ISSN:
Print - 2277 - 0755
Online - 2315 - 7453

Journal of Agricultural Science and Environment

MEAT QUALITY CHARACTERISTICS OF IMPROVED INDIGENOUS CHICKENS (FUNAAB-ALPHA) FED TURMERIC (*Curcuma longa*) OR CLOVE (*Syzygium aromaticum*) AS FEED ADDITIVES

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ABSTRACT

The experiment was conducted to investigate meat quality of improved indigenous chickens (FUNAAB alpha) fed diet containing turmeric (*Curcuma longa*) and clove (*Syzigium aromaticum*) powders. One hundred and thirty-five (135) mixed sexed day-old improved indigenous FUNAAB alpha chicks were brooded collectively for two weeks, and assigned into three (3) treatment groups. Each treatment was replicated three times, consisting of fifteen (15) birds. Feed and water were provided *ad-libitum* through the duration of experiment**.** The control group was fed the basal diet at starter and finisher phases (T1), while the other groups were fed clove (*Syzygium aromaticum*) powder at 3 g/kg (T2) and turmeric (*Curcuma longa*) (T3) powder at 4 g/kg respectively as additives. Data obtained were subjected to a One – Way Analysis of Variance in a Completely Randomised Design. Muscle obtained after evisceration was subjected to quality analysis. Proximate composition of meat obtained from chickens fed the basal diet had the highest ($p<0.05$) moisture content value of 75.45% compared to other treatments. Water absorptive capacity and cook loss of meat obtained from chickens fed 4 g/kg dietary turmeric showed ($p<0.05$) values of 3% and 16.4% respectively. Meat sensory properties analysed revealed ($p<0.05$) score in groups fed 3g/kg and 4 g/kg clove and turmeric powders respectively, for tenderness (6.14) and overall acceptability (7.19). Meanwhile ($p<0.05$) lipoprotein profile was observed in group fed 4 g/kg turmeric powder. Inclusion, turmeric and clove had beneficial effects on FUNAAB Alpha.

Keywords: Meat Quality, improved indigenous chicken, Turmeric and Clove.

INTRODUCTION

Genetic diversity, adaptability to available feed, temperature fluctuations and other environmental stressors in the tropical regions have significant influence on livestock growth and subsequent quality of meat and its products. Improvement in body weight (1.6 - 2.1 kg at 20 weeks) of 4 generations of selected local chickens via artificial insemination was achieved by Adebambo (2005) with the FUNAAB Alpha chicken breed developed. Adebambo, (2015) cross-bred Indian locally bred dual purpose chickens with selected Nigerian local breed to improve body dimension and egg production.

Marcinčák *et al*. (2011) termed phytogenic feed additives as products derived from plants that can be incorporated into animal feed to stimulate improved productivity, ani-

mal hygiene, and product quality. Additionally, plant additives were added to feedstuffs to improve taste and smell of feed, with improved intake and growth of animals (Tanabe *et al*., 2002). They demonstrated this by evaluation of the impact of 22 selected herbs and spices on pigs with spice incorporation capable of eliciting beneficial meat properties.

Turmeric (*Curcuma longa*), is a rhizomatous herbaceous perennial flowering plant of the ginger family – *Zingiberacea* (Priyadarsini (2014), It contains an active compound called curcumin which has powerful anti-inflammatory and antioxidant properties (Kris, 2017). Jingfei *et al.* (2015) reported that incorporation of curcumin into basal diet of broiler chickens lowered excess production of reactive oxygen species, enhanced the antioxidant defence system as well as improved colour and water holding properties of broiler meat. Clove (*Syzygium aromaticum*), unlike turmeric is a dried flower buds from the clove tree (Megan, 2018). Friedman *et al.* (2002), documented that one teaspoon of clove contain a decent amount of manganese, fibre, vitamin C and K, which boost immunity and prevent blood clotting. This research is therefore designed to examine meat quality of improved indigenous chickens (FUNAAB Alpha) fed dietary clove and turmeric as additives.

