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Effect of Turmeric Rhizome Powder as Feed Additive on Broiler Chicken's Growth Performance, Carcass Characteristics and Nutrient Digestibility Coefficient

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Abstract

A research investigation aimed to assess the impact of different levels of turmeric rhizome powder as a feed additive on broiler chickens' growth performance, carcass characteristics, and nutrient digestibility coefficient. The study utilized two hundred and fifty-day-old chicks of the Abor Acre strain. Five diets were formulated for both the starter and finisher phases, incorporating turmeric rhizome powder at levels of 0g, 100g, 200g, 300g, and 400g per 100kg of feed. These diets were designated as T_1, T_2, T_3, T_4 and T_5, respectively. The birds were separated into five groups of fifty birds each, and each group was assigned one of the diets in a completely randomized design (CRD). A further division within each group resulted in five replicates, each containing ten birds. The birds' performance assessment findings during the starter phase revealed significant differences ($P<0.05$) in final body weight, body weight gain, and feed intake among the birds. T_5 had the highest values for the three parameters. The values for the feed conversion ratio of the broiler chickens at the starter phase were 1.80, 1.79, 1.69, 1.64 and 1.59 for T_1, T_2, T_3, T_4 and T_5 respectively. T_5 recorded the lowest value though statistically similar ($P>0.05$). At the finisher phase, the final body weight, body weight gain and feed intake of the birds followed the same trend as in the starter phase. Significant differences were observed in final body weight gain and feed intake of the birds. There was no significant difference ($P>0.05$) in the feed conversion ratio of the birds in the finisher birds. T_5 had the lowest FCR (feed conversion ratio) values. Significant differences were recorded in the live weight, dressed weight, dressing percentages and primal cut-parts (breast, thigh, drumstick, back, wing and abdominal fat) of the birds. T_5 had the highest values in all the traits measured (2510.43g, 2243.51g and 89.37%, 40.07%, 29.55%, 30.56%, 28.51% and 23.05% for live weight, dressed weight, dressing percentage, breast, thigh, drumstick, back and wing respectively).The abdominal fat of the broiler chickens were significantly affected ($P<0.05$) by the diet. T_4 also had the highest value 80.48%. The nutrient digestibility coefficient of the experimental birds was significantly affected ($P<0.05$) by the diet. This suggests that incorporating turmeric rhizome powder up to 400g in the diet of broiler chickens improved their growth performance, carcass quality, and nutrient digestibility coefficient.

Key words: Turmeric rhizome, Broiler chickens, Nutrient digestibility, Carcass

1.0 Introduction

The tremendous increase in human population has created an unprecedented demand in the supply of animal protein (Alphonsus *et al*., 2012; Sam *et al*., 2017). This has intensified the production of animal species with short generation intervals, quick turnover and low capital investment such as poultry (Akpa *et al*., 2010; Christopher *et al*., 2023; Ebong *et al*., 2023). Poultry is renowned for producing high-quality animal protein, including both meat and eggs.

Feed additives are incorporated into poultry diets to enhance performance, boost immune functions, and prevent diseases (Essien *et al.,* 2022a). The extensive use of antibiotic growth promoters (AGPs) in broiler chicken diets has over the years yielded tremendous increase in productivity. Unfortunately, these products are known for bacterial resistance and residues in meat which exert negative impact on consumers' health. This led the European Union in 2006 to place a ban on them (EU-2005). However, the ban on these conventional supplements has forced nutritionists to search for viable and natural alternative feed additives (Okon *et al*., 2022).

