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Effects of Natural Antioxidant Extracts Supplementation on Meat Quality of Broiler Chickens

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Abstract

The study examined the effect of dietary antioxidant supplementation on meat tenderness characteristics and sensory evaluation of broiler chickens. Three hundred (300) day old Abhor acre broiler chicks were fed starter diet from 1-4 weeks and finisher diet for the last 4weeks. Birds were randomly assigned to treatments based on antioxidants supplementation in drinking water at 0.02% butylated hydroxyanisole (BHA), ordinary water (OW), 0.02% sweet orange peel extracts (SOPE), 0.02% shaddock peel extracts (SHPE) and 0.02% lemon peel extracts (LMPE) per litre of water in a completely randomized design experiment. 3 birds were selected in each treatment and slaughtered, and the pectoralis muscles of the chicken was used for meat quality determination. There were significant differences (P<0.05) on the meat tenderness (force peak and yield) on the dietary antioxidants fed to the birds. Sensory parameters (taste, aroma and overall acceptability) shows significant differences (P<0.05) amongst the treatments. However, there were no differences (P>0.05) on meat appearance and texture perception broilers fed different antioxidants supplemented diets. OW and LMPE can serve as a substitute for BHA on overall acceptability perception for meat quality evaluation.

Key words: *Synthetic Antioxidant, Natural Antioxidants, Meat Tenderness, Sensory Parameters, Perception*

Introduction

Broiler meat has several desirable nutritional characteristics such as high protein, low lipid contents and high polyunsaturated fatty acids [1]. These make it preferable, health wise, when compared to red meat. Broiler meat is, however, highly susceptible to lipid oxidation during storage [2]. Lipid oxidation is reported to have adverse effects on meat quality parameters such as colour, juiciness, tenderness and flavour, thus leading to the reduction of the meat's shelf-life [3]. [4] recommended the use of dietary antioxidant in enhancing its meat quality. In recent years, the use of synthetic compounds like antibiotics as feed additives has been discouraged. In response to this, there is increased interest in the use of natural antioxidants from plants and these antioxidants have gained popularity because they are believed to be safer than synthetic antioxidants [4].

The problems associated with the side effect of synthetic antioxidants (BHA) on human health particularly their toxicity and carcinogenic effect has resulted in shifting research focus on antioxidants that are safe and are of natural origins [5]. The objective of this study was to determine the effect of natural antioxidants on meat quality of broiler meat.

Materials and Methods

The field experiment was conducted at Kwara State University Teaching and Research farm, Malete, on a geographical location of latitude 08^{o} 71′ N and longitude 04^{o} 44′ E at 365 m above sea level. The climate of Malete is characterised by distinct wet and dry seasons with the annual mean rainfall of about 1,150 mm and a mean annual temperature that ranges from 25 – 28.9^{o} C [6]. Three hundred (300) day-old, abhor acre broilers were used in this study. The chicks were weighed and randomly allotted to five treatments in a completely randomized design and were replicated in three units with twenty birds per replicate. Birds were housed in a metabolic battery cage. Organic solvent extraction using the methods described by [7] was used to obtain extracts from the peels. The treatments were based on the natural antioxidants supplementation in drinking water as stated below [8]:

1. Treatment one - Positive control (drinking water with 200 ppm BHA/litre)
2. Treatment two - Negative control (drinking water with no antioxidant supplement)
3. Treatment three (drinking water with 200 ppm of sweet orange peel extract (SOPE)/litre)
4. Treatment four (drinking water with 200 ppm of shaddock peel extract (SHPE)/litre)
5. Treatment five (drinking water with 200 ppm of lemon peel extract (LMPE)/litre)

Routine management and vaccination were followed [9]. Feed and water were given ad libitum for the 8 weeks' trial. The birds were placed on formulated broiler starter diet containing 23% CP and 2879Kcal/kg ME for the first four weeks and broiler finisher diet containing 17% CP and 2700 kcal/kg ME for the second four weeks (Table 1).

Table 1: Composition of The Diets (%DM)

Ingredients	Starter (%)	Finisher (%)
Maize	57.50	56.50
Wheat offal	0.00	8.00
Soybean meal	20.00	15.00
Groundnut cake	16.00	8.50
Fish meal	2.00	1.00
Bone meal	2.50	4.00
Limestone	1.00	6.00
Vitamin Premix	0.25	0.25
Methionine	0.25	0.25
Lysine	0.25	0.25
Salt	0.25	0.25
Total (kg)	100.00	100.00
Calculated Analysis		
CP %	23	17
ME Kcal/kg	2879	2700

DM= Dry matter, kg = kilogramme, CP = Crude protein, ME = Metabolisable energy, Kcal = Kilocalorie.

Data Collection

At 8 weeks of age, 5 birds from each replicate (with no visible abnormalities) were randomly selected, slaughtered after fasting overnight, in accordance to the Halal procedure as outlined in MSI 500:2009 (Department of standards Malaysia 2009), deplumed and eviscerated. 50 g of pectoralis major muscle were dissected from the outer surface of the breast meat of each of the chicken per replicate and used to determine the tenderness of the meat using the Volodkovitch bite jaw attached to a TA. HD plus (texture analyser), a procedure described by [10]. A consumer type sensory evaluation as described by [11] on the sensory parameters (tenderness, juiciness, flavour and overall acceptability) using a 9-point hedonic scale with 9 indicating extremely liked and 1, disliked extremely.

