EFFECT OF VITAMIN E SUPPLEMENTATION ON EVOLUTION OF MEAT FATTY ACID COMPOSITION DURING STORAGE IN HIGH OXYGEN PACKS

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Keywords: lamb meat, fatty acids, vitamin E, modified atmosphere packaging.

Introduction

Muscle foods, by virtue of the fact that they contain unsaturated lipid and prooxidant components, are prone to lipid oxidation, whereby molecular oxygen reacts with unsaturated lipids to form lipid peroxides. Because of this, high oxygen packs (MAP) can promote lipid oxidation. Vitamin E (VE) content of meat, a widely studied antioxidant, has been shown to be a critical determinant of the susceptibility of meat stored in MAP to lipid oxidation. It is now well established that lipid oxidation produces the lost of essential fatty acids reducing the nutritive value of meat. Numerous studies have been devoted to oxidative changes in lamb meat during its storage under refrigeration by an increase in the amount of Thiobarbituric Acid Reactive Substances (TBARS) (Lauzurica *et al.*, 2005). On the contrary, few works have studied fatty acid (FA) changes in lamb meat during refrigerated storage. The aim of this research was to study the evolution of total FA composition of intramuscular lipids of VE supplemented lamb meat during refrigerated storage in MAP.

Materials and Methods

Thirty-six weaned male Manchego breed lambs were randomly assigned to one of the four dietary treatments (9 lambs per treatment) consisting of one non-supplemented (E0) and three VE-supplemented diets: 250 (E250), 500 (E500) and 1000 (E1000) mg/kg feed. The fattening period lasted an average of 37 ± 1.5 days, from an initial live weight of 13.2 ± 0.5 to a slaughter weight of 26.2 ± 0.3kg. The lambs were slaughtered in a commercial abattoir. After a 24h chilling period (4ºC) the right m. *longissimus dorsi* (LD) was dissected and cut in 4 slices which were randomly assigned to 0, 14, 21 and 28 days of MAP storage (70% O_2; 30% CO_2). Muscle slices were kept in darkness at 2 ± 1ºC during storage. The concentration of VE (α-tocopherol) in LD was determined at initial time according to Cayuela *et al.* (2003). Intramuscular fat was extracted from LD at each time of storage (Hanson and Olley, 1963). FA methyl esters were formed according to Morrison and Smith (1964) and then gas chromatographic analysis of them was performed. Data were statistically analysed using the MIXED procedure of the Statistical Analysis System package (SAS, 1996).

Results and Discussion

Table 1 shows α-tocopherol concentration, intramuscular fat proportion and FA profile of E0, E250, E500 and E1000 in LD. α-Tocopherol deposited in muscle increased as the concentration of VE in feed rise (Lauzurica *et al.*, 2005). Initial intramuscular fat proportion and FA profile were not significantly different among experimental groups. Significant interaction was observed between level of VE supplementation and storage time for saturated FA (SFA), monounsaturated FA (MUFA), polyunsaturated FA (PUFA), PUFAn6 and PUFA/SFA ratio. Non-supplemented lambs had the highest change in FA profile during storage, increasing SFA (10%) and MUFA (7%) and decreasing PUFA (40%), principally PUFAn6, after 28 days of storage respect to initial values. In the other groups, there was also a change in FA profile, but it was moderate. E250 group displayed an increase of MUFA (4%) and a reduction of PUFA (13%) after 28 days of storage respect 0 day. E500 and E1000 only showed a change in MUFA proportion, which after 14 and 21 days of storage increased, and a week later decreased to a similar level to day 0. During lipid oxidation, oxygen attacks the double bond in fatty acids, increasing this sensitivity when increasing unsaturation. Therefore, PUFA were more prone to oxidation compared with MUFA and SFA during storage in MAP. Besides, higher α-tocopherol concentration in meat, which acts as an effective antioxidant by acting as a free radical quencher, implied lower changes in fatty acid composition during storage. From a nutritional point of view, due to a decrease in PUFA, the PUFA/SFA ratio decreased significantly in E0 from 0.43, which came closest to the nutritional recommendation of 0.45 (Department of Health, 1994), to 0.23, whereas VE-supplemented groups did not modify their ratio during refrigerated storage.

Conclusions

Non-supplemented VE lamb meat had the highest change in FA profile during storage, increasing SFA and MUFA and decreasing PUFA after 28 days of MAP storage with respect to initial values. FA profile in VE-supplemented lamb meat was more stable from a level of supplementation of 250 mg of VE / kg in feed. VE supplementation reduced changes in FA profile and the nutritional lipid value of meat was better conserved.

