4.II - P8

EFFECT OF THE DIETARY ENRICHMENT WITH ANIMAL FAT AND VITAMIN E ON RABBIT MEAT SHELF-LIFE AND SENSORY PROPERTIES

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Background

Rabbit meat contains low cholesterol levels and its lipids are characterised by high proportions of PUFA. These two main characteristics put this meat among the dietetic foods. However, most relevant consequence concerns its shelf-life. In fact, PUFA easily undergoes peroxidative damage and the meat results not suitable for further storage, processing and cooking treatments (Fernández-Esplá and O'Neill, 1993; López-Bote *et al.*, 1997a, 1997b). This phenomenon could strongly affect sensory properties, as flavour, colour, texture and the human safety. For human dietetic reasons, there is a large tendence to increase the PUFA contents, mainly that of the n-3 series, in foods. As occurs on other monogastrics, the FA profile of rabbit meat lipids is strongly dependent on that of dietary lipids (Bernardini *et al.*, 1997; Oliver *et al.*, 1997) and the feedstuffs commonly used for the intensive rabbit meat production contain lipids highly unsaturated. In order to prevent lipid oxidation, α-tocopheryl acetate is usually incorporated in diets for beef, pigs and poultry, at supranutritional level. Numerous studies on vitamin E supplementation and meat quality have been carried out on other species. In the rabbit, the supranutritional levels of vitamin E significantly improve the meat oxidative stability in fresh, refrigerated and frozen stored samples (Lopez-Bote *et al.*, 1997b; Castellini *et al.*, 1999; Dal Bosco *et al.*, 1999) Some phisicochemical traits, such as carcass drip loss, WHC, cooking loss (Dal Bosco and Castellini, 1998; Castellini *et al.*, 1998), surface colour (Corino *et al.*, 1999), are also improved. The sensory properties of rabbit meat submitted to dietary fat and vitamin E enrichment were not yet investigated.

Objectives

The objectives of the present study were to evaluate the effect of rabbit dietary α-tocopheryl acetate and animal fat supplementation on oxidative stability and on sensory properties (colour, appearance, flavour and texture) of fresh or 7days-refrigerated hamburgers.

Methods

Sixty Grimaud Frères hybrid rabbits, allocated at the experimental rabbitry of the Department of Animal Science of the University of Padova (Italy), were divided into 4 homogeneous groups and fed *ad libitum*, from 49 to 78 days of age, the following experimental diets (Table 1): F0-E0 (control diet); F0-E200 (200 mg α-tocopheryl acetate/kg diet); F2-E0 (2% of animal fat); F2-E200 (2% fat and 200 mg α-tocopheryl acetate). After slaughter and 24h chilling at 4°C, meat of each carcass, was ground twice and used to prepare hamburgers of about 50g each. One hamburger per rabbit was inmediately analysed (T1) while the other one was stored at 5±2°C for 7 days (T7). On experimental diets the chemical composition and FA profile was determined. Lipid oxidation was assessed by the TBA test (Robards *et al.*, 1988). Sensory analysis was performed by a selected panel which evaluated subsequently raw and cooked meat samples according to a ranking classification (AFNOR, 1989) in standard conditions (Ouhayoun and Dalle Zotte, 1996). Analysis of variance (Harvey, 1987) tested the effect of fat and vit. E supplementations and, for the TBA test also the effect of the storage length. Sensory parameters were also treated using Friedman (1937) non-parametric test.

Results and discussion

Dietary fat enrichment increased the hamburgers lipid content (8.6 *vs* 8.1%; P>0.05) and produced a general improvement of the sensory characteristics of hamburgers derived from F2 groups, but it was significant only on 7d-refrigerated storage hamburgers. In particular, the appearance (P<0.05) of raw hamburgers and the texture of cooked ones (P<0.01) were considered improved by the F2 treatment, due to the increased lipidic infiltration. Contrarly to that observed by other authors (Bernardini *et al.*, 1996; López-Bote *et al.*, 1997a; 1997b), the dietary fat enrichment does not increased the lipid oxidation of hamburgers, probably because of the weak difference on lipid content found among hamburgers belonging to the control and experimental groups. The most relevant effect of the use of α-tocopheryl acetate at supranutritional level was the improved appearance of the raw hamburgers (P<0.05), observed both on T1 and more markedly on T7, particularly on meat of animals fed with fat diets, indicating the good protective effect of the vitamin E even on comminuted rabbit meat. Texture was also positively influenced by dietary vitamin E enrichment. This effect was significant on T1 hamburgers, meanwhile on T7 ones it was manifested only at tendency level. The hamburgers stored refrigerated up to 7days worsened TBA index (0.048 *vs* 0.101 mg MDA/kg; P<0.01). Finally, the use of vitamin E reduced TBA values (0.056 *vs* 0.094 mg MDA/kg; P<0.01) according to the results in literature (Castellini *et al.*, 1998; López-Bote *et al.*, 1997a, b; Corino *et al.*, 1999) and it seems to be profitable when the rabbit meat is sold ready to cook, such as the hamburger preparation.

