Haematological parameters, antioxidant status and carcass analysis of broiler chickens fed diets supplemented with turmeric (*Curcuma longa*)

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Abstract

The experiment was conducted to investigate the effect of turmeric (*Curcuma longa*) on haematological parameters, antioxidant status and carcass analysis of broiler chicken. A total of 108-day old broiler chicks were divided into three treatment groups in completely randomised design. The birds were assigned at the rate of 36 birds per treatment in 4 replicates of 9 chicks per replicate. Turmeric powder was supplemented to the feed at the rate of 0%, 0.5% and 1.0% throughout the experiment (8week). All data generated were subjected to one-way analysis of variance. Results showed that haematological parameters like PCV, RBC, Hb and monocyte increased as the level of turmeric supplementation increases. The antioxidant enzymes glutathione-peroxidase (GPx), superoxide dismutase (SOD), catalase (CAT) and total antioxidant activity (TAA) positively increased with increase in the turmeric supplementation. Increasing level of turmeric supplementation significantly ($P < 0.05$) decreased live weights, dressed weights and eviscerated weights of broiler chicken. Some of relative internal organ weights were affected by turmeric supplementation except heart, kidney, lung and pancreas. It was concluded that the turmeric can be added to the diets of broilers chicken up to the level 1.0% and protect cell from excess production of reactive oxygen species also it has the potential to improve immune response in broiler chicken.

Keywords: Antioxidant enzymes, broiler chicken, carcass, haematology, internal organs

Introduction

Over the years, the synthetic antibiotics have been used in poultry feed to provide supplementary support to fight against harmful exogenous pathogens (Dono, 2014). These antibiotics help to overcome with the morbidity and mortality issues with poultry farming, however can affect the public health by developing drug resistant microflora (Casewell *et al.*, 2003). It has been found that the feeding of turmeric rhizome powder in the poultry diet helped to improve the morbidity and mortality of broiler chickens (Al-Kassie *et al.*, 2011). Curcumin is the active ingredient that is present at 1.5-2% of weight of turmeric root. Turmeric contains 3 different analogues of curcumin, which contains 5% bis-demethoxycurcumin, 18% demethoxycurcumin and 77%

diferuloylmethane. Rhizomes of this plant are dried to obtain turmeric powder, a yellow or gold-colored spice, which is also used for health care, food preservation and as a dye in textile industry. Its colour is due to a pigment which is diferuloylmethane in structure. Curcumin is insoluble in water and soluble in methylsulfoxide, ethanol, oils and acetone (Aggarwal *et al.*, 2007). Feed is the key constituent of overall costs of poultry farming responsible for about 80% of the total expenses is on the procurement of feed. The awareness in feed additives flourished over the last decade of the past century (Hosseini-Vashan *et al.*, 2012). Turmeric has good pharmacological properties and effect of turmeric (*Curcuma longa*) supplementation is a useful natural growth promoter and safe alternative to antibiotics (Zeinali *et al.*, 2011) therefore

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supplementation of antioxidant to diets may decrease the oxidative reaction in chicken products under heatstress condition. The main antioxidant component in turmeric is curcumin that is a phenolic antioxidant. Turmeric has beneficial on many biological reactions including anti-inflammatory, antioxidant, antiviral, antibacterial, anticoagulant and antimicrobial (Emadi *et al.*, 2010). The objective of this study was to assess the effect of turmeric (*Curcuma longa*) on the antioxidant status, haematological parameters and carcass analysis and internal organs of broiler chicken.

Materials and methods

The experiment was carried out at the Teaching and Research Farm, Department of Agricultural Technology, Federal Polytechnic, Ado-Ekiti, South west of Nigeria. The climate has average annual rainfall of 1247mm and mean temperature of 26.2°C. Test ingredient turmeric (*Curcuma longa*) rhizome was purchased at the local market. It was washed to

dislodge dirt, sliced, sundried for 13 days and grinded into fine particles prior to diet formulation. A total of 108, one day-old *Arbor acre* unsexed broiler chicks were randomly distributed into 12 pens of 9 birds each. The pens were allotted to three dietary treatment groups replicated three times. The experimental treatments consist of 0%, 0.5% and 1% of dietary supplementation levels of ground turmeric into basal diets at starter and finisher phases. The composition of basal starter and finisher diets are presented in Tables 1 and 2. The basal diets were formulated for broiler starter (0-28day) and finisher phase (29-56day) respectively to meet the NRC (1994) requirements for broilers. The diets were formulated to be iso-caloric and iso-nitrogenous. The birds were floor brooded on litter of wood shavings. The temperature was controlled within the range of 32±2°C the first week and reduced by 2°C on each successive week and thereafter maintained at 28±2°C until the end of the experiment. The birds were fed their respective experimental diets and water *ad-libitum* for eight weeks of feeding trial.

