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Some meat quality parameters of broiler chickens fed diets containing different additives

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Abstract

Poultry meat is relatively rich in polysaturated fatty acid and is therefore, readily susceptible to oxidative deterioration. Poultry researchers and nutritionist have sought for feed additive for broilers birds that will be able to absorb the additives in dietary component directly in their tissues thereby getting the bioactive compounds in this supplements through broiler meat into the human food chain while avoiding the resentment due to its direct consumption. In this study, the meat quality and storage stability of meat obtained from Cobb strain of broiler chickens fed diets containing different additives were investigated. A total of 150 day old birds were purchased and brooded. After two weeks of brooding, the birds were (control) (T1) , basal diet + 4 g/kg of cloves (T2) , basal diet + 4 g/kg of turmeric (T3), basal diet + 2.0 mg of Selenium (T4) and basal diet + 0.25 mg/kg of butylated hydroxytoluene (BHT) (T5), The feeding trial lasted for a period of six weeks. At the end of the experiment, three birds from each replicates were selected and slaughtered. Data were collected on water absorptive power (WAP), water holding capacity (WHC), refrigeration loss, pH, colour, cooking loss, lipid profile, oxidative stability, total bacterial count and sensory evaluation. Results revealed that supplemented Cobb strain broiler chicken diet with 4 g/kg of either clove or turmeric had decreased cooking loss of 8.02 and 9.91, respectively as compared to 28.04 for the control samples. There was a decreased total cholesterol (59.25 and 62.45 against 69.10 for the control samples) of the meat . It was also observed that all the additives had significant decrease in the pH (6.27, 6.31, 6.37, 6.35 for cloves, turmeric, selenium and BHT, respectively as compared to 6.50 for the control diets. The addition of 0.25 mg of BHT and 4 g/kg of cloves in the diets Cobb strain of broiler chickens reduced the total bacterial count (0.95 and 1.00 respectively). It is concluded that the addition of 4 g/kg of cloves and turmeric powder improved the meat quality of Cobb strain of broiler chickens.

Keywords: Broilers chicken, additives, meat quality.

Certains paramètres de qualité de la viande de régimes alimentés par poulets à griller contenant différents additifs

Résumé

La viande de volaille est relativement riche en acide gras polysaturé et est donc facilement sensible à la détérioration oxydante. Les chercheurs et nutritionnistes de volaille ont cherché à l'additif alimentaire pour les oiseaux de poulets qui seront capables d'absorber les additifs dans la composante alimentaire directement dans leurs tissus, obtenant ainsi les composés bioactifs dans ces suppléments par la viande de poule humaine dans la chaîne alimentaire humaine tout en évitant le ressentiment en raison de sa Consommation directe. Dans cette étude, la qualité de la viande et la stabilité de la viande de la viande obtenues à partir de la souche de cobb de poulets de poulets de poulets de chair fédérale contenant différents additifs ont été examinées. Un total de 150 jours d'oiseaux de 150 jours ont été achetés et *couvés. Après deux semaines de couvement, les oiseaux étaient (contrôle) (T1), régime de base + 4 g / kg de clous de girofle (T2), régime basal + 4 g / kg de curcuma (T3), régime de base + 2,0 mg de sélénium (T4) et régime basal + 0,25 mg / kg d'hydroxytoluènebutylé (HTB) (T5), l'essai d'alimentation a duré une période de six semaines. À la fin de l'expérience, trois oiseaux de chaque réplicat ont été sélectionnés et abattus. Les données ont été collectées sur l'alimentation d'absorption de l'eau (AAE), la capacité de maintien de l'eau (CME), la perte de réfrigération, le pH, la couleur, la perte de cuisson, le profil lipidique, la stabilité oxydative, le nombre total de bactéries et l'évaluation sensorielle. Les résultats ont révélé que le régime de poulet de fileuse à griller de Cobb supplémenté avec 4 g / kg de gousse de gousse ou de curcuma avait diminué de la perte de cuisson de 8,02 et 9,91, respectivement par rapport à 28,04 pour les échantillons de contrôle. Un cholestérol total a diminué (59,25 et 62,45 contre 69,10 pour les échantillons de contrôle) de la viande. Il a également été observé que tous les additifs avaient une diminution significative du pH (6,27, 6,31, 6,37, 6,35 pour les gousses, le curcuma, le sélénium et le HTB, comparativement à 6,50 pour les régimes de commande. L'ajout de 0,25 mg de HTB et 4 g / kg de clous de girofles dans la souche des poulets de gril de régime alimentaire des poulets bactériens totale (0,95 et 1,00 respectivement). Il est conclu que l'ajout de 4 g / kg de gousses et de la poudre de curcuma a amélioré la qualité de la viande de la souche de la chair de coilateur poulets.*

