

Carcass Characteristics of Broiler Chickens Fed on Turmeric (*Curcuma longa*) Powder

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Abstract

Modern poultry farmers adopt the use of herbs of medicinal importance in feeds to alleviate the potential of infectious diseases but its effects on carcass need to be ascertained. This research aimed to determine the effect of different levels of turmeric (*Curcuma longa*) powder on the carcass characteristics of broiler chickens. Four experimental rations designated as TC, T1, T2, and T3 having 0g, 50g, 100g and 150g Turmeric (*Curcuma longa*) powder per 25kg of feed respectively were fed to 120 broiler chicks for 7 weeks, the chicks were randomly distributed into four groups comprising of 30 chicks per group. The following weights (before fasting, fasting, bled, plucked and organs) were taken and recorded. The results of this study shows that the carcass traits- musculature (drumstick weight: 152.55±3.18; neck weight: 53.4±11.74) of the broilers significantly ($P<0.05$) improved by the turmeric (*Curcuma longa*) powder compared to the control group (drumstick weight: 134.05±11.95; 49.15±6.58). No significant ($P>0.05$) difference in the carcass quality traits and on the weight of the visceral organs of the broiler chickens at different levels was found. It was concluded that the supplementation has a positive significant effect on the cut-up-parts (breast, back and thigh) of the different treatment groups of the broilers. However, it has no significant effect on the carcass quality traits and visceral organs. It was recommended to supplement turmeric (*Curcuma longa*) powder in broiler feed for improved cut-up-parts.

Keywords: Broilers, Carcass quality traits, Cut- up- parts, Turmeric powder, Visceral organs.

1.0 Introduction

To meet the increasing demand for an inexpensive and safe supply of meat and eggs, the poultry industry has made tremendous adjustments [1]. The goal of poultry production is to optimize growth performance through better growth rates and improved feed conversion efficiency. This goal is mostly dependent on the genetic potential of the bird, quality of feed, environmental conditions, and disease outbreaks [2]. The removal of antibiotic growth promoters (AGPs) was problematic for growth performance and led to an increase in the incidence of certain poultry diseases, especially sub-clinical necrotic enteritis. This led to the discovery of alternatives to AGPs [3].

There are modern trends to replace AGPs with natural growth promoters. Because of that, different natural growth promoters are used worldwide. Probiotics, prebiotics, antioxidants, enzymes, organic acids, and herbs are good antibiotic alternatives. The variety and beneficial activities of herbs and their extracts make them a good alternative [2].

The wide use of antibiotics at sub-therapeutic doses in animal feed as growth promoters enhances animal growth performance and production. However, resistant cells survive and grow, producing an antibiotic-resistant population in the final products, which is hazardous to the consumers [4]. The rising cost of antibiotics and other drugs coupled with their residual effects has demanded the need to research natural herbal

plants that could be inexpensive and good alternatives to commercial (synthetic) antibiotics [5].

The European Union (EU) has banned the application of antibiotics as growth promoters in animal feed since January 2006 because of their residual effects in animal tissues and subsequent antimicrobial resistance in human beings. This ban in the EU has resulted in growing pressure on livestock producers in other parts of the world. This has led to the investigation of alternative substances and strategies for animal growth promotion and disease prevention, among which photogenic and herbal products have received increased attention since they have acquired more acceptability among consumers as natural additives [4].

Bioactive plant substances have beneficial effects on animal nutrition, which include the stimulation of appetite and feed intake, the improvement of endogenous digestive enzyme secretion, activation of immune responses, and antiviral, antibacterial, and antioxidant actions [6].

Because of the significant biological properties of turmeric powder, it is a potential substitute for in-feed antibiotics in livestock diets. Several studies have been conducted to evaluate its effects on the performance of rabbits, broiler chickens, and laying hens [4].

2.1 Materials and Methods

2.1.1 Experimental Location

This research project was conducted in the poultry house City Campus Usmanu Danfodiyo University, Sokoto. The state is geographically located in the Northwestern part of Nigeria between the longitudes 4°8'E and 6°54'E and latitudes 12°N and 13°58'. It shares borders with the Niger Republic to the north, Kebbi State to the south, and Zamfara State to the east [9].

2.1.2 Source of Sample

The turmeric (*Curcuma longa*) powder was obtained from Sokoto Central Market. It was taken in a polythene bag to a botanist from UDUS herbarium for professional identification and was labeled as UDUSH/ANS/0100.

