PE9.44 CLA total, specific contents and CLA isomeric profile from native and exotic lambs, raised under extensive and intensive production systems, respectively

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Abstract The suckling lamb market is gradually changing. In a near past suckling lamb was produced from native breeds raised under extensive production systems, but this production system and native breeds have been disappearing progressively and being replaced by exotic breeds, that are raised under intensive production practices. These changes have been occurring, without knowledge of what is being lost in the process. Considering the biological importance of CLA and the absence of available data on Portuguese autochthonous breeds of lamb, it was the present work objective to study CLA isomeric profile and CLA contents in lamb from autochthonous and exotic breeds raised under extensive and intensive production systems, respectively.
Lambs of similar ages and carcass weight of pure bred Churra da Terra Quente raised under extensive production system and pure bred Assafraised in an Intensive dairy farm were slaughtered in the Easter season. Samples of longissimus lumborum were collected from the abattoir. The methyl esters of CLA isomers were individually separated by triple silver-ion columns in tandem using a high performance liquid chromatography equipped with a diode array detector (DAD) adjusted to 233 nm.
The results of this study show that suckling lambs from native breed plus extensive production system encloses significantly higher contents of total lipids, total and specific CLA, offering a singular CLA isomeric profile in comparison with the exotic plus intensive production system.

I. INTRODUCTION

Conjugated linoleic acid (CLA), is defined as a collective term to all the geometric and positional isomers of linoleic acid (C18:2n-6) with conjugated double bounds, in either *cis* or *trans* configurations. CLA is produced in the rumen by isomerization of linoleic acid (LA), while the *cis*-9, *trans*-11 (*c9,t11*) CLA isomer, the most abundant isomer found in meat and dairy products, , is predominantly produced in ruminant tissues by Δ-9 desaturation of vaccenic acid (18:1 *trans*-11) [1] and, to a lesser extent, from bacterial hydrogenation of dietary PUFA in the rumen [2]. Although representing a relatively minor component of the total fatty acid composition of foods, CLA exhibits several health promoting properties against atherosclerosis, hypertension, diabetes, inflammation, and some kinds of cancer [3]. CLA is also known due to its ability to reduce body fat while enhancing lean body mass [4, 5].

In Portugal, the consumption of suckling lamb during the Christmas and Easter seasons is an ancient tradition. Nowadays, different market alternatives with different labels and prices make the choice complex. Among these options, one is particular relevant and involves the choice between certified or indiscriminate products (i.e. traditional and intensive production systems). Certified meats (PDO and PGI) are produced from autochthonous breeds, raised under extensive production systems based on pasture grazing. On the other hand, lamb from indiscriminate origin is also available on the market, at lower price. The majority of it outcomes, as a by-product, from dairy farms (exotic breeds) and are raised under intensive production methods. Besides different genetic background (native *versus* exotic), there is another important difference in these production systems that rely on the milk used to feed lambs (maternal milk *versus* milk replacer). Therefore, certified and indiscriminate lamb enclose several important differences (genetics plus production system), which should result in nutritional differences, that are unknown.

Considering the biological importance of CLA and the absence of available data on Portuguese autochthonous breeds of lamb, it was the present work objective to study CLA isomeric profile and CLA contents in lamb from autochthonous and exotic breeds raised under extensive and intensive production systems, respectively.

II. MATERIAL AND METHODS

In this study we have two different breeds, the native breed and the exotic breed, and two different production systems, extensive and intensive. One lamb is the result of native genetics and extensive production system (TRADITIONAL), while the other is the result of exotic genetics and intensive production system (MODERN). In the TRADITIONAL side we find Terrincho-PDO a certified lamb of (Churra da Terra Quente breed (a native Portuguese breed), raised in accordance with the certification specifications fed on maternal milk, following their dams in pasture). On the other side, MODERN, we find an exotic breed (Assaf) kept in a dairy farm, their lambs are fed with milk replacer and kept apart from their dams since birth, the common management in dairy sheep farms.

