Comparative Effects Of Post Mortem Addition Of Natural And Synthetic Antioxidant Sources On Cooking Yield, Cooking Loss And Oxidative Stability Of Broiler Chichen Meat.

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Abstract: A worldwide concern in the use of synthetic antioxidants in food safety necessitates investigation into natural sources of antioxidants. An invitro assay of antioxidant properties of alpha-tocopheryl acetate, thyme leaf extract, Ethiopian pepper extract and wheat germ vitamin E was carried out using eight 14 weeks old broiler chicken. The muscle tissue of each chicken were separated, chopped, mixed thoroughly and divided into treatment group of 800g each. Experimental samples were prepared by blending 0.8% w/w addition of thyme leaf extract, Ethiopian pepper extract, wheat germ vitamin E and alpha-tocopheryl acetate while the control did not contain any. Each treatment sample was further divided into 8 sub-samples (80g each). Four samples per each treatment were separately packed in aluminum foil paper and refrigerated for 12 days at $4^{o}C$ for raw meat Thiobarbituric Acid Reactive Substances (TBARS) analysis at interval of 3, 6, 9, and 12 days. Four sample per each treatment were steam cooked for 12 minutes, separately packed in aluminum foil paper and refrigerated for 6 days for cooked meat TBARS analysis at interval of 2, 4 and 6 days. The result indicated that post mortem addition of natural and synthetic sources of antioxidant had no significant effect (P>0.05) on cooking yield and cooking loss of broiler meat during storage. Comparatively, the tested natural antioxidant sources reduced the formation of peroxide more effectively (P<0.05) than alpha-tocopheryl acatete in refrigerated raw and cooked broiler chicken meat and could be used to replace synthetic compounds which poses health hazard to the consumers. However more studies are required to remove the chlorophyllization effect of thyme leaf extract and Ethiopian pepper extract on the meat.

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Introduction

The autocatalytic free-radical-mediated process of lipid oxidation, which is believed to be initiated in highly unsaturated phospholipids fraction in sub-cellular membranes, is a major cause of deterioration in the quality of muscle food during refrigerated and frozen storage (Morrissesy et al., 1997). However the susceptibility of muscle food to lipid oxidation can be controlled by the presence of antioxidants. Onibi 2003 reported two major groups of antioxidants; the natural antioxidants and synthetic antioxdants.

Natural antixidants include vitamin C and E, plant extracts, spices and herb plant especially rosemary, sage and thyme (Schirarz et al., 1996). Synthetic antioxidants include butylated hydroxytoluene (BHT) Butylated Hydroxyanisole (BHA), propyl gallate and alphatocopheryl acetate.

Most studies over the year on antioxidants have used synthetic antioxidants and have consequently shown that these synthetic antioxidants degrade cell over time and course adverse health effect. For example studies have shown that synthetic beta carotene increased risk of cancer (Karen, 2007). Synthetic vitamins have been shown to be treated like foreign substance in the body just as the drugs are. This means the body has to work hard to detoxify the body from them (Karen, 2007).

The importance of natural antioxidants especially of plant origin has greatly increased in recent years (Chidamabaramurthy and others 2002).v

Thyme (Thymus Vulgaris) and its leaf extract have been shown to possess strong antioxidative properties (Ayoola and Olorunsanya 2007). Ethiopian pepper has ample amount of tocopherol (25mg/100g) (Bolu, 2002), belong to the group of spices and could be a good natural antioxidant. Numerous studies with meat from poultry fed diets supplemented with elevated level of synthetic vitamin E have shown that the oxidative stability of both lipid and myoglobin was improved and the development of rancid deterioration and coloration of the meat delayed.

Growing consumer interest in natural food ingredient and their tendency to avoid synthetic products which they perceived as unsafe have driven this investigation. In this study, comparative effects of post mortem addition of Natural and Synthetic antioxidant sources on cooking yield, and oxidative stability of refrigerated broiler chicken meat was investigated.

MATERIALS AND METHODS

Ducros thyme (Ducros International Ltd, Onitsha, Nigeria) was purchased at Baboko Market in Ilorin, Kwara State, Nigeria. 500g of the thyme leaf was soaked in 2.5 litre of 96% ethanol for 48 hours. The mixture was thereafter filtered through a Wattman no 1 filter paper. The filtrate was concentrated on a hot water bath until a constant weight was obtained (Cromwell *et al.,* 1980)

Ethiopian pepper was purchase at Oja Oba in Ilorin, Kwara State, Nigeria. Its extract was prepared following the procedure as described for thyme leaf extract. Wheat germ vitamin E extract was purchased from Golden-Neo-life-Diamite (GNLD) agent at Ilesa in Osun State, Nigeria. Alpha-tocopheryl acetate was purchased from a pharmaceutical shop in Ilorin. The extracts and alpha-tocopheryl acetate were used for the sample preparation.

