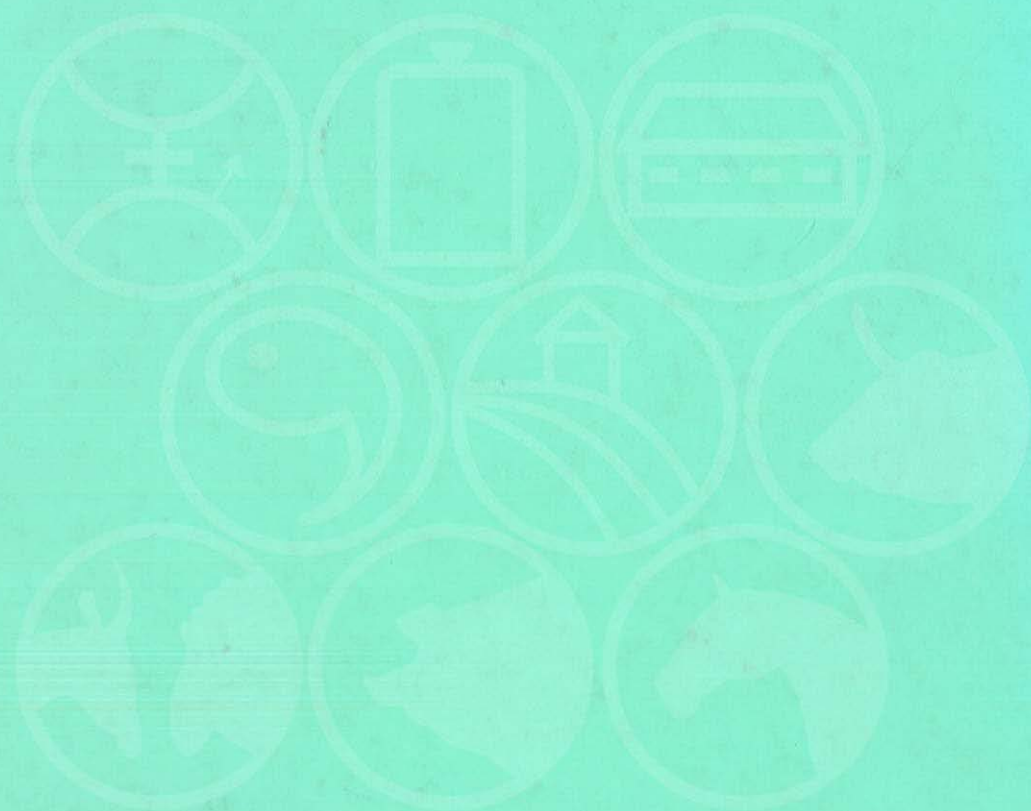


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Characterization of collagen and fatty acid composition of “Carne Mirandesa PDO” veal

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Summary

The objective of this study was to evaluate chemical parameters related to meat quality, contributing to a better characterization of “Carne Mirandesa PDO” veal. This study was made in three farms, from the Northeast region of Portugal (PG, FA1 and FA2), where calves were raised permanently indoors, nurse from their dams overnight, and fed with hay and concentrate made with local ingredients and soybean meal. Twenty five calves were slaughtered at 7 months old. Twenty four hours after slaughtering, samples were collected from four different muscles: *longissimus dorsi* (LD), *semimembranosus* (SM), *gluteus biceps femoris* (GB) and *triceps brachii caput longum* (TBL), vacuum packaged and freeze-dried. Determinations of crude protein (CP), ether extract (EE), collagen and fatty acid were made. Collagen, CP and EE were significantly ($P < 0.001$) affected by muscle type. Fatty acid composition was mostly affected by farm and by muscle type. The SM muscle was poor in saturated fatty acids (14:0, 15:0, 16:0, 17:0 and 18:0) and richer in polyunsaturated fatty acids than the other muscles. The ratio between n-3 and n-6 PUFA observed in this study are close to the usually found for pasture fed animals indicating the healthy value of “Carne Mirandesa PDO” veal.

