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Effects Of Turmeric Oil As A Dietary Supplements on The Growth Performance and Carcass Characteristics of Broiler Chickens

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ABSTRACT: An experiment was carried out to study the effect of turmeric oil as a dietary supplement on the growth performance, carcass characteristics and blood profile of broiler chickens. Two hundred one-day-old commercial broiler chicks (Arbo acre) were reared in a deep litter poultry house and divided into five groups of forty (40) birds each. The groups were assigned to five dietary treatments each of the treatments had four replicates consisting of 10 birds each in a Completely Randomized Design. Basal diet was formulated to meet the nutritional requirement of birds according to NRC (1994). Treatment 1 (T1) contained basal diet with 0 % turmeric oil (TOL), while T2, T3, T4 and T5 were fed diet supplemented with TOL at 0.1 %, 0.2 %, 0.3 % and 0.4 % respectively. The experiment lasted for 8 weeks during and the data obtained were used to evaluate the average daily weight gain (ADWG), average total feed intake (AFTI), mortality and relative organ /carcass weights. Significant differences (P<0.05) were recorded in the ADWG, ADFI and feed conversion ratio among the treatments. The relative weights of the organs and dressing percentage were significantly (P<0.05) influenced across the treatments. It was concluded that turmeric oil contains several bioactive chemicals which confers it the ability to perform multiple biological functions and its supplementation at 0.4 % does not have any deleterious effect on the general performance of the animal.

KEYWORDS: Arbo acre, broiler chicks, turmeric oil, performance, organs.

Introduction

Antibiotics such as neomycin, oxytetracycline, salinomycin, deoxycycline and collistin have been used as growth stimulants to prevent economic losses resulting from diseases, stresses, and other adverse environmental conditions (Xiaoli *et al*., 2013).The concern about development of antibiotic resistance, residue accumulation in animal products (carcass), alteration (imbalance) of natural gut micro flora of the animal (Santi and Kim, 2017; Alagbe *et al*., 2018) and ban of antibiotics as growth promoter have initiated the surge for exploring alternatives to antibiotics with similar antimicrobial and growth promoting effects. Such feed additive is expected not to induce resistance to bacteria and have no potential side effects to animals. Among the potential alternative is the use of plant extracts which are generally regarded as safe, effective and relatively cheap (Oluwafemi *et al*., 2020).

Turmeric (*Curcuma longa*) is a rhizomatous herbaceous perennial plant of the ginger family Zingiberaceae (Chan *et al*., 2009). This medicinal plant possesses rhizomes and underground root-like stems (Araujo and Leon, 2001) that had been originally used as food additives in curries to improve the storage condition, appearance, flavour, palatability and preservation of food (Prakash *et al*., 2005).

Turmeric contains a wide variety of phytochemicals including curcumin,

demethoxycurcumin, bisdemethoxycurmin zingiberene, curcumenol, curcumol, eugenol, tetrahydrocurcumin, turmerin, turmerones, and turmeronols (Chattopadhyay *et al.*, 2004). The main yellow bioactive substances isolated from the rhizomes of Turmeric are curcumin, demethoxycurcumin and bisdemethoxycurcumin which are present to the extent of 2-5% of the total spice in turmeric powder (Nunes, 1989; Alagbe *et al*., 2017). The rhizome is rich in curcumnoid pigments (6%) and essential oils (5%). It also contains 69.43% carbohydrate, 6.30% protein, 3.50% mineral, 5.0% starch, 3.0% crude fibre, moisture 6.0%, 4.5% volatile oil, 3.5% fixed oil and 3.1% curcumin (Olojede *et al*., 2005).

Scientific studies have shown that essential oils from garlic (*Allium sativum*), onion (*Alliumcepa*) and mint (*Mentha spp*.) are found to be effective against gastrointestinal parasites and are also capable of enhancing the palatability of feed (Williams, 2007; Alagbe *et al*., 2018). They also enhance the growth of birds and enhance the production of beneficial bacteria in the gut of animals (Williams, 2007). However, there is dearth information on the use of turmeric oil on the performance of birds.

In view of the tremendous potential in the plant and to promote food safety, this experiment was designed to determine the effects of turmeric oil as a dietary supplements on the growth performance and carcass characteristics of broiler chickens.

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.

Collection and processing of turmeric oil

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 65^{o}**C**, the oil obtained after evaporation was weighed.