Table 1: Ingredients and nutrient compositions of basal diet for broiler starter

Ingredients	Compositions (%)
Maize	46.0
Soybean meal	26.0
Groundnut cake	16.0
Fish meal	2.00
Bonemeal	6.00
Oyster shell	3.00
NaCl	0.20
Methionine	0.30
Lysine	0.20
Premix	0.30
Calculated nutrients (%)	
Crude protein	24.09
Crude fibre	3.43
Calcium	3.43
Phosphorus	1.16
Vit A -*10,000,00iu., D ₃ *2,000iu., B ₁ *0.75g. B ₂ .5g., Nicotinic aci*25g., Calcium pantothanate 12.5g., B ₁ *0.015g., K ₃ *2.5g.,E*25g.,Biotin***0.050g., Folic acid***1g., Manganese64g.,Choline chloride 250g., Cobalt**0.8g., Copper 8g., Manganese 64g., Iron -32g., Zn -40g., Iodine -0.8g., Flavomycin -100g., Spiramycin5g., DI-methionine-50g, Selenium 0.6g., Lysine 120g.	

Table 2: Ingredients and nutrient compositions of basal diet for broiler finisher

Ingredients	composition (%)
Maize	56.00
Soybean meal	18.00
Groundnut cake	15.00
Fish meal	5.00
Bonemeal	3.00
Oyster shell	2.00
Nacl	0.30
Methionine	0.20
Lysine	0.20
Premix	0.30
Calculated nutrients (%)	
Crude protein	21.13
Crude fibre	3.06
Calcium	0.97
Phosphorus	3.06

VitA-10,000,00 iu., D₃-2,000iu., B₁-0.75g.,B₂*5g., Nicotinic acid-25g., Calcium pantothenate 12.5g.,B₁₂-0.015g.,K₃*2.5g., E-25g.,Biotin-0.050g., Folic acid -1g.,Manganese 64g., Choline chloride250g., Cobalt -0.8g.,Copper 8g.,Manganese 64g.,Iron -32g., Zn -40g.,Iodine-0.8g., Flavomycin -100g.,Spiramycin 5g., DI -methionine-50g., Selenium 0.6g.,Lysine 120g., BA

Data collection

On the last day of the experiment (56th day), blood samples collection was done in the morning after the birds were starved overnight in order to attain a stable haematological and antioxidant evaluations. Four birds were randomly selected from each treatment and blood samples were collected from the jugular vein of the birds. About 3mLs of blood samples were collected from each birds in labelled ethylene diamine tetra-acetate (EDTA) bottles to determine the haematological indices. The tubes were immediately capped and the contents mixed gently for about 1 minute by repeated inversion. The samples were taken immediately to the laboratory to determine packed cellvolume (PCV), total red blood cell (RBC) count, haemoglobin concentrate (Hb), mean corpuscular haemoglobin concentration (MCHC), mean cell haemoglobin (MCH), mean corpuscular volume (MCV) and white blood cells were determined according to Lambs (1981). Neutrophils (N), lymphocytes(L), monocytes (M), and

Eosinophils were determined by the micro-haematocrit method (Dacic and Lewis, 1991). 3mLs of blood collected from the birds was put into a plain bottle for antioxidant enzyme determination. The Glutathione peroxidase (GPx) was determined in erythrocytes using Rotruck *et al.* (1973) method. Superoxide dismutase (SOD) was determined by the (Misra and Fridovich, 1972) method. Catalase (CAT) activity was determined at room temperature by using the method of Aebi (1974) and absorbance of the sample was measured at 240nm for 30s in a spectrophotometer. Total antioxidant activity was determined. Two birds from each replicate were randomly selected for carcass analysis.

The selected birds were weighed before severing the jugular veins allowing blood to drain freely, the carcasses were scalded in water bath maintained at 75°C for about 30 seconds after scalding the birds were defeathered completely. They were then washed and re-weighed to obtain plucked weights. They were decapitated, eviscerated and weighed again to obtain the eviscerated

weights.