Recently the use of phytogenic as a possible replacement for antibiotics growth promoter in livestock feed has been advocated widely, due to their beneficial effects on animal health and productivity as reported in several studies (Essien 2021; Okon *et al*., 2022; Solomon *et al*., 2022; Essien *et al*., 2022b; rbs and spices or their extract in the form of essential oil (Windisch *et al*., 2008). These plants are known to contain numerous bioactive compounds that demonstrate a wide raOkon *et al*., 2023). Phytogenic are a group of natural growth promoters derived from henge of pharmacological activities, including antioxidant, anti-carcinogenic, anti-inflammatory, immunomodulatory, antidiarrheal, hypolipidemic, and antimicrobial properties. Additionally, they possess flavoring attributes (Udedibie *et al.,* 2005; Essien and Udedibie, 2007; Windisch *et al*., 2008). Studies by Stanacev *et al*. (2011) and Dhana (2014, 2015) have substantiated the ability of these plants to improve the performance, feed conversion ratio as well as carcass quality of meat animals. This is in addition to their ability to boost immune functions and prevent diseases in animals (Alagawany *et al*., 2015a, 2015b).

Turmeric (Curcuma longa) is a promising alternative feed additive that has been shown to have a wide range of beneficial effects on the production performance of various livestock species. Turmeric, a perennial rhizomatous herbaceous plant native to India and Southeast Asia is used as a spice, coloring agent and medicinal remedy (Priyadarsini, 2014). Curcumin, a phenolic compound, has been reported to be the principal bio-active compound in turmeric; it forms 70-75% of the rhizome. Other compounds identified in turmeric are desmethoxycurcumin and bisdemethoxycurcumin (Kocaadam and Sanlier, 2017). Curcumin, present as curcuminoids, is reported to possess a variety of beneficial properties, including anti-inflammatory, hypercholesterolemic, antimicrobial, antirheumatic, antioxidant, antifibrotic, antivenomous, antiviral, antidiabetic, antihepatotoxic, anticancer, and anthelmintic effects (Voreavuthikunchai, 2007). Curcumin is known to improve nutrient digestibility and prevent diseases in farm animals (chattopaddhyay *et al.,* 2004). Nwoko *et al.,* (2022) reported improved performance, carcass yield and lipid profile of New Zealand rabbits fed varying levels of turmeric rhizome meal. The plant contains an appreciable amount of ether extract (4.17%), crude fibre (6.77%), crude protein (12.72%), ash (6.53%), nitrogen-free extract (59.92%) and dry matter (88.11%) (Nwoko *et al*., 2022). However, with the rich nutrients and pharmacological profile of turmeric, supplementing turmeric in broiler diet would be beneficial to the animals as well as humans. This research was therefore carried

out to assess the effects of turmeric on broiler chickens' performance, carcass quality, and nutrient digestibility.

2.0 Materials and Methods

2.1 Study Area

The study was conducted at the Teaching and Research Farm of the Department of Animal Science, Faculty of Agriculture, Akwa Ibom State University, Obio Akpa Campus. The area is located between Latitude $4^0$30N and $5^0$00N and longitude $70^0$30^{0}E and $80^0$00E (AKSG, 2024).

2.2 Source and Processing of Experimental Material

The turmeric (*Curcuma longa*) rhizomes were procured from Akpan Andem Market in Uyo, Akwa Ibom State. The purchased rhizomes were washed and severed using a kitchen knife into smaller pieces. The sliced turmeric was sun-dried for 3-5 days before milling to obtain turmeric rhizome powder (TRP). The ground turmeric rhizome was subsequently stored in dry, airtight containers until required, ensuring protection against contamination and mould infestation.

2.3 Proximate and Phytochemical Analysis of Turmeric Rhizome Powder

A 10g sample of turmeric rhizome powder was extracted and subjected to proximate analysis in the laboratory. This analysis aimed to determine the levels of crude protein, lipid, ash, and crude fibre, following the guidelines outlined by AOAC (2005). Additionally, phytochemical analysis for saponin, flavonoid, polyphenol, tannin, and alkaloid content was carried out using the method described by Harborne (1998).

2.4 Experimental Diets

Five experimental diets were formulated at the starter phase to contain a crude protein level of 22.78% and metabolizable energy of 2887.53kcal/100kg of feed. Another five experimental diets were formulated at the finisher phase and they contained 21.31% crude protein and metabolizable energy of 2998.43kcal/100kg of feed. The diets labeled T_1, T_2, T_4 and T_5 contained turmeric rhizome powder at 100g, 200g, 300g and 400g per 100kg of feed respectively. Tables 2.1 and 2.2 detail the ingredients and nutrient composition in the broiler's experimental diet.