MATERIALS AND METHODS

Experimental Site

The research was carried out at the College of Animal Science and Livestock Production (COLANIM) farm of the Federal University of Agriculture, Abeokuta (FUNAAB), Alabata Abeokuta Ogun State, Nigeria. The area lies on Latitude 7° 10'N and longitude 3° 2'E, it is 76m above sea level and located in the tropical rain forest vegetation zone with an average temperature of 37 ° C and relative humidity of 82%.

Processing of Test Ingredients

The turmeric (*Curcuma longa*) rhizome and clove (*Syzygium aromaticum*) pods were sourced from a reputable market in Abeokuta, Ogun State, were properly dried under ambient temperature until the moisture content was reduced and constant weight attained prior to milling into powdery form.

Experimental Birds and their Management

One hundred and thirty-five (135) unsexed day old FUNAAB Alpha chickens were used for the experiment. The experimental pens were thoroughly washed and disinfected before the commencement of the brooding and feeding trial. The birds were collectively brooded for two weeks and randomly allotted into three (3) treatment groups consisting of fifteen birds per replicate with average weights between 35 – 40g. The birds were fed *ad libitum* with diets containing either clove (*Syzygium aromaticum*) or turmeric (*Curcuma longa*) powders at different levels of inclusion for 6 weeks. At the expiration of the 6 weeks of feeding trial, meat quality analysis was carried out.

Experimental Diets and Design

The basal diet was formulated and the test ingredients were added to the basal diet as specified below.

T1 = Basal Diet (No dietary additives)
T2 = Basal Diet + 3g/kg of *Syzygium aromaticum*
T3 = Basal Diet + 4g /kg of *Curcuma longa*

Table 1: Gross composition (%) of Experimental diets at Starter Phase (2 – 4 weeks)

Ingredients (%)	Control	Clove (3 g/kg)	Turmeric (4 g/kg)
Maize	52.00	52.00	52.00
Wheat bran	4.30	4.30	4.30
Soybean meal	18.50	18.50	18.50
Groundnut cake	17.00	17.00	17.00
Fishmeal (72% CP)	2.20	2.20	2.20
Bone meal	3.00	3.00	3.00
Limestone	2.00	2.00	2.00
Salt	0.25	0.25	0.25
* Premix	0.25	0.25	0.25
Methionine	0.25	0.25	0.25
Lysine	0.25	0.25	0.25
Clove	-	+	-
Turmeric	-	-	+
Total	100.00	100.00	100.00

*Premix composition per kg diet: vitamin A: 400,000.00IU, vitamin D3:800,000IU, vitamin E: 9,200mg, vitamin K: 800.00mg, vitamin B6: 500mg, vitamin B12: 25.00mg, Niacin: 600.00mg, pantothenic acid: 200.00mg, folic acid: 200.00mg, biotin: 8.00mg, Mn: 300,000.00g, Zn: 20,000.00g, cobalt: 80.00mg, iodine: 40.00mg, chlorine: 80,000.00g, anti-oxidants: 800.00mg.

*Metabolizable Energy was calculated using the method described by Pauzenga, (1985)

Table 2: Gross composition (%) of experimental diets at Finisher phase. (5 – 8 weeks)

Ingredients (%)	Control	Clove (3g/kg)	Turmeric(4g/kg)
Maize	58.40	58.40	58.40
Wheat bran	10.60	10.60	10.60
Soybean meal	10.00	10.00	10.00
Groundnut cake	14.00	14.00	14.00
Fishmeal (72%)	1.00	1.00	1.00
Bone meal	3.00	3.00	3.00
Limestone	2.00	2.00	2.00
Salt	0.25	0.25	0.25
*Premix	0.25	0.25	0.25
Methionine	0.25	0.25	0.25
Lysine	0.25	0.25	0.25
Clove	-	+	-
Turmeric	-	-	+
Total	100.00	100.00	100.00
Determined analysis (%)			
Dry matter	83.70	83.50	82.13
Crude protein	19.10	19.58	19.60
Crude fibre	5.35	5.14	5.30
Ether extract	4.28	4.20	4.27
*ME (MJ/Kg)	11.85	11.29	11.36

*Premix composition per kg diet: vitamin A: 400,000.00IU, vitamin D3:800,000IU, vitamin E: 9,200mg, vitamin K: 800.00mg, vitamin B6: 500mg, vitamin B12: 25.00mg, Niacin: 600.00mg, pantothenic acid: 200.00mg, folic acid: 200.00mg, biotin: 8.00mg, Mn: 300,000.00g, Zn: 20,000.00g, cobalt: 80.00mg, iodine: 40.00mg, chlorine: 80,000.00g, anti-oxidants: 800.00mg.

