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Influence of Dietary Turmeric (*Curcuma longa*) Leaf Meal on Growth Indices and Carcass Characteristics of Broiler Chickens

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Abstract

The prohibition of artificial antibiotic growth promoters in poultry feed due to their implication in drug-resistant microflora and consumer preference for naturally produced foods has led to the quest for utilizing natural additives in poultry feed which enhance productivity without compromising bird health. Therefore, the impact of incorporating Turmeric (*Curcuma longa*) Leaf Meal (TLM) at varying inclusion levels on the growth performance and carcass characteristics of broiler chickens were assessed. One hundred and eight (108) Ross 308 strains of day-old chicks were allotted four (4) treatments including: 0%, 0.5%, 1.0% and 1.5% per 100g of feed. The treatments were replicated three times with nine (9) birds per replicate and the experiment was laid out in a completely randomized design. Weight gain, feed intake, and feed conversion ratio data were collected for seven (7) weeks. Two (2) birds from each replicate were selected at random, weighed, slaughtered, and dressed for carcass parameters viz live weight, eviscerated weight, dressing percentage, head, neck, wing, and thigh, drumstick, and organ weights. Data obtained were subjected to ANOVA. The final weight and weight gain of the birds improved when treated with the highest level of TLM (1.5%), while TLM did not influence dressed weight and dressing percentage. The live weight and eviscerated weight were also enhanced as the levels of TLM increased while drumstick, back, wing, and neck weights of TLM-fed birds decreased. The thigh and breast were not affected. The gizzard, kidney, and lungs followed the same trend, while the liver, proventriculus, and intestines were not affected. The inclusion of TLM at 1.5% in broiler chicken diet improved growth without adverse effects on the carcass and internal organs of the birds. Therefore, incorporating TLM into broiler feed may improve productivity and meet consumer's quest for residue free-meat. Hence, it is recommended for broiler producers.

Keyword: Turmeric, Leaf meal, Broilers, Feed additive, Carcass, Chicken

1.0 Introduction

Broiler production offers the most rapid and cost-effective means of making high quality animal protein available for humans globally. In Europe and America, poultry meat is preferred over beef because of its higher protein and lower calories content, in addition to other favourable meat qualities such as tenderness (Dafwang, 2002). A 100g of chicken contains 70.3% water, 9.7% lipids/fat, and 20% protein (Aldelis, 2018). Poultry products are gaining popularity worldwide because of high cultural acceptance, quick turnover and better nutritional composition (Sola-Ojo *et al*., 2013; Sam and Okon, 2022). Tremendous successes recorded in the poultry production via broiler venture are because of improvements in productivity indices such as growth, yield and composition of the carcass (Oluwami *et al*., 2019; Ebong *et al*., 2023).

Over the decades, poultry feed has been supplemented with antibiotics to help combat dangerous external infections. Although these antibiotics helped to overcome the disease and death in chicken production, they in turn affected the health of consumers by developing drug-resistant microflora. Gouda and Bhandary, (2018) reported that European nations prohibited the use of antibiotics in chicken diets since January 2006. Also, in Nigeria, the incorporation of antibiotics in feed for animals had been prohibited by National Agency for Food and Drug Administration and Control (NAFDAC) (Reu, 2018). In this regard, poultry industries and poultry farmers have been seeking a natural alternative, such as plant parts, that will yield better, reduce the rate of mortality and morbidity, with better weight gain without negative impact on health.

Various herbs and spices have been utilized in poultry production for a variety of purposes as alternative feed additives and supplements (Abou-Elkhair *et al*., 2014; Essien *et al.*, 2022; Essien *et al.*, 2024) and they act as sources of natural antibacterials, coccidiostats, antivirals and antioxidants. Some examples of these herbs and spices include; turmeric, garlic, nutmeg, pepper, mustard and thyme (Suganya *et al*., 2016).

Turmeric (*Curcuma longa* L.), a member of the Zingiberaceae family, has its usage recorded in history as a medicinal herb, dietary spice, food source, food preservative, and coloring agent in Asia. It is a short-stemmed perennial plant whose leaves are long, oblong, dark green on top and pale green at the bottom. The rhizomes are tuberous, pale yellow to brownish orange, with rough, segmented skin that resembles ginger. They possess antimicrobial properties. Extracts of turmeric due to their bioavailability have extensively been utilized in agronomic and drug purposes because it has the potential to reduce residual effects (Azhari *et al*., 2018).