2.1.2.1 Feed Ingredients

Maize, wheat offal, and salt were bought from Sokoto Central Market. The maize was ground into smaller size units suitable for consumption by the birds. Wheat offal was used in the same state. Soya bean, groundnut cake, bone meal, premix, methionine, limestone, and lysine were obtained from the Faculty of Agriculture, Usmanu Danfodiyo University, Sokoto.

2.1.2.2 Diet Formulation (Basal diet) for the Experimental Birds

The experimental diet whose composition is shown in Table 1 was compounded manually having made all the ingredients available. Turmeric powder was incorporated at different levels of 0g, 50g, 100g, and 150g per 25kg of feed for TC, T1, T2, and T3 respectively. During feed formulation, the feed components with the larger particle size (maize, soya bean, groundnut cake, and wheat offal) were weighed and placed on a clean floor, then the other feed ingredients (bone meal, limestone, methionine, premix, lysine, and salt) including the turmeric powder were weighed and mixed then added to the other feed ingredients and thoroughly mixed using shovel 4-5 times. The prepared feed (25kg) was packed into a labeled bag according to the treatment and kept. Table 2 shows the grouping and the treatments given.

2.1.2.3 Experimental Stock

The experimental birds were purchased from Olam[®] Nigeria Limited Kaduna, at day old. One hundred and twenty (120) day-old chicks were used for the experiment, the initial weight was recorded before the experiment using a standard digital weighing scale (METTLER TOLEDO[®]).

2.1.3 Experimental Design

Broiler feed was compounded; day-old chicks were sourced from, and grouped into four groups. A control group and three experimental groups.

The birds were brooded for two weeks and randomly divided into four (4) treatment groups of thirty (30) birds each, after which the birds were divided randomly into three (3) replicates per treatment. TC was the control group, T1, T2, and T3 had 0g, 50g, 100g, and 150g Turmeric (*Curcuma longa*) powder respectively incorporated per 25kg feed to evaluate its effect on different carcass traits and organs following the standard procedure and protocol of the ARRIVE

guidelines [5]. The weight of the birds before fasting, after fasting, bled, plucked and organs were taken and recorded using a standard digital weighing scale (METTLER TOLEDO®). The birds were fed for seven (7) weeks before the experiment was terminated.

They were brooded and the experimental birds were fed with different levels of Turmeric powder added to their feed following the standard protocol of [6].

Table 1: Experimental design

Group	Treatments
TC	Basal diet (control)
T1	Basal diet + Turmeric powder 50g
T2	Basal diet + Turmeric powder 100g
T3	Basal diet + Turmeric powder 150g

2.1.3.2 Housing and Feeding

Before the arrival of the experimental chicks, the brooding pen was cleaned, washed, disinfected, and left to dry for three (3) days. Four demarcated brooding pens (TC, T1, T2 and T3) were selected for the experiment. Thirty (30) birds were randomly selected into each pen with two (2) feeding and drinking troughs each. A broiler starter diet was fed to the birds for two weeks. Each treatment was replicated into three replicas with ten birds each, one drinker and one feeder was allotted to each replica. The experimental broiler finisher diet was fed to the birds for five weeks. The pen was constructed to have good ventilation by using a wire net at the front and side of the pen. The floor of the pen was cemented and covered with wood shaving to prevent the birds from contracting diseases and to ease the cleaning of the pen. The pen was monitored every morning and evening throughout the experiment, feed, and water were supplied ad libitum after the feed was weighed first day of the week, and the remnant was also weighed at the end of the week. The drinker in each pen was cleaned daily and refilled with fresh cool water.

2.1.4 Data Collection

The birds and the feed were weighed weekly throughout the experiment. There were twelve replicates each containing ten birds. Each replicate was weighed collectively and divided by the total number of birds in the pen to determine the

average weight per bird for the week. The weight was recorded every week. Twelve birds one from each replica were randomly selected and isolated, they were weighed and fasted for twelve hours (7 pm to 7 am). By the next day, the birds were weighed indicating the fasted weight, then slaughtered before the bled weight and plucked weight were taken.

2.1.5 Organs Measurement

At the end of the trial, the birds were slaughtered and the internal organs such as the liver, spleen, kidney, heart, lungs, intestines, abdominal fat, gizzard, and proventriculus were removed and weighed separately. The breast, back, drumstick, thigh, wings, crop, head, neck, and feet were cut separately and weighed using a weighing balance.

