FLUENCE OF DIETARY VITAMIN E (α-TOCOPHEROL) ON THE COLOUR STABILITY OF PORK CHOPS

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MMARY

The effect of oxidized corn oil and α-tocopheryl acetate in pig diets on the oxidative stability of muscle lipids and on the face colour characteristics of pork chops in refrigerated storage was investigated. Lipid oxidation (TBARS values) and face redness (Hunter 'a' values) were significantly influenced ($P < 0.01$) by dietary α-tocopheryl acetate levels but not by gree of oxidation of dietary corn oil. TBARS values were lower and Hunter 'a' values higher in pork chops from pigs 100 and 200 mg α-tocopheryl acetate/kg diet compared to pigs fed 10 mg/kg diet after 2, 4, 6 and 8 days of refrigerated rage. Hunter 'a' values showed significant ($P < 0.01$) correlation coefficients, r, with the logarithm of TBARS values. e results suggest that oxidation of myoglobin preceeds oxidation of muscle lipids in pork chops stored at 4°C.

TRODUCTION

The willingness of consumers to purchase fresh meats is strongly influenced by the appearance of the meat in display ssens et al., 1987). In red meats, a bright red colour is perceived by consumers as being indicative of freshness while sumers discriminate against meat which has turned brown in colour (Jeremiah et al., 1972; Hood and Riordan, 1973; cDougall, 1982; Lynch et al., 1986).

The rate of discolouration of meat is believed to be related to the effectiveness of oxidative processes and enzymic ducing systems in controlling metmyoglobin levels in the meat (Faustman and Cassens, 1989). Which system has the minant effect on metmyoglobin formation appears to be related to the age of the meat, oxidative processes decreasing ponentially with time post-slaughter and the reducing system decreasing much more gradually (Ledward, 1991). vironmental factors, including packaging material (Brewer and Harbers, 1991), gas flushing (Nolan et al., 1989; Hwang et 1990) and light (Giddings, 1977), also affect colour stability.

Pigment oxidation in meat systems may also be related to lipid oxidation (Greene, 1969; Faustman et al., 1989). dition of exogenous antioxidants, both synthetic (Greene, 1969) and natural (Miles et al., 1986), to restructured meats has n shown to inhibit both lipid and haem oxidation. In studies with Holstein steer beef, Faustman et al. (1989) onstrated that beef from animals fed an α-tocopheryl acetate-supplemented diet was significantly more colour-stable n that from animals fed a non-supplemented diet. The rates of metmyoglobin formation and lipid oxidation were wn to be positively correlated in Holstein beef (Faustman et al., 1989). However, the nature of the relationship ween lipid oxidation and colour deterioration is unclear (Ledward, 1987). For example, Verma et al. (1985) showed that rate of metmyoglobin formation in a meat model system was not influenced by the presence of oxidizing lipids.

The objectives of the present study were: (i) to investigate the effect of dietary fat quality and α-tocopherol on colour bility and lipid oxidation in pork; (ii) to examine the relationship between lipid oxidation and colour deterioration.

TERIALS AND METHODS

imals and diets

Seventy-two Yorkshire x Landrace pigs (barrows and gilts), 80 - 90 days old and averaging 30 kg in weight, were divided o six groups of twelve. Pigs were allocated to receive grower diets containing either 3% fresh corn oil (2 meq roxide/kg oil) or 3% oxidized corn oil (150 meq peroxide/kg oil) with 10, 100 or 200 mg α-tocopheryl acetate/kg diet nahan et al., 1992). The pigs were given feed and water *ad libitum*. The average weight of the pigs at slaughter was 98

mpling procedure

Six pigs were randomly selected from each group for slaughtering. Following evisceration, the carcasses were chilled rnight. One loin was removed from each chilled carcass, vacuum packaged and stored at -20°C until required. After 4 nths of storage, boneless pork chops (approximately 1.5 cm in thickness) were obtained from each loin.

