CARCASS CHARACTERISTICS AND SENSORY PROPERTIES OF BROILER CHICKEN FED DIETS CONTAINING GARLIC, GINGER AND TURMERIC AS FEED ADDITIVES

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ABSTRACT
A total of one hundred and ninety-eight (198) broiler chicks were used in a 56-day feeding trial to determine the carcass characteristics and sensory properties of broiler chickens fed diets containing garlic, ginger and turmeric as additives. The birds were randomly allocated into six (6) treatments (T1-T6). Each treatment had three replicates with eleven (11) birds per replicate. T1 was the control diet; T2 had an inclusion level of 0.75 % turmeric; T3 had an inclusion level of 0.75 % turmeric and 0.50 % garlic; T4 had an inclusion level of 0.75 % turmeric and 1.00 % inclusion level of garlic; T5 had an inclusion level of 0.75 % turmeric and 0.50 % inclusion level of ginger; T6 had an inclusion level of 0.75 % turmeric and 1.00 % inclusion level of ginger. The birds were offered feed and clean drinking water ad libitum for eight weeks. At the end of the feeding trial, two birds from each replicate were randomly selected and deprived of feed for 12 hours; then weighed to determine their live weights. The birds were then slaughtered, by cutting their jugular veins to allow proper bleeding. The slaughtered birds were defeathered using hot water and eviscerated to evaluate their carcasses. The results showed that there were no significant (P>0.05) differences in the values obtained for dressing percentage and the primal cuts such as neck, wings, breast, thigh, drumsticks, shanks and back. However, there were significant (P<0.05) differences in the values obtained for live weight, defeathered weight, dressed weight and weight of the head. For the sensory properties, there were no significant (P>0.05) differences in the values obtained for appearance, flavour, aroma and overall acceptability. However, there were significant (P<0.05) differences in the values obtained for juiciness and tenderness. The highest juiciness value was recorded in broiler birds fed diet T6 (8.35) but was not significantly different from those recorded for broiler birds fed diet T2 (7.85), T3 (8.00), T4 (7.75) and T5 (7.95). The least value (7.55) was recorded in broiler groups fed the control diet T1. It can be concluded that the inclusion level of 0.75 % turmeric and 1.0 % inclusion level of garlic as feed additives in broiler diet improved the live weight, defeathered weight and dressed weight of broiler chicken. It also improved the sensory properties of the meat of broiler chicken, especially the juiciness and tenderness.
Keywords: **Carcass characteristics, sensory properties, feed additives, broiler chicken.**

INTRODUCTION

Nigeria has the highest population in Africa, which is estimated to be over 200 million. This population is continuously growing, and needs to be fed with quality protein from both plant and animal origin. The daily intake of animal protein is estimated to be 7 g, which falls short of the 35 g recommended per head per day by the Food and Agriculture Organization of the United Nations (FAO, 2005).

The Nigerian poultry industry has been rapidly expanding in recent years, and is one of the most commercialized sub-sectors of the Nigerian agriculture (Adene and Oguntade, 2006). The popularity of poultry production can be explained by the fact that poultry has many advantages over other livestock. Poultry birds are good converters of feed into usable protein in meat and eggs. The production costs per unit remain relatively low, and the return on investment is high. Therefore, farmers need a relatively small amount of capital to start a poultry farm (Ojo, 2003; Aboki, 2013). Also, poultry meat is very tender and its acceptability to consumers is high, regardless of their religious beliefs. Also, of importance, is the fact that the production cycle is quite short, so capital is not tied up over a long period of time (Ojo 2003; Aboki, 2013).

Feed additives are minor components of the animal ration that are used for improving the quality or digestibility of feed, improving the nutritive and aesthetic quality of food or improving animal performance and health. The main aim of adding feed additives to the diet of broiler chicken is to

improve the growth rate, achieve better feed conversion efficiency, greater livability and reduced mortality. It is reported that up to one third of all commercial chicken rations in Europe now use mixture of herbs and spices to accelerate growth and maintain health (Odoemelam *et al.,* 2013). Turmeric improves the growth performance when added at the rate of 0.75 % level as feed additive in broiler feeds (Kafi *et al*., 2017); ginger at 0.75 % (Duwa *et al*, 2020) and garlic at 1.0 % (Karangiya *et al*, 2016). It is the aim of this study to examine the combined effect of turmeric, ginger and garlic as feed additives on the carcass characteristics and sensory properties of the meat of broiler chicken. These additives are reported to have antioxidants, antibacterial, anti-inflammatory, antiseptic, anti-parasitic, anti-diabetic, hypocholesteroemic and immunomodulatory properties (Chattopadhyay *et al*., 2004; Dieumou *et al*., 2009; Morakinyo *et al*., 2011).

