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The effect of Turmeric (Curcuma longa) Powder on Serum Biochemical parameters of Broilers

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ABSTRACT

Poultry products (meat and egg) are some of the common/cheap sources of protein in Africa but the issue of Antimicrobial Resistance due to the inappropriate use of antibiotics in birds is threatening the poultry production subsector and causing serious public health concerns. As such, there is a need to find alternatives (phytogenic) to antibiotics that can improve animal health and reduce antibiotic use by farmers. The study aimed to determine the effect of the graded level of turmeric (*Curcuma longa*) on the liver enzymes of broilers. The study was conducted with 120 one-day-old broiler chicks (Cobb 500) fed turmeric (*Curcuma longa*) powder as supplement were used for the experiment (7 weeks). The birds were reared on deep litter system and were randomly allotted to four (4) equal dietary groups (T_C, T_1, T_2, and T_3) fed turmeric powder levels of 0, 50, 100, and 150 g/25kg feed for seven (7) weeks. Blood samples were collected at the end of the experiment for laboratory (serum biochemical) analysis; each dietary group contained three replicates with 10 birds each. The results showed that the concentration of total protein (TP), aspartate aminotransferase (AST), and alanine aminotransferase (ALT) were not affected statistically ($P > 0.05$) in groups treated with turmeric powder when compared with the control group. In contrast, the activity of alkaline phosphatase (ALP) was affected statistically ($P < 0.05$) across the group. The study concludes that turmeric positively affected some serum biochemical parameters; although further research is required to elucidate its effect at different inclusion levels on other biochemical parameters.

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INTRODUCTION

The increasing cost of antibiotics and their residual effects has necessitated the need to research natural plant base products that could serve as a cheap and effective alternative compared to commercial (synthetic) antibiotics. Using plants with phytogenic properties as additives in livestock nutrition is becoming popular due to its resultant effect on animals such as improved productivity, reproduction, and quality of animal products through improved health **(Olayemi *et al.*, 2016).**

Poultry production has a very crucial role in the economic development of any country **(Kafi *et al.*, 2017).** Agriculture accounts for about 35.2% of Nigeria's GDP; therefore, it plays a relevant role in reducing poverty and enhancing food security **(Heise *et al.*, 2015)**. With the gradual rise in human population, increasing demand for poultry meat as a source of protein is expected in the nearest future; as such, poultry health is a significant issue. Due to extremely crowded poultry pens, poor hygiene, and other management problems, antibiotics and other therapeutic chemical agents are used extensively to maintain health and improve poultry growth **(Guil-Guerrero *et al.*, 2017).**

These chemical agents help to overcome the issues of morbidity and/or mortality with poultry production; however, they can cause adverse public health issues by developing drug-resistant microflora **(Mahesh and Prabhakar, 2018).** In addition, the reduction of natural gut microorganisms predisposes the birds to opportunistic infections. In 2006, the European Union banned antibiotics as feed additives due to their residual effects in animal tissues, subsequently leading to antimicrobial resistance in humans **(Gobiraju *et al.*, 2017).** To avoid the extreme use of antibiotics and other medication, it is essential to

find alternative feed supplements, to improve and decrease the cost of production through efficient feed utilization. Alternatives include phytogenic feed additives, prebiotics, probiotics, enzymes, organic acids, and essential oils. Phytogenic feed additives are obtained from plants with antimicrobial properties **(Gobiraju *et al*., 2017).** Turmeric (*Curcuma longa*) is a tropical plant native to southern and southeastern tropical Asia **(Wang *et al*., 2015).**