Mots-clés: Broilers chicken, additives, meat quality.

Justification

Poultry meat is relatively rich in polysaturated fatty acid and is therefore, readily susceptible to oxidative deterioration and as a consequence, flavour and nutritional value are decreased (Enberg *et al*.,2006). Over the last century, the amount and proportion of fats in human diets have increased in many societies, this increase has been associated with cardiovascular diseases (Kathak,2014). With this great concern, poultry researchers and nutritionist have sought for feed additive for broilers birds that will be able to absorb the additives in dietary component directly in their tissues thereby getting the bioactive compounds in this supplements through broiler meat into the human food chain while avoiding the resentment due to its direct consumption (Onibi *et al.,* 2009). Also, poultry feed additives, natural herbs and some synthetic additives have been widely advocated due to their reported widespread beneficial effects (Khan *et al.,*2012). Turmeric, cloves and selenium are potential feed additives which have been reported as having wide range of beneficial effects on the production performance, physiological biochemistry, feed efficiency as well as stimulation of immune system and increasing the shelf-life of broiler birds (Khan *et al.,*2012). However, BHT have also been reported to improve production performance in broiler chickens. This study therefore intends to examine the meat quality and storage stability of meat obtained from Cobb strain of broiler chickens fed diets containing different additives were investigated.

Introduction

Consumption of poultry meat is constantly increasing and the meat nutrition quality depends largely on the composition of poultry feed (Kafi *et al*., 2017). The basic poultry diet consists of cereals (wheat, corn etc.) in general, but biological active additives are widely used in commercial broiler feed. These biological active additives like cloves, turmeric, thyme and anise have established a great consideration as feed supplements for numerous purposes in poultry production throughout the recent years (Akbarian *et al.,* 2012). Feed additives are groups of non-nutritive products added to rations to improve the efficiency of animal production via an improve intake, gastrointestinal micro flora, production characteristics, meat quality, eggs of poultry, vitality and health condition (Hashemi *et al.,* 2010). Natural feed additives are a relatively young class of feed additives and in recent years these feed additives have gained considerable attention in the feed industry. They may exert multiple functions in the animal body like increased feed intake and digestive enzyme secretions (Windisch *et al.,* 2008). Natural feed additives are derived from herbs, spices or aromatic plants and have shown antimicrobial, antifungal, antiviral, antioxidant and sedative properties (Hashemi *et al.,* 2010) examples are turmeric, ginger, thyme, cloves and garlic. Alongside the Natural additives there are some synthetic feed additives of importance in poultry diets e.g. Butylatedhydroxyanisole and Butylatedhydroxytoluene (BHT), evening primerose (EVE 500) and Selenium. For many years, BHA and BHT have been used as additives in meat and poultry products (Jayathilakan *et al.,* 2007). They are generally recognized as safe by the Food and Drug Administration in foods to maintain freshness and prevent spoilage. Over the last century, the amount and proportion of fats in human diets have increased in many societies, this increase has been associated with cardiovascular diseases (Kathak,2014). With this great concern, poultry researchers and nutritionist have sought for feed additive for broilers birds that will be able to absorb the additives in dietary component directly in their tissues thereby getting the bioactive compounds in this supplements through broiler meat into the human food chain while avoiding the resentment due to its direct consumption (Onibi *et al.,* 2009). Also, poultry feed additives, natural herbs and some synthetic additives have been widely advocated due to their reported widespread beneficial effects (Khan *et al.,*2012). Turmeric, cloves and selenium are potential feed additives which have been reported as having wide range of beneficial effects on the production performance, physiological biochemistry, feed efficiency as well as stimulation of immune system and increasing the shelf-life of broiler birds (Khan *et al.,*2012). However, BHT have also been reported to improve production performance in broiler chickens.

