COMPARISON OF TOTAL CONTENT OF LIPID AND CHOLESTEROL IN PORTUGUESE BOVINE MEATS-PDO FROM FOUR DIFFERENT AUTOCHTHONOUS BREEDS (BARROSÃ, AROUQUESA, ALENTEJANA AND MERTOLENGA)

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Background

Portuguese bovine meat production is based either on intensive rearing of crossbred and meat specialized exogenous breeds or on traditional extensive rearing of autochthonous breeds. The traditional meat production system of the Portuguese bovine autochthonous breeds represents an important socio-economical factor of wealth to the rural populations as it provides meat, milk and labor. In a recent past, the introduction of exotic bovine breeds specialized in meat or milk production, such as Charolais, Limousine and Friesian, have created a threat to the preservation of Portuguese autochthonous bovine livestock and to the traditional meat production system, characterized by the utilization of local agricultural resources with little or no costs in pellet feeding. In the present days, autochthonous bovine population is increasing thanks to active producer associations, and the meat of these breeds is being commercialized under the Protected Designation of Origin (PDO) certification, which obliges producers to follow the traditional rearing methods. Arouquesa and Barrosã, from the North Atlantic territory of Portugal, and Alentejana and Mertolenga, from the South Mediterranean territory of Portugal, are four commercially important autochthonous Portuguese breeds (Figure 1). It is supposed that each meat-PDO has unique characteristics, particularly in its lipid fraction, thanks to traditional, unique production system and to the breed own characteristics. However, for the consumers, the meat-PDO represents an expensive choice, which can only be justified by enhanced sensorial and nutritional characteristics.

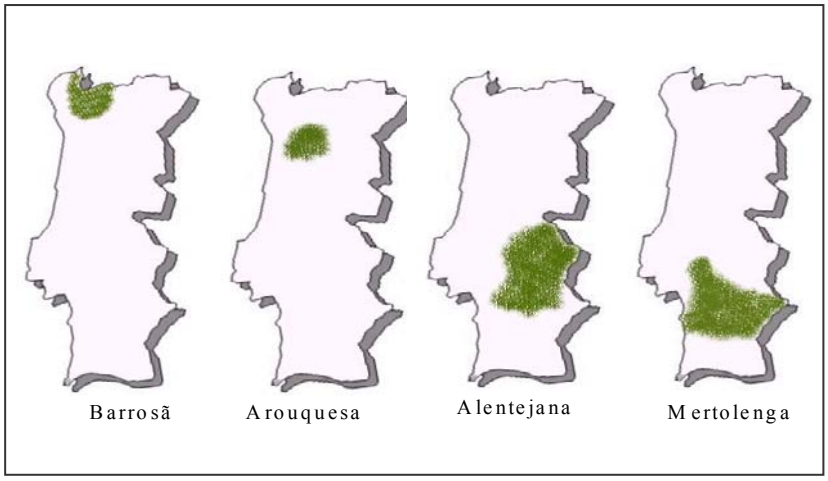

Figure 1. Geographical distribution of the Portuguese autochthonous bovine breeds analyzed in this study.

Objectives

The aim of this work was to compare the total content of lipids and cholesterol in Arouquesa-PDO veal, Barrosã-PDO veal, Alentejana-PDO beef and Mertolenga-PDO beef, all obtained from autochthonous bovines fed extensively during winter and early-mid spring (with the most abundant green pastures) and slaughtered in late spring (June).

Materials and methods

Meat samples from Arouquesa (113 ± 18 kg of carcass weight, 8.5 ± 0.9 months) and Barrosã (106 ± 21 kg, 7.9 ± 1.8 months) breed calves, and from Alentejana (357 ± 32 kg, 20 ± 2 months) and Mertolenga (236 ± 31 kg, 23.6 ± 2.8 months) breed bulls, were taken from the ribeye (*longissimus thoracis*; T1-T3), from the loin (*longissimus lumborum*; L1-L3) and from the distal portion of the *semitendinosus* muscle. The samples were collected in late spring, 2-3 days after slaughter, and stored at -80ºC until analysed.

Total lipids were extracted from meat (dry matter) by ultrasonication, using methylene-chloride (4:1 v/v) (3×) and *n*-hexane (1×), as was described by Fritsche *et al.* (2000). Total lipid content of the samples was calculated, in duplicate, by weighing the residues of solvent evaporation under a stream of nitrogen.

Total cholesterol was also extracted from meat (dry matter) with *n*-hexane after direct saponification with 0.5 M KOH solution for 15 min at +80ºC (Fletouris *et al.*, 1998). Cholesterol quantification was performed by normal-phase HPLC (column Zorbax Rx Sil, 4.6 mm ID × 250 mm, 5 µm particle size, Chrompack, USA), using an auto-sampler and diode array detection (DAD) at 206 nm, a solvent flow rate of 1 ml/min and injections volumes of 30 µl (Figure 2). The total cholesterol content in meat was expressed as a mean of two replicates with a variation coefficient lower than 3.5%.

