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Effect of turmeric on performance of Arbor Acres plus strain of broiler chicken

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Abstract

This study was conducted to investigate the performance response of Arbor Acres plus strain of broiler chickens fed turmeric treated diets. A total of 120 day old broiler chicks were allocated to four dietary treatments, with three replicates, having 10 birds per replicate. The dietary treatments consisted of the control diet (T_1) with 0 % turmeric powder and T_2, T_3 and T_4 with turmeric powder added @ 0.20, 0.25 and 0.30 % of feed respectively. Results showed that average final weight and daily weight gain were not significantly influenced (P>0.05) across the treatments. The average daily feed intake and feed conversion ratio of the broilers differed significantly (P<0.05) amongst the treatment groups. Turmeric supplementation showed a significant decrease in feed conversion ratio and in turn improved feed efficiency. Dietary turmeric had no significant effect on nutrient utilization across the dietary groups. Significantly higher dressing percentage was obtained in broiler group fed 0.30 % turmeric powder while other carcass cuts and internal organs did not differ significantly. Turmeric powder had no significant effect on total protein, albumin, globulin and glucose, whereas, dietary effects of turmeric on AST, ALT and ALP decreased significantly in 0.30 % turmeric fed group. It was concluded that turmeric at 0.30 % had a positive influence on feed conversion ratio, dressing percentage and oxidative stress indicators in broiler chickens. Therefore, inclusion of turmeric powder at 0.30 % is recommended.

Keywords: *Broiler chickens, feed additive, turmeric powder, performance*

Higher demand for broiler meat is driven by increased income, population growth and urbanization (Al-Mashhadani, 2015). Broiler production has shown dramatic increase in the past two decades; these are associated with researches and breeding programs which enhanced feed utilization, growth rate and production efficiency (Barazesh *et al.,* 2013).

Natural growth promoters such as prebiotics, probiotics, synbiotics, enzymes, plant extracts, etc., can be used as feed additives in broilers with no deleterious effect on the performance of birds (Al-Mashhadani, 2015). Shawky *et al*. (2020) reported that herbal supplementation improves growth performance, carcass characteristics, and immunological state in broilers.

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Turmeric is a herb in the Zingiberaceae family and is widely used as a feed preservative and spice and a familiar panacea with a significant spectrum of pharmacological activities (Nasri *et al*., 2014). The major bioactive component of turmeric, curcumin (diferuloylmethane) has been demonstrated as having a wide range of biological effects. These include anti-inflammatory, antimutagenic, anticoagulant, antioxidant, antidiabetic, and anticarcinogenic (Verma *et al*., 2018).

In addition, supplementation of turmeric has been demonstrated to enhance performance (Al-Sultan and Gameel, 2004). Also, curcumin in turmeric acts as an antioxidant and immune enhancer (Gandhi *et al.*, 2011). Durrani *et al.* (2006) stated that supplementation of turmeric improved weight gain and feed efficiency in broiler chicken.

Curcumin has also been demonstrated to be positively correlated to the secretion of trypsin, chymotrypsin, amylase, and lipase enzymes which aids in nutrients digestion in the intestinal tract of broiler chickens (Gobiraju *et al.,* 2017). The significant biological properties of turmeric powder make it a potential substitute for in-feed antibiotics growth promoter in livestock diets.

Several studies have been conducted to evaluate the effects of turmeric as feed additives on the performance of broiler chickens, laying hens and rabbits, however, the results are conflicting. Hence, the present study was carried out to establish the effect of turmeric on growth performance, nutrient digestibility, carcass traits and blood characteristics of Arbor Acres plus strain of broiler chicken.

Materials and methods

Experimental animals and diets

Fresh turmeric (*Curcuma longa*) rhizomes purchased from Makurdi local condiments and spices market were cleaned and sliced into smaller pieces, completely air dried and ground into powder. The powder was incorporated into the experimental diets. The dietary treatments consisted of 0 (control), 0.20, 0.25 and 0.30 g/kg of turmeric powder added to the basal diets. The Table 1 shows the basal maize-soyabean diets formulated to meet the nutrient requirements of broilers according to NRC (1994). One hundred and twenty, one-day-old mixed sex broiler chicks (Arbor Acres plus) purchased from a reputable hatchery in Ibadan, Oyo State, Nigeria were weighed on arrival and randomly assigned to one of four treatments with three replicates of 10 chicks based on a completely randomized design. Chickens were raised in floor pens (10 birds/ m^2) with wood shavings as litter material for 8 weeks. Feed and water were provided *ad libitum* throughout the experiment. The ambient temperature of the house was initially set at 33°C in the first week and gradually decreased to 25°C by the third week, which was then kept constant.

