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EFFECTS OF TURMERIC OIL AS A DIETARY SUPPLEMENTS ON THE HAEMATOLOGY AND SERUM BIOCHEMICAL INDICES OF BROILER CHICKENS

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Abstract

The objective of this current study was to examine the effects of turmeric oil as a dietary supplement on some hematological and serum biochemical indices of broiler chicken. A total of two hundred 1-day-old broiler chicks (Ross 308 strain) were randomly distributed to five treatments of 4 replicates consisting of 10 birds each in a completely randomized design. Birds in treatment 1 (T1) were fed basal diet + 0 % turmeric oil (TOL), T2, T3, T4 and T5 were fed basal diet supplemented with TOL at 0.1 %, 0.2 %, 0.3 % and 0.4 % respectively. Basal diet was formulated to meet the nutritional requirements of birds according to NRC (1994). Clean feed and water were also provided ad libitum throughout the experiment which lasted for 56 days. Results obtained showed that all the hematological parameters (Pack cell volume, hemoglobin, red blood cell, mean corpuscular volume, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration, white blood cells and its differentials) were significantly ($P<0.05$) different among the treatments. Serum biochemical parameters (Total protein, albumin, globulin, cholesterol, alanine transaminase, aspartate transaminase) were influenced by the dietary supplementation of TOL ($P<0.05$). Cholesterol level decreases as the dietary supplementation of TOL increases ($P<0.05$). However, all values were within the normal physiological range for birds. It was concluded that TOL contains several bioactive chemicals which confers it the ability to perform multiple biological functions.

Keywords: Broiler chickens, turmeric oil, hematology, serum biochemistry.

INTRODUCTION

The increasing pressure of reducing the use of antibiotics as antimicrobial growth promoters for animals due to harmful residual toxicity effects of drugs observed in the food chain calls for alternative solutions to sustain the efficiency of current livestock production (Mahima et al., 2012; Oluwafemi et al., 2020). Among the potential alternatives is essential oil which has been found to be loaded with several bioactive chemicals, less toxic and free from residues (Henhxiao et al., 2018; Alagbe 2021). According to Franz and Novak (2009), essential oils are complex mixtures of volatile compounds produced by living organisms and isolated by physical means only (pressing and distillation) from the whole plant or plant part of known taxonomic origin. The composition of essential oil in plants depends on plant species and its age, harvesting periods, methods of processing, geographical location and soil types (Bouhaddouda et al., 2016; Oke et al., 2009; Hammer and Carson, 2011).

Scientific reports showed that essential oils (EOs) can perform several biological activities such as antibacterial, anti-inflammatory, cytotoxic, hypolipidemic, hepatoprotective, antiviral, miracicidal and antioxidant (Michiels et al., 2009; Kim et al., 1995; Kommera et al., 2011; Giannenas et al., 2013). EOs are relatively cheap, effective, safe and perceived as growth promoters in poultry diets (Zhang et al., 2014), improve meat quality (Wenk, 2003, Alagbe and Akintayo, 2020), alteration of lymphocyte distribution in the gut (Purchiaroni et al., 2013; Oluwafemi et al., 2020), potentiate the immune response (Li et al., 2012; Cho et al., 2011; Halas et al., 2011) and high antimicrobial activity against pathogenic bacteria (Franz et al., 2010; Olafadehan et al., 2020).

In view of these abundant potentials in EOs, this study was designed to evaluate the effect of dietary supplementation of turmeric oil on the hematology and serum biochemical indices of broiler chickens. This experiment will further help to bridge the gap between food safety and livestock production

MATERIALS AND METHODS

Experimental Site

The experiment was carried out at the University of Abuja Teaching and Research Farm, Animal Science Section, Main Campus, along Airport Road, Gwagwalada, Abuja, Nigeria.