Materials and methods

Experimental site

The experiment was carried out at the Poultry Unit of Teaching and Research Farm of the College of Animal Science Livestock Production, Federal University of Agriculture, Abeokuta, Ogun Stated, Nigeria. Abeokuta lies within the rain forest vegetative zone of south Western Nigeria. Latitude7°13'49. 46 'N, longitude 3°s 21' 11.98 ' E and latitude 76m above sea level (Google Earth,2019).

Collection and processing of ingredients

Turmeric (*Curcuma longa*) and Cloves (*Eugenia caryophyllus*) were purchased from a reputable market while dirt was removed and clean products were sundried until constant weight was attained and milled into a fine powder (0.1mm). Selenium (enriched with yeast) and Butylatedhydroxytoluene (BHT) were obtained froma reputable pharmaceutical company (Scibic pharmaceutical). The composition of the diet is shown in Table 1.

Experimental birds, management and layout

The experimental pen was thoroughly cleaned and fumigated before the arrival of the chicks. One hundred and fifty COBB strain of broiler chickens were purchased from poultry and breeding unit hatchery Federal University of Agriculture, Abeokuta, Nigeria. All routine management practices, including recommended vaccinations and medications were strictly observed throughout water was provided *ad-libitum*. Wood shavings of about 0.2 cm thick layer served as the litter materials, artificial light (electric bulb) provided to encourage the birds to eat and charcoal was provided as a source of heat to keep the birds warm. After two weeks of brooding, the birds were balanced for weight and assigned to the five experimental diets , with each treatment containing 30 birds of 10 birds in replicate of three. The feeding trial lasted for the period of six weeks.

The experimental diets were formulated to meet the nutritional requirements of each stage of development, according to the recommendations of The treatment arrangement for each strain of bird is as follows:

T1: Basal diet with No additives
T2: Basal diet +cloves (4g/kg)
T3: Basal diet + Turmeric (4 g/kg)
T4: Basal diet + Selenium (2.0mg/kg)
T5: Basal diet + ButylatedHydroxytoluene (0.25 mg/kg)

Proximate composition of experimental diets

The proximate composition of the experimental diet was carried out to determine crude protein, ash, moisture and crude fibre as described by A.O.A.C (2015).

Table 1: Composition diets of starter and finisher phases

Ingredients (%)	Starter phase	Finisher phase
Maize	46.00	50.00
Soya beans	18.50	12.00
Groundnut cake	15.00	11.00
Fish meal	2.00	2.00
Wheat offal	12.45	19.05
Bone meal	2.00	2.00
Oyster shell	3.00	3.00
Salt (Nacl)	0.25	0.25
Premix	0.25	0.25
Methionine	0.30	0.25
Lysine	0.25	0.20
	100	**100**
Determined:		
Crude protein	23.05	19.91
ME (MJ/kg)	11.73	11.71
Ether extract(%)	3.93	3.89
Crude fibre (%)	3.67	3.79
Calcium (%)	1.75	1.74
Phosphorus (%)	0.43	0.41

1kg of premix contains: Vitamin A:10,000,000 IU; Vitamin D3: 2,000,000 IU; Vitamin E:20,000 IU; Vitamin K:2,250mg; Thiamine B1:1,750mg; Riboflavin B2:5000mg; Pyridoxine B6:2,750mg; Niacin:27,500mg; Vitamin B12:15mg; Pantothenic acid: 7,500mg; Folic acid:7 ,500mg; Biotin:50mg; choline chloride :400g; Antioxidant :125mg; Magnesium :80g; Zinc: 50g; Iron:20g; Copper :5g; Iodine: 1.2g; selenium :200mg; Colbat :200mg; ME= Metabolizable Energy