Data obtained from the experimental trial were analyzed and subjected to Analysis of variance (ANOVA) using the PROC MIXED procedure of SAS (2014). Tukey test were used to separate the means at 5 % significant level.

Results and Discussion

Table 2: Effect of Dietary Antioxidant Supplementation on Meat quality (Tenderness) of Broiler Meat

Parameters	**Treatments**						
	BHA (0.02%)	**OW**	**SOPE (0.02%)**	**SHPE (0.02%)**	**LMPE (0.02%)**	**SEM**	**P value**
Force Peak (N)	15.90^{a}	12.00^{b}	7.20^{c}	3.50^{d}	10.40^{b}	0.469	<0.0001
Force Yield (N)	3.20^{b}	11.60^{a}	1.50^{c}	1.20^{c}	3.90^{b}	0.184	<0.0001
Stress Peak(N/mm^2)	0.06	0.05	0.03	0.01	0.04	0.017	0.4029
Stress Yield (N/mm^2)	0.01	0.05	0.01	0.01	0.02	0.01	0.1297
Strain Peak (%)	71.91^{b}	10.18^{e}	52.31^{d}	95.09^{a}	59.22^{c}	0.013	<0.0001
Strain Yield (%)	11.97^{a}	0.04^{e}	3.83^{c}	5.49^{b}	0.92^{d}	0.019	<0.0001
Young's Modulus (N/mm^2)	0.1^{c}	2.13^{a}	0.05^{dc}	0.01^{d}	0.76^{b}	0.015	<0.0001
Width (mm)	25.00	25.00	25.00	25.00	25.00	1.0	1.0000
Thickness (mm)	10.00	10.00	10.00	10.00	10.00	1.0	1.0000

$^{a, b, c, d, e, dc}$ means having different superscripts along the same column are significantly different ($p < 0.05$)

BHA = butylated hydroxyanisole, OW = Ordinary water, SOPE = Sweet orange peel extracts, SHPE = Shaddock peel extracts, LMPE = Lemon peel extracts.

The current study shows that there was a significant difference ($P<0.05$) on the shear force (force peak and yield) of the broiler meat fed with different antioxidants. The synthetic antioxidant (BHA) treatment had more force peak value than other treatments (OW, SOPE, SHPE and LMPE), Table 2. Whereas, more force was expended in cutting through the (OW) meat treatment than other treatments (BHA, SOPE, SHPE and LMPE). There were no significant differences ($P>0.05$) on the stress (yield and peak) of the meat samples when subjected to texture analysing across the treatments. Also, there were significant differences on the strain (peak and yield percentage) of the meat samples across the

treatments, with treatment (SHPE) having highest percentage of strain peak and treatment (OW) having the lowest percentage of strain yield. Tenderness is the most significant component of meat quality that influences consumers' eating satisfaction [12]. Aging influences meat tenderness due to complex transformations in muscle metabolism as a result of phenolic compounds activities with glutathione peroxidase (GPx) [13]. Similar findings were found in other studies where post mortem aging increased meat tenderness [13], [14].

Table 3: Effect of Dietary Antioxidant Supplementation on Sensory Evaluation of Broiler Meat

Parameter	Treatments						
	BHA (0.02%)	**OW**	**SOPE (0.02%)**	**SHPE (0.02%)**	**LMPE (0.02%)**	**SEM**	**P value**
Appearance	7.50	7.95	7.05	7.20	7.55	0.30	0.27
Taste/Flavour	7.40^{ab}	8.00^{a}	7.00^{ab}	6.50^{b}	7.75^{a}	0.30	0.01
Texture	7.80	7.25	6.50	6.55	7.60	0.35	0.30
Aroma	7.35^{abc}	7.80^{a}	6.50^{bc}	6.30^{c}	7.45^{ab}	0.29	0.001
Overall Acceptability	7.95^{a}	7.95^{a}	7.15^{ab}	6.70^{b}	7.90^{a}	0.25	0.001

There were no significance differences (P>0.05) in the assessor's perception on the appearance and texture of the meat samples across the treatments (Table 3). Whereas, the taste of the assessors was better with treatments (OW and LMPE), and are significantly different (P<0.05) than treatments (BHA, SOPE and SHPE) with SHPE having the least taste perception. Also, the aroma perception of the broiler meat of treatment (OW) was significantly different (P<0.05) from treatments (BHA, SOPE, SHPE and LMPE). Treatments (BHA, OW and LMPE) were significantly different (P<0.05) from treatments (SOPE and SHPE) in terms of their overall acceptability. This could be absence of phytochemicals in (OW) as compared with other treatments (BHA, SOPE, SHPE and LMPE) that contains some of the phytochemicals which could impact on or affect postmortem weakening of myofibrillar proteins in the course of ageing [15]. Since treatment (OW) does not contain any phytochemical compounds as compared to other treatments (BHA, SOPE, SHPE and LMPE), could be the reason why the flavor and aroma perception of treatment (OW) was liked very much by the assessors. This agrees with [16], who postulated that phytochemicals like phenolic compounds could impact negatively on the volatile compounds like butyric acid and 2- Ethylbenzaldehyde found in meat which contributes to its flavor and aroma.

Conclusion

Generally, LMPE treatment a natural antioxidant at recommended level of 0.02% can serve as a substitute for BHA, a synthetic antioxidant, for taste perception and overall acceptability of the broiler meat. Also, no appreciable impact of SOPE, SHPE and LMPE on the broiler meat tenderness as compared to treatments BHA and OW.

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