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EFFECTS OF DIETARY TURMERIC (*CURCUMA LONGA*) RHIZOME POWDER ON LIPID OXIDATION AND SENSORY ATTRIBUTES OF BROILER CHICKENS MEAT

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ABSTRACT

This study was conducted to evaluate the effect of feeding mixing varying levels of Turmeric (Curcuma longa) Rhizome Powder (TRP) on lipid oxidation and sensory attributes of broiler chickens meat using two-hundred-broiler chickens randomly allotted to four dietary treatments with 250g, 500g, 750g and 0g/100 kg of diet representing T1, T2, T3 and T4 respectively in a completely randomized design. The results indicated significant differences in lipid oxidation of all the treatments. The TBARS values detected in T4 (Control) had highest value (0.29 mg MDA/kg) while T3 which contained highest level of TRP (750g) supplementation recorded lowest (0.13 mg MDA/kg) TBARS value. However, there were no significant differences in sensory properties except meat colour where colour of the treatments (T1-T3) increased with increase in the quantity of TRP. Irrespective of inclusion level, Turmeric Rhizome Powder (TRP) had influence lipid oxidation of the treatments evaluated. Similarly, TRP did not have much effect on sensory parameters. The present study showed that supplementation of TRP could be effective in inhibiting lipid oxidation and enhancing antioxidant capacity. The study recommended higher inclusion levels of TRP powder due to the positive effects on lipid oxidation status and enhancement of broiler chicken meat colour.

Keywords: plant powder broiler chickens, oxidative deterioration, sensory

Introduction

Lipid oxidation is a major cause of deterioration in the quality, which in turn determines the shelf life and consumer acceptance of meat and meat products (Jacobsen & Bertelsen, 2000). Oxidative changes are the main non-microbial causes of quality deterioration of meat (Descalzo *et al*., 2005; Xiong *et al*., 2007).

There are several components arising from both internal and external sources responsible for initiating lipid oxidation in muscle foods. For example, during handling, processing and storage of fresh meat, endogenous iron is partially responsible for the catalysis of lipid oxidation, formation of rancid odours and other off-flavours (Descalzo *et al*., 2005; Gatellier *et al*., 2005) Studies have indicated significant increase in feeds containing no chemical

additives by poultry producers in developed and developing countries due to health concern (Hertrampf, 2001; Abubakar *et al*., 2021;). Therefore, scientist have intensified efforts to search for feed additive and find alternatives to antibiotic growth promoters in poultry diets (Humphrey *et al*., 2002; Najafi & Torki, 2010; Zhang *et al*., 2014**).**

Turmeric (*Curcuma longa*) from the family Zingiberacae contains active constituents such as tetrahydrocurcuminoids, bisdemethoxycurcumin, demethoxycurcumin and curcumin (Kafi *et al*., 2015; Fallah & Mirzaei, 2016). Furthermore, studies (Khan *et al*., 2012; Johannah *et al*., 2018; Vlaicu *et al*., 2021) have demonstrated activities of turmeric and their relative compounds as antioxidant, anti-inflammatory, anti-viral and nematocidal. For instance, Fallah & Mirzaei (2016) investigate the effects of dietary inclusion of turmeric and thyme powders and the results showed increased anti body, lowest FCR, highest feed intake as well as lower uric acid, total cholesterol, HDL, LDL and triglyceride concentrations compared to the control groups. Therefore, the objective of this study was to investigate the effect of graded levels of dietary supplementation of TRP on lipid oxidation and sensory parameters of broiler chickens meat.

Materials and Methods

The study area

The study was conducted at the poultry production unit of the department of Animal science, Usmanu Danfodiyo University, Sokoto, Nigeria. Sokoto is located between latitude $11^0\,30^1$ -$13^0\,50^1$ N and longitude $4^0\,0^1$-$6^0\,40^1$ E in the semi-arid zone of northern Nigeria. Sokoto lies on altitude of 350m above sea level (Mamman *et al.,* 2000) and annual rainfall of about 760mm with high temperature range of 35-40^{o}C. Sokoto state is characterized by scanty vegetation, made up of few trees and abundant shrubs and grasses.

Experimental design and diets

The treatment groups (4 treatments, replicated 5 times with 10 birds/ replicate) were allocated in a Completely Randomized Design (CRD). Four starter and finisher diets were formulated to provide a similar nutrient profile with the exception of using feed additive (TRP). The treatments were assigned as:

T1: Formulated feed supplemented with TRP (250 g/100 kg diet)
T2: Formulated feed supplemented with TRP (500 g/100 kg diet)
T3: Formulated feed supplemented with TRP (750 g/100 kg diet)
T4: Formulated feed supplemented with TRP (0g/100 kg diet)

Table 1 showed Four (4) Iso-caloric and Iso-nitrogenous diets fed to the experimental broiler chickens for seven (7) weeks at the starter and the finisher phases.

