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Effects of Different Species of Pepper (*Capsicum)* on Oxidative Stability of Raw and Cooked Pork Patties

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Abstract: Antioxidant properties of different species of pepper (*Capsicum)* were evaluated in pork patties from two weeks frozen pork. In 200 g pork patties was added 1.5 % cayenne, bell, tobasco or habenero pepper and a control. A positive reference control was prepared with 200 mg of α-tocopherol acetate in 200 g of pork patties. The preparations were made for raw and cooked samples. The addition of any specie of pepper in the patties showed a better antioxidative property ($p<0.05$) than the α-tocopherol acetate for raw and cooked samples. Cayenne pepper exhibited the best antioxidant property of all the pepper species studied. The control samples had the worst lipid deterioration.

Key words: Pepper, α-tocopherol, antioxidant, raw, cooked, pork

INTRODUCTION

Pork eating is experiencing a phenomental increase in major cities of Nigeria, despite the religious constraint. This is due to its relatively low cost per kilograms when compared to beef or poultry. Pork meats are commonly purchased from retailing shops where it is common for meat to be stored for several days to weeks, where deterioration in the quality and colour of meat are often encountered.

Lipid oxidation has been observed to be a major cause of deterioration in the quality of meat and meat products (Asgbar *et al*., 1988; Ladikos and Lougovois, 1990). The changes in quality are manifested by the formation of a number of volatile secondary products associated with changes in flavour, colour, texture and nutritive values as well as production of toxic compounds (Commission of the European Communities, 1989). Lipid oxidation in muscle foods is due to autoxidation of the highly unsaturated phospholipids fraction in sub cellular biomembranes (Igene and Pearson, 1979).

A common approach in retarding the production of oxidation in meat and meat products is the use of antioxidation (Allen and Foegeding, 1981). Antioxidants could be synthetic or natural. However, there is a negative perception by consumers to the use of synthetic antioxidant due to its safety concern. Hence, there is an increase interest in the use of natural antioxidative ingredients.

Pepper is well known all over the world as a delicious spice with characteristic colour, taste and pungency. In Nigeria, as in all other parts of the world there are different varieties of pepper in cultivation. They differ in size, colour, shape, flavour, pungency and uses. Pepper contain many chemicals including water, fixed (fatty) oils, steam volatile oil, carotenoids, resin, protein, fibre and mineral elements. The carotenoids are responsible for the diverse and brilliant colours as well as their antioxidative effects (Bartley and Scolnik, 1995). Capsanthin accounts for 30-60% total carotenoids while the rest is capsorubin with small quantities of α-carotene, zeaxanthin and α-cryptoxanthin in a full ripe pepper (Matsufuji *et al*., 1998; Minguez-Mosquera and Hornero-Mendez, 1994; Chen *et al*., 1996). Lee *et al*. (1995) observed the presence of flavonoids (quercetin and luteolin), phenolic acids, nitrates and nitrites in fresh peppers (*capsicum annuum*).

The objective of this study was to elucidate the effectiveness of pepper species (*Capsicum annuum*) that are common in Nigerian markets in improving the shelf life of fresh and cooked pork patties under refrigeration.

MATERIALS AND METHODS

Pork meats from the hind and fore legs of freshly slaughtered pig were obtained from a local retail outlet. The skin and bones were removed manually before storing in a deep freezer for two weeks. The peppers were purchased at a local market in Ilorin, Nigeria. They were finely ground using a kitchen blender, bottled and stored in a dry place. The α-tocopherol was obtained as 'Evitol 100 mg' (manufactured by Teve Pharmaceutical Industry). At the commencement of the experiment the meat was thawed in the refrigerator, cut into small cubes before mincing in a food processor (National MK-5080M Matsushita Electric Industrial, Japan). The minced meat was divided into 12 batches of 200 g, six of which were added 1.5% w/w of cayenne, bell, tabasco or habenero pepper and a control (no addition) respectively. A positive control was prepared with 200 mg α-tocopherol acetate. These were for raw studies a similar preparation was made for cooked studies. The test ingredients were thoroughly mixed with the meat to

ensure even distribution before they were formed into patties (10 g) using a locally fabricated patty mould (Faculty of Engineering, University of Ilorin). Cooking was done in a microwave oven for $1^{1}/_{2}$ min. The patties were stored under refrigeration (4°C) for 9 days evaluating at 3 days interval for the raw patties and 6 days for cooked patties, evaluation was at 2 days interval.

