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EFFECTS OF DIETARY THYME LEAF ON OXIDATIVE STABILITY OF REFRIGERATED RAW AND COOKED BROILER CHICKEN MEAT

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Abstract

Thyme (Thymus vulgaris) has been reported to possess strong antioxidants properties. Aromatic and medicinal herbs like Thyme are rich sources of natural radical scavenging compounds like industrially used antioxidants which inhibit the oxidative chain reaction by inactivating free radicals formed during peroxidation of lipids. Eighty day-old mixed sex Anak broiler chicks were used to investigate the effect of dietary thyme leaf on oxidative stability of refrigerated raw and cooked broiler meat. The birds were fed with starter diet (Animal Care Feed) for five weeks after which the birds were randomly allotted to four treatments of two replicates with ten (10) birds per replicate and fed experimental diet containing varying levels of thyme leaf meal for four weeks before slaughtering. Lipid oxidation in cooked and raw meat stored over 6 days and four weeks respectively were assessed by measuring thiobarbituric acid reacting substances (TBARS). Inclusion level of 2.0% in broiler feed could efficiently reduce post mortem peroxidation in both raw and cooked broiler meat thereby increasing its shelf life and reducing the hazardous effect of oxidized meat to the consumers. Results showed that dietary thyme leaf reduced oxidative deterioration in refrigerated raw and cooked broiler meat. This could also be considered as a good replacement for synthetic antioxidants that are capable of exerting carcinogenic effect on the consumers.

Key words: Broiler meat, Diet, Lipid oxidation, Thyme leaf.

Introduction

Fresh poultry meat has a relatively short shelf life. Beside bacteria spoilage, oxidation of lipids has been recognized as the major cause of deterioration of muscle food. As a result of lipid oxidation, various undesirable breakdown products are released, giving rise to the typical off-odour and off-flavour of rancid meat. These breakdown products are considered to be harmful to human health. Furthermore, through oxidation of myoglobin, an unpleasant change of surface meat colour occurs (Morrissey *et al.,* 1997).

Anti-oxidants are capable of delaying or preventing the development of deterioration reaction due to oxidation. There are two major groups of anti-oxidants: the natural anti-oxidants and the synthetic anti-oxidants. The former include pure extracts of vitamin C and E, plant extracts, spices and herb plants especially rosemary, sage and thyme (Schwarz *et al.,* 1996) while the later include a wide range of conventional or synthetic compounds such as Butylated hydroxyanisole (BHA) and Butylated hydroxytoluene (BHT).

Results from numerous studies carried out on meat from poultry fed diets supplemented with elevated levels of synthetic vitamin E have shown that the oxidative stability of both lipid and myoglobin was improved and the development of rancid deterioration and discolouration of the meat were delayed. These effects were observed in fresh, cooked and processed meat under various conditions of refrigerated or frozen storage that resulted in a considerable extension of the shelf life of a variety of poultry products (Morrissey *et al.,* 1997; Coetzee and Hoffman,2001).

Improving the natural anti-oxidant status of meat by dietary means has received considerable attentions. Vitamin E

supplementation in the diets of cattle (Faustman *et al.,* 1989), sheep (Wulf *et al.*, 1995), chicken (Dirinck *et al.*, 1996), veal calves (Engeseth *et al.,* 1993) and pigs (Cannon *et al.,* 1995) increased both the level of vitamin E and the oxidative stability of muscle. Numerous other natural extracts have recently been investigated for their anti-oxidant activity in meats (Cheah and Hasim, 2000; Nakatani, 1992). McCarthy *et al.,* (2001) reported worldwide interest in anti-oxidant from natural sources because of the concern being raised as to safety of the synthetic compounds.

Thyme (*Thymus vulgaris*) has been reported to possess strong antioxidants properties (Schwarz *et al.,* 1996, Lacroix *et al.*, 1997). Dapkevicius (2002) reported that aromatic and medicinal herbs are rich sources of natural radical scavenging compounds like industrially used antioxidants which inhibit the oxidative chain reaction by inactivating free radicals formed during peroxidation of lipids. He also reported the isolation of more compounds (rosmarinic acids, eriodicytol, taxifolin, luteolin, 7 – glucuronide, p-cymene 2, 3-diol, p-cymene, 2, 3-diol, p-cymene,2, 3-diol 6 –6-dimer, thymol, carvacrol and 3-0- {8-2-caffeoyl}06–rosemaric acid with different polarity and distinctive antioxidant reactivity from leaf extract of thyme. Herbs are consumed not only as concentrated herbal oils but also as drink extracts. In Nigeria and some other parts of the world, leaves of thyme or its powdered herbs are used as spices to add flavour to meats and vegetables. Onibi (2003) reported anti-oxidative activity of added dried leaves of thymes to ground fresh and cooked broiler chicken meat during refrigerated storage. However he had the problem of chlorophylization of the products.