Keywords: PDO meat, collagen, fatty acids, muscles, Mirandesa.

Introduction

Mirandesa cattle are a local meat breed from the Northeast region of Portugal, with an important role on the rural spaces maintenance, contributing to the fixation of the populations and the environmental preservation. Cows graze natural pastures (herbaceous species) during spring and early summer and afterwards are fed with hays (of natural pasture or oat) and straws (oat, barley or wheat), complemented with local feeds like squash or potatoes. The nutritive value of the feedstuffs allows the sustainability of this traditional production system, with aptitude for meat production (Galvão *et al.*, 2005).

Calves present at birth a mean live weight of 32-35 kg, are weaned at 7 months old and slaughtered with a mean live weight of 180-200 kg. Dressing percentage was about 53% and the percentage were 16.5 for fat, 62.0 for muscle and 19.3 for bone (Vaz Portugal *et al.*, 2001). The genetic characteristics of this breed, associated with the particular feed management of calf (milk complemented with hay and farm-made concentrates) contribute to particular meat characteristics like tenderness

and succulence, together with tastes and flavours, very appreciated by the consumers. Its specificity, quality and genuineness, was recognized conducting to the Protected Denomination of Origin of "Carne Mirandesa". The objective of this study was to evaluate chemical parameters related to meat quality, contributing to a better characterization of "Carne Mirandesa PDO".

Material and methods

This study was made in three farms, from two villages: Prado Gatão (PG) and Fonte da Aldeia (FA1 and FA2), located in the Northeast region of Portugal. Calves were raised permanently indoors, nurse from their dams overnight, and fed with hay and concentrate made with local ingredients and soybean meal. PG concentrate presented a mean (\pm standard deviation) crude protein (CP) of 13.8 ± 0.49 % dry matter (DM) and starch of 46.8 ± 8.75 % DM. The concentrates used in FA1 and FA2 were similar, with a CP content of 15.6 ± 0.45 % DM and a starch content of 44.8 ± 6.94 % DM. Twenty five calves (11 males and 14 females: 6 from PG, 7 from FA1 and 12 from FA2) were slaughtered at 7 months old. Twenty four hours after slaughtering, samples were collected from four different muscles: *longissimus dorsi* (LD), *semimembranosus* (SM), *gluteus biceps femoris* (GB) and *triceps brachii caput longum* (TBL), vacuum packaged and freeze-dried.

Determinations of nitrogen (N) and ether extract (EE) without acid hydrolysis were made following the procedures described in AOAC (1990). Soluble and total collagen was calculated from the hydroxyproline content according to the method of Hill (1966). Fatty acid were extracted and methylated by the method of Rule (1997). Fatty acid methyl esters were analysed by gas chromatography using a Varian CP-3800 chromatograph (Varian Analytic Instruments, Walnut Creek, CA, USA) equipped with a 30-m fused silica capillary column OmegaWax 250 (Supelco, Bellefonte, PA, USA) with a 0.25-mm internal diameter and a 0.25- μ m film thickness. Peak identification was based on co-chromatography with known standards of fatty acid methyl esters (Sigma, St Louis, MO, USA). All results are presented as weight percentage of identified fatty acids.

Data were analysed using the "proc mixed" from SAS (SAS, 2004). The model considered the fixed effects of sex, farm and muscle. Muscles were treated as repeated measures.

Results and discussion

The effect of sex and farm were not significant for N, EE and collagen content of muscles. All these parameters were significantly ($P < 0.001$) affected by muscle type (Table 1). SM muscle was the

Table 1. Nitrogen, ether extract content and collagen (% of dry matter) of *gluteus biceps femoris* (GB), *longissimus dorsi* (LD), *semimembranosus* (SM), and *triceps brachii caput longum* (TBL) muscles from "Carne Mirandesa PDO" veal.