Analyses

Pork chops were placed on polystyrene trays (6 per tray) and overwrapped with an oxygen permeable PVC wrap. Ch
were stored at 4°C under fluorescent light for up to 8 days. Measurements of tristimulus colour coordinates (L, a, b) of
Longissimus Dorsi muscle were recorded using a Hunterlab (Model D25 L) tristimulus colourimeter (Hunter Associ
Laboratory, Inc., Reston, Virginia) at 0, 2, 4, 6 and 8 days of storage. Lipid oxidation was assessed at 2 day intervals by th
thiobarbituric method of Ke et al. (1977). Thiobarbituric acid reactive substances (TBARS) were expressed as
malonaldehyde/kg muscle. The data was subjected to analysis of variance utilizing a completely randomized split
design (Steel and Torrie, 1980). Fischers LSD test was applied to determine the significance of differences between m
values.

RESULTS AND DISCUSSION

Effect of dietary treatment on surface colour

Analysis of variance of the data relating to the surface colour coordinates (L, a, b values) of fresh pork chops revea
that Hunter 'a' values were significantly influenced ($P < 0.01$) by dietary α-tocopheryl acetate but not by dietary fat qual
Hunter 'L' and 'b' values, indicators of lightness and yellowness, respectively, were not significantly influenced by eit
dietary α-tocopherol or dietary fat.

In pork chops from all groups of pigs, Hunter 'a' value, an indicator of surface redness, decreased over the 8 day stora
period (Table 1). Hunter 'a' values of pork chops from pigs fed the high level of α-tocopheryl acetate (200 mg/kg fe
were significantly higher than those of chops from pigs fed the basal level (10 mg/kg feed) after 2, 4, 6 and 8 days
refrigerated storage. Similarly, Faustman et al. (1989) demonstrated that 'a' values were significantly higher in beef fro
Holstein steer fed an α-tocopherol-supplemented diet (370 I.U./head/day) compared to animals fed a basal diet.
intermediate level of α-tocopheryl acetate (100 mg/kg diet) was not as effective as the high level (200 mg/kg diet)
maintaining surface redness. However, 'a' values of chops from pigs fed the intermediate level were higher than those
chops from pigs fed the basal diet on each day of analysis (Table 1).

Table 1. Effect of dietary oil and α-tocopherol supplementation on Hunter 'a' values of pork chops stored at 4°C under fluorescent light.

Dietary oil	Dietary α-tocopherol (mg/kg diet)	Day of storage 0	2	4	6	8
Oxidized	10	9.9^{a}	8.7^{a}	7.3^{a}	5.4^{a}	4.1^{a}
	100	9.6^{a}	9.1^{ab}	8.0^{a}	6.9^{b}	5.0^{a}
	200	10.1^{a}	10.0^{b}	9.3^{b}	7.8^{b}	6.5^{b}
Fresh	10	10.0^{a}	8.8^{a}	7.4^{a}	5.5^{a}	4.0^{a}
	100	9.5^{a}	9.8^{ab}	9.3^{b}	8.5^{b}	5.9^{b}
	200	10.3^{a}	10.4^{b}	9.8^{b}	8.7^{b}	8.2^{c}

a,b,c For each oil type, means in the same column bearing different superscripts are significantly different ($P < 0.05$).

These results indicate that dietary α-tocopherol supplementation can reduce the rate of surface discolouration in p
chops. Surface discolouration in meats is related to the rate of metmyoglobin formation with surface redness decreasing
metmyoglobin concentration increases. Faustman at al. (1989) demonstrated that metmyoglobin formation in sir
steak showed a significant negative correlation ($r = -0.76$) with the α-tocopherol content of the meat. The mechanism
which α-tocopherol retards the oxidation of myoglobin is unclear but α-tocopherol may protect the metmyoglobi
reducing systems in meat from free radical attack and hence sustain their activity for longer periods (Faustman et al., 198