Eight 14 weeks old mixed sex Anak broiler chicken the same diet and raised in Animal production Department, University of Ilorin were used for the experimental trials. The birds were slaughtered using the conventional method, bled, defeathered, eviscerated and cut into primal parts. Thereafter, the breasts were deboned and the meats were minced and thoroughly mixed together, then divided into 5 treatment groups of 400g each. Experimental samples were prepared by blending 0.8 $^{W}/_{W}$ addition of thyme leaf extract, Ethiopian pepper extract, wheat germ vitamin E extract or alpha-tocopheryl acetate with broiler chicken meat, while the control did not contain any anti-oxidant. Each treatment sample was further sub-divided into 4 sub-samples (100g each), separately packed in aluminum foil paper and refrigerated for 12 days at 4^{o} C for raw meat TBARS analysis at intervals of 3, 6, 9 and 12 days.

The thigh muscle of each chicken was separated, chopped and thoroughly mixed together, later divided into 5 treatment groups of 400g each. Cooked samples were prepared by blending 0.8 $^{W}/_{W}$ addition of thyme leaf extract, Ethiopian pepper extract, wheat germ vitamin E extract or alpha-tocopherol acetate with broiler chicken meat, while nothing was added to the control. Each portion was then subdivided into 4 replicates (100g each) separately kept in cellophane bags and sealed. These were steam cooked for 12 minutes and re-weighed to determine the cooking yield and cooking loss.

Cooking yield and cooking loss were calculated as follows:

$$\text{Cooking yield} = \frac{W_y}{W_x} \times \frac{100}{1}$$

$$\text{Cooking loss} = \frac{W_x - W_y}{W_x} \times \frac{100}{1}$$

Where

W_x = Weight of fresh meat before cooking

W_y = Weight of meat after cooking.

Each steam-cooked sample was repacked in aluminum foil paper and refrigerated for 6 days at 4^{o} C for cooked meat TBARS analysis at intervals of 2, 4 and 6 days.

Lipid oxidation in the meat was determined by quantifying Malonaldehyde (MDA) production, based on the Thiobarbituric Acid Reactive Substances (TBARS) test using the aqueous extraction 2– thiobarbituric acid (TBA) procedure described by Pikul *et al.*, (1989).

Ground chicken meat (10g) was homogenized with 34.25ml of cold (4^{o} C) extracting solution containing 4% Trichloroacetic acid (TCA). The blended sample was filtered through whatman No 1 filter paper into a 50ml Erlenmeyer flask and washed with 5ml of distilled water. The filtrate was adjusted to 50ml by adding 4% TCA. Thereafter, 5ml aliquots of the filtrate were transferred to separate test tubes and mixed with 5ml of 0.02M TBA in distilled water and was heated in a boiling water bath for 1hour and then cool for 10minutes in cold tap water. The absorbance was determined at 532nm against a blank containing 5ml of Trichloroacetic acid (4%) and 5ml of TBA reagent with the aids of spectronic 20 Spectrophotometer (Camspec M105 spectrophotometer, 11 High street, Sawston, Cambridge U.K).

The TBARS value used to express the result of the modified extraction method was calculated by multiplying the absorbance by a constant coefficient K, which was calculated from standard curve and known dilutions, as:

K extraction = S/A x 72.063 x 106/ E x 100/P

Where S is the standard concentration (range from 1 x 10^{-8} to 8 x 10^{-8} mol) of 1, 1, 3, 3, -tetramethoxypropane (TMP) 5ml of filtrate. A is the absorbance of the standard, 72.663 is the molecular weight of malonaldehyde (MDA), E is the sample weight equivalent and P is the percent recovery (Pikul *et al.*, 1989).

STATISTICAL ANALYSIS

Data collected on cooking yield and cooking loss were subjected to one way analysis of variance (ANOVA) of a Complete Randomized Design using the statistical package of IBMPC (SPSS/PC +) while data collected on TBARS analysis of refrigerated raw and cooked broiler meats were subjected to factorial analysis using Microsoft Excel statistical package (V.XP Microsoft corp. W.A; USA).

RESULTS AND DISCUSSION

TABLE 1. Comparative effect of post-mortem addition of natural and synthetic anti-oxidants on cooking yield and cooking loss of broiler Chicken meat (%).

Parameter	Control	Alphatocopheryl Acetate	Wheat germ vit E	Thyme leaf extract	Ethiopian pepper extract	±SEM
Cooking yield	76.50	75.00	77.47	74.42	74.38	1.12 NS
Cooking loss	23.50	25.00	22.53	25.58	25.62	1.12 NS

***NS:** Not significant (P>0.05)*

Cooking yield was higher and cooking loss lower in broiler meat treated with 0.8w/w wheat germ vitamin E however; no significant effect (P> 0.05) was noticed among the treatments (Table 1).This result of cooking yield showed that plant extracts tested and alpha-tocopheryl acetate exert no effect on cooking yield of broiler meat. This observation is similar to that of Morenikeji (2004) who reported that cooking yield of broiler breast muscle marinated in 0.00%and 2.50% monosodium glutamate levels were similar (P<0.05).