All primecut-parts and organs were separated and weighed to obtain their fresh weights which were then recorded. All carcass except the dressed and eviscerated weight were exposed in g/kg of the dressed weight.

Experimental design and statistical analysis

The experiment was carried out using the completely randomised design. All data collected were

subjected to one-way analysis of variance using SPSS 17 package. Significant means were separated using Duncan multiple range test of the same software.

Results and discussion

The effect of turmeric as feed additives on haematological parameters of broiler chicken is presented in Table 3. The values of red blood cell and monocyte increased with increase in the turmeric dietary supplementation. There were significant ($P<0.05$) increase in birds on diets 2 and 3 than birds on control diet. The values recorded for PCV, Hb, MCV, MCH, MCHC, granulocyte, lymphocyte and WBC of birds were not significantly ($P>0.05$) affected by turmeric supplementation. Haematological parameters are good indicators of the physiological status of the animal (Esonu *et al.*, 2006). All values obtained for packed cell value (PCV), red blood cell (RBC), haemoglobin (Hb) studied falls within the normal ranges for broiler as reported by the Merck veterinary manual (2015). There were increased in PCV, Hb and RBC which are comparable with the findings of Vivian *et al.* (2015) and Ajit *et al.* (2014) who opined that the increased in the vital constituents like PCV, Hb and RBC in birds fed with herbal ingredients like turmeric, garlic and ginger is an indication of improving oxygen carrying capacity of the cells which translated to a better

availability of nutrients for utilization of the birds consequently affecting their well being with an active immune system. Thus, this finding strongly agree with Gowda *et al.* (2008) who reported that better principle of medicinal plants possess a strong influence on haematological traits depending on their nutritional status. The increase in monocyte values may be attributed to endogenous corticosteroid which may be due to stress. The antioxidant parameters catalase (CAT), glutathione peroxidase (GPx), superoxidase dismutase (SOD), and total antioxidant activity (TAA) in birds fed turmeric as feed supplement is presented in Table 4. The activity of catalase, glutathione, superoxidase dismutase and total antioxidant activity in birds increased significantly ($P<0.05$) as the dietary supplementation of turmeric increased. The highest values of CAT, GPx, SOD and TAA were recorded for birds on diet 3 while the lowest values were recorded for birds on control diet. The demand for use of natural antioxidant in animal feed has been an increase due to its health benefit against oxidative stress and several diseases. Tumeric has been identified as excellent poultry antioxidants with active ingredients of turmeric (curcumin) which have strong antioxidant effects including neutralization of superoxide, hydrogen peroxide either by scavenging radicals or by increasing the production of catalase, superoxide dismutase (SOD) and glutathione peroxidase (Yarru *et al.*, 2009). Tumeric has been shown to increase the SOD, GPx, CAT and TAA. The beneficial antioxidant effect of turmeric has been due to the presence of tetra-hydrocurcumin, cinnamic acid (Khan *et al.*, 2012). The high total antioxidant activity could be due to the activity of one or more component antioxidant and serves to protect cells from excess production of reactive oxygen species.

Table 3: Haematological indices of broiler chickens fed experimental diets

Parameters	Turmeric supplementation			± SEM	P-value
	1 (0%)	2 (0.5%)	3 (1 %)		
PCV (%)	26.33	26.58	26.82	0.59	0.48
RBC ($\times 10^6 \text{mm}^3$)	15.70 ^b	16.54 ^a	16.68 ^a	0.41	0.05
HB (g/100ml)	8.77	8.80	8.82	0.21	0.37
MCV (fl)	16.89	16.37	16.07	0.54	0.85
MCH (pg)	5.62	5.67	5.65	0.16	0.99
MCHC (g/dl)	33.33	33.33	33.17	0.01	0.01
Granulocyte (%)	24.00	23.00	20.67	1.45	0.69
Lymphocyte (%)	77.00	74.00	76.33	2.78	0.92
Monocyte (%)	2.66 ^b	5.33 ^a	5.40 ^a	0.57	0.07
WBC (mm^3)	2.43	2.53	2.30	0.14	0.84

^{a,b}: Means with different superscript on the same row differ significantly ($p < 0.05$). PCV= Packed cell value; Rbc= Red blood cells; Hb=Haemoglobin concentration; MCV= Mean corpuscular volume; MCHC= Mean cell haemoglobin concentration, MCH =Mean cell haemoglobin; WBC=White blood cell.