lationship between lipid oxidation and colour deterioration

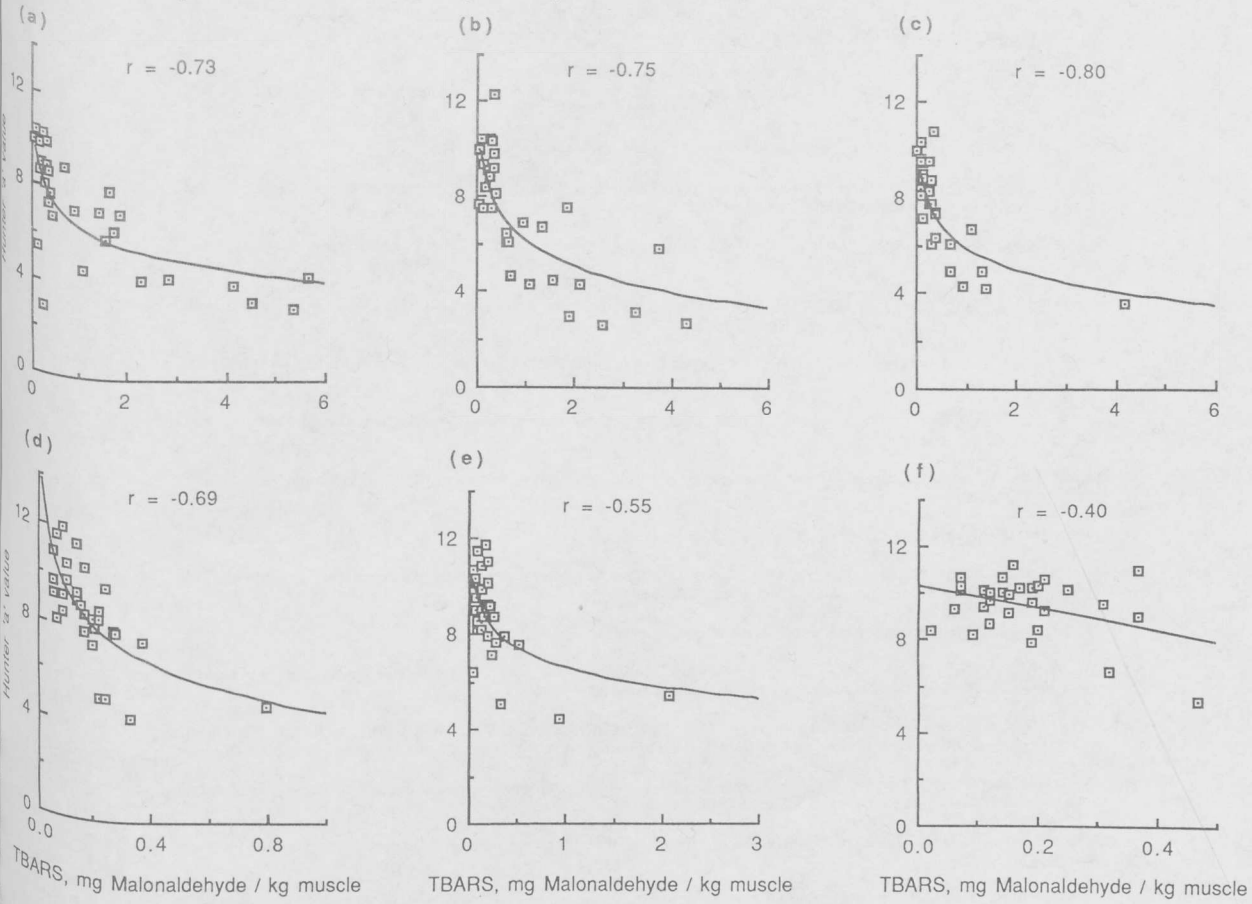
Analysis of variance of the lipid oxidation data revealed that the TBARS were significantly influenced by dietary α-pheryl acetate ($P < 0.01$) but not by dietary oil. Lipid oxidation, after 2, 4, 6 and 8 days of refrigerated storage, was found e significantly lower in pork chops from pigs fed the α-tocopherol-supplemented diets (100 and 200 mg/kg diet) pared to those from pig fed the basal diet (Table 2).