Meat quality parameters

Colour measurements

At the end of the feeding trial, three birds per replicate were sacrificed. Colour measurement was performed using a colorimeter Chroma Meter (Minolta CR 410, Japan). Two wings from different birds per replicate were selected. Perceived colour intensity was determined following the procedures of (Jung *et al.,* 2012). Colour parameters that were observed on the chicken meat were lightness (L), redness (a), and yellowness (b).

pH measurement

The pH of the meat samples was measured using a digital pH meter (MP230, Mettler Toledo, Switzerland). Approximately 1g of the sample was ground and mixed with 9 ml of distilled water, and the pH was measured by using pH meter. The pH meter was calibrated before use with standard buffers of pH 4.0 and 7.0 at 25ºC (Jung *et al*., 2012). All measurements were performed in triplicate.

Determination of proximate composition

Meat samples were obtained for each replicate and analyzed for its proximate compositionfollowing the procedures of AOAC (2015).Parameters analyzed are crude protein, ash, moisture, and ether extract,

Determination of refrigeration loss

A known quantity of meat samples was obtained from three dressed carcasses of broiler chickens from each replicate were obtained before refrigeration and re–weighed after 24 hours to determine the refrigeration loss

Refrigeration loss (g) = weight of sample before refrigeration- weight after refrigeration

Determination of cooking loss

The thigh muscle (50g) of post-slaughtered meat sample from each replicate was weighed, wrapped in separate air thigh polythene nylon and cooked in a water bath at 70˚C for 15 minutes (Sanwo *et al*., 2013). After cooking, residual moisture was removed from each of the meat sample, and the samples were allowed to cool to room temperature. The meat samples were re-weighed.

Cook loss (%) = weight of sample before cooking (g) – weight of sample after cooking (g) x 100

Weight before cooking (g)

Determination of water absorptive power

Three grams of the thigh muscle was excised from each replicate, weighed and placed in a clean test tube: About 10mL of distilled water was poured in the test tube and left for an hour. After one hour each sample was removed and re-weighed. The increase in weight of the sample indicate the volume of the water absorbed.

Water holding capacity

Fifteen grams each from breast muscle was usedin determining this parameter. Each of the samples were blended using conventional blender and placed in centrifuge tubes, 22.5ml of 0.6 moles of saline solution was added, and stirred with a glass rod for 1 minute(Hamm 1975). After stirring, the samples were placed in a refrigerator for 15 minutes, with the slurry stirred again for 1 min and immediately placed in centrifuge (MERLIN 503 Spectra scientific Ltd, Great Britain) for 15 minutes. The supernatant layers were decanted, and recorded. The amount of solution retained by meat was reported as water holding capacity in ml per 15g meat.

WHC = Before centrifuge – After centrifuge X 100

Before centrifuge

Lipid profile and cholesterol determination

Composite paste of the thigh muscle was prepared with a known amount of chloroform and methanol mixture 1:1(v/v) for each replicate. The resulting paste solvent was filtered and rinsed and additional volume of the combined homogenate and allowed to stand for five (5) minutes. The filtered homogenate was equilibrated to remove non lipid material by adding 2% (0.32M) w/v KLC solution to the aqueous layer (Folch *et al.,* 1957). The filtrate was centrifuge and lipid extract was decanted. The extract wasthen be made up to a final volume by adding chloroform. The decanted mixture obtained was used for the determination of cholesterol triglycerol, high and low density lipoprotein values.

Thiobarbituric acid reactive substance (TBARS)

Five grams (5g) each meat sample from the thigh muscle was homogenized in 15ml distilled water. Sample homogenate (5ml) was transferred to a test tube and lipid oxidation wasdetermined as the 2-thiobarbituric acid-reactive substance (TBARS) value by methods of Ahn *et al.* (1999).Values isexpressed as mg malonaldehyde kg^{-1} of sample (Jang *et al.,*2007).