Lipid oxidation determination: Lipid oxidation in the patties was evaluated using the 2-thiobarbituric acid (TBA) test of Pikul *et al.* (1984). The 2-thiobarbituric Reactive Substances (TBARS) were expressed in mg-malonaldehyde per kg (MDA/kg meat). Triplicate patty samples were analyzed in duplicate for each ingredient.

Statistical analysis: Data collected were subjected to analysis of variance (ANOVA) using Genstat 5 program (Payne, Lane and Genstat 5 committee, 1987) package. The differences between means were determined by the least significant difference test and significance was defined at $p<0.05$.

RESULTS AND DISCUSSION

The raw pork patties were observed to have a higher TBARS value than the cooked ($p<0.05$) as shown in Table 1. The reason for this could be due the fact that the meats used for the study were previously frozen for 2-weeks. McCarthy *et al.* (2001) stated that oxidation increased more rapidly in patties manufactured from previously frozen pork. G□ntensperger *et al.* (1998) observed lower oxidative rates in precooked meat samples than the uncooked samples. Although these observations were contrary to the general belief by several workers that cooking and refrigerated storage intensify lipid oxidation (Tims and Watts, 1958; Keller and Kinsella, 1973 and Mortran, 1987).

Table 1: Mean thiobarbituric acid (TBARS) values for minced raw and cooked pork patties* treated with different species of pepper and α-tocopherol acetate

Pork patties	TBARS values (mg/kg meat)
Raw	2.183[b]
Cooked	2.085[a]

[a,b]values with different letters are significantly different ($p<0.05$),
*Means were pooled for both test ingredient and storage time
(n = 144)

In Table 2 the effects of different species of pepper and vitamin E were evaluated irrespective of the storage days or the state of meat (raw or cooked). The control samples were observed to be very susceptible to lipid oxidation with the highest TBARS value ($p<0.05$). This was closely followed by the pork patties containing vitamin E (2.398) ($p<0.05$). The addition of any specie of pepper in the pork patties incurred a significant reduction ($p<0.05$) in lipid oxidation over those containing α-tocopherol acetate. Ahn *et al.* (2002) did not observe any retardation of lipid oxidation when beef patties were treated with α-tocopherol at 0.05% and 0.1% when compared with the control. Higgins *et al.* (1998) had stated that direct addition of α-tocopherol had no significant effect ($p>0.05$) on the inhibition of lipid oxidation of cooked turkey meat. Ahn *et al.* (2002) further reported that dietary supplementation with vitamin E delayed lipid oxidation more effectively than direct application of α-tocopherol to ground beef. Vitamin E in the diet are incorporated into the polar membrane lipids which are more prone to oxidation than the neutral lipids, suggesting that α-tocopherol concentration in unstable polar membrane lipids might play an important role in the prevention of lipid oxidation in meat products. Mitsumoto *et al.* (1993), Buckley *et al.* (1995) and McCarthy *et al.* (2001) reported that exogenous α-tocopherol added postmortem to meat are only incorporated into the neutral lipid fraction thus exhibiting poor antioxidant properties. The antioxidative properties of pepper were observed to correspond to their pungency. The pungency of pepper is influenced by breeding environment such as cultivating area, heat level, rainfall level and temperature (Kim *et al.*, 2002). In this study the species of pepper were observed to reduce TBARS values of minced pork meat by 39.25, 30.49, 27.88 and 25.24% for cayenne, habanero, tabasco and bell respectively; α-tocopherol acetate only gave 13.17% reduction.

The TBARS values of minced pork meat treated with different species of pepper and α-tocopherol acetate stored in refrigeration (4°C) are shown in Table 3. During the cold storage of the raw meat at day 3 a general increase in TBARS values were observed over the starting day. However, at day 6 of storage a reduction in TBARS values were observed except with samples treated with Tabasco pepper and α-tocopherol acetate where increases in TBARS values were seen. Pork meat samples treated with cayenne pepper maintained a steady decline in TBARS values between days 6 and 9. This trend observed with cayenne pepper is characteristic of a natural oxidative curve, increasing during the first day and then decreasing as the secondary products react with the meat components.