The active ingredients found in turmeric are curcumin, demethoxycurcumin, bisdemethoxy-curcumin, and tetrahydro curcuminoids **(Kafi *et al*., 2017).** Curcumin isolated from the rhizomes of turmeric is the principal bioactive ingredient of *C. longa*, which has been found to have antioxidant, antiviral, and antibacterial effects **(Wang *et al*., 2015).** Curcumin (diferuloylmethane), turmeric's most bioactive ingredient, represents 3-5 % of the curcuminoids in turmeric rhizomes and is a strong phenolic antioxidant **(Qasem *et al*., 2016)**. Turmeric also has other pharmacological activities, including hepatoprotective, immunostimulant, and anticancer **(Sun *et al*., 2012).** The immunomodulatory effects of turmeric extensively boost the immune system's ability, providing instant natural antibiotic capability against invading pathogens. Turmeric can specifically regulate inflammation which is very important in preventing the progression of inflammation-induced pathology in poultry **(Kurkure *et al*., 2000).** The World Health Organization (WHO) has declared turmeric a safe dietary product to be used in the human diet and animal feed **(Mahesh and Prabhakar, 2018).**

MATERIALS AND METHODS

Experimental Location

The research was conducted in Sokoto, the capital of Sokoto state, Nigeria. Sokoto is located northwest of the country on the border with The Republic of Niger. Sokoto is located near the confluence of Sokoto River and Rima River located between latitude 13^0 01^1 North and longitude 05^0 15^1 East about 350 m above sea level **(Sokoto and Muhammad, 2014).**

Experimental Site

The experiment was conducted at the poultry unit of Sokoto South Zonal Veterinary Clinic along Aliyu Jodi road, Sokoto South Local Government Area, Sokoto State.

Source of Dietary Sample

Turmeric (*Curcuma longa*) powder was purchased commercially from Sokoto central market, Nigeria.

Experimental Diet Formulation

The composition of the experimental diets is shown in table (1). Turmeric powder was incorporated at different levels of 0g, 50g, 100g, and 150g per 25kg of feed for T_C, T_1, T_2, and T_3, respectively. The prepared diets (25kg) were packed into a labeled bag according to the treatment and kept within the pen.

Table 1: Composition of experimental broiler starter and finisher diet for 25kg

Ingredients	Starter (kg)	Finisher (kg)
Maize	12.50	12.25
Soya bean	4.50	5.50
Groundnut cake	5.00	3.00
Wheat offal	2.00	3.25
Limestone	0.38	0.13
Bone meal	0.38	0.63
Premix	0.06	0.06
Lysine	0.06	0.06
Methionine	0.06	0.06
Salt	0.06	0.06

Experimental Stock

The experimental birds were purchased commercially from Olam Nigeria Limited, Kaduna, Nigeria at one (1) day old. One hundred and twenty (120) one-day-old mixed-sex broiler chicks (Cobb 500) were used for the experiment.

Experimental Design

The birds were brooded for two weeks in four (4) treatments (T_C, T_1, T_2, and T_3) of thirty (30) birds each; T_C representing the control group while the groups fed 50g, 100g, and 150 g/25kg are represented as T_1, T_2, and T_3 respectively. The birds were divided randomly into three (3) replicates per treatment and fed for five (5) weeks before the experiment was terminated.

Housing and Feeding

Before the arrival of the experimental chicks, the brooding pen was cleaned, washed, disinfected, and left to dry for five (5) days. The pen was constructed in such a way that the birds could have enough ventilation by using a wire net at the front and side of the pen. The pen's floor was cemented and covered with wood shaving to prevent the birds from contracting the disease and ease the pen's cleaning.

Four demarcated spaces in the brooding pen (T_C, T_1, T_2, and T_3) were selected for the experiment. Thirty (30) birds were randomly selected into each pen with two (2) feeders and drinkers each. The experimental broiler starter diet was fed to the birds for two (2) weeks. Each treatment was replicated into three (3) replicas with ten (10) birds each. Two drinkers and two feeders were allowed to each replica. The experimental broiler finisher diet was fed to the birds for five (5) weeks. The pen was monitored every morning and evening throughout the experiment, feed and water were supplied ad-libitum, and the drinkers in each pen were cleaned daily and refilled with fresh water.