Experimental birds and their management

A total of 200 day-old broiler chickens were sourced from a reputable company in Nigeria and prior to the experiment the experimental house was cleaned, washed and disinfected. Vaccination against Newcastle and Gumboro diseases as at when due and other standard management practices were observed according to the recommendations of Oluyemi and Roberts (2000). Feed and clean fresh water were given to the birds *ad-libitum*.

Table 1: Gross and Calculated Chemical Composition of Starter and Finisher Diets

Ingredients (Kg)	**STARTER**	**FINISHER**
Maize	53.5	50.5
	14.0	15.0
GNC	15.0	13.0
Fish meal	2.0	2.0
Wheat Offal	11.0	12.0
Limestone	2.0	5.4
Bone meal	1.5	3.0
Minerals and Vitamins Premix	0.25	0.25
Salt	0.25	0.25
Methionine	0.25	0.25
Lysine	0.25	0.3
Total	**100 Kg**	**100 Kg**
Crude Protein	21 %	19 %
Energy (Kcal/Kg)	3000	2800
Methionine	0.5	0.5
Lysine	1.0	1.0
Calcium	1.3	2.8
Phosphorus (Available)	0.5	0.7
Crude Fibre (%)	5.3	5.5

* SBM = Soya Bean Meal GNC= Ground Nut Cake

Sampling and sample size

At seven (7) weeks, the experiment was terminated. A total of one hundred birds, 25 birds per treatment from the four (4) treatments were selected based on stratified sampling method and starved of feed but left with drinking water for 6 hours and slaughtered according to halal procedure, hoisted for about 10 minutes. The birds were defeathered, eviscerated and breast muscles were sampled for subsequent meat quality evaluation according to the procedure described by Garba *et al*. (2019).

Data Collection

Meat lipid oxidation

Meat samples were subjected to lipid oxidation analysis. Data on lipid oxidation was measured as 2-thiobarbituric acid reactive substances (TBARS) using Quanti Chrom TM TBARS Assay Kit (DTBA-100, Bio Assay Systems, USA) following the instruction of the manufacturer.

Sensory Evaluation

The breast muscle was placed on steel trays covered using aluminium foil and oven cooked with salt and spices at 180◦C for approximately 30 min to an internal temperature of 72◦C, which was measured using a thermometer with a handheld probe (Fluke 51 II**,** Fluke Europe B.V.**,** Eindhoven, Netherlands). The cooked breast was cut into approximately 2 × 2 × 2 cm pieces and kept warm until the slices were served. The panelist tasted and assessed colour, aftertaste, flavor, juiciness and tenderness of blind coded samples using numbers.

Data Analysis

Data on lipid oxidation and sensory attributes were analyzed using the General Linear Model procedure of Statistical Analysis System (SAS)

package version 9.2 software (SAS, 2007). Significant differences between means were detected using Duncan's multiple range tests and statistical significance was set at P<0.05.

Results and Discussion

Meat lipid oxidation

Figure 1 showed the level of thiobarbituric acid reactive substance at different levels of dietary TRP. The results have indicated significant differences among the treatments. Level of supplementation affects the TBARS values detected in T4 (Control) had highest value (0.29 mg MDA/kg) while T3 which contained highest level of TRP (750g) supplementation recorded lowest (0.13 mg MDA/kg) TBARS value.