	GB	LD	SM	TBP	s.e.m.	Sig
N	14.1 ^a	14.3 ^a	14.7 ^b	13.7 ^a	0.19	***
EE	10.0 ^b	10.3 ^{bc}	6.4 ^a	12.6 ^c	1.07	***
Sol. Col.	3.1 ^a	4.3 ^b	2.8 ^a	6.2 ^c	0.43	***
Tot. Col.	7.4 ^a	9.0 ^a	9.5 ^a	14.1 ^b	0.79	***
Sol. Col %	41.7 ^b	44.0 ^b	28.9 ^a	44.2 ^b	1.58	***

N- nitrogen, EE- ether extract, Sol. Col. - soluble collagen, Tot. Col. - total collagen, Sol. Col. % - soluble collagen in percentage of total collagen. Means with different superscripts are significantly different ($P < 0.05$).

Table 2. Effect of farm (PG, FA1 and FA2) and muscle type (gluteus biceps femoris-GB, longissimus dorsi-LD, semimembranosus- SM, and triceps brachii caput longum- TBL) on fatty acid composition of "Carne Mirandesa PDO" veal.

	Farm				Muscle				s.e.
	AI	PG	VG	s.e.m.	GB	LD	SM	TBP	
12:0 ^F	0.14 ^a	0.22 ^b	0.12 ^a	0.022	0.17	0.16	0.15	0.17	0.00
14:0 ^{F,M}	3.71 ^a	4.98 ^b	3.63 ^a	0.307	4.24 ^a	4.32 ^a	3.69 ^b	4.16 ^a	0.20
15:0 ^{F,M}	0.50 ^a	0.62 ^b	0.47 ^a	0.038	0.55 ^a	0.57 ^a	0.49 ^b	0.52 ^a	0.02
16:0 ^{F,M}	25.1 ^a	26.8 ^b	25.4 ^a	0.49	26.1 ^a	26.7 ^a	24.8 ^b	25.5 ^a	0.36
16:1 ^M	4.24	4.42	4.45	0.275	4.11 ^a	4.23 ^a	4.90 ^b	4.24 ^a	0.19
17:0 ^M	0.96	0.88	0.96	0.045	0.99 ^a	0.98	0.82 ^b	0.94 ^a	0.02
17:1	1.00	0.85	0.96	0.046	0.94	0.91	0.97	0.93	0.02
18:0 ^{F,M}	14.3 ^a	12.6 ^b	14.3 ^a	0.45	14.2 ^a	14.2 ^a	12.1 ^b	14.3 ^a	0.33
18:1 ^F	38.0 ^a	32.1 ^b	36.0 ^a	1.04	35.0	35.8	34.9	35.7	0.65
18:2n-6 ^M	5.62	7.17	6.60	0.572	6.31 ^a	5.51 ^b	7.70 ^a	6.34 ^a	0.57
18:3n-3 ^{F,M}	0.71 ^a	1.54 ^b	0.71 ^a	0.053	0.99 ^a	0.90 ^a	1.14 ^b	0.93 ^a	0.04
20:1 ^F	0.17 ^a	0.12 ^b	0.16 ^a	0.011	0.14	0.15	0.15	0.15	0.00
20:2n-6 ^M	0.28	0.26	0.31	0.030	0.26 ^a	0.23 ^a	0.36 ^b	0.27 ^a	0.02
20:3n-6 ^M	0.46	0.58	0.58	0.066	0.51 ^a	0.44 ^a	0.70 ^b	0.52 ^a	0.04
20:4n-6 ^M	1.80	2.43	2.06	0.232	1.90 ^a	1.64 ^a	2.77 ^b	2.09 ^a	0.18
20:3n-3 ^F	0.03 ^a	0.00 ^b	0.02 ^a	0.005	0.01	0.01	0.02	0.01	0.00
20:5n-3 ^{F,M}	0.47 ^a	1.28 ^b	0.54 ^a	0.080	0.75 ^a	0.63 ^a	1.09 ^b	0.58 ^a	0.07
22:5n-3 ^{F,M}	0.82 ^a	1.50 ^b	0.89 ^a	0.097	0.97 ^a	0.81 ^a	1.49 ^b	1.02 ^a	0.09
22:6n-3 ^{F,M}	0.14 ^a	0.28 ^b	0.22 ^a	0.031	0.23 ^a	0.16 ^a	0.32 ^b	0.16 ^a	0.02
Σ Odd-br	3.99	3.70	4.02	0.127	4.06 ^b	4.02 ^b	3.65 ^a	3.88 ^b	0.09
Σ n-3 ^{F,M}	2.19 ^a	4.60 ^b	2.38 ^a	0.242	2.96 ^a	2.51 ^a	4.05 ^b	2.71 ^a	0.22
Σ n-6 ^M	8.16	10.4	9.56	0.883	8.98 ^a	7.82 ^a	11.5 ^b	9.23 ^a	0.68
n6/n3 ^{F,M}	3.89 ^b	2.30 ^a	4.16 ^b	0.222	3.43 ^b	3.41 ^b	3.13 ^a	3.83 ^c	0.14
PS ^{F,M}	0.23 ^a	0.32 ^b	0.26 ^a	0.025	0.25 ^a	0.22 ^a	0.36 ^b	0.26 ^a	0.02