Sensory evaluation

Sensory evaluation was conducted immediately after cooking. Ten untrained panelists were used in the assessment procedure. They were instructed to chew the sample from each treatment and score it for colour, flavour, texture, juiciness and tenderness. Water was served to panelist to rinse their mouth after tasting each sample to reduce carry over effects. The panelist scored each sample on a nine-point hedonic scale(1 = dislike extremely,2= dislike very much, 3= dislike moderately, 4= dislike slightly, 5= intermediate, 6= like slightly, 7= like moderately, 8= like very much, 9= like extremely) as described by Sanwo *et al.* (2013).

Determination of microbial load

The determination of meat microbial load was carried out in the microbiology Laboratory of the College of Veterinary Medicine, Federal University of Agriculture Abeokuta.Approximately 10g of meat each from the wing of broiler chickens from each treatment diets were weighed into sterile water in a beaker and appropriate serial dilution was carried out to 10^{-5}. this method was used for the total viable bacterial count on Plate Count Agar (PCA,LAB-M) and mould and yeast count on acidified Potato Dextrose Agar (PDA,LAB-M). All cultures were inoculated at 37˚C for 24hours. Spoilage bacteria that were identified include *Lactobacillus algidus, Pseudomonas spp., Enterobacteriaceae, Staphilococcus aureus, Escheria coli and klebbs spp* were identified.

Sterilization of materials

Culture plates were washed with detergent and allowed to air dry. They were carefully packed into canisters and placed into hot air oven for sterilization at 160˚C for 2 hours.After sterilization, the plates were allowed to cool to about 45˚C before used for pour plate technique used in the microbiological analyses. Other glass wares used were sterilized in a similar way.

Preparation of media

Media for microbiological analyses (PDA, PCA and Nutrient Agar) were weighed and prepared according to the manufacturers specifications. Media for bacterial and fungal culture (pour plate) was prepared in conical flask while those for storage (slant culture) was prepared. Both was carefully packed into autoclave and sterilized at 121˚C for 15 minutes. Prior to use, the media was cooled to about 45˚C and where the media cannot be used immediately, they were stored in refrigerator.

Pour plate technique

After serial dilution 10^{-1} to 10^{-5}, 1mL of the last two dilutions was aseptically drawn with the aid of a syringe and dispensed into already sterilized and labeled Petri dishes. Then about 10-15mL of suitable media (PCA or PDA cooled to 45˚C) were poured into each petridish and carefully swirled to homogenize. The plates were allowed to cool and set, and then was incubated at inverted position at 37 ˚C and 27 ˚C for bacterial and fungal count respectively. The colonies on the plates was counted to obtain the colony forming unit per gram (cfu/mL) and recorded.

Statistical model

Data collected were subjected to Complete Randomized Design using analysis of variance (ANOVA) with the general linear model of (SPSS 1999). Significant means were separated using New Duncans Multiple Range Test of SPSS Software

Experimental models are as follows:

Non stored samples

Complete randomized design (CRD)

$Y_{ijk} = \mu + M_i + '_{ijk}$

Where;

Y_{ij} = Observed mean value of dependent variable

μ = Population mean

M*i* = Effect of treatment

$'_{ij}$ = The random residual error

Results

Proximate composition of meat obtained from broiler chickens fed diets containing different additives

The result of the proximate composition of meat obtained from Cobb strain of broiler chicken fed the various additives is as shown in Table 2. The added cloves and other additives had similar effect on all the proximate parameters considered.

Table 3 shows the meat quality of Cobb strain of broiler chickens fed diet containing Cloves (*Syzygium aromaticum*),Turmeric (*Curcuma longa*), Selenium and Butylated Hydroxytoluene. The mean values for refrigerated loss , water absorptive power (WAP) and total bacterial count (TBC) were found to be statistically similar ($p>0.05$).However, significant ($p<0.05$) differences were observed for water holding capacity, cooking loss, pH and colour. Highest mean values (70.30, 39.13, 6.50) were documented for, water holding capacity, cookloss and pH, respectively. On the other hand the lowest mean values recorded were (53.90, 8.05, 6.26,) for water holding capacity, cooking loss and pH respectively. The total bacterial count had the highest value in birds fed selenium (1.25) and the lowest found in the birds fed Cloves diet (0.95). All the parameters considered in colour measurement were significantly ($p<0.05$) different by the addition of various additives in the diets of the birds. The lightness (L) had its highest mean value recorded in the group of birds fed cloves (54.38) and the lowest in the group offered BHT (47.3) while redness (a) and yellowness (b) had their highest mean values in the group fed cloves (15.74) and turmeric (12.77) while the lowest values were 4.64 and 6.86 in the group of birds fed turmeric and cloves respectively.