Health Management

Before the arrival of the chicks, the pen was cleaned, washed, and disinfected with formalin, Izal solution, and potassium per manganese. The feeders and drinkers were also washed and disinfected. The birds were given an intra-ocular vaccine against Newcastle disease at day old at the hatchery center. The first Gumboro vaccine was administered to the birds via drinking water at ten (10) days old. In the third week, the Newcastle vaccine (Lasota) was administered via drinking water before the vaccination exercise water was withdrawn for 5 hours to ensure the birds became thirsty enough to drink the vaccine. After every vaccination, anti-stress (vitalyte®) was administered for three (3) days. At five (5) weeks of age, some birds show respiratory signs such as gasping and coughing, and medication (Maxicocc® and V-OX®) was administered.

Sample Collection

At the end of the experiment, 2mls of blood was collected aseptically with sterile syringes and needles from the wing vein (brachial vein) of three birds per group into plain tubes without anticoagulant. The samples were transported to the laboratory and then stood for 3 hours at room temperature, whereupon the serum was collected after being centrifuged at 4000 rpm for 5 minutes. Serum biochemistry parameters such as Total Protein (TP), Aspartate Aminotransferase (AST), Alanine Aminotransferase (ALT), and Alkaline Phosphatase (ALP) were analyzed.

Sample Analysis

Alanine Aminotransferase (ALT)

The serum alanine aminotransferase (ALT) was estimated colorimetrically using an ALT reagent kit (IVD Dialab company, Wiener Neudorf, Austria) as described by **Thefeld *et al*., 1974)**

The ALT concentration was calculated using the formula below:

ALT (µ/L) = Δ A/min × factor **(Thefeld *et al*., 1974).**

Aspartate Aminotransferase (AST)

Serum aspartate aminotransferase (AST) was estimated using a commercial kit (IVD Dialab Company, Wiener Neudorf, Austria). A modified method of the International Federation of Clinical Chemistry (IFCC) was used.

The AST concentration was calculated using the formula below:

AST (µ/L) = Δ A/min × factor **(Thefeld *et al*., 1974).**

Alkaline Phosphatase (ALP)

Serum alkaline phosphatase (ALP) was determined using a commercial kit (IVD Dialab Company, Wiener Neudorf, Austria).

The ALP level was calculated using the formula below:

A/min = (Δ A/min sample) - (Δ A/min blank)

ALP (µ/L) = Δ A/min × factor **(Thefeld *et al*., 1974).**

Total Protein (TP)

Total protein was determined using the Biuret reaction (Weichselbaum, 1946).

Statistical analysis

The laboratory results obtained were assessed statistically using two-way analysis of variance (ANOVA) using GraphPad Prism 8.0.2 (263) software for windows. A P-value of less than 0.05 was considered statistically significant.

RESULTS

Table 2: The effects of turmeric (*Curcuma longa*) on the serum biochemical profile of broiler chickens

Parameters	T_C	T_1	T_2	T_3
ALT (µ/L)	2.33±0.58	3.00±1.00	2.33±0.58	3.00±1.00
AST (µ/L)	36.00±5.00	41.33±5.51	41.33±10.50	40.00±12.53
ALP (µ/L)	$142.00±69.54^{c}$	$113.67±33.50^{d}$	$194.67±157.50^{a}$	$168.67±66.03^{b}$
TP (g/dl)	3.97±0.75	4.20±0.2	3.63±0.35	3.93±0.50

abc: Mean ± SD in the same row with different superscripts differ significantly ($p<0.05$).

Key: AST - Aspartate Aminotransferase, ALP - Alkaline Phosphatase, TP - Total Protein, ALT - Alanine Aminotransferase, T_C - Control group, T_1 - Group fed with 50 g of turmeric per 25 kg, T_2 - Group fed with 100 g of turmeric per 25 kg, T_3 - Group fed with 150 g of turmeric per 25 kg.