Many authors have reported the use of turmeric rhizome in different forms such as extracts, essential oil, fresh or processed and found it to be a natural preservative for food (Gumus *et al*., 2018, Buch, *et al*., 2014, Abdellatif *et al*., 2023). Conversely, turmeric leaves, despite being a by-product of turmeric farming, possess abundant phytochemical compounds. These compounds can scavenge free radicals because they are antioxidants (Kim *et al*., 2021). Turmeric leaves also possess antifungal effects as evident in the study of Moselhy, *et al*., (2018).

Curcumin a component of tumeric is a bioactive compound, known to be capable of acting as an antioxidant and antimicrobial and can help enhance carcass characteristics and meat quality of broiler, as the diet also has an impact on the carcass and meat qualities of chicken

(Comert, *et al*., 2016). Carcass characteristics in a broad term sum up quality (composition) and quantity of the carcass. Carcass quantity traits encompass pre-slaughter live weight, hot carcass weight and dressing percentage. Nevertheless, certain factors such as nutrition, production system and breed cause variation in the carcass characteristics. The purpose of this study was to investigate the impact of turmeric leaf meal as a natural additive on growth performance and carcass yield traits of broiler chickens.

2.0 Materials and Methods

2.1 Experimental Site

The study was carried out at the Poultry unit of the University of Uyo Teaching and Research farm and the Animal Science Laboratory of the University of Uyo, Uyo, Akwa Ibom State. Uyo is located at latitude 4°58'N and 5°04'N and longitude 7°51'Eand 8°01'E (Ekpenyong *et al.,* 2019). The area falls within the tropical rain zone of Nigeria. The area has two distinct seasons: Wet season (March-mid November) and Dry season (November-March). It has an average rainfall range of 2200mm to 3500mm.

2.2 Experimental Design and Treatments

The turmeric leaves were obtained from the University of Uyo Research farm. The leaves were collected, washed, cut and sun-dried to a desirable texture. A total of one hundred and eight (108) day old chicks of Agrited Ross 308 strains were purchased from a reputable distributor in Uyo, Akwa-Ibom state and used in the study. The experiment was a completely randomized design (CRD) with four (4) treatments which were dietary groups containing 0%, 0.5%, 1% and 1.5% (Treatment 1, 2, 3, and 4) levels of turmeric leaf powder. The treatment groups were in triplicates of nine (9) birds respectively. The four experimental diet of turmeric leaf powder were formulated in two phases: starter phase and finisher phase. The ingredient composition of the experimental diets are presented in Table 2.1 and 2.2

2. 3 Data Collection and Analysis

Data were gathered for the performance, the carcass and the internal organ attributes of the birds.

2.3.1 Variables for Performance

Body Weight and Body Weight Gain

The initial weight of the birds was recorded using a digital weighing balance. The gain in weight of the birds was calculated by deducting the initial body weight from the final body weight.

Feed Intake

Feed intake was determined daily as the difference between the feed quantity given and the leftover the following morning.

Feed Conversion Ratio

Feed conversion ratio was calculated as the ratio of feed intake over body weight gain.

$$FCR = \frac{Feed\ intake}{Body\ weight\ gain} \quad \text{.....Equation 2.1}$$

2.3.2 Carcass Evaluation Parameters/Analysis

One bird from each replicate was selected, fasted throughout the night and allowed access to water and their weights recorded as the experiment ended at seven weeks. These birds were slaughtered by slitting the jugular vein, bled properly and scalded in hot water of about 65^{o}C. The feathers were plucked out carefully to avoid bruising the skin. The dressed carcasses were then weighed to obtain the dressed weight and further cut into different parts such as the back, thigh, drumsticks, breast, wings, neck, and intestinal organs (intestine (filled) gizzard, heart, liver lungs, kidney, and proventriculus). The above listed cut parts and intestinal organs (visceral) were weighed separately using the SF-400 sensitive electronic balance. These weights were recorded as a percentage of the live weight of the birds.

2.3.3 Data Analysis

All data generated were subjected to Analysis of Variance (ANOVA) and the significant differences between means were separated using the Duncan's Multiple Range test option of SPSS version 25 (IBM, 2017).