Table 4: Effect of turmeric on antioxidant parameters of broiler chicken fed experimental diets

Parameters	Turmeric supplementation			± SEM	P-value
	1 (0%)	2 (0.5%)	3 (1 %)		
GPx (μmol)	12.59 ^c	19.76 ^b	29.57 ^a	2.19	0.01
SOD (%)	1.08 ^c	1.52 ^b	2.26 ^a	0.16	0.01
CAT (mg/g)	8.06 ^b	9.79 ^{a,b}	11.60 ^a	0.53	0.01
TAA	0.91 ^c	1.85 ^b	2.48 ^a	0.22	0.01

^{a,b}: Means with different superscript on the same row differ significantly ($P < 0.05$), GPx : glutathione peroxidase; SOD: superoxide dismutase; CAT: catalase.

The effect of turmeric (*Curcuma longa*) as feed supplement on carcass analysis and internal organs of broiler chicken is presented in Table 5. All the carcass traits were affected ($P < 0.05$) by turmeric supplementation. The liveweights, dressed weights and eviscerated weights of the broiler chickens decrease ($P < 0.05$) with increase in the turmeric supplementation level from 0% to 1.0%. The weights of liver, gizzard (full), gizzard (empty), proventriculus and spleen of birds on 1.0% supplementation of turmeric were significantly ($P < 0.05$) higher than birds on basal diet and 0.5% turmeric supplemented diet. However, the weights of heart, kidney, lungs and pancreas of birds increased with increase in the turmeric supplementation levels but the internal organs were not significantly ($P > 0.05$) affected. It was observed that the values of carcass characteristics of the broiler chicken in this study reduced with an

increase in the inclusion level of turmeric. This may be linked to the activities of the phytochemicals in the diet which may be too high to exert a positive effect on the growth and carcass traits of the broiler chickens. The negative effects of turmeric supplementation on the carcass trait being recorded in this study disagree with the earlier report of Daneshyar *et al.* (2012) who recorded insignificant ($P > 0.05$) effect of turmeric supplementations (0%, 2.5%, 5.0% and 7.5%) on broiler chickens. This variation may be as a result of the differences in the methods of turmeric processing and environmental factors. The organ-body weight ratio is a marker of cell constriction and inflammation. (Ayodele *et al.*, 2016). The stability of the relative weights of the heart, kidney, lungs and pancreas in this study may be as a result of level of supplementation of turmeric in the diet which did not affect or alter the normal anatomical and physiological functions of these organs.

Table 5: Effect of turmeric on carcass traits and relative weight of internal organs of broiler chicken fed experimental diets

Parameters	Turmeric supplementation			± SEM	P-value
	1 (0%)	2 (0.5%)	3 (1 %)		
Live weight (g)	2491.25 ^a	2156.00 ^b	1924.75 ^c	71.28	0.00
Dressed weight (g)	2206.50 ^a	1983.25 ^b	1733.50 ^c	62.48	0.00
EW (g)	1897.25 ^a	1754.00 ^b	1526.00 ^c	47.54	0.00
Heart (%)	0.44	0.43	0.45	0.01	0.28
Kidney (%)	0.57	0.59	0.57	0.01	0.78
Liver (%)	1.84 ^b	1.89 ^b	2.04 ^a	0.03	0.01
Lungs (%)	0.55	0.58	0.59	0.02	0.59
Pancrease (%)	0.28	0.31	0.31	0.01	0.29
Gizzard (%)	2.74 ^b	2.86 ^b	3.15 ^a	0.06	0.00
Proventriculus (%)	0.33 ^b	0.35 ^{ab}	0.38 ^a	0.01	0.02
Spleen (%)	0.21 ^b	0.22 ^b	0.26 ^a	0.01	0.01

^{a,b} Means with different superscript on the same row differ significantly ($p < 0.05$).

EW- Eviscerated weight. The weight of internal organs are expressed in percentage dressed weight.

Conclusion

The study indicated that the use of turmeric in the diets of broiler chicken does not have any adverse effect on the health status. It increases the antioxidant enzymes and protect cells from excess production of reactive oxygen. It was also observed that the values of carcass characteristics of the broiler chicken reduced with the increase in the inclusion level of turmeric. In conclusion turmeric could be safely used as a phyto-additive for broiler chicken.

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