*Metabolizable Energy was calculated using the method described by Pauzenga, (1985)

Chemical and Physical Analysis of Meat Samples

Proximate composition: Proximate composition of meat from the respective breast muscles were analysed using the method described by AOAC (2005).

Muscle pH: was determined by the method described by Kim *et al*. (2009).

Chilling Losses: 50 grams of breast muscle from each replicate in a treatment was weighed and labelled before chilling and weighed again after 24 hours of chilling at 4^0 C to determine the chilling loss.

Chilling loss (g) = weight before chilling – weight after chilling

Cook Losses Determination: Fifty (50) grams each from the breast muscles of each replicate was used to ascertain meat cook losses. Two replicates were chosen as representatives of each treatment group with the meat weighed, wrapped in separate airtight polythene bags and cooked in a water bath at 70^oC for 30 minutes. After cooking, residual moisture was removed from each sample and further allowed to cool to room temperature. Meat samples were weighed as follows:

Cook loss (g) = weight of samples before cooking (g) – samples weight after cooking (g)

Cook loss (%) = $\frac{\text{weight of samples before cooking – sample weight after cooking}}{\text{Weight before cooking}} \times 100\%$

Determination of Water Absorptive Power (WAP): Three (3.)grams of raw meat samples from the thigh was weighed and placed in test tubes; 10 ml of water was thereafter added and left for an hour. The sample was subsequently removed and re-weighed. The increase in weight of samples indicated volume of water absorbed.

Determination of Water Holding Capacity (WHC): Water Holding Capacity was determined via centrifugation technique as described by Hamm (1960). Triplicate of 15 grams of meat samples was placed in a Centrifuge tube, 2.25 ml of 0.6 M of common salt (NaCl) solution was added and the content stirred for a minute with a glass rod. Afterwards, the tube were placed in the Refrigerator at 4^oC for 15 minutes and the meat slurry were stirred again for one minute to be immediately centrifuged at 2000 revolution per minutes for 15 minutes. The supernatant layer was decanted and volume documented. The amount of solution retained by the meat samples were reported as the water holding capacity of the meat per 100 g meat

Determination of Meat Cholesterol, Triacylglycerol and Lipoproteins Content: Composite paste of 3 grams of thigh muscle was prepared using chloroform and methanol mixture at a ratio of 1:1 (v/v) and 2% (0.32M) w/v of KCl solution was added to the aqueous layer (Folch *et al*., 1957). The filtrate was centrifuged and lipid extract decanted. Decanted mixture obtained was used to determine cholesterol level, triacylglycerol as well as high and low-density lipoprotein content.

Sensory Evaluation: One hundred and fifty (150) grams of meat from the breast muscle of dressed carcass was cut out, and 50g from each three replicates per treatment was excised. Samples were washed, packed in transparent polythene bag and tagged for identification. Samples were then boiled in water bath at 70^oC for 20 minutes and allowed to cool for sensorial grading. Bite size portions of boiled meat samples were served at room

temperature to the untrained panellists. Each Panellist were required to score the following sensory qualities; Colour Acceptability, Juiciness, Meaty flavour, Tenderness, Saltiness, Overall flavour and Overall acceptability using 9-point Hedonic scale described by Sanwo *et al.* (2011).

Colour Measurement: The colour of breast meat was measured by Chroma meter model (CR-400; Konica Minolta, Tokyo, Japan). Meat colour ranged from light L*>53; to normal, 48< L*<51; and dark, L*<46. Colour categorization was based on 3 points on every duplicate meat sample.

Statistical Analysis

The data collected were subjected to a One-way Analysis of Variance in a Completely Randomized Design using SAS (2012). Significant differences among means were separated using Duncan's Multiple Range Test of the same statistical package.