Table 2.1: Composition of starter diets using varying levels of turmeric leaf meal

Ingredients	**T1 (0.0%)**	**T2 (0.5%)**	**T3 (1.0%)**	**T4 (1.5%)**
Maize	50 .00	50.00	50.00	50.00
Soya bean meal	11.00	11.00	11.00	11.00
Ground nut cake	11.00	11.00	11.00	11.00
Sesame seed cake	9.00	9.00	9.00	9.00
Fishmeal (55%)	3.00	3.00	3.00	3.00
Wheat offals	10.30	9.80	9.30	8.80
Turmeric leaf meal (TLM)	0.00	0.50	1.00	1.50
Bone meal	5.00	5.00	5.00	5.00
Common salt	0.25	0.25	0.25	0.25
Vitamin/mineral premix	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10
Total	100	100	100	100
Calculated analysis				
Crude protein (%)	22.13	22.13	22.14	22.14
ME(kcal/kg)	2845.10	2847.60	2850.10	2852.60
Crude fibre (%)	3.60	3.63	3.66	3.69
Calcium (%)	1.83	1.83	1.83	1.83
Phosphorus (%)	1.02	1.02	1.02	1.02

Vitamin minerals premix - vitamin A, D3, E, K, B1, B6, B12, Nacin, Pantothemic Acid, Folic Acid, Biotin, chlorine, chloride, manganese, zinc, iron, copper, iodine, selenium, cobalt and antioxidant

Table 2.2 presents the gross composition of the experimental finisher diet. The birds were kept for three weeks on the finisher diets. A range from 19.10 – 19.12% was obtained for crude protein while the metabolisable energy is 2830.60 -2838.10 kcal/kg.

Table 2.2: Composition of finisher diet using varying levels of TLM

Ingredients	**T1 (0%)**	**T2 (0.5%)**	**T3 (1.0%)**	**T4 (1.5%)**
Maize	55.55	55.55	55.55	55.55
Soya beans meal	7.00	7.00	7.00	7.00
Ground nut cake	6.00	6.00	6.00	6.00
Sesame seed cake	8.00	8.00	8.00	8.00
Fishmeal (55%)	3.00	3.00	3.00	3.00
Wheat offals	15.30	14.80	14.30	13.80
Turmeric leaf meal (TLM)	0.00	0.50	1.00	1.50
Bone meal	5.00	5.00	5.00	5.00
Common Salt	0.25	0.25	0.25	0.25
Vitamin/mineral premix	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10
Total	100	100	100	100
Calculated analysis				
Crude protein (%)	19.10	19.11	19.11	19.12
ME (kcal/kg)	2830.60	2833.10	2835.60	2838.10
Crude fibre (%)	3.60	3.63	3.67	3.70
Calcium (%)	1.83	1.83	1.83	1.83
Phosphorus (%)	1.02	1.02	1.02	1.02

Vitamin minerals premix vitamin A, D3, E. K. B1, B6,812. Nacin. Pantothemic Acid, Folic Acid, Biotin, chlorine, chloride, manganese, zinc, iron, copper, iodine, selenium, cobalt and antioxidants

3.0 Results and Discussions

3.1 The Growth Performance of Broiler Chickens Fed Varying Dietary Levels of TLM

The Growth performance of broiler chickens fed varying dietary levels of TLM is shown in Table 3.1 below. The initial weights of the birds were about 125g across the treatment groups. The final weight of the birds after seven (7) weeks showed that T4 (1994.44 ± 34.69) had the heaviest weight compared to T1 (1839.89 ± 58.42) while T2 (1901.67 ± 60.85) and T3

(1938.89 ± 67.36) were significantly (P>0.05) similar to both T1 and T4. Comparable observations were made for total weight gain, where birds in T4 (1869.44 ± 34.69) gained the most weight compared to birds in T1 (1713.89 ± 58.53) that had the least weight while T2 (1781.32 ±71.18) and T3 (1813.89 ± 67.36) were significantly similar to both T1 and T4. This was also evident in daily weight gain. The birds in T4 (38.15 ± 0.70) gained more weight than birds in T1 (34.98 ± 1.19) while T2 (36.35 ± 1.45) and T3 (37.02 ± 1.37) were