MATERIALS AND METHODS

Experimental site

This study was conducted at the Poultry Unit of the Department of Animal Production Teaching and Research Farm, Gidan Kwano Campus, Minna. Minna is located within latitude 09° 36' 50'"N and longitude 06° 33' 25"E respectively. It has an attitude of 700 kilometers above sea level, and bounded by River Niger which runs through the North - Western part down to the South - Western part of the State. It falls within the Southern Guinea Savannah agro-ecological zone of the country. The average rainfall is 1209.7 mm (Minna Niger Geography, 2004 - 2017).

Experimental design and management of the experimental birds

The experimental design was a completely randomized design (CRD) model. A total of one hundred and ninety-eight (198) broiler chicks were used for the study. The birds were randomly divided into six (6) treatment groups having 3 replicates with 11 broiler chicken per replicate and placed in a 2.6 m × 3 m deep litter pen (with fresh wood shavings), under an intensive system of management. Coal lit stoves were used to provide heat during brooding for 21 days for the birds. At the commencement of the experiment, chicks in each replicate were weighed individually; feed and water were supplied *ad libitum* throughout the period of the feeding trial which lasted for eight weeks.

Experimental diets

A single phase diet was compounded for both starter and finisher phases with varying levels of additives inclusion thus: Treatment 1 served as control diet, without turmeric, ginger and garlic; Treatment 2 contained 0.75 % of turmeric only; Treatment 3 contained 0.75 % of turmeric and 0.50 % garlic; Treatment 4 contained 0.75 % turmeric and 1.00 % garlic; Treatment 5 contained 0.75 % turmeric and 0.50 % ginger while Treatment 6 contained 0.75 % turmeric and 1.0 % ginger. Each of the diets was formulated to contain 22 % CP and 3000 Kcal/kg metabolizable energy (ME). Table 1 shows the ingredient composition of the experimental diets as well as the calculated nutrient composition of these diets.

Data Collection

Carcass characteristics and sensory evaluation

At the end of the feeding trial, two birds from each replicate were randomly selected, deprived of feed for 12 hours, and then weighed to determine their live weights. The birds were then slaughtered by cutting their jugular veins, to allow proper bleeding, and their weights recorded as slaughtered weights. The slaughtered birds were defeathered using hot water and eviscerated to evaluate their carcasses. The weight of the primal cuts of the dressed carcasses were taken: breast, back, thighs, wings, shanks and drumsticks as well as the weights of the internal organs (visceral). Thereafter, the carcasses were deboned and packed for sensory evaluation. And for the sensory evaluation, equal parts of the breast and drumsticks from the carcasses of the birds of the six treatment groups were collected. The meat samples were cooked by boiling at 100^0C for 20 minutes, with little quantity of salt added to improve the taste. Boiled meat samples were then placed in covered containers individually, coded and then displayed on a long table for evaluation by twenty semi trained panelists, using a nine-point Hedonic Scale as follows:

Table 1: Ingredients composition of the experimental diets for both the starter and finisher phases

