intake in birds fed TRP. This might be due to differences in the breeds of the birds used in the two studies and inclusion levels of the TRP (El-Gogary *et al*., 2025). Gowda *et al*. (2009) also observed a significant decrease in the birds' feed intake when TRP was added to the basal diet of the birds which is similar to the current study's results obtained. Other works have reported no significant difference in feed intake in birds fed turmeric rhizome powder as feed additive compared to control diet (Emadi and Kermanshahi, 2007; El-hakim *et al*., 2009; Kafi *et al.*, 2017; Razib and Salisu, 2026). This current observation of no significant differences in feed intake of the birds used in this experiment confirms the earlier findings (El-Gogary *et al.* 2025).

Table 3: Effect of turmeric rhizome powder on growth performance of Ross 308 broilers chicken

Parameters	Treatment		SEM	p-value	Sig. level
	T1 (Control)	T2 (TRP)			
Initial body weight, kg	0.57	0.58	0.0017	0.695	NS
Total feed intake, kg	5.41	5.37	0.0149	0.215	NS
Daily feed intake, kg	0.18	0.15	0.0004	0.215	NS
Total body weight gain, kg	3.19	3.13	0.0289	0.674	NS
Daily weight gain, kg	0.08	0.07	0.0008	0.674	NS
Feed Conversion Ratio (FCR)	2.13	2.11	0.0255	1.00	NS
Final body weight, kg	3.17	3.15	0.0289	0.674	NS
Feed cost/kg (¢)	2.30	2.47	-	-	-
Feed cost per kg wt. gain (¢)	4.84[b]	5.22[a]	0.0947	0.016	Sig

**Means with the no superscripts are not significantly different ($p>0.05$) while means with different superscripts are significantly different ($p<0.05$). NS = Not Significant ($p>0.05$)*

Body weight

The final body weight of birds recorded in both treatments were 3.17 and, 3.15 kg (Table 3) for control and TRP treatment group accordingly. No significant difference ($p>0.05$) existed between the two treatments. The average weight gain of birds under both T1 and T2 were 3.15 kg and 3.13 kg respectively, and no significant difference ($p>0.05$) in birds weight gain was also observed. It is understandable that since the feed intake of birds in both treatments did not show any significant difference, it resulted in insignificant difference in the total weight gain of birds in both treatments. This, however, does not agree with the work of Gowda *et al*. (2009) who observed significant weight gain when broiler chickens were fed with diet containing turmeric products. Emandi and Kermanshaho (2007) on the other hand observed no significant difference in the total weight gain of birds fed with turmeric, which is in line with these current results. Although the total weight gain of birds under T1 was slightly higher than birds in T2, the difference was not significant ($p>0.05$). However, some other works have attributed a higher weight gain to the anti-oxidative properties of turmeric due to its content of antioxidants (Osawa *et al*., 1995; Al-Sultan, 2003). Moeini *et al.* (2025) alluded that the anti-oxidative properties of turmeric stimulate weight gain increases in poultry birds when added to the feed of the birds.

Feed Conversion Ratio

The feed conversion ratio (FCR) of birds on both treatments T1 and T2 recorded similar values of 2.13 and 2.11 respectively during the experiment. The difference between T1 and T2 was not significant ($p>0.05$). Wang *et al*. (2015) observed that birds fed with turmeric as feed additive had a lower FCR value as compared to the birds on control. This does not agree with the current study results that showed that TRP did not affect the birds feed conversion levels. Similar FCR values obtained here was a good indication of a high-quality turmeric used in an optimum inclusion level into the basal diet. In line with this study results, Emadi and Kermanshaho, (2007) recorded no significant difference in the FCR of birds on turmeric additive as well. However, El-Gogary *et al.* (2025) reported decrease in feed conversion ratio due to an addition of turmeric in the diet of poultry birds and alluded that the significant or no meaningful results could be a dose-dependent issue.

Carcass Characteristics

The carcass characteristics of birds on both treatments is presented in Table 4 for full carcass and premier cuts as well as internal organs. The dressing percentage, the weights of the shanks, breasts, drumsticks, and the abdominal fat of birds fed with turmeric incorporated basal diet and the control diet did not show any significant difference ($p>0.05$). According to Essien *et al*., (2024), the carcass characteristics of bird fed with turmeric as feed additive might not differ from birds on control diet depending on the inclusion levels. This might have accounted for the non-significant differences observed in the carcass dressing percentage and the premier cuts of the birds in this current study.

The bled weight of birds on T1 was 2.73 kg while that for T2 was 2.85 kg (Table 4). This parameter did not show any significant difference ($p>0.05$). However, birds under T2 showed a slightly higher absolute value of weight than birds under T1 bled weight. This implies that with increasing level of TRP inclusion, there might be significant difference in the bled carcass weight and agrees with the report of Khan *et al.* (2019) and Essien *et al*. (2024).