F – significant effect for farm ($P<0.05$). M – significant effect for muscle type ($P<0.05$). Σ Odd-br – sum of odd chain and branched chain fatty acids, n6/n3 – ratio between n-6 and n-3 polyunsaturated fatty acids, PS – ratio between polyunsaturated fatty acids and saturated fatty acids. Means with different superscripts in farm and in muscle type sections are significantly different ($P<0.05$).

leanest and with higher N content, whereas the TBP was the fatter muscle. These muscles presented also the extreme values of soluble collagen, which in TBP was significantly higher compared to the other muscles. Differences in composition between muscles are well known.

Fatty acid composition was mostly affected by farm and by muscle type (Table 2). Few fatty acids were affected by sex with 20:2 n-6, 22:6 n-3 and sum of n-3 PUFA higher ($P<0.05$) in males than in females and 22:5 n-3 higher ($p<0.05$) in females. However, 18:1 cis-9 (oleic acid) tended ($P<0.06$) to be higher in females, whereas 18:2 n-6 (linoleic acid) ($P<0.07$) tended to be higher in males.

Farm effects were significant for most of the fatty acids studied. The animals from PG farm had higher 12:0, 14:0, 15:0, 16:0, 18:3 and n-3 polyunsaturated fatty acids (PUFA) and lower 18:0, 18:1 and 20:1 than animals from FA1 and FA2 farms. Veal from FA1 and FA2 farms had no differences in fatty acid composition. The differences between farms could be related with the reported differences between concentrates and geographical factors.

The effects of muscle type on fatty acid composition were mainly attributed to the SM muscle and only slight differences were observed between GB, LD and TBP. The SM muscle was poor in saturated fatty acids (14:0, 15:0, 16:0, 17:0 and 18:0) and richer in polyunsaturated fatty acids than the other muscles. This is consistent with the fact that SM muscle is leaner than the other muscles (Table 1) and, consequently, with higher relative proportions of phospholipids and PUFA. Muscle differences in fatty acid composition are well known and related to total fat content and proportions of muscle fiber types (Wood *et al.*, 2004).

The ratio between n-3 and n-6 PUFA is an important index of health nutritional quality of foods. Meat from pasture fed animals have a low n3/n6 PUFA ratio, ranging between 2.0 and 2.3 (Nuernberg *et al.*, 2002; Raes *et al.*, 2004) and are considered healthier than concentrate fed beef, ranging from 16 to 20 (Enser *et al.*, 1998). The values observed in this study are close to those reported for pasture fed animals indicating the healthy value of "Carne Mirandesa PDO" veal.

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