Source of the experimental birds, experimental diets and experimental design

A total number of 200 one- day -old Arbo acre broiler chicks were purchased from CHI Hatchery, Oluyole Extension, Ring Road, Ibadan, Oyo State in Nigeria. The birds were randomly allocated to five treatments of turmeric oil (TOL) in a completely randomized experimental design. Each of the treatments had four replicates with ten birds per replicate. The birds were acclimatized for one week before being assigned to experimental treatments. Treatment 1 was the Control of which contained 0 % turmeric oil; Treatment 2, 3, 4 and 5 were given 0.1, 0.2, 0.3 and 0.4 % (TOL) respectively.

Data obtained

Weight gain (g) = final weight (FW) – initial weight (IW)

Feed intake (g) = Amount of feed consumed – remaining feed

Average daily gain (ADG) = Final body weight – Initial body weight

Total days of the experiment

Feed conversion ratio (FCR) = feed intake (g)/ weight gain (g)

% mortality = number of dead birds/total number of birds × 100

Carcass evaluation

At the end of the experiment (56 days), two (2) birds were randomly selected per replicate for carcass evaluation; the birds were feed starved overnight, weighed, slaughtered and manually de-feathered. Weights of internal organs (liver, lungs, spleen, gizzard, heart and intestine) were recorded and the parameters below were estimated:

Dressing % = dress weight/live weight × 100

% organ/ primal cut parts = weight of primal cut or organ/live weight × 100

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

Chemical composition of experimental diets

Table 1 reveals the chemical composition of experimental diet. The crude protein ranged between 20.91-23.23 % for broiler starter and finisher diets while those of metabolizable energy are ranged between 2901.9 - 3100.7 MEkcal/kg. However, the diet was formulated to meet the nutritional requirement of birds according to NRC (1994).

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
Calculated 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.

Phytochemical analysis of turmeric oil

Phytochemical analysis of turmeric oil is presented in Table 2. The phytochemical components are curcumin, flavonoids, phenols, tannin and oxalates at 16.22 %, 6.89 %, 10.41 %, 3.27 % and 0.97 % respectively.

Table 2: Phytochemical analysis of turmeric oil

Parameters	% Composition	*Safe recommended rate
Curcumin	16.22	-
Flavonoids	6.89	31.22
Phenols	10.41	20.91
Tannins	3.27	8.82
Oxalates	0.97	1.30

*Alagbe and Oluwafemi (2019).

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Growth performance of broiler chicks fed diets supplemented with different level of turmeric oil

Table 3 revealed the growth performance of broiler chicks fed diet supplemented with different levels of turmeric oil. The final body weight ranges between 2100.4 – 1870.5 g while those of total feed intake are 3640.1, 3604.5, 3600.5, 3569.5 and 3533.8 (g) for treatment 1, 2, 3, 4 and 5 respectively. The feed conversion values obtained are 1.99, 1.90, 1.84, 1.82 and 1.72 for treatment 1, 2, 3, 4 and 5 respectively. The highest mortality of 4.22 % was recorded in T1 while the lowest was recorded in T2 with 1. 22%, none was recorded in T3, T4 and T5. Significant differences (P<0.05) were observed in the final feed intake, final weight gain, feed conversion ratio and mortality.

Table 3: Growth performances of broiler chicks fed diets supplemented with turmeric oil

Parameters	T1	T2	T3	T4	T5	SEM
IBW (g)	43.70	43.74	43.72	43.70	43.00	0.04
FBW (g)	1870.5^{c}	1945.0^{b}	2001.3^{a}	2009.6^{a}	2100.4^{a}	47.72
BWG (g)	1826.8^{c}	1901.3^{b}	1957.6^{b}	1965.9^{b}	2057.4^{a}	40.91
ADWG (g)	32.62^{b}	33.95^{b}	34.96^{a}	35.11^{a}	36.74^{a}	3.11
TFI (g)	3640.1	3604.5	3600.5	3569.5	3533.8	11.5
ADFI (g)	65.00	64.37	64.29	63.74	63.10	0.08
FCR	1.99^{a}	1.90^{a}	1.84^{b}	1.82^{b}	1.72^{c}	0.17
Mortality	1.22	-				0.01

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

IBW: Initial body weight; ADWG: Average daily weight gain; TFI: Total feed intake; ADFI: Average daily feed intake; FCR: feed conversion ratio.

Carcass characteristics of broiler chicks fed different diets supplemented with turmeric oil

Carcass characteristics of broiler chicks fed different diets supplemented with turmeric oil is presented in Table 4. The dressing percentage ranges between 80.01 – 75.26 % while the values obtained for the wings are 8.78, 10.22, 11.56, 14.71 and 15.79 (%) for treatments 1, 2, 3, 4 and 5 respectively. The values obtained for back are 9.61, 12.31, 13.21, 13.77 and 14.01 (%) for treatments 1, 2, 3, 4 and 5 respectively while those of thigh are 11.44, 17.21, 20.03, 22.45 and 24.81 (%) for treatments 1, 2, 3, 4 and 5. All the parameters measured were significantly (P<0.05) different among the treatments.