Conclusions

Fat supplementation improved the appearance of the raw stored hamburgers. On stored and cooked hamburgers also texture was improved. Supranutritional Vitamin E intake significantly improved the appearance of raw hamburgers, either at T1 or at T7. On cooked hamburgers only the texture was improved, but the significant effect was limited to the T1 treatment. Animals which fed the E200 diets showed significantly lower TBA values. Data suggest the opportunity of adding vitamin E to prevent oxidative mechanism and to increase the shelf-life of stored meat.

Pertinent literature

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Tables

Table 1. Chemical composition and FA classes of experimental diets

		F0-E0[1]	F0-E200[2]	F2-E0[3]	F2-E200[4]
- Dry matter	%	89.89	89.85	89.92	90.24
- Protein	% dm	16.4	16.8	17.0	17.2
- Ether extract	"	2.9	2.8	4.8	5.0
- Fiber	"	15.3	15.5	15.8	15.1
- Ash	"	7.9	8.0	8.0	8.0
- α-tocoferyl acetate	mg/kgdm	62	222	74	219
- SFA [5]	%	23.0	21.9	30.4	30.3
- MUFA [6]	"	19.0	17.3	29.7	30.1
- PUFA [7]	"	58.0	60.8	40.0	39.6

(1) F0-E0: control diet (ED= 10.4 MJ/kg); (2) F0-E200: control diet plus 200 mg/kg α-tochoferyl acetate/kg. (3) F2-E0: control diet plus 2% of animal fat; (4) F2-E200: control diet plus 2% animal fat and 200 mg di α-tocoferyl acetate/kg; (5) Saturated Fatty Acids; (6) Mono-unsaturated FA; (7) Poli-unsaturated FA; Main FA composition of the added animal fat: 12.7-24.4% stearic acid, 37-45% oleic acid, 0.2-1.2% linoleic acid.

Table 2. Sensory analysis of hamburgers T1

	Diets				Fat		Vitamin E		RSD
	F0-E0	F0-E200	F2-E0	F2-E200	F0	F2	E0	E200	
Raw:									
-Colour [1]	2.29	2.98	2.65	2.09	2.64	2.37	2.47	2.54	0.95
-Appearance[2]	2.30^{a}	2.79^{b}	2.45^{a}	2.47^{a}	2.55	2.46	2.38^{a}	2.63^{b}	0.45
Cooked:									
-Appearance	2.48	2.63	2.40	2.50	2.56	2.45	2.44	2.57	0.92
-Flavour[3]	2.50	2.47	2.73	2.30	2.49	2.52	2.62	2.39	0.90
-Texture[4]	2.03	2.77	2.50	2.70	2.40	2.60	2.27^{a}	2.74^{b}	0.88

Table 3. Sensory analysis of hamburgers T7

	Diets				Fat		Vitamin E		RSD
	F0-E0	F0-E200	F2-E0	F2-E200	F0	F2	E0	E200	
Raw:									
-Colour [1]	2.24	2.71	2.66	2.38	2.48	2.52	2.45	2.55	0.91
-Appearance[2]	2.12^{a}	2.44^{ab}	2.43^{a}	3.01^{b}	2.28^{a}	2.72^{b}	2.28^{a}	2.73^{b}	0.80
Cooked:									
-Appearance	2.79	2.40	2.20	2.60	2.60	2.40	2.50	2.50	0.89
-Flavour[3]	2.67^{b}	1.93^{Aa}	2.43^{ab}	2.97^{Bb}	2.30	2.70	2.55	2.45	0.80
-Texture[4]	2.30^{a}	2.10^{a}	2.57^{ab}	3.03^{b}	2.20^{A}	2.80^{B}	2.44	2.57	0.82

[1] Ranking scale 1 to 4 (1= less coloured to 4= coloured meat); [2] Ranking scale 1 to 4 (1= less fresh to 4= fresh meat);
[3] Ranking scale 1 to 4 (1= less flavoured to 4= flauvored meat); [4] Ranking scale 1 to 4 (1= less tender and juicy to 4= tender and juicy)

Table 4. TBARS values of raw hamburgers (mg MDA/kg)

	Diet				Storage length		RSD
	F0-E0	F0-E200	F2-E0	F2-E200	T1	T7	
TBARS	0.095^{B}	0.058^{A}	0.092^{B}	0.053^{A}	0.048^{A}	0.101^{B}	0.056

A, B: P<0.01; a, b: P<0.05;