2.5 Management of Experimental Animals and Layout of the Study

The poultry house underwent thorough cleaning, disinfection, and two weeks of air drying before the arrival of the two hundred and fifty (250) day-old Arbor Acre broiler chicks sourced from a reputable commercial poultry distributor in Uyo, Akwa Ibom State. Upon arrival, the chicks were individually weighed and divided into five (5) specific units of forty birds each. Each unit was thereafter assigned a specific diet in a completely randomized design (CRD). Subsequently, each group was further subdivided into five replicates of ten (10) birds each. The chicks were initially fed a starter diet from weeks 1 to 4, followed by a finisher diet from weeks 5 to 8. Feed and water were provided ad libitum throughout the experiment. The birds were housed in a deep litter pen measuring 2m x 2m. All required routine vaccines and medications were administered promptly according to schedule, following strict biosecurity principles. The experiment duration spanned 56 days.

2.6 Data Collection

The broiler chickens' initial body weights were measured upon arrival in the pen. Subsequently, body weights were recorded weekly throughout the study. The amount of leftover feed was subtracted from the quantity of feed provided the previous day to obtain the feed intake of the birds. The feed conversion ratio was determined by dividing the daily feed intake by the daily weight gain.

2.7 Carcass Analysis

At the conclusion of the experiment, five birds were chosen at random from each treatment group for carcass measurements. The selected birds were fasted overnight, weighed in the morning, and then slaughtered by severing the jugular vein to ensure thorough bleeding. The slaughtered birds were scalded in hot water of 60^0C for minutes and defeather was done manually followed by evisceration. The dressed weight and dressing percentage of the birds were expressed as a percentage of live weight, while the cut-parts were weighed and their weight expressed as a percentage of dressed weight.

2.8 Nutrient Digestibility Coefficient

At the end of the experiment, one bird per replicate was placed in an individual metabolic cage equipped with facilities for feeding, drinking, and the collection of droppings. The birds were given a four-day adaptation period before starting the trial. A measured amount of feed was provided to the birds daily, and faeces were collected daily over five days. The collected droppings were then dried in an oven at 60°C for 24 hours. The faecal mass of each dropping per day was mixed thoroughly and representative samples were preserved. At the end of the trial, the bulk droppings were transported for proximate composition analysis at the laboratory, following the methods outlined in AOAC (2005).

$$Digestibility\ coefficient = \frac{Nutrient\ in\ feed - Nutrient\ in\ feaces}{Nutrient\ in\ feed}\ x\ 100$$

Equation 2.1

2.9 Data Analysis

All data obtained were subjected to Analysis of Variance (ANOVA) using SAS Statistical package (SAS, 2002). Significant differences between means were separated using the Duncan's Multiple Range Test (Duncan, 1995).

3.0 Results and Discussion

3.1 Proximate and Phytochemical Composition of Turmeric Rhizome Powder

The result of the proximate and phytochemical composition of turmeric rhizome powder is presented in Table 3.1. The turmeric rhizome powder contains 10.96% crude protein, 6.31% ether extract, 4.37% crude fibre, 5.51% ash, 60% nitrogen-free extract and 87.49% dry matter. The crude protein, ether extract and crude fibre values of turmeric rhizome powder in this study were comparable to values 10.7, 6.64 and 4.87% reported by Imoru *et al*. (2018). The values for ash in this study were lower than 7.81% and 6.24% reported by Ahatotu and Lawal (2019) and Nwoko *et al*. (2022) respectively, but the crude protein and crude fibre values were similar to the values reported by Ahatotu and lawal (2019). However, the disparity in the values of some of the proximate parameters analyzed may be as a result of influence by species diversification, differences in soil nutrient, variations in the climatic conditions of the area of cultivation (Ekpo and Okon, 2022; Ekpo *et al*., 2022).