Growth data collection

Data on feed intake, body weight gain and feed to gain ratio. Feed intake was calculated as quantity difference of feed given and leftover after 24 hours. Average daily weight gain was determined from the difference in the weight of the birds after 56 days period. Feed: weight gain ratio was calculated average daily feed intake per daily weight gain per bird.

$$\textit{Average daily weight gain} = \frac{\textit{Average weight gain}}{\textit{Number of experimental days}}$$

$$\textit{Feed conversion ratio} = \frac{\textit{Average daily feed intake}}{\textit{Average daily weight gain}}$$

Carcass evaluation

On the last day of the study (8 weeks), three birds from each treatment groups were live weighed and slaughtered using a sharp and cleaned knife. The head, shank, and all internal visceral organs, including abdominal fat were removed and the carcass was weighed. The carcass weight was expressed in terms of dressing percentage as follows:

Dressing percentage = (Carcass weight/Live weight) x 100. Relative weights of other carcass parts were determined using the formula below:

Table 1. Gross composition of the experimental diets

	Experimental Diets	
Ingredients (kg)	**Starter (0 – 28 days)**	**Finisher (29 – 56 days)**
Yellow maize	53.00	56.60
Soya bean meal	30.30	24.90
Groundnut cake	4.00	4.40
Brewer dried grain	2.50	4.00
Rice bran	2.00	2.00
Bone meal	3.00	3.00
Blood meal	3.00	2.80
Palm oil	1.00	1.50
L-Lysine	0.15	0.15
Herbo-Methionine	0.20	0.20
Vitamin/mineral premix*	0.25	0.25
Common salt	0.25	0.20
Total	100	100
Calculated analysis		
Metabolizable Energy (Kcal/kg)	2941	2994
Crude protein (%)	23.24	21.28
Crude fibre (%)	4.00	4.08
Ether extract (%)	4.84	5.26
Lysine (%)	1.48	1.19
Methionine (%)	0.54	0.52
Calcium (%)	1.29	1.38
Available Phosphorus (%)	0.71	0.68

$$\text{Carcass part (\% DW)} = \frac{\text{Cut part}}{\text{Carcass weight}} \times 100$$

Liver, kidney, pancreas, heart and spleen were collected, weighed and weight expressed as a percentage of live body weight.

Nutrient digestibility

Nutrient digestibility evaluation was done at the last week of the experiment (week 8). Six birds per treatment were selected and transferred into metabolic cages. Three days adaptation period was allowed for the birds with the respective diets offered to the birds. Daily feed intake and faecal output were recorded for 4 days. The droppings were collected per replicate once daily at 8:00 am; it was weighed and dried in an oven at 70°C to constant weight. Dried excreta were bulked and ground. Proximate composition of experimental diets and feacal samples were determined (AOAC, 2006).

Blood constituent estimation

Haematological and biochemical parameters were done according to the procedure of Jain (1986). Samples were collected from each treatment group at the end of the feeding trial. Three birds per treatment were bled and blood collected from the jugular vein for laboratory analysis. Out of 12mL of blood collected from each bird, 2mL was put into labeled and sterilised bijou bottles containing EDTA for the determination of the haematological indices. The remaining blood sample was allowed to clot to exude sera for determination of biochemical indices. Blood samples were analysed within three hours of their collection for total erythrocyte (RBC) and leukocyte (WBC) counts, haematocrit (PCV) and haemoglobin concentration (Hb). The bottles of clotted blood were centrifuged at 3000 rpm for ten minutes for serum separation. Thereafter, the harvested sera were used for estimation of total serum protein (TSP), serum albumin (SA), globulin, glucose and enzymes

Table 2. Effect of turmeric powder on growth performance of finisher broiler chickens

Parameter	T_{1} - Control diet	T_{2} - 0.20 % turmeric	T_{3} - 0.25 % turmeric	T_{4} - 0.30 % turmeric
AIW (g)	39.00±0.00	39.00±0.00	39.00±0.00	39.00±0.00
AFW (g)	2000±43.49	1940±35.11	1830±98.65	1905±102.51
AWDG (g)	40.85±0.90	39.60±0.73	38.31±2.05	38.88±2.13
ADFI (g)	91.46±0.63[a]	87.50±1.36[b]	84.72±1.20[b]	85.46±1.10[b]
FCR	2.24±0.03[a]	2.20±0.01[b]	2.21±0.14[b]	2.19±0.10[b]