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Table 4: Relative weight of internal organs of broiler chicks fed different levels of turmeric oil

Parameters	T1	T2	T3	T4	T5	SEM
FW (g)	1819.2^{b}	1987.8^{b}	2000.7^{a}	2100.7^{a}	2188.3^{a}	12.5
DW (g)	1369.2^{c}	1532.0^{b}	1544.7^{b}	1640.7^{a}	1728.3^{a}	29.10
D %	75.26^{b}	77.10^{b}	77.21^{b}	78.10^{b}	80.01^{a}	6.35
Wing (%)	8.78^{c}	10.22^{b}	11.56^{b}	14.71^{a}	15.79^{a}	2.67
Back (%)	9.61^{c}	12.31^{b}	13.21^{b}	13.77^{b}	14.01^{a}	3.09
Thigh (%)	11.44^{b}	17.21^{b}	20.03^{a}	22.45^{a}	24.81^{a}	1.88
Heart (%)	1.51^{b}	3.47^{a}	3.44^{a}	3.57^{a}	3.50^{a}	0.34
Liver (%)	0.92^{c}	1.26^{a}	1.27^{a}	1.19^{b}	1.49^{b}	0.22
Pancreas (%)	1.26^{b}	2.27^{a}	2.22^{b}	2.24^{b}	2.26^{b}	0.18
Gizzard (%)	2.17^{b}	3.13^{a}	3.09^{a}	3.00^{a}	3.10^{a}	0.27
Proventriculus(%)	1.27^{c}	1.44^{b}	1.51^{a}	1.52^{a}	1.49^{b}	0.29

FW: final weight; DW: dressing weight; D %: dressing percentage; SEM: standard error of mean
^{abc} means different superscript along rows differs significantly at $P<0.05$

Discussion

Phytochemicals are biologically active compounds found in plants in small amounts which are not established nutrients but, nevertheless, contribute significantly to protection against degenerative disease (Omale and Okafor, 2008). The antimicrobial mechanisms include different activities, such as membrane disruption and metal chelation by phenolics and flavonoids, and effect on genetic material by coumarin and alkaloids that are thought to inhibit growth of microorganisms (Cowan, 2009). However, all the phytochemical components observed in this experiment were within the permissible range reported by Alagbe and Oluwafemi (2019).

The average daily weight gains of the birds were highest in T4 and T5, intermediate in T2, T3 and lowest in T1 ($P<0.05$). This result could be due to the presence of secondary metabolites which are capable of favorably affecting gut functions by stimulating digestive secretions e.g. bile and mucus, and enhanced enzyme activity (Platel, 2004; Manzanilla *et al*., 2004). Highest mortality was recorded in T1 (1.22 %), none were recorded in the other treatment ($P<0.05$). According to Burt (2004), essential oils (EOs) are effective against Gram-positive and Gram-negative pathogens because they have an outer membrane surrounding the cell wall which limits the intrusion of hydrophobic compounds through its lipo-polysaccharide structures (Vaara, 1992). Many EOs stimulate growth of beneficial microbes and limit number of pathogenic bacteria in poultry (Wenk, 2000). Best FCR were recorded in birds fed T3 (0.3 %) and T4 (0.4 %) turmeric oil, this result is agreement with the findings of Singh *et al*. (2021) when turmeric oil was fed to laying birds.

Dress weights and relative organ weights were significantly different ($P<$ 0.05) among the

treatments. This shows that turmeric oil is capable of enhancing the palatability of feed which further translates to a higher dress weights. No noticeable inflammations were observed in the organs, which is an indication that anti-nutrients in the oil were below lethal levels. This result agrees with the findings of Oluwafemi *et al*. (2020); Jamoz *et al*. (2003) ; Lee *et al*. (2003) when essential oils were fed to female broiler chickens. According to Shittu *et al*. (2020) organ weight are influenced by age of birds, sex, breed as well as presence of toxic substance in feed (nutrition).

Conclusion

Turmeric essential oil contains numerous biologically active compounds such as nutrients and phytochemicals which have physiological actions on the human body and these inherent ingredients can be used to treat various ailments. It enhances effective, cheap and enhances food safety. It could therefore be included up to 0.4 % in the diets of broilers without causing any deleterious effect on the health of the animals and it can also be used to replace synthetic antibiotic as growth promoter.

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Conflicts of Interest

The authors declare no conflict of interest.

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