Table 2.1: Ingredients and nutrient composition of the starter broiler chickens, fed diet containing varying levels of turmeric rhizome powder

Ingredients	T_1 0g TRP	T_2 100g TRP	T_3 200g TRP	T_4 300g TRP	T_5 400g TRP
Yellow maize	50.00	50.00	50.00	50.00	50.00
Soyabean meal	30.00	30.00	30.00	30.00	30.00
Fish meal	3.00	3.00	3.00	3.00	3.00
Palm kernel cake	5.00	5.00	5.00	5.00	5.00
Wheat offals	7.00	7.00	7.00	7.00	7.00
Bone meal	4.00	4.00	4.00	4.00	4.00
Common salt	0.25	0.25	0.25	0.25	0.25
Min/vit premix	0.25	0.25	0.25	0.25	0.25
l-lysine	0.25	0.25	0.25	0.25	0.25
l-methiomine	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Chemical composition (%DM)					
Crude protein	22.78	22.78	22.78	22.78	22.78
Crude fibre	4.05	4.05	4.05	4.05	4.05
Ether extract	4.53	4.53	4.53	4.53	4.53
Ash	4.31	4.31	4.31	4.31	4.31
NFE	64.33	64.33	64.33	64.33	64.33
ME/mca1/kg	2887.53	2887.53	2887.53	2887.53	2887.53

TRP- Turmeric rhizome powder, NFE-Nitrogen free extracts

Table 2.2: Ingredients and nutrient composition of broiler finisher feed diet with varying levels of turmeric rhizome powder

Ingredients	T_1 0g TRP	T_2 100g TRP	T_3 200g TRP	T_4 300g TRP	T_5 400g TRP
Yellow maize	60.00	60.00	60.00	60.00	60.00
Soyabean meal	24.00	24.00	24.00	24.00	24.00
Fish meal	3.00	3.00	3.00	3.00	3.00
Palm kernel cake	4.00	4.00	4.00	4.00	4.00
Wheat offal	4.00	4.00	4.00	4.00	4.00
Bone meal	4.00	4.00	4.00	4.00	4.00
Common salt	0.25	0.25	0.25	0.25	0.25
Min/vit premix	0.25	0.25	0.25	0.25	0.25
l-lysine	0.25	0.25	0.25	0.25	0.25
l-methiomine	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Chemical Composition (%DM)					
Crude protein	21.31%	21.31	21.31	21.31	21.31
Crude fibre	4.62	4.62	4.62	4.62	4.62
Ether oxtract	4.53	4.53	4.53	4.53	4.53
Ash	5.31	5.31	5.31	5.31	5.31
NFE	64.23	64.23	64.23	64.23	64.23
ME/mca1/kg	2988.43	2988.43	2988.43	2988.43	2988.43

TRP-Turmeric rhizome powder, NFE-Nitrogen free extract, ME-Metabolizable energy

The phytochemical composition of turmeric rhizome powder indicated the presence of flavonoids, phenols, alkaloids, saponin and tannin at 5.07%, 4.41%, 1.42%, and 2.31% respectively. These results disagree with the report of Harshel *et al.* (2014) who reported the absence of saponin and tannin in their phytochemical analysis. Phytochemicals are a group of naturally occurring biologically active compounds inherent in plants. They act as a natural defense system for the host plant. Phytochemical analysis is useful in detecting the content of bioactive principles in plants which might help in the discovery and development of medicinal drugs (Harshel *et al*., 2014).

Flavonoids are known to exert anti-inflammatory, antioxidant and anti-allergic effects. Antioxidants, among their numerous benefits are known to inhibit lipid oxidation and scavenge free radicals and superoxide anions (Ikpeama *et al*., 2014; Okon *et al*., 2024). Tannins perform different physiological functions such as antimicrobial, antiparasitic, anti-irritant, and antifungal and inhibit the growth of yeasts, bacteria, viruses and fungi. They form complexes with dietary protein thereby reducing protein digestibility (Prasad *et al*., 2005). Phenols are known for antioxidant and enzyme activation. They cause a reduction in x-tocopherol radicals, chelate metal catalysts and inhibit oxidases (Oboh *et al*., 2007). Saponins are known for their hypocholesterolemia and anticarcinogenic effects; they also have soapy characteristics (Korathar and Rao, 1997). Alkaloids exert analgesic and anti-bacterial activities and have been used massively as a pharmaceutical agent (Madziga *et al.*, 2010).