Table 2: Proximate composition of meat obtained from Cobb strain of broiler chickens fed diets containing different additives

	Additives						
Parameters(%)	**Control**	**Cloves**	**Turmeric**	**Selenium**	**BHT**	**SEM**	**P-values**
Moisture content	77.99	75.99	77.78	76.84	77.65	1.25	0.09
Dry matter	27.01	27.01	29.17	28.29	27.48	2.05	0.09
Crude protein	19.10	20.95	19.29	20.59	19.01	1.02	0.08
Crude fat	0.72	0.68	0.72	0.72	0.77	0.98	0.09
Ash	0.95	0.87	0.90	0.92	0.94	0.69	0.07

BHT = Butylatedhydroxytoluene, SEM= Standard error of mean

Table 3: Meat quality parameters of Cobb strain of broiler chickens fed diets containing different additives

	Additives					
Parameters	**Control**	**Clove**	**Turmeric**	**Selenium**	**BHT**	**P-value**
WHC%	68.30 ^{a}	59.40^{b}	53.90^{b}	60.20^{b}	70.30^{a}	0.12
Ref Loss %	0.62	0.51	0.35	0.52	0.13	0.34
Cook Loss %	28.04	8.02^{c}	39.13	27.90'	29.91'	0.16
Muscle pH	6.50'	6.27	6.31' '	6.37'	6.35'	0.00
WAP	3.23	3.33	3.23	3.63	3.33	0.55
TBC count	1.10	0.95	1.25	1.10	1.00	0.66
Colour						
L	48.88 ^{b}	54.38^{a}	51.64^{a}	50.76^{a}	47.3^{b}	0.03
A	12.12^{c}	15.74^{a}	14.64^{b}	10.49^{c}	14.93 ^{b}	0.01
B	7.28^{c}	6.86^{c}	12.77 ^{a}	10.24^{b}	11.25^{ab}	0.00

WHC=water holding capacity, Ref Loss= Refrigeration loss, WAP = water absorption power, MBR= Meat to bone ratio, TBC= Total bacterial count, L = lightness, a= yellowness, b= Redness, $^{a\,b\,c}$ mean across rows with different superscripts are significantly (P< 0.05 different)

Lipid profile of Cobb strain of broiler chickens fed diet containing different additives

The lipid profile of Cobb strain of broiler chickens fed diet containing cloves (*Syzygium aromaticum*), turmeric (*Curcuma longa*), selenium and ButylatedHydroxytoluen is shown in Table 4. Most of the parameters considered were statistically similar (p>0.05) across the dietary treatments. However, total cholesterol was significantly (p<0.05) influenced with highest comparable mean values observed in birds fed selenium, BHT and control. Birds offered cloves had the lowest mean value (59.25mg/dl).

The oxidative stability of meat obtained fromCobb strain of broiler chickens fed diets containing different additives

Table 5 shows the oxidative stability of Cobb strain of broiler chicken offered diets containing Cloves (*Syzygium aromaticum*), Turmeric (*Curcuma longa*), Selenium and Butylated Hydroxytoluene. The addition of phytogenic and synthetic feed additive in the diets of the experimental birds did not influence (p>0.05) the Superoxidase dismutase and Malondialdehyde

Table 4: Lipid profile of Cobb strain of broiler chickens fed diet containingdifferent additives

	Additives						
Parameters (mg/dl)	Control	Cloves	Turmeric	Selenium	BHT	SEM	P-Values
Total cholesterol	69.10^{ab}	59.25 ^{c}	62.45 ^{b}	79.90^{a}	73.75 ^{a}	4.89	0.03
Triglycerides	202.45	208.45	193.25	232.40	215.1	10.59	0.89
HDL	11.35	10.50	12.15	13.85	11.50	0.53	0.42
LDL	17.30	7.15	11.65	19.60	19.30	2.96	0.71