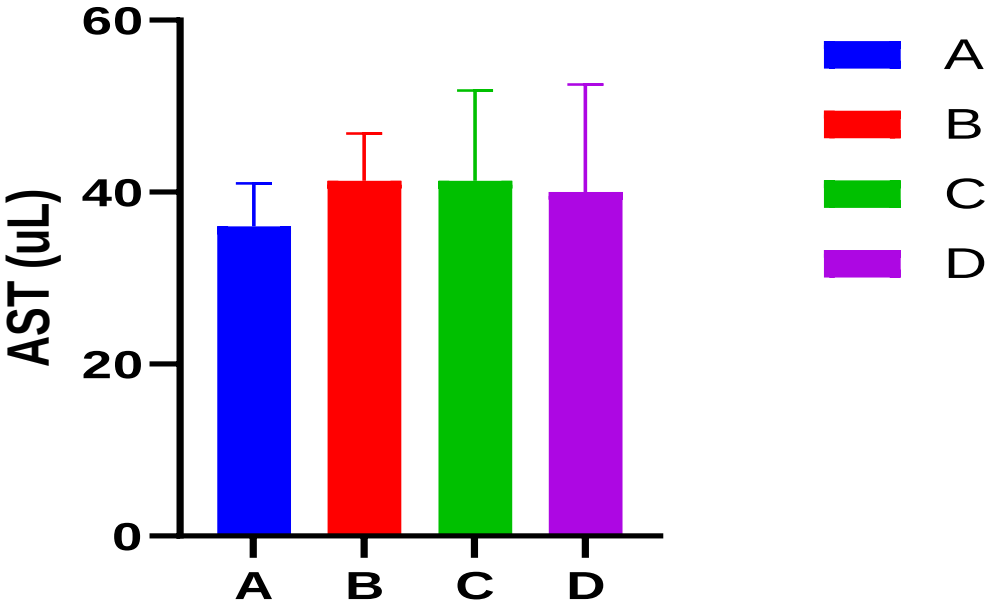

Fig.1: Graph showing the mean value of Aspartate Aminotransferase (AST) across the groups
Key: A = $T_{C,}$ B = $T_{1,}$ C= $T_{2,}$ D = T_3

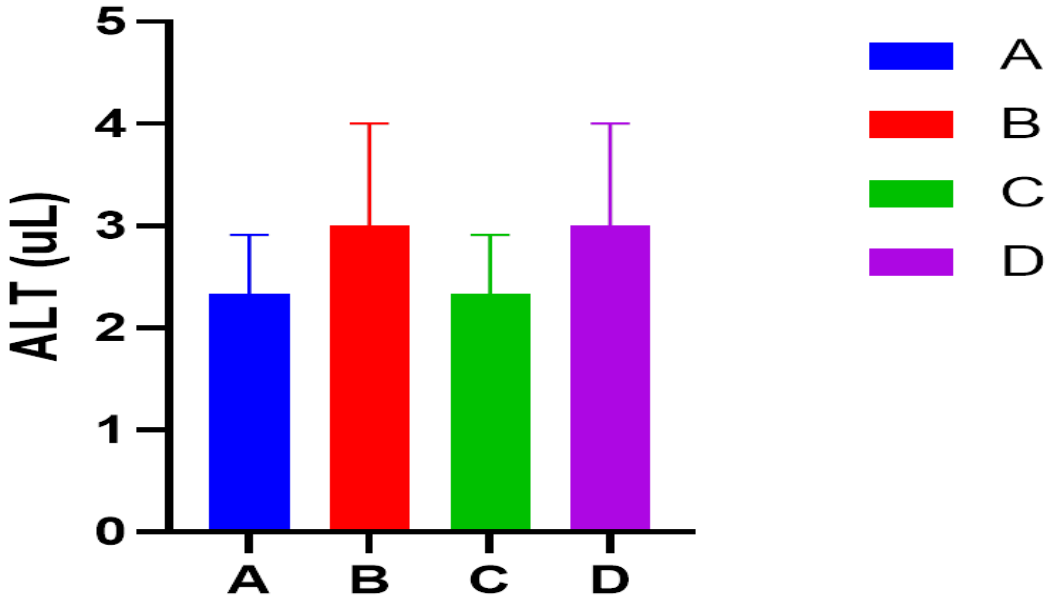

Fig. 2: Graph showing the mean value of Alanine Aminotransferase (ALT) across the groups