Table 3.1: Proximate and phytochemical composition of turmeric powder

Parameter	**Composition % DM**
Crude protein	10.96
Crude fibre	4.37
Ash	5.51
Ether extract	6.31
Nitrogen free extract	60.00
Dry matter	87.49
Anti-nutrient	**(mg/100g)**
Flavonoid	5.07
Phenols	4.41
Alkaloid	1.42
Saponin	2.31
Tannin	0.56

3.2 Performance of Birds Fed Varying Levels of Turmeric Rhizome Powder at the Starter Phase

The performance results of the birds during the starter phase indicate the beneficial effects of feeding broiler chickens with diets containing turmeric rhizome powder (Table 3.2). The findings showed significant differences ($P<0.05$) in both the final body weight and body weight gain values of the birds. T_5 recorded the highest values for the two parameters followed by T_4, T_3 T_2 and T_1 which had the lowest values for the parameters. The significant improvement observed with birds fed diet supplemented with turmeric rhizome powder could be attributed to the presence of curcumin in turmeric which possess anti-oxidant and anti-microbial activities capable of destroying pathogens in the digestive tract, creating an enabling environment for effective digestion and absorption of the digestive products which consequently result in enhanced growth. Similarly, observations were made by Al-Sultan,

(2013) when broiler birds fed a diet containing turmeric powder recorded a significant increase in weight gain compared with the control. The values obtained in the final body weight were similar to the reports of Essien and Udoh (202) and Sam and Okon (2022). Significant differences (P<0.05) were also observed in feed intake among the birds at the starter phase across treatments. This result could indicate improved palatability of the diet and appetite-stimulating effect in turmeric rhizome powder.

No significant differences (P>0.5) were observed in the feed conversion ratio of the birds. T_5 had the lowest feed conversion ratio indicating that feed utilization was improved by adding turmeric rhizome powder to their diet which was also reflected in the body weight gain and feed consumption efficiency of the birds.

Table 3.2: Performance characteristics of starter broiler chickens fed a diet with different levels of turmeric rhizome powder

Parameter	T_1 (0gTRP)	T_2 (100gTRP)	T_3 (200gTRP)	T_4 (300gTRP)	T_5 400gTRP	SEM
Initial weight (g)	47.51	47.51	47.54^{c}	47.60	47.55	0.01
Final body weight (g)	872.51^{e}	898.43^{d}	980.71^{c}	1030.11^{b}	1100.17^{a}	0.14
Total weight gain (g)	825.00^{e}	850.86^{d}	933.17^{c}	982.51^{b}	1052.62^{a}	0.32
Daily weight gain (g)	29.40^{e}	30.39^{d}	33.33^{c}	35.09^{b}	37.59^{a}	0.17
Total feed intake (g)	1484.28^{e}	1520.68^{d}	1576.96^{c}	1610.28^{b}	1660.96^{a}	1.43
Daily feed intake(g)	53.01^{e}	54.31^{d}	56.32^{c}	57.51^{b}	59.32^{a}	0.03
FCR	1.80	1.79	1.69	1.64	1.59	0.01
Mortality	0.00	0.00	0.00	0.00	0.00	0.00

TRP – Turmeric Rhizome Powder, FCR-Feed Conversion Ratio
abcde – Means across treatment bearing different superscripts differ significantly (P<0.05)