Ingredients (%)	T1	T2	T3	T4	T5	T6
Maize	50.00.	50.00	50.00	50.00	50.00	50.00
Maize offal	4.00	3.25	2.75	2.25	2.75	2.25
Garlic	0.00	0.00	0.5.0	1.00	0.00	0.00
Ginger	0.00	0.00	0.00	0.00	0.50	1.00
Turmeric	0.00	0.75	0.75	0.75	0.75	0.75
Soya bean meal	10.00	10.00	10.00	10.00	10.00	10.00
Full fat soya	28.50	28.50	28.50	28.50	28.50	28.50
Fish meal	2.00	2.00	2.00	2.00	2.00	2.00
Limestone	2.00	2.00	2.00	2.00	2.00	2.00
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00
Common salt	0.25	0.25	0.25	0.25	0.25	0.25
*Premix	0.25	0.25	0.25.	0.25	0.25	0.25
L-Lysine	0.50	0.50	0.50	0.50	0.50	0.50
DI-Methionine	0.50	0.50	0.50	0.50	0.50	0.50
	100.00	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated analysis						
Crude protein (%)	22.16	22.09	22.04	21.99	22.04	22.00
Metabolizable energy (Kcal/kg)	2997	2978	2965	2953	2965	2953
Crude fibre (%)	4.26	4.17	4.11	4.05	4.11	4.05
Ether extract (%)	8.09	8.07	8.05	8.04	8.05	8.04
Lysine (%)	1.64	1.64	1.63	1.63	1.63	1.63
Methionine (%)	1.12	1.12	1.12	1.12	1.12	1.12
Calcium (%)	1.44	1.44	1.44	1.44	1.44	1.44
Phosphorus (%)	0.63	0.63	0.63	0.63	0.63	0.63

**2.5 kg of the premix contained Vitamin A1,000,00 i.u, Vitamin D_3 200,000 i.u, Vitamin E 2300, Vitamin K_3 200.00mg Vitamin B_1 180, Vitamin B_2 550, Niacin 2,750mg, Pantothenic acid 750mg, Vitamin B_6 Vitamin B_{12} 1.5mg, Folic acid 75mg, Biotin $H_2$6mg choline chloride 30,000mg, Cobalt 20mg, Copper 300mg, Iodine 100mg, Iron 2000mg, Manganese 4,000mg Selenium 20mg, Zinc 3000mg, Antioxidant 125mg*

T1 = Control diet
T2 = Normal diet + 0.75% dietary inclusion level of Turmeric only
T3 = 0.75% dietary inclusion level of Turmeric + 0.50% dietary inclusion level of Garlic
T4 = 0.75% dietary inclusion level of Turmeric + 1.0% dietary inclusion level of Garlic
T5 = 0.75% dietary inclusion level of Turmeric + 0.50% dietary inclusion level of Ginger
T6 = 0.75% dietary inclusion level of Turmeric + 1.0% dietary inclusion level of Ginger

dislike extremely (1), dislike very much (2), dislike moderately (3), dislike slightly (4), neither like or dislike (5), like slightly (6), like moderately (7), like very much (8), and like extremely (9). Each member of the taste panel was made to rinse his or her mouth with provided bottled water before tasting the meat from a specific treatment, and then rinse his or her mouth thereafter. The parameters on which the meat samples were evaluated are as follows: aroma, taste, juiciness, tenderness and general acceptability.

Data analysis

Data collected were subjected to a one-way analysis of variance (ANOVA) based on a completely randomized design model, using the statistical analytical system (SAS, 2000). Where means were significant, they were separated using the Duncan Multiple Range Tests, as contained in the Package.

RESULTS AND DISCUSSION

The carcass characteristics of broiler chicken fed diets containing garlic, ginger and turmeric as feed additives is presented in Table 2 while the sensory properties of the meat of broiler chicken fed the additives diets is presented in Table 3.

Table 2: Carcass characteristics of broiler chicken fed feed additives-based diets

Parameters	T1	T2	T3	T4	T5	T6	SEM	P-value
Live weight (g)	1681.00^{b}	1628.70^{b}	1764.30^{ab}	1860.30^{a}	1658.00^{b}	1759.00^{ab}	25.48	0.05
Def. weight (g)	1582.70^{ab}	1541.70^{b}	1658.70^{ab}	1733.30^{a}	1549.30^{b}	1649.30^{ab}	23.25	0.05
Dressed weight (g)	1163.00^{b}	1162.00^{b}	1244.30^{b}	1339.30^{a}	1169.00^{b}	1244.70^{b}	18.01	0.05
Dressing (%)	69.19	71.45	70.65	72.01	70.48	70.79	0.44	0.63
Cut up parts (% dressed weight)								
Head	3.66^{bc}	3.53^{bc}	3.87^{ab}	3.03^{c}	3.94^{bc}	4.47^{a}	0.14	0.03
Neck	6.39	6.97	5.57	6.30	6.47	6.69	0.19	0.47
Wings	15.91	17.82	18.04	15.36	17.58	19.16	0.72	0.72
Breast	29.31	30.66	26.84	31.98	28.07	26.37	0.77	0.24
Thigh	17.50	16.92	16.92	17.13	16.64	18.08	0.24	0.64
Drumsticks	15.04	14.36	16.10	14.81	15.32	15.80	0.32	0.72
Shanks	6.06	9.55	6.70	8.26	6.33	7.01	2.38	0.50
Back	17.69	16.84	17.70	17.74	18.19	17.74	1.38	0.94