Extraction of turmeric oil (TOL)

Fresh turmeric rhizome was purchased from an open market in Gwagwalada, Abuja. The outer layer of the rhizome was peeled using a kitchen knife, it was thereafter separated and sun-dried for one week. The dried rhizome was granulated into coarse particles using a laboratory grinder. A 100 g of grinded rhizome placed onto a thimble and the thimble was put into the sohxlet extractor. N-hexane solvent was poured into three-neck- round bottom flask that is joined with the extractor and flask along with the condenser on the top to avoid any solvent losses. The whole assembly was then placed on the temperature controller heater to provide the required

temperature. The temperature was measured by a thermometer that was inserted in one of the necks of the round bottom flask. After certain interval of the time the experiment was stopped and the trapped oil in the solvent was separated. The mixture of solvent and oil was separated using rotary evaporator under vacuum at temperature of 65oC, the oil obtained after evaporation was weighed.

Pre-experimental operations

Prior to the commencement of the experiment, pens were properly disinfected, drinkers and feeder were properly washed, electrical fittings were fixed and foot dip was provided to ensure proper biosecurity.

Management of experimental animals

200- 1- day old (Ross 308) broiler chicks with mixed sex were used for the experiment. The birds were purchased from a commercial hatchery in Ibadan, Nigeria. It was weighed on arrival to obtain their initial body weight and thereafter weekly. A deep litter housing system was used and birds were divided to five treatments with four replicates consisting of 10 birds in a completely randomized design. Electric bulbs (200 Watts) were used as heat source, complimented with charcoal pot to maintain temperature, wood shavings served as the litter material. Vaccination was done according to the prevailing disease condition in the environment and all other management practices were strictly adhered to throughout the experiment which lasted for 56 days

Ration formulation

The basal diet was formulated to meet the nutrient requirements of birds according to NRC (1994) as presented in Table 1.

Treatment 1: Basal diet + 0 % TOL

Treatment 2: Basal diet + 0.1 % TOL

Treatment 3: Basal diet + 0.2 % TOL

Treatment 4: Basal diet + 0.3 % TOL

Treatment 5: Basal diet + 0.4 % TOL

DATA COLLECTED

Chemical analysis

Proximate compositions of experiment diet were determined by using official method of analysis by AOAC (2000).

Hematological and serum biochemical analysis

Blood samples were collected very early in the morning from the wing vein from three (3) randomly selected birds per replicate into a 5 ml sterile syringe using 23-gauge needles and transferred into an ethylene diamine tetra acetic acid (EDTA) bottle. Hematological parameters: pack cell volume (PCV), red blood cell (RBC), hemoglobin (Hb), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), mean corpuscular volume (MCV), white blood cell (WBC) and its differentials were analyzed using an automated machine (Sysmex, Model KU-30 HG, India).

Serum analysis was carried out using bottles free from EDTA, blood was analyzed for total protein, albumin, globulin, cholesterol, alanine transaminase (ALT) and aspartate transaminase (AST) were assayed using diagnostic kit manufactured by Merck India Ltd (Model PS-09R)

Statistical analysis

All data were subjected to one -way analysis of variance (ANOVA) using SPSS (23.0) and significant means were separated using Duncan multiple range tests (Duncan, 1955). Significant was declared if $P \leq 0.05$.

RESULTS AND DISCUSSIONS

Table 1: Percentage composition of experimental diet

Ingredients	Starter mash (0-4 weeks)	Finisher mash (5-8 weeks)
Maize	52.00	60.00
Soya meal	38.60	30.10
Groundnut cake	3.00	4.00
Fish meal (72%)	1.00	-
Bone meal	3.00	3.00
Limestone	1.50	2.00
Lysine	0.15	0.15
Methionine	0.20	0.20
Toxin binder	0.01	0.01
*Premix	0.25	0.25
Salt	0.30	0.30
Total	100.00	100.00

Determined analysis (% DM)		
Crude protein	23.23	20.91
Crude fibre	3.14	4.00
Ether extract	5.01	4.74
Calcium	1.28	1.31
Phosphorus	0.63	0.68
Energy	2901.9	3100.7

* Premix supplied per kg diet :- Vit A, 10,000 I.U; Vit E, 5mg; Vit D3, 3000I.U, Vit K, 3mg; Vit B2, 5.5mg; Niacin, 25mg ; Vit B12, 16mg ; Choline chloride, 120mg ; Mn, 5.2mg ; Zn, 25mg ; Cu, 2.6g ; Folic acid, 2mg ; Fe, 5g ; Pantothenic acid, 10mg ; Biotin, 30.5g ; Antioxidant, 56mg.