$^{a\,b\,c}$ mean across rows with different superscripts are significantly (P< 0.05different), HDL = High density lipoprotein, LDL = Low density lipoprotein, SEM = Standard error of mean, BHT = Butylatedhydroxyltoluene

Table 5: Oxidative stability of meat obtained from broiler chicken fed diets containing different additives

	Additives						
Parameters (mg/dl)	**Control**	**Cloves**	**Turmeric**	**Selenium**	**BHT**	**SEM**	**P-Values**
SOD	0.67	1.36	1.58	0.92	1.55	0.3	0.91
MDA	0.02	0.01	0.01	0.01	0.01	3.68	0.21

SEM= Standard error of mean, MDA = Malondialdehyde, SOD =Superoxide Dismutase

The sensory evaluation of meat obtained from cobb strain of broiler chickens fed diets containing different additives

Table 6 shows the sensory evaluation of meat obtained from Cobb strain of broiler chicken fed diet containing Cloves (*Syzygium aromaticum*) , Turmeric (*Curcuma longa*), Selenium and Butylated Hydroxytoluene (BHT)

Table 6: The sensory evaluation of broiler chicken meat fed dietcontaining different additives

	Additives						
Parameters	**Control**	**Cloves**	**Turmeric**	**Selenium**	**BHT**	**SEM**	**P-Values**
Colour	7.35	6.95	7.05	6.40	7.00	0.14	0.27
Juiciness	6.95	6.70	6.85	6.50	6.75	0.16	0.92
Meaty Flavour	7.05	6.65	6.95	6.85	7.10	0.15	0.89
Tenderness	7.05	6.60	6.75	6.85	7.10	0.16	0.86
Saltiness	5.05	5.30	5.05	5.05	5.35	0.14	0.92
Overall Flavour	7.25	6.65	6.75	6.80	7.20	0.12	0.40
Overall Acceptability	7.15	6.90	6.65	6.90	6.75	0.15	0.87