RESULTS

Proximate Composition of FUNAAB Alpha chicken meat fed the experimental diets showed no significant (P>0.05) difference in all the measured parameters except moisture as shown in Table 3. Birds fed the basal diet had highest (P<0.05) moisture content of 75.45 % as opposed to the values of 70.97 and 72.05 % in groups fed clove and turmeric powder respectively which were not significantly different from each other.

Table 3: Proximate composition of FUNAAB Alpha chicken meat fed turmeric (*Curcuma longa*) and clove (*Syzygium aromaticum*) as feed additives

Parameters (%)	Control	Clove (3 g/kg)	Turmeric (4 g/kg)	SEM	P-value
Moisture	75.45[a]	70.97[b]	72.05[b]	0.91	0.0401
Dry Matter	24.55	29.03	28.35	0.95	0.0521
Fat	1.93	1.48	1.47	0.10	0.2049
Ash	1.77	1.72	1.81	0.02	0.4463
Crude Protein	18.85	18.55	19.35	1.65	0.8730
Nitrogen Free Extracts	6.54	7.16	7.23	0.17	0.2829

[a, b,] mean values with different superscript along the same rows are significantly different (P<0.05)

SEM – Standard Error of Mean

Addition of clove (*Syzygium aromaticum*) and turmeric (*Curcuma longa*) powders at 3 and 4 g/kg of feed respectively, significantly (p < 0.05) influenced water absorptive capacity (WAC) and water holding capacity and cook loss properties of breast meat as shown in Table 4. The meat pH, refrigeration loss and water absorptive power (WAP) were not influenced (p>0.05) by dietary additives inclusion in the diet as shown in Table 4. Groups fed turmeric powder as additive had the highest (p<0.05) meat absorption capacity of 3.00 %, closely followed by the 2 % absorptive capacity in meat of group fed clove powder as additives. Both groups fed dietary powders as additives had higher (p<0.05) meat absorptive power compared against meat from chickens fed the basal diet only.

Table 4: Physical parameters of FUNAAB Alpha chicken meat fed turmeric (*Curcuma longa*) or clove (*Syzygium aromaticum*) as feed additives

Parameters	Control	Clove (3g/kg)	Turmeric (4g/kg)	SEM	P-value
pH	5.33	5.23	5.33	0.06	0.7703
Cooking Loss (%)	21.87[a]	20.00[a]	16.40[b]	0.92	0.0143
Refrigeration Loss (%)	3.60	2.73	2.67	0.34	0.5133
WAP (%)	5.17	5.23	5.14	0.79	0.210
WHC (%)	1.33[c]	2.00[b]	3.00[a]	0.26	0.0025

[a, b] mean values with different superscript along the same rows are significantly different (P<0.05)
SEM – Standard Error of Mean
WAP – Water Absorptive Power
WHC– Water Absorptive Power or Water Holding Capacity

Table 5 showed that the additive effects of Clove (*Syzygium aromaticum*) and turmeric (*Curcuma longa*) in the diet of FUNAAB Alpha chicken had significant effects on the lipoprotein profile of meat. The result revealed a significant (p<0.05) effect on high density lipoprotein (HDL) and low-density lipoprotein (LDL) of breast meat but no significant (p>0.05) effect was observed for meat cholesterol and triglyceride. Highest HDL (28.58 mg/dl) value was recorded for meat of birds fed diet supplemented with turmeric (*Curcuma longa*) at 4 g/kg, while the least value of 13.1mg/dl was recorded for meat of birds from the control group. Also, a significant (p<0.05) decrease in LDL was documented for meat of birds fed diet supplemented with turmeric (*Curcuma longa*) at 4 g/kg (15.74mg/dl) when compared with birds from other treatment groups (24.50mg/dl, 21.31mg/dl). Cholesterol and triglyceride values recorded in this study ranges between 51.77 - 59.4mg/dl and 102.45 – 127.20 mg/dl respectively. The numerically (p>0.05) highest meat cholesterol (51.77 mg/dl) and triglyceride (102.45 mg/dl) content was recorded in birds fed diet supplemented with turmeric (*Curcuma longa*) at 4 g/kg.