2.1.6 Ethical clearance

Ethical clearance was obtained from the Faculty Animal Research and Ethical Committee / Institutional Committee of the UDUS for the study with a given code of UDUS/IACUC/2014/AUP-RO- 11.

2.1.7 Data analysis

During this study, the data obtained was accessed using an Excel sheet and Graph Pad Prism 9.1.2 to perform the statistical analysis (ANOVA) and to obtain the P-value ($P < 0.05$) which indicates the statistical difference of the mean and standard deviation of the data.

3.0 Results

Table 2: Composition of compounded broiler starter and finisher diet for 25kg.

Ingredients	Starter (kg)	Finisher (kg)
Maize	12.50	12.25
Soyabean	4.50	5.50
Groundnutcake	5.00	3.00
Wheat offal	2.00	3.25
Limestone	0.38	0.13
Bonemeal	0.38	0.63
Premix	0.06	0.06
Lysine	0.06	0.06
Methionine	0.06	0.06
Salt	0.06	0.06

Table 3 below indicates that supplementation of turmeric powder (*Curcuma longa*) in the feed of broiler chickens at different levels showed no

significant ($P>0.05$) difference in the carcass quality traits (live weight, fasted weight, bled weight, and plucked weight).

Table 3: Effect of turmeric (*Curcuma longa*) powder on the carcass characteristics of broilers

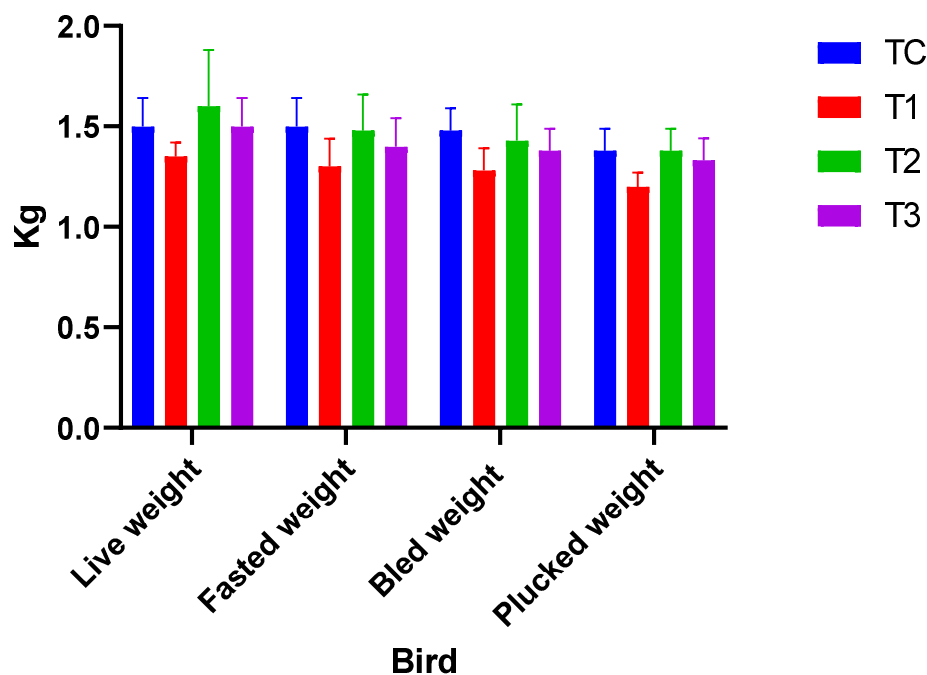
Parameters	TC	T1	T2	T3
Live weight (kg)	1.50 ± 0.14 ^a	1.35 ± 0.07 ^a	1.60 ± 0.28 ^a	1.50 ± 0.14 ^a
Fasted weight (kg)	1.50 ± 0.14 ^a	1.30 ± 0.14 ^a	1.48 ± 0.18 ^a	1.40 ± 0.14 ^a
Bled weight (kg)	1.48 ± 0.11 ^a	1.28 ± 0.11 ^a	1.43 ± 0.18 ^a	1.38 ± 0.11 ^a
Plucked weight (kg)	1.38 ± 0.11 ^a	1.20 ± 0.07 ^a	1.38 ± 0.11 ^a	1.33 ± 0.11 ^a

^{a,b,c,d} M±SD with different superscripts in the same row are significantly different from each other ($P < 0.05$).