[ab]Means within each row with different superscripts are significantly different (P< 0.05); AIW = average initial weight; AFW = average final weight; ADWG = average daily weight gain; ADFI = average daily feed intake; FCR = feed conversion ratio;

Table 3. Effect of turmeric powder on nutrient digestibility of broiler chickens

Parameter (%)	T_{1} - Control diet	T_{2} - 0.20 % turmeric	T_{3} - 0.25 % turmeric	T_{4} - 0.30 % turmeric
Dry Matter	80.15±1.36	78.36±2.65	77.87±2.44	80.19±1.82
Crude Protein	80.88±1.19	78.60±2.64	79.11±2.22	79.81±1.48
Crude Fibre	82.82±0.61	79.46±2.38	79.68±2.16	80.83±1.63
Ether Extract	82.76±0.27	79.59±3.15	79.51±2.20	81.60±1.70
Nitrogen Free Extract	79.13±1.56	78.06±2.67	76.55±2.66	80.06±1.96

such as aspartate amino transferase (AST), alanine aminotransferase (ALT), and alkaline phosphatase (ALP).

Statistical analysis

The data were subjected to one way analysis of variance using SAS (2008) software package and the means of the parameters which were significantly different (P<0.05) were separated using Duncan's Multiple Range Test.

Results and discussion

The effect of turmeric on average final weight and daily weight gain of broilers were not significant (Table 2). This result corroborate the findings of Sherif *et al*. (2022) and Nouzarian *et al.* (2011) who did not find significant differences in body weight when broiler chickens were fed diet supplemented turmeric powder. However, this result disagree with that of Ekine *et al.* (2020) who reported significant effect at an inclusion rate of 0.25, 0.50, 0.75 and 1.0 % on weight of broilers. Durrani *et al*. (2006) reported that inclusion of turmeric in feed increased body weight of broiler birds, and concluded that, the significant increase in body weight might be due to antioxidant activities of turmeric that stimulates protein synthesis by enzymatic system. Average daily feed intake was significantly reduced in the birds fed turmeric powder compare to control. Similar observations were made by Ekine *et al.* (2020) and Nouzarian *et al.* (2011). However, Sunmola *et al.* (2022) reported no significant effect in feed intake when broiler chicks were fed diets containing turmeric powder. The low feed conversion ratio of the experimental birds in turmeric treated groups may be due to influence of growth promoting substance in addition, turmeric powder limit the growth and colonisation of numerous pathogenic and non-pathogenic species of bacteria in birds. Similar observations were made in a study when chickens were fed diets supplemented turmeric powder (Emadi and Kermanshahi, 2006).

Dietary effect of turmeric powder on nutrient utilization of broiler chickens is presented in Table 3. There were no significant differences among the means of the parameters evaluated across the dietary treatments. Observed result confirmed the findings of Cross et al. (2007) who observed non significant differences in nutrient utilisation when extract of three herbal products included in corn-soybean meal diets fed to male Hubbard broilers. Lee et al. (2004) also reported non significant differences between non-supplemented control and the phytoadditive treatments

Table 4. Effect of turmeric powder on carcass characteristic of broiler chickens

Parameter	T_1 - Control diet	T_2 - 0.20 % turmeric	T_3 - 0.25 % turmeric	T_4 - 0.30 % turmeric
Dressing percent	66.85±2.16[b]	62.05±1.78[b]	63.28±0.86[b]	70.67±1.32[a]
Drum stick (% DW)	14.82±0.32	14.45±0.31	14.17±0.50	15.01±0.24
Thigh (% DW)	14.68±0.44	14.42±0.93	13.76±0.35	15.01±0.42
Breast (% DW)	34.02±1.45	34.83±1.94	34.11±0.49	33.38±0.74
Back (% DW)	14.01±0.70	15.85±1.24	14.81±0.06	15.94±1.33
Liver (% LW)	2.20±0.10	2.34±0.11	2.40±0.12	2.28±0.09
Kidney (% LW)	0.63±0.04	0.64±0.04	0.59±0.05	0.65±0.03
Heart (% LW)	0.43±0.02	0.45±0.01	0.42±0.02	0.48±0.01
Pancreas (% LW)	0.28±0.01	0.27±0.02	0.26±0.02	0.27±0.01
Lungs (% LW)	0.58±0.02	0.61±0.03	0.60±0.02	0.65±0.04

