EFFECT OF SLAUGHTER SEASON AND MUSCLE TYPE ON FATTY ACID COMPOSITION AND RELATED NUTRITIONAL INDEXES IN BARROSÃ-PDO VEAL

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Introduction

Veal quality is influenced by several factors, such as breed, feeding system, gender and slaughter weight and particularly duration of milk consumption that have been reported to have an important influence on the intramuscular fat content and composition (Sañudo *et al.*, 2000; Moreno *et al.*, 2006). Barrosã-PDO (Protected Denomination of Origin) veal is a traditional meat produced in the Norwest of Portugal based on a pasture-based system according to the product specifications (Commission Regulation nº. 1263/96 of 01/07, EEC). This research focuses on the influence of two slaughter seasons (early autumn and late spring) and muscle type (*longissimus thoracis*, LT, *longissimus lumborum*, LL, and *semitendinosus*, ST) on fatty acid composition and nutritional value of Barrosã-PDO veal. This evaluation was based on the composition of main fatty acids, and related health indexes (PUFA/SFA and *n*-6/*n*-3 ratios), determined by GC-FID.

Materials and Methods

Barrosã purebred calves were raised with their dams in a semi-extensive grazing system based on natural pastures. After weaning (at 6 ± 0.5 months of age), calves were raised on a late summer grass pasture until slaughter in October 2002 (early autumn sampling; n=12; 8.0 ± 0.4 months of age and 192 ± 10.2 kg live body weight) or were exposed to the middle-late spring grass and slaughtered in June 2003 (late spring sampling; n=15; 8.0 ± 0.5 months of age and 212 ± 11.2 kg live body weight). *M. longissimus thoracis* (LT), *M. longissimus lumborum* (LL) and *M. semitendinosus* (ST) were removed and meat samples were collected 2-3 days after slaughter (+1ºC) and stored at -80°C until required for analysis. Intramuscular fat was extracted according to the method of Fritsche *et al.*, (2000). Total lipids were measured gravimetrically, in duplicate, by weighing the fatty residue obtained after solvent evaporation. Methyl esters of fatty acids (FAME) were obtained by base-catalysed transesterification (sodium methoxide in anhydrous methanol) and nonadecanoic acid (C19:0) methyl ester was used as internal standard. The FAME were separated by GC-FID, on a SP™-2560 capillary column (100 m) using a split/splitless injection system (split ratio of 1:5) and helium, as carrier gas, at flow rate of 1.5 ml/min. The column temperature was programmed to increase from 75°C to 225°C and detector and injector temperatures were set at 250°C. Fatty acids were quantified based on the internal standard technique, after adjusting the corrected response factor of each fatty acid determined using the Supelco standard mixture and according to ISO 5508 (1990). Data were analysed by analysis of variance, using the MIXED procedure of SAS (2001), considering the effect of slaughter season and muscle type (repeated measure) and its interaction.

Results and Discussion

The results concerning to the influence of slaughter season and muscle type on intramuscular fatty acid profile are summarized in Table 1. In both seasons, the predominant fatty acids in intramuscular fat were C16:0 (22-25% of total FAME) and C18:0 (13-16%) as SFA and C18:1c9 (35-37%) as monounsaturated fatty acids (MUFA). No seasonal variations ($P>0.05$) in the fatty acid composition of Barrosã-PDO veal were apparent, except for total lipids, which showed higher percentages ($P<0.05$) in meat from early autumn than in that from late spring. Total fatty acids (ranging from 996 to 1526 mg/100 g muscle), calculated as the sum of identified fatty acids, represented on average 78% of the sum of detected fatty acids (GC analysis) and 64% of total lipids (gravimetric analysis). As for total fatty acids and total lipids, the partial sums (SFA, PUFA and *n*-3 fatty acids) and the nutritional ratio PUFA/SFA were also affected by muscle type. LT and LL muscles depicted greater intramuscular fatty acid content compared with ST muscle, simultaneously with a higher proportion of SFA. In contrast, the percentages of PUFA ($P<0.05$) and *n*-3 fatty acids ($P<0.01$) were lower in LT and LL muscles than in ST muscle. These differences between muscles likely result from distinct percentages in muscle fibre type because they are reflected in differences in fatty acid composition (Wood *et al.*, 2004). Additionally, there was an interaction between slaughter season and muscle type for the fatty acids C18:0, C18:1c9, MUFA ($p<0.05$) and for total lipids ($P<0.01$). According to the current nutritional recommendations, the PUFA/SFA ratio in human diets should be 0.45 and, within the PUFA, the n-6/n-3 ratio should not exceed 4.0 (British Department of Health, 1994). Although the n-6/n-3 ratios obtained for Barrosã-PDO veal are inside the recommended values, which is favourable, for both slaughter seasons and muscle types (2.9-3.1), the values of PUFA/SFA ratios in veal-PDO were below, and so unfavourable, than the guideline recommended for the human diet.