Table 5: Lipoprotein profile of FUNAAB Alpha chicken meat fed diets turmeric (*Curcuma longa*) or clove (*Syzygium aromaticum*) as feed additives

Parameters	Control	Clove (3g/kg)	Turmeric (4g/kg)	SEM	P-value
Cholesterol (mg/dl)	59.40	56.73	51.77	1.85	0.2699
Triglyceride (mg/dl)	127.20	110.30	102.45	5.18	0.0923
HDL (mg/dl)	13.1[c]	22.92[b]	28.58[a]	2.91	0.0065
LDL (mg/dl)	24.50[a]	21.31[a]	15.74[b]	0.64	0.0087

[a, b, c,] means with different superscript along the same rows are significantly different (P<0.05)
SEM – Standard Error of Mean
HDL – High Density Lipoprotein
LDL – Low Density Lipoprotein

Significant differences (P<0.05) was observed in tenderness, saltiness and overall acceptability, while similar values were recorded among treatments for colour, juiciness, meat flavour and overall flavour in Table 6.

Significantly (p>0.05) highest value (6.14) of tenderness was recorded in breast muscle of birds fed diet supplemented with clove (*Syzygium aromaticum*) at 3 g/kg, while and breast meat from birds fed 4g/kg turmeric although scored the least (5.00) value for tenderness but was the most acceptable overall (7.19), and was also less salty (4.67) when compared with chicken meat from other treatments birds. Meat colour, juiciness, meaty flavour and overall flavour of birds fed 3 g/kg dietary clove had the numerically highest scores of 6.05, 6.00, 6.19 and 6.38.

Table 6: Sensory evaluation of FUNAAB Alpha chicken meat fed turmeric (*Curcuma longa*) or clove (*Syzygium aromaticum*) as feed additives

Parameters	Control	Clove (3g/kg)	Turmeric (4g/kg)	SEM	P-value
Colour	5.95	6.05	5.71	0.111	0.4087
Juiciness	5.86	6.00	5.05	0.19	0.0573
Meaty Flavour	5.86	6.19	5.92	0.17	0.7703
Tenderness	5.71^{ab}	6.14^{a}	5.00^{b}	0.21	0.0448
Saltiness	5.95^{a}	6.23^{a}	4.67^{b}	0.27	0.0082
Overall Flavour	6.09	6.38	6.28	0.12	0.6904
Overall Acceptability	6.67^{b}	6.57^{b}	7.19^{a}	0.11	0.0110

$^{a, b,}$ means with different superscript along the same rows are significantly different (P<0.05)
SEM – Standard Error of Mean

DISCUSSION

Proximate analysis of breast meat of FUNAAB Alpha chicken possibly point to clove and turmeric influence on the breakdown of food to release nutrients that enhance digestion and digestion efficiency of feed with potential alteration in muscle composition (Brewer, 2011). The significant reduction in moisture content of breast meat of chickens on clove and turmeric additive groups is linked to the effect of these plants to suppress drip loss as well as cook loss which is confirmed in the increase in dry matter content recorded in birds on fed clove or turmeric as feed additive. Spices contain salts that influence taste and flavour which lower moisture content in meat but increased dry matter content. Water absorption capacity (WAC) or water holding capacity (WHC) has direct bearing on the colour and tenderness of meat, and it is among the most important functional properties of raw meat. Water holding capacity reveals the extent of drip loss in meat. A low water holding capacity in muscles can increase liquid outflow and subsequent loss of soluble nutri-