Table 4 shows the TBARS values of cooked pork patties stored in the refrigerator at 4°C. The control samples were observed to have lower TBARS values ($p<0.05$) than samples treated with habenero pepper and α-tocopherol acetate at day 2 of storage. At day 4 the meat samples treated with α-tocopherol acetate had the highest values ($p<0.05$), although this was not significantly different from those of the control. By day 6 the meat samples with no addition of antioxidant experienced the most oxidative deterioration ($p<0.05$). The high oxidative power of cayenne pepper over the other peppers could be due to its high capsaicinoid contents. Sanchez-Escalante *et al.* (2003) reported an

Table 2: Effect of different species of pepper and vitamin E acetate on oxidative stability of minced pork meat

	Specie of pepper					
	Control	Cayenne	Bell	Tabasco	Habenero	Vitamin E
TBARS values	2.762^{e}	1.678^{a}	2.065^{c}	1.992^{b}	1.920^{b}	2.398^{d}

^{a,b,c}means with different letters along rows were significantly different ($p<0.05$)

Table 3: Effects of different species of pepper, vitamin E and storage days on oxidative stability of raw pork meat stored at 4°C

	TBARS (mg MDA/kg meat)			
	Days of storage			
Treatment	0	3	6	9
Control	1.616$^{a}_{x}$	3.404$^{b}_{y}$	3.387$^{b}_{z}$	3.969$^{c}_{z}$
Cayenne pepper	1.782$^{a}_{yz}$	1.869$^{b}_{x}$	1.656$^{a}_{x}$	1.470$^{a}_{w}$
Bell pepper	1.699$^{a}_{xy}$	2.134$^{b}_{x}$	1.610$^{a}_{x}$	2.429$^{b}_{x}$
Tabasco pepper	1.813$^{a}_{z}$	1.828$^{a}_{x}$	2.020$^{ab}_{y}$	2.190$^{b}_{x}$
Habanero pepper	1.434$^{a}_{w}$	1.916$^{b}_{x}$	1.821$^{b}_{x}$	1.967$^{b}_{x}$
Vitamin E	1.869$^{a}_{z}$	2.502$^{b}_{x}$	2.651$^{b}_{y}$	3.354$^{c}_{y}$

^{a,b,c}values with different letters within a row are significantly different ($p>0.05$), ^{w,x,y,z}values with different letters within a column are significantly different ($p>0.05$)

Table 4: Effect of different pepper species (capsicum), α-tocopherol acetate and storage days on oxidative stability of cooked pork meat stored at 4°C

	TBARS (mgMDA/kg meat)			
	Days of storage			
Treatment	0	2	4	6
Control	2.280$^{b}_{y}$	2.215$^{a}_{y}$	1.937$^{a}_{y}$	3.179$^{c}_{z}$
Cayenne pepper	1.630$^{a}_{x}$	1.355$^{a}_{x}$	1.411$^{a}_{x}$	2.248$^{b}_{x}$
Bell pepper	2.015$^{a}_{y}$	2.180$^{a}_{y}$	1.947$^{a}_{y}$	2.505$^{b}_{x}$
Tabasco pepper	1.934$^{b}_{x}$	1.936$^{b}_{y}$	1.577$^{a}_{x}$	2.640$^{c}_{y}$
Habanero pepper	2.023$^{b}_{y}$	2.301$^{b}_{z}$	1.695$^{a}_{x}$	2.206$^{b}_{x}$
Vitamin E	1.989$^{a}_{y}$	2.412$^{b}_{z}$	2.075$^{a}_{y}$	2.424$^{b}_{x}$

^{a,b,c}values with different letters within a row are significantly different ($p<0.05$), ^{x,y,z}values with different letters within a column are significantly different ($p<0.05$)

outstanding antioxidant effect of cayenne pepper on meat products. Martínez *et al*. (2006) observed a higher ($p<0.05$) inhibitory effect of cayenne pepper over red sweet pepper.

It is worth stating that all the pepper species used in this study inhibited lipid oxidation better than α-tocopherol acetate ($p<0.05$).

Conclusion: Addition of any specie of capsicum pepper (cayenne, bell, Tabasco or habenero) to ground pork meat effectively reduced lipid oxidation in raw or cooked patties compared to the control. It was also observed that any specie of the pepper used was a better antioxidant than 200 mg α-tocopherol acetate. The more pungent the pepper the better is its antioxidative power. The use of cayenne pepper as an antioxidant in meat and meat products is highly recommended.

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