Table 3.1: Growth indices of broilers fed varying levels of TLM

Parameters	T1	T2	T3	T4
Initial weight (g)	125 ± 0.00	127 ± 0.00	125 ± 0.00	125 ± 0.00
Final weight (g)	1839.89 ± 58.42[b]	1901.67 ± 60.85[ab]	1938.89 ± 67.36 [ab]	1994.44 ± 34.69 [a]
Weight gain(g)	1713.8900± 58.53[b]	1781.32 ±71.18 [ab]	1813.89 ± 67.36 [ab]	1869.44± 34.69 [a]
Daily weight gain (g)	34.98 ± 1.19[b]	36.35 ± 1.45 [ab]	37.02 ± 1.37 [ab]	38.15 ± 0.70 [a]
Total feed Intake	4159.07 ± 94.18	4298.88 ± 25.99	4253.30 ± 125.73	4334.63 ± 102.53
Daily feed Intake	84.88 ± 1.92	87.87 ± 0.46	86.80 ± 2.57	86. 80 ± 4.18
Feed conversion ratio (FCR)	2.44 ± 0.07	2.43 ± 0.06	2.33 ± 0.12	2.28 ± 0.13

[a-b] Means along the same row with different superscript are significantly (p>0.05) different.

similar (P> 0.05) to T1 and T4. This result aligns with the result of Ekine *et al.* (2020) and Duranni, (2006), who found a significant increase in body weight of broilers fed turmeric diet but disagrees with the works of Sherif *et al.* (2022) and Nouzarian *et al.* (2011), who reported no significant differences in body weight of broiler chickens fed diet supplemented with turmeric powder. The weights of birds were seen to increase as the levels of TLM increased. This increase in the weight of the birds may be attributed to the antioxidant activities of curcumin and other phenolic compounds present in turmeric leaf meal which improves nutrient absorption thereby enhancing digestive enzyme activities of the birds.

The feed conversion ratio (FCR) of broilers across the dietary groups was not influenced (P>0.05) by TLM but was noticed to decrease with an increase in TLM. Birds in T1 (2.44 ± 0.07) had the highest, followed by T2 (2.43 ± 0.06) and T3 (2.33 ± 0.12) respectively, while birds in T4 (2.28 ± 0.13) had the least FCR. The presence of phytogenic substances like curcumin in TLM may have enhanced nutrient utilization leading to increased weights. This result is in consonance with the reports of Olumide and Akintola (2018) as well as Emadi and Kermanshahi, (2006) who recorded no influence (P>0.05) of scent leaf (*Ocimum gratissimum)* meal and turmeric powder respectively on the FCR of broiler chickens. There were no significant variations in total feed intake and daily feed intake of birds fed TLM. The total feed intake ranged from 4159.07 ± 94.18 to 4334.63 ± 102.53 while daily feed intake ranged 84.88 ± 1.92 to 86. 80 ± 4.18. This shows that the addition of TLM did not affect the palatability of the feed in turn the acceptability of the feed. Similar result was observed by Sunmola *et al.* (2023).

3.2 Carcass Characteristics and Organs of Broilers Fed Varying Levels of Turmeric Leaf Meal (TLM)

Table 3.2 below shows the carcass characteristics and organ weights of broilers fed varying dietary levels of TLM. Live weight, dressed weight, eviscerated weight, dressing percentage, weights of various carcass parts (thigh, drumstick, breast, back, wing, neck), and weights of different organs (gizzard, liver, kidney, lungs, proventriculus, intestine) were measured.

Table 3.2: Carcass characteristics and internal organs of broilers fed varying levels of turmeric leaf meal (TLM)

Parameters	T1 0%	T2 0.5%	T3 1.0%	T4 1.5%
Live weight	1683.33 ±57.74^{bc}	1583.33 ± 76.38^{c}	1816.67 ± 76.38^{ab}	1900.00 ±180.28^{a}
Dressed weight	1433.33 ± 76.38	1450.00 ± 86.60	1633.33 ± 57.74	1666.67 ± 208.17
Eviscerated weight	1183.33 ± 28.87^{b}	1250.00 ± 50.00^{b}	1350.00 ± 50.00^{ab}	1604.00± 321.42^{a}
Dressing %	85.13 ± 3.07	91.50 ± 1.96	90.02 ± 5.26	87.55 ± 2.56
Thigh	14.19 ± 0.75	13.75 ± 0.43	13.97 ± 0.72	12.92 ± 0.65
Drumstick	13.98 ± 0.56^{a}	12.42 ± 0.28^{b}	11.30 ± 0.27^{c}	11.72 ± 0.52^{bc}
Breast	24.34 ±2.23	23.86 ± 1.33	23.05 ± 0.82	24.53 ± 3.61
Back	17.47 ± 0.95^{a}	13.62 ± 0.80^{b}	14.83 ± 1.18^{b}	15.19 ± 0.90^{b}
Wing	10.48 ± 0.57^{a}	9.27 ± 0.21^{b}	9.22 ± 0.18^{b}	8.61 ± 0.62^{b}
Neck	10.48 ± 0.57^{a}	5.54 ± .0.61^{b}	5.80 ± 0.57^{b}	4.94 ± 0.65^{b}
Gizzard	2.64 ± 0.32^{a}	2.31 ± 0.43^{ab}	2.32 ± 0.31^{ab}	1.91 ± 0.22^{b}
Liver	2.87 ± 0.08	2.80 ± 0.44	3.14 ± 0.48	2.67 ± 0.76
Kidney	0.63 ± 0.16^{ab}	0.71 ± 0.04^{a}	0.60 ± 0.06^{ab}	0.49 ± 0.06^{b}
Lungs	0.63 ± 0.16^{ab}	0.71 ± 0.04^{a}	0.60 ± 0.06^{ab}	0.49 ± 0.06^{b}
Proventriculus	0.45 ± 0.10	0.57 ± 0.08	0.49 ± 0.02	0.46 ± 0.15
Intestine	6.60 ± 0.86	6.39 ± 0.23	7.00 ±1.05	7.19 ± 1.65