ents and flavour (Otto *et al*., 2004). Results from this study showed that dietary addition clove (*Syzygium aromaticum*) or turmeric (*Curcuma longa*) increased the water holding capacity; this is an indication that the additives improved the antioxidant capacity of FUNAAB Alpha chicken meat that subsequently maintained cellular integrity of cell membranes and increased the water holding capacity properties of the meat. Kanani *et al*. (2017) had earlier reported that inclusion of turmeric powder at 0.5 % of broiler chicken diet increased the WHC of the meat. The results of this present study showed that dietary clove (*Syzygium aromaticum*)) addition increased the water absorptive power of the meat. Certain factors are known to affect absorption capabilities of samples which includes, temperature, additives used amongst others. The capacity of turmeric or clove to increase the WHC in this study can be attributed to the active ingredients - curcumn and eugenol oil which have antioxidative properties that protect muscle cellular content. Cook loss is known to be one of the main factors that define nutrient uptake from meat and its subsequent quality because some nutrients may be lost in the exudates by water loss that affect the juiciness and tenderness of cooked meat. The lowest cooking loss (16.40%) recorded in breast meat of birds fed diet with turmeric (*Curcuma longa*) as additive at 4 g/kg indicates better quality of meat than those from other treatments groups because it lost an insignificant amount of nutrients which implies a better characteristic of myofibril and connective tissues (Liyan and Shiyu, 2012 and Youngseung *et al*., 2014). Negari *et al*. (2015) reported that cook loss between 15 – 40 % indicate better connective tissue and longer sarcomere which is a characteristic feature of good meat quality. Findings of this study is similar with studies of Kolodzej -Skalaska *et al*. (2011) who reported that dietary supplementation of plant extract mixtures of carvacrol (oregano), cinnamaldehyde (cinnamon), and *Capsicum oleoresin* (Mexican pepper) decreased cooking loss.

Lipoprotein profile in living systems can influence coronary and heart health. Lipoprotein profile results from this study identify turmeric powder as additive in diet fed FUNAAB Alpha chicken to significantly improve HDL as well as reduce LDL that can maintain coronary health. The numerical decrease in triglyceride recorded is associated with the increase in HDL and decrease in LDL cholesterol, this is strongly considered as a good and healthy sign of the broiler meat. This result is in agreement with previous study of Daneshyar *et al*., (2011), where reductions in cholesterol fractions were improved by turmeric incorporation into the diet. The dietary addition of turmeric in diet of FUNAAB Alpha chickens show high promise in the development of poultry products with low LDL fraction of cholesterol as demanded by health-conscious consumers. Turmeric (*Curcuma longa*) has beneficial effects on the cholesterol and triglyceride levels related to the improvement of the liver function, which can result in reduction of cholesterol biosynthesis and stimulation of transformation of cholesterol into bile acids, and also potential therapeutic and dietary applications in humans, for example, in the treatment of diabetes and obesity (Boskou, 2006).

Sensory evaluation of meat from chickens fed dietary treatments showed breast meat from FUNAAB Alpha chickens to be influenced by dietary treatments. Meat obtained from birds fed Turmeric at 4 g/kg was considered best by the pannelist in terms of overall acceptability. This could be attribut-

ed to active ingredient (curcumin) in turmeric (*Curcuma longa*), which is absorbed into muscle tissue of chicken that can subsequently lower muscle fat and cook loss but not tenderness (Lee *et al*., 2009). The observed numerical increase in flavour in birds fed 3g/kg Clove, could be attributed to the decreased lipid oxidation as clove is known to contain anti oxidative properties. Meat tenderness improves when the proteins are denatured, while impaired protein component of myofibril may also improve meat tenderness (Doskovic *et al*., 2013). This agrees with the meat samples tenderness score for birds fed 3g/kg clove. Meat samples from FUNAAB Alpha chickens fed diet supplemented with turmeric (*Curcuma longa*) was most accepted by taste panellists in terms of overall acceptability when compared to other groups, which can be attributed to higher water holding capacity and lower cooking loss that facilitate meat nutrient retention in accordance with studies of Waskar *et al*. (2011) who reported that supplementation of herbal products in poultry diet effectively improved overall meat quality attributes such as tender yield, sensory characteristics, overall palatability and consumer acceptability of meat.

CONCLUSION

Based on the reported findings, it can be concluded that clove and turmeric in the diets of FUNAAB Alpha chickens up to 3g/kg and 4g/kg respectively as additives had beneficial effects, including decrease in cook loss, moisture content, meat water holding capacity and HDL. Additionally, meat tenderness and overall acceptability of the chicken meat was also improved.

RECOMMENDATION

It is recommended that turmeric (*Curcuma longa*) or clove (*Syzygium aromaticum*) can be used in the diet of FUNAAB Alpha chickens at the levels used in this study (4g/kg and 3g/kg respectively) with no deleterious effect on meat quality of FUNAAB Alpha chickens.

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(Manuscript received: 20th March, 2019; accepted: 29th June, 2020).