[ab]Means within each row with different superscripts are significantly different (P< 0.05);

Table 4 presents the effect of turmeric powder on carcass and internal organs weight of the broiler chickens. Turmeric powder significantly ($p<0.05$) influenced the dressing percentage with the highest value recorded on broiler chicken fed highest inclusion level (0.30 %). This result corroborate the findings of Nouzarian *et al*. (2011) and Durrani *et al.* (2006) who reported significant increase in dressing percentage in broilers fed diet containing turmeric powder relative to control. Similarly, Oleforuh *et al*. (2014) reported significant differences on dressing percentage. Meanwhile, Mehala and Moorthy (2008) failed to observe any significant impact of turmeric powder (up to 10 g/kg of diet) on carcass percentage of broiler chickens reared to six weeks of age. El-Hakim *et al*. (2009) did not find any significant effect of turmeric supplementation at the rate of 1.0 and 2.0 g/kg on carcass characteristics. Carcass cuts were not affected by dietary treatment. This result confirm the findings of Al- Sultan and Gameel (2004) who reported no differences in the weight of breast and thigh muscles following turmeric meal supplementation in the broiler diets. Oleforuh *et al*. (2014) reported non significant differences in drum stick, thigh, breast and drumstick. On the contrary, Durrani *et al* (2006) reported higher breast, thigh and giblet weight in broilers fed diet containing 5g/kg turmeric powder. Non significant effect observed in the weight of kidney, liver, pancreas, heart and lungs confirmed the findings of Al-Mashhadani (2015) who reported that internal edible and non-edible organs weight were not statistically influenced by the turmeric. Durrani (2006) observed no effect on liver and lungs weight by dietary application of turmeric. Interestingly, in line with our observations on liver weight, Ahmadi (2010) indicated the favourable effects of turmeric powder inclusion at 0.3 and 0.6 g/kg on relative liver weight of aflatoxin treated chickens.

Non significant effect obtained for total protein, albumin, globulin and glucose (Table 5) in the blood sera of broiler birds indicated normal nutrients metabolism in treated birds. Noori *et al*. (2011) reported that different dietary levels of turmeric at 42 days of age had no significant effect on total protein of the chickens. However, Emadi and Kermanshahi (2007) reported that supplementation of chickens diets with turmeric at 0.25, 0.50 and 0.75% levels had significant effect on blood albumin and total protein. Oxidative stress is generally connected with increased activity of AST, ALT and ALP. Significantly lower values of AST, ALP and ALT recorded on broiler chickens fed turmeric supplemented diets relative to control confirmed the findings of Malekizadeh *et al*. (2012), Mirbod *et al.* (2017) and Saraswati *et al*. (2013).

Conclusion

Based on the findings of the study, it could concluded that turmeric addition at 0.30 % resulted in better feed conversion ratio, dressing percentage and lower oxidative stress in broiler chicken. Therefore, inclusion of turmeric powder at 0.30 % is recommended.

Table 5. Effect of turmeric powder on serum biochemical of broiler chickens

Parameter	T_1 - Control diet	T_2 - 0.20 % turmeric	T_3 - 0.25 % turmeric	T_4 - 0.30 % turmeric
Total Protein (g/dL)	6.05±0.14	5.15±0.20	5.05±0.20	3.85±0.89
Albumin (g/dL)	3.30±0.34	2.15±0.60	2.40±0.05	2.30±0.05
Globulin (g/dL)	2.75±0.20	3.00±0.80	2.65±0.14	1.55±0.83
Glucose (g/dL)	66.00±0.23	62.40±20.78	40.00±2.30	74.40±12.93
AST (U/L)	178.75±3.60[a]	161.75±1.06[a]	161.20±4.79[a]	122.40±17.43[b]
ALT (U/L)	104.70±0.34[a]	88.10±0.17[c]	91.60±0.23[b]	86.95±0.35[d]
ALP (U/L)	98.20±0.11[a]	100.60±4.50[a]	63.00±13.27[b]	62.60±2.19[b]

[abc]Means within each row with different superscripts are significantly different (P< 0.05);

Conflict of interest

The authors declare that they have no conflict of interest.

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