$^{a-c}$ Means along the same role with different superscript are significantly different.

The live weight of the broilers showed a trend of increasing with higher TLM inclusion levels, mirroring the findings from final weight in Table 3.1. The T4 group (1.5% TLM) exhibited the highest live weight (1900.00 ± 180.28), which was significantly greater than the T1 (1683.33 ± 57.74) and T2 (1583.33 ± 76.38) groups. The T3 group (1.0% TLM) also showed a significantly higher live weight compared to T2. Similar trends were observed for dressed weight and eviscerated weight, although the statistical significance was only evident for eviscerated weight, where the T4 group (1604.00 ± 321.42) was significantly ($P<0.05$) heavier than the T1 (1183.33 ± 28.87) and T2 (1250.00 ± 50.00) groups.

These results suggest that TLM supplementation, particularly at 1.0% and 1.5%, contributes to heavier live and eviscerated weights, indicating a positive impact on overall carcass yield. There were significant differences in live weight and eviscerated weight while dress weight

and dressing percent were not influenced (P>0.05) by TLM. Birds fed the highest percentage (1.5%) of TLM (T4) had the heaviest live weight (1900.00±180.28) compared to birds in T1 (1683.33±57.74) which was the control and the birds in T2 that were fed the least percentage of TLM (0.5%). The eviscerated weight of birds from T4 (1604.00±321.42) was also greater than (P<0.05) those of birds in T1 (1183.33 ±28.87), T2 (1250.00±50.00) and T3 (1350.00±50.00) which were similar (P>0,05) to each other.

The dressed weight ranged from 1433.33 ± 76.38 to 1666.67 ± 208.17 while the dressing percentage ranged from 85-91%. This result agrees with the result of Mehala and Moorthy (2008) who did not observe any significant influence of turmeric powder (up to 10 g/kg of diet) on carcass percentage of broiler chickens reared to six weeks of age but disagrees with Sunmola *et al.*, (2023) who reported highest dressing percentage for birds fed the highest inclusion levels of turmeric. However, the addition of turmeric leaf meal to broiler chicken diet improved the live weight and eviscerated weight of the chickens but did not affect the dressed weight and dressing percentage of the birds. Furthermore, the thigh, breast muscles, liver, proventriculus and intestines were not influenced by the treatments. The drumsticks, back, wings, neck, gizzard, kidney and lungs were remarkably (P<0.05) reduced in weight compared to the control. Contrary to the result of this study, higher dressing percentage, higher breast, thigh and giblet weights were reported for chickens fed 5g/kg turmeric powder in their diets (Durrani *et al.*, 2006). The liver, heart, gizzard were not affected when fed with turmeric as noted by Mondal *et al.* (2015). Since the liver plays a major role in nutrient metabolism (Udedibie and Omekam, 2001) and its size was not influenced in this study, it therefore implies that inclusion of turmeric leaf meal has no detrimental effect on metabolism

4.0 Conclusion

The result of this study reveals that adding turmeric leaf meal (TLM) at 1.5% in broiler chicken diet significantly improved broiler growth without adverse effects on carcass yield and internal organ development. Incorporating TLM into commercial feeds may improve productivity without compromising absolute carcass yield while aligning with consumer demand for residue-free meat.

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