3.3 Performance of birds fed varying levels of turmeric rhizome powder at the finisher phase

At the finisher phase, dietary supplementation of turmeric rhizome powder showed significant effects on the performance of the chickens in terms of final body weight and the body weight gain of the birds increased with increasing substitution levels (Table 3.3). T_5 had the highest value following the beneficial effect of turmeric rhizome powder as spice which culminated into higher or better final body weight and body gain values obtained with birds fed turmeric rhizome powder compared with the control. Spices are known to enhance growth and performance in birds by stimulating the secretion of endogenous digestive enzymes in the stomach, small intestine, and pancreas and also increase bile flow for efficient digestion and utilization of the digestive products (Okwu, 2003; Ingweye *et al.*, 2020), thereby improving digestion. However, this result is in consonant with the report of Nouzarian *et al*. (2011) and Kafi *et al*. (2017) who reported improvement in body weight gain of broiler chickens fed diet supplemented with turmeric powder.

The feed intake of the birds during the finisher phase followed the same trend as observed in the starter phase. The feed intake of the birds increased as the inclusion level of turmeric rhizome powder in the diet increased, showing significant differences (P<0.05) between treatments. This increase may indicate adequate intake of minerals and vitamins which might have stimulated the appetite of the birds. Nwoko (2022) reported that turmeric contains a reasonable amount of vitamins and minerals.

There was no significant effect (P>0.05) of the test diet on the feed conversion ratio (FCR) of the birds. Birds fed T_5-based diet were observed to be the best with lowest feed conversion ratio, followed by T_4 T_3 T_2 and T_1. This result indicates that the FCR was better in birds fed diets supplemented with turmeric rhizome powder compared with the control. Lower values were obtained in birds fed diet supplemented with turmeric rhizome powder. The present result showed that turmeric rhizome powder significantly increased the performance index of finisher broiler chicken with a concomitant decrease in feed conversion ratio values.

Table 3.3: Growth performance of finisher broiler chickens fed turmeric rhizome powder at varying levels

Parameter	T_1 (0gTRP)	T_2 (100gTRP)	T_3 (200gTRP)	T_4 (300gTRP)	T_5 400gTRP	SEM
Initial weight (g)	976.39	977.01	976.81	977.53	976.89	0.01
Final body weight (g)	2258.18^{e}	2299.98^{d}	2343.61^{c}	2431.33^{b}	2510.43^{a}	0.43
Weight gain (g)	1281.79^{e}	1322.97^{d}	1366.80^{c}	1489.92^{b}	1533.54^{a}	0.37
Daily weight (g)	45.77^{e}	47.25^{d}	48.81^{c}	53.21^{b}	54.77^{a}	1.01
Total feed intake (g)	$3,374.84^{e}$	3458.28^{d}	3516.24^{c}	3643.08^{b}	3699.08^{a}	1.13
Daily feed intake(g)	120.53^{e}	123.51^{d}	125.58^{c}	130.11^{b}	132.11^{a}	0.03
FCR	2.63	2.61	2.57	2.45	2.41	0.03
Mortality	0.00	0.00	0.00	0.00	0.00	0.00

TRP – Turmeric Rhizome Powder
abcde – Means on the same row bearing different superscript differ significantly (P<0.05)

3.4 Carcass Characteristics of Broiler Birds Fed Turmeric Rhizome Powder at Varying Levels

All carcass parameters evaluated in this study were significantly influenced by the diet (P<0.05), as shown in Table 3.4. The results indicated significant differences (P<0.05) in live weight, dressed weight, and primal cut parts (thigh, drumstick, breast, wing, and back) of the birds. Birds in the T_5 group recorded the highest values for these parameters.

However, the result of the dressed weight, dressing percentage, live weight and primal cut parts showed a positive relationship with the final weight and weight gain of the birds, where the heaviest group of birds produced higher dressed weight, dressing percentage and cut parts. The breast weights of the birds in groups fed diets supplemented with turmeric rhizome powder suggest adequate protein intake, digestion, and better protein metabolism, resulting in better muscle deposition.