This study therefore aimed at investigating the effects of dietary thyme leaf on oxidative stability of broiler chicken meat.

Materials and methods

Experimental Animals

Eighty day old mixed sex Anak broiler chicks were used for this study. The birds were fed with starter diet (Animal Care Feed) for five weeks under a deep litter management system after which they were randomly allotted to four treatments of two replicates with ten (10) birds per replicate and fed experimental diets containing varying inclusion levels of thyme leaf meal (i.e. 0, 1.0, 2.0 and 3.0 %) for four weeks before slaughtering.

Table 1: Ingredient composition of experimental diets

Ingredients (%)	Thyme leaf inclusion levels (%)			
	0.0	**1.0**	**2.0**	**3.0**
Basal diet				
Maize	45	45	45	45
Maize Offal	5	5	5	5
Wheat Offal	5	5	5	5
Groundnut Cake	25	25	25	25
Soybean Meal	10	10	10	10
Palm Kernel Cake	5	5	5	5
Limestone	1.45	1.45	1.45	1.45
Bone Meal	2.8	2.8	2.8	2.8
Lysine	0.1	0.1	0.1	0.1
Methionine	0.1	0.1	0.1	0.1
Salt	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Enzyme	0.05	0.05	0.05	0.05
Total	100	100	100	100
Basal Diet Inclusion	100	99.0	98.0	97.0
*Thyme leaf Inclusion	0	1.0	2.0	3.0
Total	**100**	**100**	**100**	**100**

*Ducrose thyme by Ducros International Limited, OnitshaNigeria, Reg. Trade Mark No. T.P. 15609

Thyme (was purchased from Baboko market in Ilorin, Kwara State, Nigeria. This was milled before incorporation into the broiler feed purchased. The inclusion levels were 0, 1.0, 2.0 and 3.0 % of the gross diet composition.

The commercial starter diet (Feed master) used contained 23.0%, 4.5%, 4.0% and 2800kcal/kg crude protein, crude fat, crude fibre and energy respectively while the basal finisher diet contained 20.0%, 3.5%, 8.0% and 2800kcal/kg crude protein, crude fat crude fibre and energy respectively.

Experimental diets and water were supplied *ad libitum* for a period of four (4) weeks. Six birds from each treatment (a total of 24 birds) were randomly selected weighed and then slaughtered by cutting the jugular vein. The birds were given equal time of bleeding (30 minutes), then scalded in hot water of about 80^{o}C for 30 seconds before they were manually defeathered. The carcasses were then eviscerated and cut into primal parts (breast, thigh, drumstick, back and wing).

The breast portions of birds were taken, labeled according to their treatments, packed in a wrapper and refrigerated for lipid oxidation assessment for a period of 28 days.

Lipid oxidation determination

Lipid oxidation of cooked and raw meat stored over 6 days and 4 weeks respectively were assessed by measuring thiobarbituric acid reacting substances (TBARS) using the method of Wills (1989).

Two grams of ground meat sample was weighed and quickly removed into 5ml ice-cold 0.25M sucrose solution and thereafter homogenized. With the aid of clean and dried pipettes 2.0ml of the sample (i.e. tissue homogenate) was transferred into a test tube and 2ml of 20% trichlocoacetic acid (TCA) was added followed by addition of 2ml of 0.07% thiobarbituric acid (TBA).

The mixture was heated in a tightly stopper tube for 30 minutes in a hot water bath at 80^{o}C. The precipitated protein was then centrifuged. The mixture developed a yellow-orange colour and the absorbance was read at 530nm with the aid of Spectronic 20 Spectrophotometer (Cam Spec M105 Spectrophotometer, 11 High Street Sawsto, Cambridge U.K).

The TBA value used to express the result was calculated by multiplying the absorbance by a constant co-efficient K, which was calculated from a standard curve and a known dilution factor as K-extraction = S/A x 72.063 x 106/E x 100/P where S is the standard concentration range from $1x10^{-8}$ to $8x10^{-8}$ mol of 1, 1, 3, 3-tetramethoxy propane (TMP) in 5ml of fitrate. A is the absorbance of the standard, 72.063 is the molecular weight of malonaldehyde (MDA), E is the sample weight equivalent and P is the percent recovery (Wills, 1989)

Statistical Analysis

Data collected on TBARS analysis of raw and cooked broiler meat were subjected to 4 x 4 and 3 x 4 factorial analyses for 4 thyme levels versus 4 weeks of TBARs assessment and 4 thyme levels and 3 days of assessment respectively using Microsoft Excel statistical package (V X P Microsoft Corp; W.A; USA).