Key: M= Mean, SD=Standard deviation; TC=Basal diet (control), T1=Basal diet + Turmeric powder 50g; T2= Basal diet + Turmeric powder 100g, T3=Basal diet + Turmeric powder 150g.

Figure 1 below indicates that supplementation of turmeric powder (*Curcuma longa*) in the feed of broiler chickens at different levels showed no

significant ($P>0.05$) difference in the carcass quality traits (live weight, fasted weight, bled weight, and plucked weight).



Keys: TC=Basal diet (control), T1=Basal diet + Turmeric powder 50g; T2= Basal diet + Turmeric powder 100g, T3=Basal diet + Turmeric powder 150g

Figure 1: Graph representation of the mean and standard deviation of the effect of turmeric (*Curcuma longa*) powder on the carcass characteristics of broilers.

Table 4 below indicates that supplementation of turmeric powder (*Curcuma longa*) in the feed of broiler chickens at different levels showed no significant ($P>0.05$) difference in the visceral

organs quality traits (crop weight, gizzard weight, liver weight, spleen weight, intestine weight, lung weight, abdominal weight and heart weight).

Table 4: Effects of turmeric (*Curcuma longa*) powder on the carcass characteristics (visceral organs) of broilers

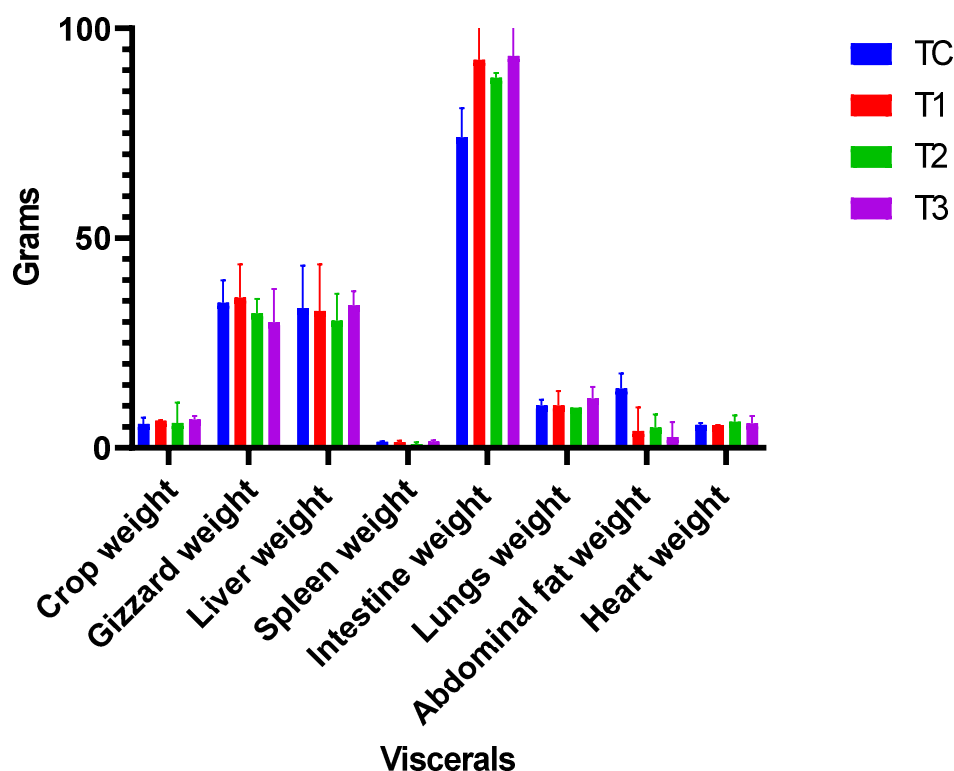
Visceral Organs	TC	T1	T2	T3
Crop weight (g)	5.70 ± 1.56 ^a	6.45 ± 0.21 ^a	5.95 ± 4.88 ^a	6.8 ± 0.85 ^a
Gizzard weight (g)	34.6 ± 5.37 ^a	35.8 ± 7.92 ^a	32.1 ± 3.39 ^a	29.95 ± 7.99 ^a
Liver weight (g)	33.3 ± 10.18 ^a	32.65 ± 11.1 ^a	30.35 ± 6.43 ^a	34.0 ± 3.39 ^a
Spleen weight (g)	1.40 ± 0.14 ^a	1.35 ± 0.35 ^a	0.85 ± 0.49 ^a	1.45 ± 0.35 ^a
Intestine weight (g)	74.05 ± 7.0 ^a	92.55 ± 15.91 ^a	88.2 ± 1.13 ^a	93.45 ± 26.52 ^a
Lungs weight (g)	10.15 ± 1.34 ^a	10.1 ± 3.39 ^a	9.6 ± 0.0 ^a	11.8 ± 2.69 ^a
Abdominal fat weight (g)	14.15 ± 3.61 ^a	4.0 ± 5.66 ^a	4.85 ± 3.18 ^a	2.55 ± 3.61 ^a
Heart weight (g)	5.5 ± 0.42 ^a	5.45 ± 0.07 ^a	6.25 ± 1.48 ^a	5.9 ± 1.7 ^a