Key: A = $T_{C,}$ B = $T_{1,}$ C= $T_{2,}$ D = T_3

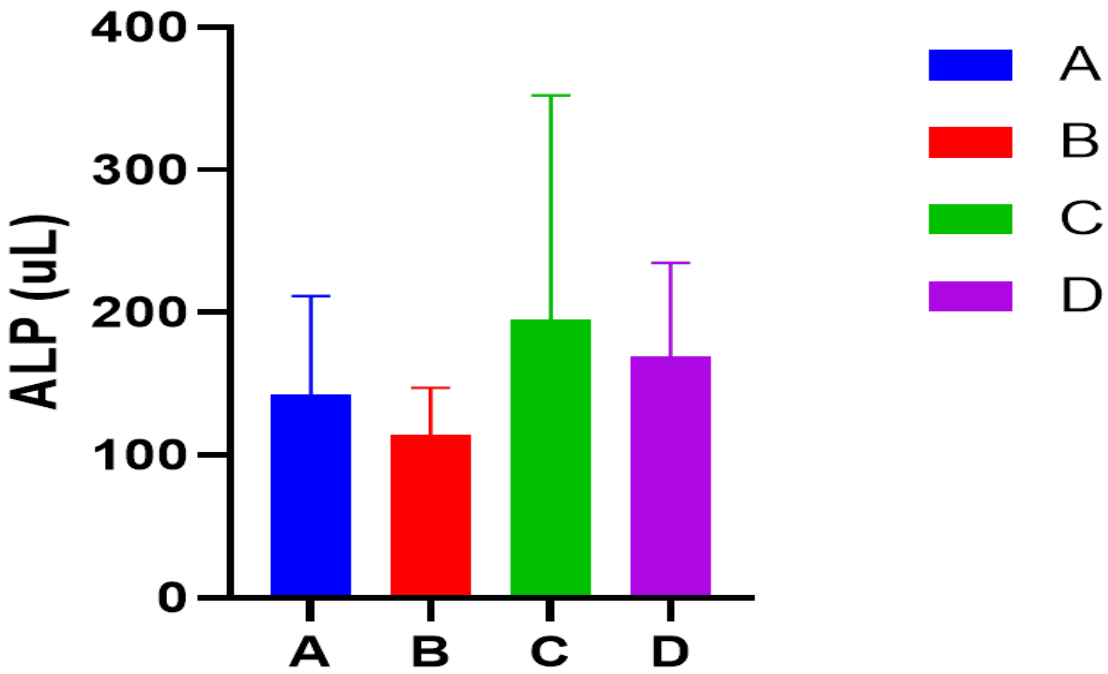

Fig.3: Graph showing the mean value of Alkaline Phosphatase (ALP) across the group
Key: A = T_C, B = T_1, C= T_2, D = T_3