Results and discussion

Table 2 shows that TBARS values for refrigerated raw broiler meat in the control diet were significantly higher (1.45) ($P<0.05$) than values obtained from carcass of birds fed graded levels of thyme leaf meal (0.65- 1.20). This indicates that thyme leaf inclusion in broiler diet significantly reduced ($P<0.05$) oxidation in refrigerated raw meat when compared with the control. TBARS value was observed to decrease with increasing levels of dietary thyme leaf meal.

Lipid oxidation in refrigerated raw broiler meat was significantly higher

(P<0.05) on day 28 of storage when compared with other days and interaction between levels of thyme leaf in the diet and storage days were significant (P<0.05).

This result was in agreement with model lipid system studies, which reported the stabilizing activity of essential oil from thyme (Farag *et al.*, 1989, Haraguchi *et al.*, 1996; Dapkevicius, 2002). Thyme (*Thymus vulgaris*) and a number of its constituent compounds have been reported to possess strong antioxidant properties (Schwarz *et al.*, 1996; Lacroix *et al.*, 1997).

Table 2: Effects of dietary thyme leaf on TBARS value of refrigerated raw broiler chicken

Parameters		TBARS Value
Thyme Leaf Inclusion Levels (%)		
	0	1.45[c]
	1.0	1.20[b]
	2.0	0.65[a]
	3.0	0.72[a]
Storage Time (Days)	7	1.49[a]
	14	0.45[a]
	21	0.40[a]
	28	1.66[b]
Thyme Leaves Inclusion Levels x Days		
0	7	1.92[c]
	14	0.96[c]
	21	0.51[b]
	28	2.42[f]
1.0	7	1.94[e]
	14	0.46[b]
	21	0.55[b]
	28	1.83[c]
2.0	7	1.07[c]
	14	0.20[a]
	21	0.35[ab]
	28	0.98[c]
3.0	7	1.04[c]
	14	0.20[a]
	21	0.21[a]
	28	1.43[d]
± SEM	0.07	
Thyme Leaf Inclusion Levels		P< 3.77E-11
Storage Days		P< 7.49E-20
Interaction		P< 0.0032

a,b,c,d,e,f - means within column having different superscripts differ significantly (P< 0.05).

Results of TBARS values of refrigerated cooked broiler meat are as presented in Table 3. Result showed that thyme inclusion in broiler diet significantly reduced (P<0.05) peroxidation in refrigerated cooked broiler meat. TBARS values were observed to decrease with increasing levels of thyme leaf meal in the diet to the regime of 20% inclusion level, though not statistically significant.

Table 3: Effects of dietary thyme leaf on TBARS value of refrigerated cooked broiler meat

Parameters		TBARS Value
Thyme Leaf Inclusion Levels (%)		
	0	3.09[b]
	1.0	1.88[a]
	2.0	1.27[a]
	3.0	1.50[a]
Storage Time (Days)	2	1.64[a]
	5	2.31[b]
	7	1.85[a]
± SEM	0.18	
Thyme Leaf Inclusion Levels		P< 1.44E-06
Storage Days		P< 0.039
Interaction		P> 0.077 (NS)

[a,b] Mean values within column having different superscripts differ significantly.(P<0.05)

NS: Not significant (P>0.05).

Lipid oxidation was observed to be highest on day 5 of the assessment however; there was no significant interaction between levels of thyme leaf in the diet and days of storage on lipid peroxidation (Table 3). This result indicates that thyme leaf inclusion in broiler diet exerted anti-oxidant effect on refrigerated cooked broiler meat. This is in conformity with the findings of Onibi (2003) when he blended different levels of thyme leaf with broiler muscle. Cooked meat oxidized more than raw meat and effect of thyme as an anti-oxidant in reducing oxidative deterioration was more in the former.

Conclusion

Thyme leaf is efficient in reducing oxidative deterioration in refrigerated raw and cooked broiler meat. Inclusion level of 2.0% in broiler feed could efficiently reduce post mortem peroxidation in both raw and

cooked broiler meat thereby increasing its shelf life and reducing the hazardous effect of oxidized meat to the consumer.

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