^{a,b,c,d} M±SD with different superscripts in the same row are significantly different from each other (P < 0.05).

Keys: M=Mean, SD=Standard deviation, TC=Basal diet (control), T1=Basal diet + Turmeric powder 50g; T2= Basal diet + Turmeric powder 100g, T3=Basal diet + Turmeric powder 150g

Figure 2 below indicates that supplementation of turmeric powder (*Curcuma longa*) in the feed of broiler chickens at different levels showed no significant (P > 0.05) difference in the visceral

organs quality traits (crop weight, gizzard weight, liver weight, spleen weight, intestine weight, lung weight, abdominal weight, and heart weight).



Keys: TC=Basal diet (control), T1=Basal diet + Turmeric powder 50g; T2= Basal diet + Turmeric powder 100g, T3=Basal diet + Turmeric powder 150g

Figure 2: Effect of turmeric (*Curcuma longa*) powder on the carcass characteristics (visceral organs) of broilers.

Table 3 below indicates that supplementation of turmeric powder (*Curcuma longa*) in the feed of broiler chickens at different levels showed the

mean weight of cut-up parts (musculature), such as breast, back, and thigh was significantly (P < 0.05) different when compared to the control group. The

difference in the mean breast weight was highest in the control group (TC), followed by T2, T3, and T1. Similarly, the back weight was highest in the

control group, followed by T2, T3, and T1, while the thigh weight was highest in T2, followed by the control group, T3, and T1.

Table 5: Effect of turmeric (*Curcuma longa*) powder on the carcass characteristics (Musculature) of broilers.

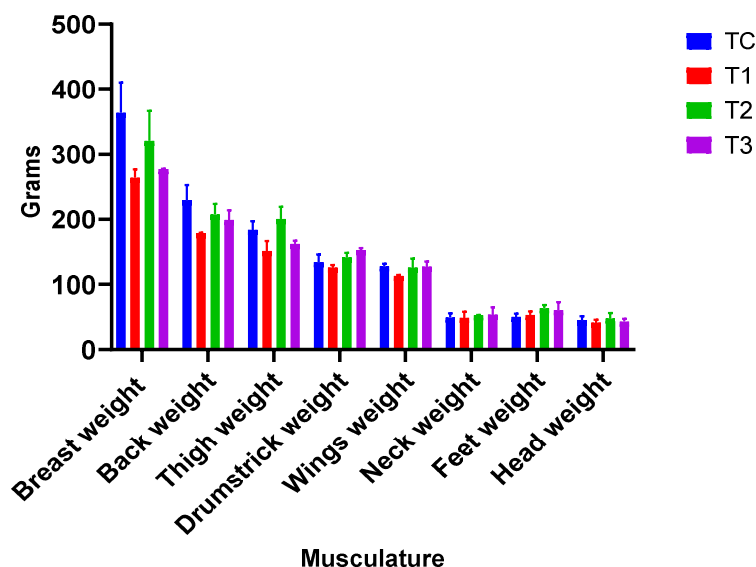
Prime cuts	TC	T1	T2	T3
Breast weight (g)	363.7 ± 46.39 ^a	263.75 ± 13.22 ^b	320.35 ± 46.32 ^c	276.95 ± 0.78 ^d
Back weight (g)	229.45 ± 23.26 ^{ab}	178.85 ± 0.64 ^b	207.25 ± 16.76 ^{ab}	198.65 ± 15.2 ^c
Thigh weight (g)	183.65 ± 13.51 ^{abc}	151 ± 15.7 ^{bd}	200.5 ± 19.09 ^{abc}	162.2 ± 5.37 ^{bd}
Drumstick weight(g)	134.05 ± 11.95	125.75 ± 4.31	141.2 ± 7.5	152.55 ± 3.18
Wings weight (g)	127.70 ± 4.38	112.85 ± 2.05	125.5 ± 13.86	127.1 ± 8.34
Neck weight (g)	49.15 ± 6.58	48.25 ± 9.83	52.1 ± 0.85	53.4 ± 11.74
Feet weight (g)	49.75 ± 5.30	53.0 ± 5.66	63.35 ± 5.02	60.3 ± 12.45
Head weight (g)	44.90 ± 6.51	41.10 ± 4.81	47.25 ± 8.84	42.85 ± 4.6