^{abc}Means with different superscripts in the same row differs significantly (P<0.05).
T1 = Control diet
T2 = Normal diet + 0.75 % dietary inclusion level of Turmeric
T3 = 0.75 % dietary inclusion level of Turmeric + 0.50 % dietary inclusion level of Garlic
T4 = 0.75 % dietary inclusion level of Turmeric + 1.00 % dietary inclusion level of Garlic
T5 = 0.75 % dietary inclusion level of Turmeric + 0.50 % dietary inclusion level of Ginger
T6 = 0.75 % dietary inclusion level of Turmeric + 1.00 % dietary inclusion level of Ginger
Def. Wt = Defeathered weight; SEM = Standard error of the means; P-Value = Probability value

Table 3: Sensory properties of the meat of broiler chicken fed feed additives-based diets

Parameters	T1	T2	T3	T4	T5	T6	SEM	P-value
Juiciness	7.55^{b}	7.85^{ab}	8.00^{ab}	7.75^{ab}	7.95^{ab}	8.35^{a}	0.09	0.05
Appearance	7.50	7.95	7.80	7.65	7.60	7.80	0.08	0.68
Flavour	8.05	8.05	7.75	7.95	7.70	7.65	0.08	0.55
Aroma	7.55	7.75	7.90	8.05	7.90	8.05	0.08	0.47
Tenderness	7.90^{b}	8.00^{ab}	8.00^{ab}	8.20^{ab}	8.15^{ab}	8.45^{a}	0.08	0.05
Overall accpt	8.30	8.20	8.20	8.60	8.20	8.40	0.07	0.47

^{abc}Means with different superscripts in the same row differs significantly (P<0.05).

T1 = Control diet
T2 = Normal diet + 0.75 % dietary inclusion level of Turmeric
T3 = 0.75 % dietary inclusion level of Turmeric + 0.50 % dietary inclusion level of Garlic
T4 = 0.75 % dietary inclusion level of Turmeric + 1.00 % dietary inclusion level of Garlic
T5 = 0.75 % dietary inclusion level of Turmeric + 0.50 % dietary inclusion level of Ginger
T6 = 0.75 % dietary inclusion level of Turmeric + 1.00 % dietary inclusion level of Ginger
accpt = acceptability; SEM = Standard error of the means; P-Value = Probability value

The results show that the additives did not significantly (P>0.05) influence the weight of the cut-up-parts of broiler chicken. This is in line with the findings of Dieumou *et al*. (2009) and Pourali *et al*. (2010) who reported that carcass parts were not significantly affected by the consumption of ginger and garlic. This is however contrary to the results of Raeesi *et al*. (2010) who reported a significant effect on the carcass parts of broilers fed with garlic. The authors noted that these herbs may have controlled and limited the growth and colonization of numerous pathogenic and non-pathogenic species of bacteria in the gut, leading to improved conversion of feed to meat. The sensory evaluation of broiler chicken fed diets supplemented with garlic, ginger and turmeric revealed that the meat tenderness and juiciness were significantly improved (P<0.05). This is in agreement with the findings

of Barreto *et al*. (2008) and Musa *et al*. (2020) when different mixture of additives were fed to broiler chicks This is a clear indication that the additives contain phytochemicals which enhanced the quality of the meat.

CONCLUSION AND RECOMMENDATIONS

It can be concluded that the inclusion level of 0.75 % turmeric and 1.0 % inclusion level of garlic as feed additives in broiler diet improved the live weight, defeathered weight and dressed weight of broiler chicken. It also improved the sensory properties of the meat of broiler chicken, especially the juiciness and tenderness. Hence, 0.75 % dietary inclusion level of turmeric and 1.00 % level of garlic is recommended for broiler chicken for optimum live weight; and for producing juicy and tender carcass.

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