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EFFECT OF DIETARY VITAMIN E SUPPLEMENTATION ON THE QUALITY OF LAMB MEAT

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BACKGROUND

Lipid oxidation in muscle foods is initiated in the highly unsaturated phospholipid fraction of subcellular membranes. It is generally accepted that susceptibility to lipid oxidation is influenced by tissue levels of α-tocopherol. Recent studies in our laboratory have shown that dietary vitamin E supplementation inhibits lipid and cholesterol oxidation, colour deterioration and loss of water holding capacity in muscle foods from pigs, poultry and turkeys.
The objective of the present study was to determine the effects of dietary vitamin E supplementation on tissue α-tocopherol levels and on the susceptibility of muscle from lamb to lipid oxidation and colour deterioration during frozen storage.

METHODS

Twelve ewes were selected at random and divided into two groups, and fed diets containing 20 (basal) or 1000 (supplemented) mg α-tocopheryl acetate/kg feed for 9 weeks prior to lambing, and for 3 weeks post-partuition. The lambs were weaned at week 3, and 6 lambs were selected at random from each of the two groups. The respective groups were fed the basal and supplemented diets to time of slaughter at week 13. Blood samples were taken from each ewe at the time of lambing and from each lamb at the point of slaughter. Liver, heart, brain and kidney were taken, blast frozen to -20°C, and stored at -20°C until required. The carcasses were chilled overnight and specific muscles were removed from each carcass. The muscles were either used immediately of vacuum-packed and stored at -20°C.
Cores (2.5cm diam.) were taken from fresh and 5-month frozen muscles, placed on polystyrene trays and overwrapped with an oxygen permeable PVC wrap. Meat samples were stored at 4°C under fluorescent light for up to 7 days.
Lipid oxidation in meat samples was assessed by the 2-thiobarbituric acid method of Ke *et al.* (1977). Measurement of tristimulus colour coordinates (L,a,b) of muscle were recorded using a Perkin Elmer (Lambda 2) spectrophotometer. Metmyoglobin content was determined by the method of Krzywicki (1979). α-Tocopherol in plasma and tissues was determined using the extraction procedures of Bieri *et al.* (1975) and Buttriss & Diplock (1984),respectively, and quantified by HPLC.

RESULTS

The mean α-tocopherol concentrations in plasma (ewes and lambs) and tissues from lambs were significantly ($P<0.001$) influenced by diet. The levels in tissues responded to dietary intake in the order: liver > heart > brain > kidney > muscle (Table 1). Hunter 'a' values decreased over the 7-day storage period for the fresh samples, but the values were not significantly influenced by dietary α-tocopherol.
Following frozen storage (-20°C) for 5 months, Hunter 'a' values were significantly higher in *M.longissimus dorsi* ($P<0.05$) and *M.gluteus medius* ($P<0.01$) for lambs fed the high α-tocopherol diet compared with lambs fed the basal diet (Figs 1A and B). Metmyoglobin accumulation was greater for control animals than for those supplemented with α-tocopherol. *M.gluteus medius* had higher levels of metmyoglobin compared to *M.longissimus dorsi* after 6 days of storage. The muscle samples from lambs supplemented with α-tocopherol were also more resistant to oxidation (Fig.2). Accumulation of TBARS was greater in control lambs ($P<0.001$) at 3, 5 and 7 days in *M.longissimus dorsi* and days 3 and 6 in *M. gluteus medius*.

CONCLUSIONS

The dietary supplementation of lambs with α-tocopheryl acetate appears to be an efficacious means for improving the colour and oxidative stability of frozen lamb.