Hematological parameters of broiler chicken fed diet supplemented with turmeric oil

Table 2 reveals the hematological parameters of broiler chicken fed turmeric oil (TOL). PCV, Hb, RBC, MCV, MCH and MCHC ranged between 30.10 – 38.96 %, 9.88 – 13.80 g/dl, 2.01 – 3.95 (10^6/µL), 101.2 – 149.8 fl, 32.77 – 49.15 pg and 30.49 – 35.53 % respectively. Highest value was recorded in T4 and T5, intermediate in T2, T3 and lowest in T1 (P<0.05). The PCV, Hb, RBC and WBC values increased as the level of turmeric oil increases in the diets of the animals (P<0.05). This result is in agreement with the findings of Gerardo *et al.* (2017) who noted that administration of Mexican oregano oil at 0.4g/kg showed positive haematological activities in broiler chicks. Similar recommendation was made by Alagbe and Grace (2019); Hippenstiel *et al.* (2014); Cubuk *et al*. (2006) who reported a significant difference (P<0.05) in broilers fed herbal essential oil as a Phyto additive. This effect could be attributed to the presence of bioactive chemicals or secondary metabolites in turmeric oil. However, all the values of the haematological parameters fall within the ranges for broilers as reported by Talebi *et al* (2005); Ibrahim Albokhadaim (2012). Hematological studies have been found useful for disease prognosis and for therapeutic and stress monitoring (Braun *et al*, 2010) but can vary due to age, gender, environment, infection and poisoning (Khan and Zafar, 2005; Abdi-Hachesoo *et al*., 2011). Red blood cell is involved in the transport of oxygen and carbon dioxide in the body (Isaac *et al*, 2013). This is a clear indication that birds in T5 will have a have enough oxygen especially in situation of oxygen starvation. Nse Abasi *et al*. (2014); Subhadarsini and Silpa, 2020 reported that hematocrit or PCV is an index of toxicity; lower value could be a sign of anemia.

WBC, leucocytes, monocytes, heterophils, basophils and eosinophils values ranged between 19.89 – 30.22 (10^3/µL), 14.18 – 18.22 %, 0.99 – 1.44 %, 5.09 – 7.58 %, 1.04 – 2.90 % and 1.03 – 1.74 % respectively. Significant differences (P<0.05) were observed among the treatments, WBC helps to fight against infections and provide resistance against diseases (Soetan *et al*, 2013). This is an indication that birds in T4 and T5 have high resistance to infections which amounts to low mortality and healthy stocks. Basophils and eosinophils play a role in regulating allergic and inflammatory processes and host defense responses against parasitic infections like helminthiasis and ectoparasitic infestation (Butterworth, 1999; Alagbe *et al*., 2020).

Table 2: Haematological parameters of broiler chicken fed diet supplemented with turmeric oil