Table 1: α-Tocopherol concentration in LD, intramuscular fat percentage and FA profile of E0, E250, E500 and E1000 during lamb storage in MAP.

	Time	Level of supplementation (VE)												Sig.		
	(T)	E0	SE		E250	SE		E500	SE		E1000	SE		S_{ve}	VE	T	VE*T
αTocopherol (μg/g) [1]	0	0,95	0,09	d	2,17	0,20	c	2,67	0,18	b	3,57	0,15	a	-	***	-	-
IM Fat (%)	0	1,82	0,11		1,89	0,13		1,78	0,11		1,66	0,11		-	ns	-	-
SFA (%)	0	41,67	0,71	y	42,17	0,86		41,43	0,68		40,93	0,68		ns	**	**	**
	14	42,56	0,75	ay	43,30	0,86	a	39,91	0,74	b	39,87	0,70	b	**			
	21	43,53	0,78	axy	43,33	0,81	ab	39,63	0,77	bc	40,66	0,68	c	***			
	28	45,99	0,83	ax	42,44	0,86	ab	41,60	0,70	b	42,03	0,70	b	***			
S_t		***			ns			*			ns						
MUFA (%)	0	40,61	0,84	y	41,35	0,97	y	40,39	0,79	y	42,09	0,79	y	ns	ns	***	**
	14	43,77	0,85	x	43,74	0,97	x	41,87	0,82	x	43,85	0,81	x	ns			
	21	44,62	0,87	x	42,58	0,95	x	42,30	0,83	x	43,51	0,79	x	ns			
	28	43,40	0,89	x	43,15	0,97	x	41,48	0,81	xy	42,49	0,81	xy	ns			
S_t		***			**			**			**						
PUFA (%)	0	17,72	1,05	x	16,50	1,23	x	18,17	0,99		16,98	0,99		ns	**	***	***
	14	13,67	1,08	by	13,02	1,23	by	18,25	1,05	a	16,25	1,02	ab	**			
	21	11,89	1,12	ayz	14,09	1,19	abxy	18,06	1,09	b	15,83	0,99	ab	**			
	28	10,56	1,17	az	14,34	1,23	abxy	16,93	1,02	b	15,46	1,02	b	**			
S_t		***			*			ns			ns						
PUFAn6 (%)	0	14,34	0,89	x	14,14	1,05	x	16,01	0,85		14,32	0,85		ns	**	***	**
	14	11,68	0,92	by	10,94	1,05	by	15,97	0,89	a	13,73	0,87	ab	**			
	21	10,27	0,95	byz	11,93	1,01	bxy	15,89	0,93	a	13,42	0,85	ab	***			
	28	8,94	0,99	bz	12,19	1,05	abxy	14,75	0,87	a	13,16	0,87	a	***			
St		***			**			ns			ns						
PUFAn3 (%)	0	1,41	0,18		1,88	0,21		1,78	0,17		1,48	0,17		ns	ns	ns	ns
	14	1,67	0,19		1,59	0,21		1,99	0,18		1,97	0,17		ns			
	21	1,30	0,19		1,71	0,20		1,89	0,19		1,87	0,17		ns			
	28	1,04	0,21		1,71	0,21		1,83	0,17		1,72	0,17		*			
St		ns			ns			ns			ns						
PUFA/SFA	0	0,43	0,03	x	0,40	0,04		0,44	0,03		0,42	0,03		ns	**	***	**
	14	0,32	0,03	by	0,30	0,04	b	0,46	0,03	a	0,41	0,03	ab	**			
	21	0,27	0,03	byz	0,33	0,03	b	0,46	0,03	a	0,39	0,03	ab	***			
	28	0,23	0,03	bz	0,34	0,04	ab	0,41	0,03	a	0,37	0,03	a	**			
St		***			ns			ns			ns						

SFA: C10:0, C12:0, C14:0, C15:0, C16:0, C17:0, C18:0, C20:0; MUFA: C17:1, C16:1, C18:1; PUFA: C18:2n6, C18:2 *Cis-9 Trans-11* C18:3n3, C20,3n6, C204n6, C20:5n3,C225n3, C226n3. SE: Standard error; Sig.: [1]Significance of the Model $y_{ijk} = \mu + VE_i + T_j + VE_i \times T_j + \varepsilon_{ij(k)}$; S_{ve}: Significance of dietary supplementation of VE within each storage period; S_t: Significance of storage period within each dietary supplementation VE level; ns: no significant; * P < 0,05; ** P < 0,01; *** P < 0,001; a,b,c Means in the same row with different superscripts differ significantly (P < 0,05),; x,y,z Means in the same column with different superscripts differ significantly (P < 0,05). [1]Also published in Lauzurica *et al.* (2005)

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