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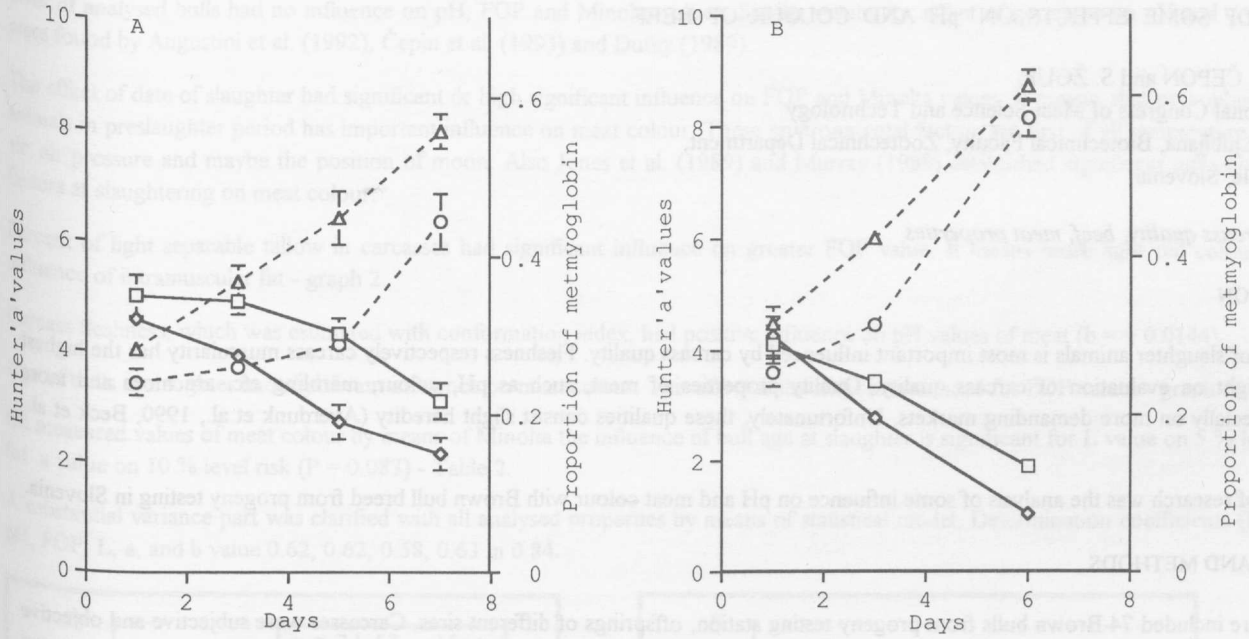

Fig.1.Effect of dietary α-tocopherol(1000mg α-tocopheryl acetate/kg feed) on Hunter'a'values and metmyoglobin accumulation in 5 month frozen M.longissimus dorsi(A)and M.gluteus medius(B) held at 4ºC under fluorescent light for up to 7 days

Hunter 'a' values: —◇— ,20 mg/kg feed; —□— ,1000 mg /kg feed.

Proportion of metmyoglobin: --△-- ,20 mg/kg feed; --○-- ,1000 mg/kg feed.

Table 1 Mean α-tocopherol content of plasma from ewes and lambs and tissues from lambs fed a basal diet (20mg/kg feed) or a supplemented diet (1000mg/kg feed) with α-tocopheryl acetate

	Control		Supplemented	
	Mean	SEM	Mean	SEM
Plasma(μg/ml)				
Ewes	4.98	0.30	22.48	0.85
lambs	3.62	0.50	15.75	1.28
Tissue(μg/g)				
Liver	1.67	0.34	20.58	0.34
Heart	2.51	0.32	9.82	0.63
Brain	2.68	0.24	9.40	0.71
Lung	1.48	0.41	7.70	0.43
Kidney	1.08	0.22	5.46	0.52
M.longissimus dorsi	0.77	0.17	5.32	0.28
M.gluteus medius	0.75	0.13	4.36	0.46

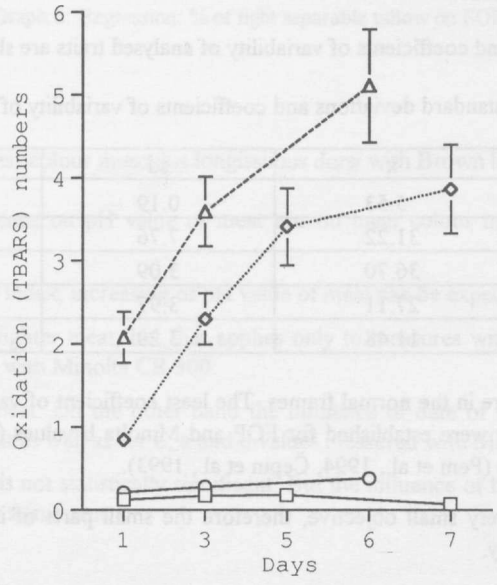

Fig.2.Effect of dietary α-tocopherol(1000mg α-tocopheryl acetate/kg feed) on TBARS numbers in 5 month frozen storage *M.longissimus dorsi* and *M.gluteus medius* muscles held at 4ºC under fluorescent light for up to 7 days

M.longissimus dorsi
····◇···· Control —□— Supplemented

M.gluteus medius
----△---- Control —○— Supplemented