^{a,b,c,d} M±SD with different superscripts in the same row are significantly different from each other (P < 0.05).

Keys: M= Mean, SD=Standard deviation, TC=Basal diet (control), T1=Basal diet + Turmeric powder 50g; T2= Basal diet + Turmeric powder 100g, T3=Basal diet + Turmeric powder 150g

Figure 3 below indicates that supplementation of turmeric powder (*Curcuma longa*) in the feed of broiler chickens at different levels showed the mean weight of cut-up parts, such as breast, back, and thigh was significantly (P<0.05) different when compared to the control group. The

difference in the mean breast weight was highest in the control group (TC), followed by T2, T3, and T1. Similarly, the back weight was highest in the control group, followed by T2, T3, and T1, while the thigh weight was highest in T2, followed by the control group, T3, and T1.



Keys: TC=Basal diet (control), T1=Basal diet + Turmeric powder 50g; T2= Basal diet + Turmeric powder 100g, T3=Basal diet + Turmeric powder 150g

Figure 3: Effect of turmeric (*Curcuma longa*) powder on the carcass characteristics (Musculature) of broilers.

4.0 Discussion

In this study, the supplementation of turmeric powder (*Curcuma longa*) in the feed of broiler chickens at different levels showed no significant ($P>0.05$) difference in the carcass quality traits (live weight, fasted weight, bled weight, and plucked weight). This result is in agreement with prior findings [4], which state that carcass traits were not statistically ($P>0.05$) influenced by dietary treatments with turmeric. However, it contradicts other research [7], which demonstrated significant ($P<0.05$) differences in carcass traits, with the highest results found in 0.5% turmeric powder-supplemented diets compared to control diets.

The supplementation of turmeric (*Curcuma longa*) powder in the feed of broiler chickens at different levels also showed no significant ($P>0.05$) difference in the weight of the visceral organs (crop, gizzard, liver, spleen, intestine, lungs, abdominal fat, and heart). This result aligns with findings [7], which reported no significant ($P>0.05$) effect of turmeric powder on the internal organ weights (heart, liver, and gizzard). These results also support the findings of another study [8], which found no significant effect on organ weights when broiler chickens were fed turmeric rhizome powder.

The cut-up parts of different treatment groups are presented in the results. The mean weight of cut-up parts, such as breast, back, and thigh, was significantly ($P<0.05$) different when compared to the control group. The difference in the mean breast weight was highest in the control group (TC), followed by T2, T3, and T1. Similarly, the back weight was highest in the control group, followed by T2, T3, and T1, while the thigh weight was highest in T2, followed by the control group, T3, and T1. These findings contradict the results of another study [7], which reported no significant ($P>0.05$) difference in percent yields of cut-up parts, including neck, wings, back, breast, thighs, and drumsticks, among different treatment groups.

5.0 Conclusion

Based on the results of this study, it was concluded that turmeric powder supplemented at different levels has no significant effect on carcass characteristics (carcass quality yield and visceral organs) of broiler but has a significant difference

on the cut-up-parts like breast, back, and thigh weight.

6.0 Recommendation

It was recommended that further research should be conducted to determine the effect of turmeric at higher concentrations on carcass characteristics in broilers and other birds.

7.0 Acknowledgments

The authors wish to acknowledge the immense support and contribution given by Dr. Sani Garba and Dr. Aminu Umar A. of the Animal Science Department, Usmanu Danfodiyo University, Sokoto, Nigeria.

8.0 Conflict of Interest

The authors declare that there is no conflict of interest in this study.

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