Table 2. Effect of dietary oil and α-tocopherol supplementation on TBARS values of pork chops stored at 4°C under fluorescent light.

Dietary oil	Dietary α-tocopherol (mg/kg diet)	Day of storage 0	2	4	6	8
Oxidized	10	0.19^{a}	0.51^{b}	0.93^{b}	2.01^{b}	3.00^{b}
	100	0.18^{a}	0.11^{a}	0.29^{a}	0.61^{a}	1.27^{a}
	200	0.12^{a}	0.09^{a}	0.18^{a}	0.15^{a}	0.74^{a}
Fresh	10	0.19^{a}	0.22^{b}	0.63^{b}	1.27^{b}	2.80^{b}
	100	0.14^{a}	0.09^{a}	0.17^{a}	0.21^{a}	0.34^{a}
	200	0.17^{a}	0.14^{a}	0.14^{a}	0.14^{a}	0.31^{a}

^{a,b} For each oil type, means in the same column bearing different superscripts are significantly different ($P < 0.05$).

A logarithmic function was found to best describe the relationship between lipid oxidation (TBARS) and colour nter 'a' value) in pork chops from all groups except those from pigs fed fresh oil with 200 mg α-tocopheryl acetate/kg



ure 1. Relationship between TBARS and Hunter 'a' value of pork chops stored over 8 days at 4°C from pigs fed: (a), oxidized oil with 10 α-tocopheryl acetate/kg diet; (b), fresh oil with 10 mg α-tocopheryl acetate/kg diet; (c), oxidized oil with 100 mg α-tocopheryl etate/kg diet; (d), fresh oil with 100 mg α-tocopheryl acetate/kg diet; (e), oxidized oil with 200 mg α-tocopheryl acetate/kg diet and fresh oil with 200 mg α-tocopheryl acetate/kg diet.

diet (Figure 1). In chops from the latter group the rates of lipid oxidation and colour deterioration were low over the 8 storage period and correlation was weak. A first order regression fit was found to best describe the data from this gr (Figure 1(f)). TBARS values and Hunter 'a' values of pork chops were significantly correlated with correlation coeffici (r) of -0.73 ($P < 0.01$), -0.75 ($P < 0.01$), -0.80 ($P < 0.01$), -0.69 ($P < 0.01$), -0.55 ($P < 0.01$) and -0.40 ($P < 0.05$) for groups fed oxidi oil with 10 mg α-tocopheryl acetate/kg, fresh oil with 10 mg α-tocopheryl acetate/kg, oxidized oil with 100 mg α-tocoph acetate/kg, fresh oil with 100 mg α-tocopheryl acetate, oxidized oil with 200 mg α-tocopheryl acetate/kg and fresh oil mg α-tocopheryl acetate/kg, respectively. The data (Figure 1) indicate however, that even at low TBARS values, 'a' va were low in some samples. This suggests that oxidation of myoglobin may preceed lipid oxidation. Akamittath e (1990) also found that discolouration occurred in beef steaks even though lipid oxidation was low. These researc suggested that the metmyoglobin formed initially could react with endogenously produced H_2O_2 to form H_2O_2-activa metmyoglobin which could catalyse lipid oxidation (Harel & Kanner, 1985).

CONCLUSIONS

Surface colour, which contributes to the appearance of pork chops in refrigerated display, is stabilized by α-tocoph supplementaion of swine diets. The improvement in pork chop colour stability may be due to a reduction in the ra metmyoglobin formation. The results suggest that the oxidation of myoglobin preceeds lipid oxidation supporting contention that metmyoglobin may catalyse the oxidation of muscle lipids.

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