The statistical analysis of the total lipids and total cholesterol contents were performed using the GLM procedure of SAS (1989) at a significance level of 5% ($p<0.05$). When the *F*-test of analysis of variance was significant, the least-squares means were compared at the same significance level.

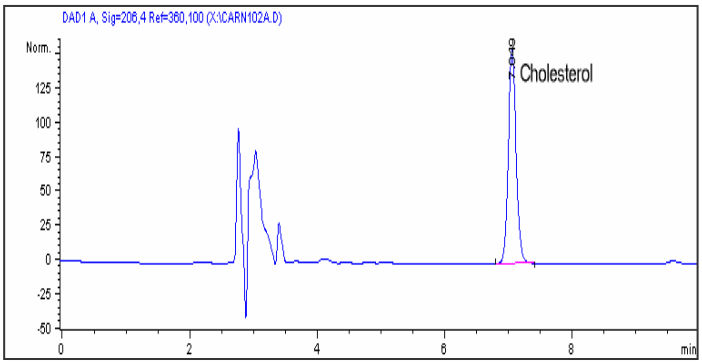

Figure 2. Typical normal-phase HPLC chromatogram of total cholesterol in a meat sample, detected at 206 nm.

Results and discussion

These data do not allow us to identify breed differences "*per se*" but the overall effect of breed and local production system (traditional production system). Total cholesterol content was higher in *semitendinosus* muscle than in the other muscles analyzed in all four breeds (Table 1). The total cholesterol content of Alentejano and Mertolengo bulls are similar to those reported for Podolian young bulls (Cifuni *et al.*, 2004) and feedlot beef cattle (Rule *et al.*, 2002). Arouquesa and Barrosã veal had slightly lower total cholesterol content than the average reported by Chizzollini *et al.* (1999). Total lipid content of meat did not show a common pattern in the different muscles of the four breeds (see Table 1). However, according to the criteria set by the Food Advisory Committee (1990) (less than 5% of fat), all meats analyzed were lean. This trait alone can be considered a quality characteristic of these meats-PDO, because it is independent of the season and availability of nutrition. The analysis of specific cholesterol content showed that *longissimus thoracis* had the highest content, while *longissimus lumborum* and *semitendinosus* had similar specific cholesterol contents in all breeds, except for Alentejana bulls. The specific cholesterol contents distribution among the different muscles analyzed did not show a regular pattern. The total lipid content and total cholesterol content showed a highly significant positive correlation ($R^2=0.135$, $P<0.0001$, $n=180$), although, according to earlier work, marbling depots seemed to have minimal effect on the total cholesterol content of meat (Kinney Sweeten *et al.*, 1990). This controversy may be explained by the fact that cholesterol deposits are mainly in the membranes not in the cytoplasm of the adipose tissue. The statistical analysis performed to evaluate the possible interaction between muscle and breed, revealed a significant interaction between the two factors for all analyzed parameters, which means an absence of a common pattern for the different muscles of the breed calves and bulls analyzed.

Table 1. Means of total lipids (TL, mg/g meat), total cholesterol (TC, mg/g meat) and specific contents of total cholesterol (SC, mg/g lipids) measured in *semitendinosus* (ST), *longissimus lumborum (LL)* and *longissimus thoracis (LT)* muscles of four Portuguese bovine meats-PDO.

	Arouquesa			Alentejana			Mertolenga			Barrosã		
	ST	LL	LT	ST	LL	LT	ST	LL	LT	ST	LL	LT
[1] TC	0.61^{a}	0.54^{e}	0.58^{b}	0.49^{d}	0.45^{e}	0.43^{e}	0.50^{d}	0.44^{e}	0.44^{e}	0.61^{a}	0.52^{cd}	0.57^{bc}
[2] TL	30.8^{a}	23.7^{b}	17.3^{cde}	14.1^{abc}	20.7^{def}	10.9^{h}	17.9^{edc}	16.3^{defg}	12.1^{gh}	22.5^{bc}	16.3^{defg}	14.9^{efgh}
[3] SC	23.8^{a}	25.5^{a}	35.7^{bcd}	41.2^{d}	25.2^{a}	41.5^{d}	29.5^{ab}	28.8^{ab}	38.8^{cd}	30.1^{ab}	32.9^{bc}	40.9^{d}

[1] – Significant interaction ($p< 0.01$) between muscle type (M) and breed (B); standard error of means (s.e.m.) = 0.0107
[2] – Significant M*B interaction ($p< 0.0001$), s.e.m. = 1.75
[3] - Significant M*B interaction ($p< 0.04$), s.e.m. = 2.647

Conclusions

We conclude that the Portuguese autochthonous breeds studied, although not specialized for meat production, represent an important source of lean meat with similar cholesterol content. These breeds are produced with the local resources in a production system where the specialized breeds cannot compete.

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