The use of TRP in the broiler diet did not have any significant effect ($p>0.05$) on most of the carcass characteristics measured. However, there was an increasing trend in the following parameters: defeathered weight, dressed weight, breast weight, shank weight, neck weight, head weight, wing weight, and abdominal fat recorded values in T2, as compared to T1. Contrary to these findings, Mondal *et al*. (2015) recorded a significant decrease ($p< 0.05$) in the abdominal fat of birds fed diets supplemented with dietary turmeric compared to the birds on the control diet. Likewise, Khan *et al*. (2019) also observed a decrease in abdominal fat deposition in birds whose diets were supplemented with TRP compared to the control. The supplementation of TRP in broiler diet therefore, help to reduce fat deposition. They also added that there are varying observations from other works on carcass

parameters of broiler birds and could be attributed to varying levels of inclusion and the species of turmeric used (Khan *et al*., 2019; El-Gogary et al., 2025).

All the internal organ parameters measured showed no significant differences (p>0.05) between the two treatment groups (Table 5).

Despite the non-significant difference observed in all the parameters measured on birds under T1 and T2, there was an increasing trend in the weight of the internal organs of birds that had TRP supplemented in their diet. This may be associated with the species of the turmeric used in this study. The non-significant (p>0.05) effect of turmeric powder on the weight of internal

Table 4: Effect of turmeric rhizome powder in broiler diet on carcass characteristics of broilers

Parameters	Treatment		SEM	p-value	Sig. level
	T1 (Control)	T2 (TRP)			
Live Weight (kg)	2.90	3.03	0.0498	0.342	NS
Bled Weight (kg)	2.73	2.85	0.046	0.269	NS
De-feathered Weight (kg)	2.50	2.58	0.0479	0.319	NS
Dressed Weight (kg)	2.09	2.18	0.0453	0.213	NS
Dressing Percentage (%)	72.02	71.87	0.993	0.928	NS
Breast Weight (g)	519.80	581.63	25.800	0.14	NS
Shank Weight (g)	59.63	59.79	1.080	0.96	NS
Neck Weight (g)	124.70	129.64	4.250	0.68	NS
Head Weight (g)	53.08	57.53	1.530	0.218	NS
Wing Weight (g)	220.99	227.59	5.630	0.641	NS
Thigh and drumstick (g)	565.23	551.36	10.200	0.53	NS
Abdominal fat (g)	34.11	39.54	2.530	0.277	NS

**Means with different superscripts are significantly different at p<0.05; NS: Not Significant (p>0.05)*

Table 5: Effects of the supplementation of turmeric rhizome powder in broiler diet on their internal organs

Parameters (g)	Treatment		SEM	p-value	Sig. level
	T1 (Control)	T2 (TRP)			
Gizzard (full)	50.84	52.11	1.06	0.208	NS
Gizzard (empty)	35.61	38.21	0.71	0.051	NS
Intestine (full)	121.25	144.80	6.81	0.138	NS
Intestine (empty)	91.66	101.15	3.24	0.191	NS
Heart weight	11.51	13.89	0.85	0.06	NS
Liver weight	46.80	49.01	1.79	0.486	NS
Spleen weight	2.75	2.84	0.17	0.735	NS

**Means in a row with different superscripts are significantly different (p<0.05); NS: Not Significant (p>0.05); SEM = Standard Error of Mean*

organs (heart, liver and gizzard) of broilers, is in agreement with the observation made by Al-Sultan *et al*. (2003), that feeding turmeric powder to broilers does not alter the size of liver, gizzard and heart.

Cost benefit analysis

The cost of feed per kg weight gain of birds under T1 (₵4.84) was lower than that of birds under T2 (₵5.22) (Table 3). A significant difference ($p<0.05$) in the feed cost per kg weight gain was observed between the two treatments; birds under T1 had a lower value, 4.84 feed cost/ kg weight gain, than those under T2. Similar values were recorded by Khan *et al*. (2019). The cost of turmeric was high in the market, probably because of its numerous other uses and benefits. The supplementation of TRP in broiler diet can significantly increase the cost of broiler production (Al-Sultan *et al*., 2003; Khan *et al*., 2019; El -Gogary *et al*., 2025).

CONCLUSION

The results of this study showed that the supplementation of turmeric (*Curcuma longa*) rhizome powder at 0.5 kg/100 kg basal diet has no effect on growth performance of Ross 308 broiler chickens in Ghana. The same inclusion level (0.5 kg/100 kg) did not show any adverse effect on carcass characteristics and vital organs of Ross 308 broiler chickens in Ghana. It, however, increased the production cost of the broiler chickens. It is recommended that further studies on the effect of turmeric rhizome powder on the antioxidant properties and its effects on morbidity and mortality rate of broilers chickens should be conducted.

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