BHT= Butylatedhydroxytuluene, SEM= Standard error of mean

Discussion

Water holding capacity (WHC) is among **the** important functional properties of **meat** (Nasir *et al*., 2017). The group of birds fed BHT has the highest water holding capacity this may be attributed to the high antioxidant content of BHT compared to the other additives used. Cooking loss refers to the percentage of water that is lost in cooking (Al-Owaimer *et al.*, 2014). According to Petracci *et al.* (2009), high cooking loss also implies poor ability of meat to hold water during processing Birds fed 0.15 ppm of Se showed a significantly higher (21.92%) cooking loss ($P < 0.05$) in the research conducted by **Oliveira *et al.* (2014)** which is comparable to this study. Marcinčák *et al*. (2011) observed changes within the composition of the thigh muscle of broilers (higher proportion of crude protein and lower proportion of fat) that were fed with diets containing clove powder, harvest-lice and sweet balm extracts, and **Oliveira *et al.* (2014)** reported a discount in shear force values and lipid oxidation of the M. longissimus dorsi (LD) in pigs that got a diet with ferulic acid and vitamin E. Jiang *et al*. (2007) and Kang *et al*. (2012), using soy isoflavone as a phytochemical in broiler feed (40 mg /kg) and quercetin (42 ppm) in cattle, respectively, and observed a rise in water holding capacity (WHC) and pH of the meat. The non-significant differences in water absorptive power and meat to bone ratio and significant differences in water holding capacity, refrigerated loss, cook loss, and muscle pH are contrary to the work of Da-Silva *et al.* (2017) who studied the response of broiler chickens to diet containing conventional feed supplements, proximate composition, color, pH, shear force, microbial quality and sensory. The pH of meat is the measurement of acidity. The pH of muscle at slaughter is around 7.0 – 7.1, as the glycogen increases the value of the pH decrease accordingly (Wood and Richard, 1975). The dietary treatments had influence on the muscle pH. All the treatment groups caused an increase in the pH compared to the control with the highest pH observed in the muscle of birds fed cloves (6.27). This could be as a result of the presence of magnesium in clove responsible for the increase in pH. This was also observed by Campion *et al*. (1971) who reported that supplementation of high level of magnesium in the diets of pigs increase the initial muscle pH, delay the onset of rigor motis in pigs genetically susceptible to stress and reduce the rate of glycolisis. An increase in the pH of broiler breast meat was reported when thyme was added to their diets at levels of 0.1% and 0.3% Jang *et al.* (2007). Herawati and Marjuki (2011) also reported an increase in pH of broiler meat as a result of the addition of ginger (a type of spice herb). Meat is considered to have a very good quality at the pH of 6.2, when the value is higher than 6.7 meat becomes uneatable Jang *et al.* (2007). In this present study, the pH values falls within the range which is considered as meat of good quality**.** Colour appearance is one of the primary physical attributes that determine consumer's acceptability of products. In the food industry, although visual color standards are still used, instrumental color measurements are extensively employed Yang *et al*. (2007). The birds fed cloves had the highest L value and this indicates that it has a lighter color while control had the lowest L value indicating that it was darker than all the meat samples.The L, a b obtained from the birds offered selenium was lower higher than (L 48.78), (a 5.51) and (b 3.54) reported by **Marcel *et al*. (2014) when broiler birds were fed with 2mg of sodium selenite.** Qiao *et al*. (2001) and Medić *et al*. (2009) noticed that meat with higher L values had low pH which is contrary to the findings in this study. The reason of the disparity may be attributed to stress prior to slaughter. Salakova *et al*. (2009) reporteda negative correlation between pH and L values (r = -0.41, P50). However, no correlations was observed between meat pH and all colour parameters obtained in the present study. This can probably result from relatively low variation in meat pH values estimated for the analysed categories of samples. Lipid is one of the important components of meat and contributes to several desirable sensory characteristics of meat and meat products. Lipid enhance the flavor and aroma and also increase the tenderness and juiciness of meat (Gorelik *et al*., 2008); however, it is generally accepted that lipid oxidation is the primary process responsible for quality deterioration of meat during storage. In this study, lipid oxidation of tissues of broiler chicken fed the different additives were minimal as similar MDA and SOD were recorded. According to Dorman *et al*. (2000) eugenol found in cloves possesses strong antioxidant activity which is comparable to the activities of synthetic BHT and pyrogal meanwhile similar result was obtained for both control and additives. According to the consumer research published by Puvača *et al.* (2015), the sensory quality of meat has high scores in juiciness and overall acceptability, demonstrating that the addition of spice including garlic, black pepper and hot red pepper in the diet did not have an adverse effect on meat quality, which is in line with this study but contrary to the study of Jang *et al.* (2008) reported the enhancement of flavour after feeding a mixture of herbal tree extracts to broilers. The results of sensory evaluation revealed that the feeding of additives did not induce any abnormal colour, flavour or smell in the meat. From the result obtained, the significant difference observed in colour might be due to difference in perception of colours by panelist used. Appearance is known to influence consumers' initial selection of meat. As a result, this influences the overall acceptability which is a function of rating in palatability and the preference of a product to a consumer (Joseph, 1999). The non-significant differences in juiciness and tenderness are in accordance with the work of Egbeyale *et al.* (2012) who studied the meat quality characteristics of broiler chicken fed varying levels of *Ocimum gratissimum*. The author reported that parameters such as juiciness, tenderness, and saltiness were not significantly affected by the varying levels of *Ocimumgratissimum*which is in agreement with this study.

Conclusion

From this study, it was concluded that the supplementation with 4g/kg of both clove and turmeric in the diets of cobb strain of broiler chickens had beneficial effects, including decrease in cook loss, increase in meat water holding capacity and lipid profile of the meat. Additionally, meat tenderness and overall acceptability of the chicken meat was also improved while Increase days of storage caused a decrease lab and pH of the meat samples. It was also concluded that the supplementation of Clove (4g/kg) and turmeric (4g/kg) reduced the total cholesterol both in the meat samples.

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