Significant effects of the diets were observed on the abdominal fat of the birds. As the level of turmeric rhizome powder in the diet increased, a notable reduction (P<0.05) in abdominal fat values was observed. The highest abdominal fat values were recorded by the birds in T_1, while the lowest was observed in T_5. This decline in abdominal fat with increasing turmeric levels could be linked to the presence of antioxidants and flavonoids in turmeric, capable of inhibiting lipid peroxidation, other fat-oxidizing agents, and scavenge free radicals.

Table 3.4: Carcass characteristics of broiler chickens fed diet containing turmeric rhizome powder

Parameter	T_1 (0gTRP)	T_2 (100gTRP)	T_3 (200gTRP)	T_4 (300gTRP)	T_5 400gTRP	SEM
Live weight g	2258.18e	2299.98^{d}	2343^{c}	2489.92^{b}	2510.43^{a}	1.57
Dressed weight (g)	1918.00^{e}	1970.31^{d}	2014.63^{c}	2157.01^{b}	2243.51^{a}	1.23
Dressing (%)	84.94e	85.67^{d}	85.96^{c}	86.63^{b}	89.37^{a}	1.04
Primal cut parts			**(% Dressed Weight)**			
Breast	30.37^{e}	32.11^{d}	33.76^{c}	38.14^{b}	40.07^{a}	0.05
Thigh	18.20^{e}	21.23^{d}	23.04^{c}	26.71^{b}	29.55^{a}	0.03
Drumstick	21.24^{e}	23.51^{d}	25.60^{c}	27.11^{b}	30.56^{a}	0.14
Back	18.71^{e}	21.13^{d}	25.01^{c}	26.73^{b}	28.51^{a}	0.12
Wing	14.34^{e}	15.78^{d}	17.21^{c}	19.51^{b}	23.03^{a}	0.03
Abdominal fat	2.36^{a}	2.12^{b}	1.39^{c}	0.87^{d}	0.48^{e}	0.07

abcde – Means across treatment bearing different superscript differ significantly (P<0.05)
TRP – Turmeric Rhizome Powder

Table 3.5: Nutrient digestibility coefficient of broiler chickens fed turmeric rhizome powder

Parameter (%)	T_1 (0gTRP)	T_2 (100gTRP)	T_3 (200gTRP)	T_4 (300gTRP)	T_5 (400gTRP)	SEM
Crude fibre	68.70^{e}	69.58^{d}	71.39^{c}	72.78^{b}	75.61^{a}	1.01
Ether extract	73.11^{e}	74.34^{d}	76.52^{c}	77.89^{b}	80.51^{a}	0.03
Ash	80.31^{e}	80.71^{d}	82.13^{c}	85.54^{b}	87.54^{a}	0.05
Crude protein	7728^{e}	80.39^{d}	82.31^{c}	84.62^{b}	86.59^{a}	0.13
NFE	77.41^{e}	79.50^{d}	80.72^{c}	83.56^{b}	85.41^{a}	0.04

abcde – Means across treatment bearing different superscripts differ significantly (p<0.05).
TRP – Turmeric Rhizome Powder; NFE – Nitrogen Free Extract

3.5 Nutrient digestibility coefficient of broiler chickens fed varying level of Turmeric Rhizome powder

The nutrient digestibility coefficient of broiler chicken in this study is presented in Table 3.5. Compared to the control, the result revealed a better utilization of rhizome powder. Across treatments, significant (P<0.05) differences were recorded. T_5 recorded the highest nutrients digestibility coefficient for crude fibre, crude protein, atelectatic and ash. Followed by T_4, T_3, T_2, and T_1. The enhanced digestibility coefficient observed in birds may be linked to the presence of curcumin, the main bioactive compound in turmeric. Curcumin is known for its diverse pharmacological properties, including antioxidant and antimicrobial effects (Voravuthikunchai, 2007). Curcumin could have the ability to reduce the number of pathogens on the intestinal wall or manipulate the composition of microflora resulting in a stabilized intestinal tract suitable for effective digestion and absorption of digestive products.

4.0 Conclusion

The supplementation of broiler chickens' diet with varying levels of turmeric rhizome powder as indicated by the findings of this study improved performance, carcass and nutrient digestibility of the birds.

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