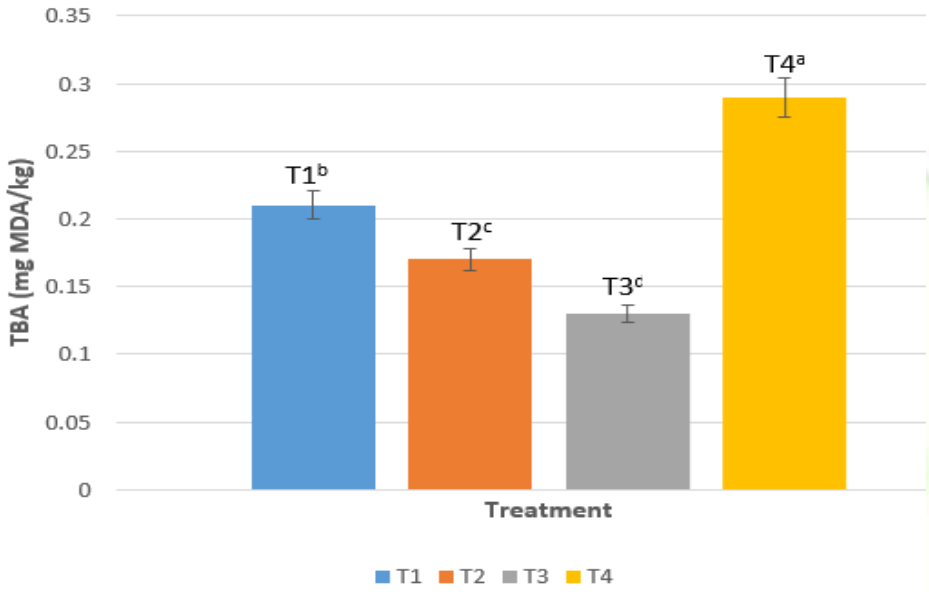

Figure 1: TBARS values mg MDA/kg meat error bars indicate SEM

Results of lipid oxidation in the present study have demonstrated the ability of the test ingredient (TRP) to suppressed TBARS value of the broiler chicken meat. Treatment 3 with highest level of TRP (750g) supplementation recorded lowest (0.13 mg MDA/kg) TBARS value while T4 (Control) had highest value (0.29 mg MDA/kg). This may suggests that very low lipid oxidation occurred in the meat with low and higher level of TRP. Furthermore, the TBARS values are within the acceptable level (Wood *et al.*, 2008). The demand for pre-cooked, refrigerated and/or ready to-eat food has witnessed a tremendous growth recently. But, preparation of such food products involves processes such as mincing and cooking prior to refrigeration which are known to accelerate lipid peroxidation of meat causing rancidity and thereby a deterioration of quality (Tichivangana *et al.*, 1985).

Poultry meat was reported to be more susceptible to such oxidative deterioration (Igene & Pearson, 1979). Addition of synthetic antioxidants to either feed as feed additive or to meat products has been shown to improve the quality of meat (Castañeda *et al.*, 2005). Nevertheless, reports on the carcinogenicity of synthetic antioxidants paved the way for identification of natural antioxidants as feed additives (Chen *et al.*, 1992). Dietary

supplementation of Rosemary, Sage and Oregano has shown to improve the oxidative stability and reduce lipid peroxidation of raw and precooked broiler meat during refrigeration (Lopez-Bote *et al*., 1998; Botsoglou *et al*., 2002). Recently, it has been shown that the use of oregano extract as a poultry feed additive improved growth performance and systemic antioxidative capacity of the chicks with an effective inhibition of lipid peroxidation leading to better quality of the meat and bird's health (Ri *et al*., 2017). The present study demonstrated a significant enhancement in the antioxidant status when broiler chicken diet is supplemented with TRP as feed additive.

Sensory Attributes of Broiler Chicken Fed Turmeric Rhizome Powder

Addition of TRP in the diet of broiler chickens indicated no significant effect (P>0.05) on the sensory attributes of the meat samples evaluated except colour of the meat (P<0.05).

Table 2: Effect of graded levels of TRP on sensory properties of broiler chicken meat

	Treatments/TRP Inclusion levels (g/100kg)				
Organoleptic Construct	**T1 (250g)**	**T2 (500g)**	**T3 (750g)**	**T4 (0g)**	**SEM**
Colour	65.3 [c]	78.20 [b]	85.60[a]	50.70 [d]	3.564
Aftertaste	82.20	82.10	82.50	82.60	4.863
Flavour	80.40	80.30	80.50	80.10	5.435
Juiciness	79.60	79.80	78.10	78.40	5.248
Tenderness	68.99	69.05	69.70	70.00	4.781

[a-d] Means within the same row with different superscripts are significantly different at P<0.05.
SEM= standard error of mean

The mean scores for organoleptic evaluation of meat of broiler chicken under different treatment groups were similar except colour of the meat. Thus, the various organoleptic parameters of broiler meat like after taste, flavor, texture, juiciness and overall acceptability were not affected due to supplementation of TRP in feed. Similar findings were also observed by Al-Sultan (2003) and Wattanachant *et al*. (2004) who showed non-significant differences in flavor and overall acceptance of broiler chicken meat among control and TRP treated groups.

Conclusion

Based on the findings of this work TRP addition could improve the antioxidant capacity of broilers and TRP supplementation did not affect sensory quality (Aftertaste, flavor, juiciness and tenderness) except improvement of the broiler chicken meat colour.

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