Table 1: Percentages of main fatty acids (% w/w), total fatty acid content (mg/100 g muscle) and total lipids (mg/100 g muscle) of intramuscular fat in *longissimus thoracis* (LT), *longissimus lumborum* (LL) and *semitendinosus* (ST) muscles of veal from Barrosã calves reared according Barrosã-PDO specifications and slaughtered in early autumn and late spring.

	Autumn			Spring				Effects[1]		
	LT	LL	ST	LT	LL	ST	SEM	S	M	S×M
C14:0	4.62	4.68	3.93	4.35	4.25	4.09	0.298	ns	**	ns
C16:0	23.04	23.57	22.22	22.73	24.68	23.57	0.541	ns	**	ns
C16:1c9	3.71	3.71	3.77	3.78	4.19	3.92	0.165	ns	ns	ns
C18:0	$14.20^{a,b}$	$14.52^{a,b}$	13.38^{a}	15.92^{b}	13.49^{a}	14.14^{a}	0.699	ns	*	*
C18:1c9	35.49^{a}	35.15^{a}	37.00^{b}	$35.64^{a,b}$	$34.95^{a,b}$	34.91^{ab}	0.927	ns	ns	*
MUFA	41.14^{a}	40.76^{a}	42.78^{b}	$42.46^{a,b}$	$42.31^{a,b}$	$42.08^{a,b}$	1.036	ns	ns	*
PUFA	10.72	10.22	11.68	8.37	9.04	10.42	0.911	ns	*	ns
SFA	43.93	44.81	41.38	44.86	44.19	43.52	0.728	ns	***	ns
TFA	3.32	3.32	3.24	3.37	3.44	3.11	0.259	ns	ns	ns
PUFA/SFA ratio	0.25	0.23	0.29	0.19	0.20	0.24	0.022	ns	**	ns
n-6 PUFA	8.03	7.56	8.56	6.32	6.77	7.73	0.740	ns	ns	ns
n-3 PUFA	2.69	2.66	3.12	2.05	2.27	2.68	0.251	ns	**	ns
n-6/*n*-3 PUFA ratio	3.10	2.98	2.99	3.05	3.03	2.92	0.235	ns	ns	ns
Total fatty acids[+]	1421	1379	1226	1526	1094	996	1.409	ns	**	ns
Total lipids	2319^{a}	2133^{b}	1960^{c}	$2294^{a,b}$	1779^{c}	1561^{d}	1.057	*	***	**

[1]Levels of significance: ns, $p>0.05$; *, $p<0.05$; **, $p<0.01$; ***, $p<0.001$; means in the same row with different superscripts are significantly different ($p<0.05$); SEM, standard error of mean. The symbols used mean as follow: S, season; M, muscle type and MUFA, PUFA, SFA and TFA refer to monounsaturated, polyunsaturated, saturated and *trans* fatty acids, respectively.
[+] Total fatty acids is the sum of identified fatty acids.

Conclusions

As we observed in this study, Barrosã-PDO veal only showed seasonal changes in the levels of total lipids. In addition, significant differences were obtained among LT, LL and ST muscles for total lipids, some main fatty acids and total fatty acids, some partial sums of fatty acids and the PUFA/SFA index. The results indicate that veal-PDO has values of pasture-fed cattle for both slaughter seasons. The low n-6/n-3 ratio (below 2), which is mainly influenced by diet, suggests that the calves were raised on a good quality grass production system.

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