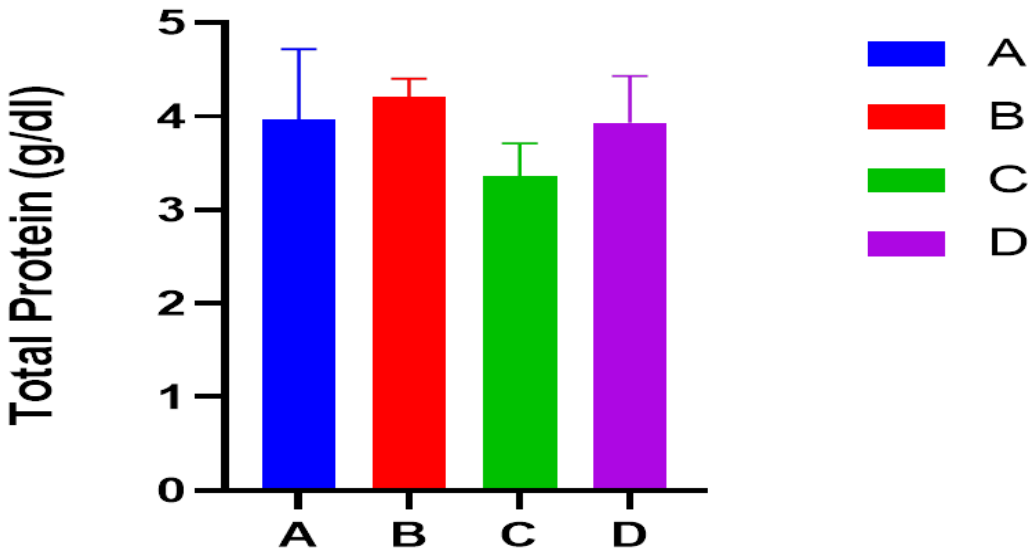

Fig. 4: Graph showing the mean value of Total Protein (TP) across the groups
Key: A = T_C, B = T_1, C= T_2, D = T_3

DISCUSSION

In this study, there was no significant difference in the total protein (TP) of treatment groups T_1, T_2, and T_3 when compared to the control group (T_C) which is in agreement with a study by **Emadi *et al.*, (2007)** which reported no significant effect on total protein and albumin concentrations in broiler chickens fed with turmeric levels of 0.25%, 0.5% and 0.75% at 21 days old. Total protein was not statistically ($P>0.05$) influenced by turmeric powder inclusion in the diet of broiler chickens in this study.

The value of aspartate aminotransferase (AST) increased in all the treatment groups (T_1, T_2, and T_3) when compared to the control group (T_C) and the value of alanine aminotransferase (ALT) slightly increased (however, this increase is minimal to cause any observable adverse effect) in treatment group T_1 and T_3 when compared to the control group (T_C). This increase contrasts with the study by **Kumari *et al.*, (2007)** which reported that the activity of some liver enzymes such as ALT, AST, and ALP did not change in the treatment group with turmeric in broiler chicken. This may be attributed to some factors, including the breed of chicken, level of turmeric inclusion, duration of the experiment, and environmental factors. **Ekine *et al.*, (2020)** reported an increase in AST and ALT in treatment 5 with 250g of turmeric per 25kg of feed. But this increase has no negative effect on the liver or muscle of broiler birds; AST and ALT can only cause hepatic disorder when it is greater than 275µL and when it is up to 800 µL, it is indicative of severe hepatic damage. In this study, AST and ALT were not statistically ($P> 0.05$) influenced by the dietary turmeric inclusion.

Alkaline phosphatase (ALP) when compared to the control group (T_C), increased in the treatment group (T_2 and T_3) which is in contrast with the study by **(Kumari *et al.*, 2007; Mehala and Moorthy 2008)** which reported that activities of liver enzymes, such as ALP, AST, LDH, and ALT did not change with the inclusion of turmeric in the diet of broiler chicken; and low in treatment one (T_1) which is in agreement with the study by **Emadi and Kermanshahi (2007)** which reported decreased ALT and ALP enzyme activities in the serum of broiler birds fed turmeric at levels of 0.25%, 0.5%, and 0.75%. The variations between these present studies and previous findings might be due to some factors which include; different levels of turmeric inclusion, different bioactive substances of turmeric plant used in these studies which depend on the plant species, type of soil, harvest season and process of preparation **(Jaggi, 2012).** In avian species, an increase in ALP has been linked with an increase in osteoblast activity including traumatic, neoplastic, and infectious disease status **(Harr, 2006).** ALP was statistically ($P<0.05$) influenced by turmeric across the groups in this study.

CONCLUSION

It was concluded under the conditions of this study that the biochemical parameters (total protein and alanine aminotransferase) of broiler chickens were affected positively by the inclusion of turmeric in the diet. Although serum alkaline phosphatase and aspartate aminotransferase were not improved, turmeric can positively affect broiler chickens' serum biochemical parameters. Further studies are needed with emphasis on elucidating the effect of turmeric powder on serum biochemical parameters of broiler chickens at different ages of the chickens and at different turmeric inclusion levels to improve broiler production through improved health, thus reducing the issue of antimicrobial resistance in poultry.

Conflicts of interest

The authors declared no competing interests.

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