TABLE 2. Comparative effect of post-mortem addition of natural and synthetic antioxidants on TBARS number of refrigerated raw broiler chicken meat.

Parameters **Antioxidant sources**		**TBARS NUMBERS**
Control		0.69^{b}
Alphatocopheryl acetate		0.58^{b}
Wheat germ vit. E		0.23^{a}
Thyme leaf extracts		0.31^{a}
Ethiopian pepper extracts		0.31^{a}
Storage time (days)	3	0.20^{a}
	6	0.40^{b}
	9	0.48^{bc}
	12	0.61^{c}
± SEM		**0.06**
Antioxidants compared		P < 2.09E -06
Storage Days		P < 2.76E -05
Interaction		P < 0.134 (NS)

Treatment mean within column carrying different superscripts differ significantly (P < 0.05)

The result shows that post mortem addition of tested antioxidant sources significantly (P<0.05) inhibited oxidative deterioration of refrigerated raw broiler meat during storage when compared with the control and tested synthetic compound.

TBARS value was observed to be lower in Alpha-tocopheryl acetate treated meat when compared with the control; however its effect was not significantly different (P>0.05) from that of the control treatment. Oxidative deterioration in refrigerated broiler meat was observed to be increasing with increase in days of storage. However interaction between natural antioxidant sources and days of storage was not significant (P<0.05).

The result suggests that thyme leaf extract, wheat germ vitamin E or Ethiopian pepper extract could be used as natural antioxidant during storage. This result is in agreement with Schwarz et-al., (1996) who reported that aromatic and medicinal herbs are rich sources of natural radical scavenging compounds like industrially used antioxidant, which inhibit the oxidative chain reaction by inactivating free radicals formed during peroxidation of lipids. Thyme and a number of its constituents compound have been shown to posses strong antioxidative properties (Lacroix et al., 1997).

The result of this study showed that the tested natural anti-oxidant significantly reduce the formation of peroxide (P<0.05) than alpha-tocopheryl acetate. This observation is in conformity with the earlier findings of Hara (1994) that crude extract of green tea reduced the formation of peroxide more effectively than alpha-tocopherol or Butylatedhydroxyanisole BHA.

TABLE 3
Comparative effect of post-mortem addition of natural and synthetic antioxidants on TBARS number of refrigerated cooked broiler chicken meat.

Parameters			**TBARS NUMBERS**
Antioxidant sources			
Control		2.21^{e}	
Alphatocopheryl acetate		1.86^{d}	
Wheat germ vit. E			0.69^{b}
Thyme leaf extracts			0.35^{a}
Ethiopian pepper extracts		1.34^{c}	
Storage time (days)	2		0.74^{a}
	3		0.80^{b}
	6		1.34^{c}
± SEM		**0.09**	
Antioxidants compared		P < 8.63E -17	
Storage Days		P < 3.07E -11	

Treatment mean within column carrying different superscripts differ significantly (P < 0.05).

Post mortem addition of different natural antioxidant sources and alphatocopheryl acetate showed significant differences (P< 0.05) in TBARS value of refrigerated cooked broiler meat. In general, TBARS values increased with increasing storage time. All the tested antioxidant sources significantly reduced (P< 0.05) peroxidation when compared with the control. Natural sources of antioxidant tested significantly (P< 0.05) reduced peroxidation in refrigerated cooked broiler meat when compared with the control or synthetic compound. This result is in conformity with the observation of Smid and Gorris (1999), they reported that plant extracts possess a characteristic flavour and sometimes show antioxidant activity.

Thyme leaf extract best reduced peroxidation of refrigerated cooked broiler meat followed by wheat germ Vitamin E. This result (Table 3) is in agreement with the study of Dapkevicius (2002) who reported that aromatic and medicinal herbs are rich sources of natural antioxidant.

Nishina *et al.* (1992) reported natural antioxidants such as polyphenols and β-diketone types to possess high antioxidative activity. Onibi (2003) reported that lipid oxidation decreased both in refrigerated fresh and cooked broiler chicken meat blended with thyme leaf. In contrast to raw meat where lipid oxidation occurs over days or weeks, these reactions proceeded rapidly in cooked meat (Mottram, 1987)

CONCLUSION

It could be concluded therefore, that the natural and synthetic anti-oxidants tested exert no effect (P>0.05) on cooking yield and cooking loss of broiler meat, however the materials tested reduced peroxidation in both raw and cooked broiler meat during storage.

Comparatively, the tested natural anti-oxidant sources reduced the formation of peroxides more effectively (P< 0.05) than alphatocopheryl acetate. These highly effective natural anti-oxidant extracts application in the meat industry may be very valuable and desirable because of the concern being raised as to the safety of the synthetic anti-oxidants.

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