Parameters	T1	T2	T3	T4	T5	SEM
PCV (%)	30.10^{c}	35.43^{b}	35.56^{b}	38.71^{a}	38.96^{a}	0.03
Hb (g/dl)	9.88^{c}	11.01^{c}	12.06^{b}	13.71^{b}	13.80^{a}	0.09
RBC ×10^6/µL	2.01^{c}	3.61^{b}	3.68^{b}	3.71^{a}	3.95^{a}	0.10
MCV (fl)	149.8^{a}	103.7^{c}	107.5^{b}	107.0^{b}	101.2^{c}	0.18
MCH (pg)	49.15^{a}	30.50^{c}	32.77^{c}	36.95^{b}	34.94^{b}	2.33
MCHC (%)	32.82^{c}	29.41^{b}	30.49^{b}	35.53^{a}	33.51^{a}	3.09
WBC ×10^3/µL	19.89^{c}	22.56^{b}	25.35^{b}	28.05^{a}	30.22^{a}	1.25
Lymphocytes %	14.18^{c}	15.90^{c}	16.56^{b}	17.08^{a}	18.22^{a}	0.21
Monocytes %	0.99^{c}	1.44^{b}	1.33^{b}	1.35^{b}	1.38^{a}	0.07
Heterophils %	5.09^{c}	6.06^{b}	6.17^{c}	6.45^{b}	7.58^{a}	0.12
Basophils %	1.04^{c}	2.10^{c}	2.17^{b}	2.23^{b}	2.90^{a}	0.09
Eosinophils %	1.03^{c}	1.41^{b}	1.51^{a}	1.58^{a}	1.74^{a}	0.01

^{abc} means different superscript along rows differs significantly at P<0.05

PCV: pack cell volume; Hb: hemoglobin; MCV: mean corpuscular volume; MCH: mean corpuscular hemoglobin; MCHC: mean corpuscular hemoglobin concentration.

Serum biochemical indices of broiler chicks fed diets supplemented with turmeric oil (TOL)

Table 3 reveals the serum biochemical indices of broiler chicks fed diets supplemented with TOL. The total protein, albumin, globulin, cholesterol, ALT and AST values ranged between 3.45 – 4.95 g/dl, 1.83 – 2.95 g/dl, 1.62 – 2.00 g/dl, 35.1 – 78.1 mg/l, 48.10 – 83.19 iu/L and 85.10 – 103.2 iu/L respectively. All the values were significantly affected (P<0.05) by the dietary supplementation of TOL. The total protein in the serum of animals are influenced by protein quality in the diet, this showed that the protein levels in the diet was enough to support normal protein reserves across the treatments (Olabanji *et al*., 2007; Alagbe, 2020; Adewale *et al.*, 2021). However, the values obtained in this study were within the normal ranges for broilers reported by Livingstone *et al*. (2020); Obiakaonu *et al*. (2011). Cholesterol level decreased as the level of turmeric increased in the diet of the animal, this is a clear indication that TOL could perform hypolipidemic activity, thus preventing cardiovascular infection (Alagbe, 2021). Alanine transaminase (ALT) and aspartate transaminase were depressed as the level of TOL increased indicating no toxicity (Musa *et al*., 2020; Oluwafemi *et al*., 2020).

Table 3: Serum biochemical indices of broiler chicks fed diets supplemented with TOL

Parameters	T1	T2	T3	T4	T5	SEM
Total protein (g/dl)	3.45^{b}	4.61^{a}	4.70^{a}	4.65^{a}	4.95^{a}	0.98
Albumin (g/dl)	1.83^{b}	2.87^{a}	2.70^{a}	2.85^{a}	2.95^{a}	0.02
Globulin (g/dl)	1.62^{b}	1.74^{b}	2.00^{a}	2.00^{a}	2.00^{a}	0.31
Cholesterol (mg/l)	78.1^{a}	48.3^{b}	45.1^{b}	38.3^{b}	35.1^{b}	2.33
ALT (iu/L)	83.19^{a}	50.61^{b}	50.10^{b}	49.41^{b}	48.10^{b}	4.12
AST (iu/L)	103.2^{a}	97.40^{b}	90.31^{b}	88.17^{c}	85.10^{c}	2.78

^{abc} means different superscript along rows differs significantly at P<0.05

ALT: Alanine transaminase; AST: Aspartate transaminase

CONCLUSION

It was concluded that turmeric oil has a great potential and can be generally considered natural, less toxic due to the presence of various secondary metabolites and can be supplemented in the diet of broilers up to 0.4 % without causing any deleterious effect on the health and general performance of broiler chicks.

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