Lambs from both breeds were pure bred animals slaughtered in the same season (Easter), with approximately the same age, which resulted in a similar carcass weight Churra da Terra Quente breed (n = 15; 5,7±1,1 kg/carcass), Assaf breed (n=14; 5,8±1,8 kg/carcass).

All meat samples were trimmed of connective, adipose tissue before blending in a food processor. Afterwards, the meat samples were frozen and lyophilised (-60 °C and 2.0 hPa) to constant weight and maintained exsiccated at room temperature until analysis, which was performed within a month.

The methyl esters of CLA isomers were individually separated by triple silver-ion columns in tandem using a high performance liquid chromatography equipped with a diode array detector (DAD) adjusted to 233 nm. For description of the procedure consult Alfaia et al. [6]. Total and individual CLA isomer contents in meat were determined based on the external standard technique (using 18:2c9,t11, 18:2t10,c12 and 18:2t9,t11 as representatives of each of the geometric groups of CLA isomers) and on the method of area normalization. The CLA isomers were expressed or as a percentage of the sum of identified CLA isomers (% total CLA) and total CLA expressed as gravimetric contents (mg/100g muscle and mg/g FAME).

III. RESULTS AND DISCUSSION

Data on total lipids (mg/g muscle), total CLA (mg/100g muscle), specific CLA (mg/g FAME) contents and CLA isomeric profile (% total CLA) of lamb intramuscular fat from both TRADITIONAL (T) and MODERN (M) systems are displayed in Table 1. Data show that differences in the production system (genetics and feeding management) contribute to significant differences in lamb total lipids, total CLA, specific CLA and total *c9,t11* CLA ($P<0.001$). The comparison of lamb from T and M systems shows that M lamb meat contains just 54.5% of total lipids, 24.3% of total CLA, 33.3% of specific CLA and 26.2% of total *c9,t11* CLA displayed by T lamb meat. CLA isomeric profile of lamb from T and M production systems revealed to be significantly different from each other, which is confirmed by the existence of 11 significant differences ($P<0.01$) on the percentages of individual CLA isomers, among 12 different CLA isomers. The CLA isomeric profile of both lambs shows a clear predominance of the *c9,t11* isomer, which comprises 81.7% and 76.6% of total CLA in M and T lamb, respectively ($P<0.05$). Lamb from the T system encloses significant higher percentages of *t11,t13, t10,t12, t9,t11, t8,t10* and *t7,t9* individual isomers, which results in a significant increase in the sums of *trans,trans* isomers. Lamb from the T production system had also a significant higher percentage of the *t11,c13* isomer and significantly lower percentages of t10,c12, c9,t11 and t7,c9 isomers than lamb from the M system.

Table 1- Total lipids (mg/g muscle), total CLA (mg/100g muscle), specific CLA (mg/g FAME), total *c9,t11* (mg/100g muscle) and CLA isomeric profile (% total CLA) of *longissimus lumborum* from lamb of MODERN and TRADITIONAL production systems (mean±SEM).

	Production system		*P*
	MODERN	TRADITIONAL	
Total lipids	9.6±0.664	17.6±0.664	<0.001
Total CLA	4.6±1.359	18.9±1.312	<0.001
Specific CLA	0.53±0.061	1.59±0.059	<0.001
Total *c9,t11*	3.8±1.069	14.5±1.033	<0.001
CLA isomers			
t12,t14	0.58±0.044	0.41±0.043	0.01
t11,t13	0.75±0.09	1.50±0.087	<0.001
t10,t12	0.50±0.149	2.14±0.144	<0.001
t9,t11	2.46±0.229	6.30±0.221	<0.001
t8,t10	0.41±0.066	0.96±0.064	<0.001
t7,t9	0.71±0.116	1.51±0.112	<0.001
t6,t8	0.53±0.139	0.90±0.134	n.s.
t,t total	5.96±0.515	13.74±0.498	<0.001
c/t12,14	1.04±0.10	0.36±0.09	<0.001
t11,c13	1.15±0.208	3.12±0.201	<0.001
t10,c12	1.18±0.183	0.42±0.177	<0.01
c9,t11	81.71±0.678	76.75±0.655	<0.001
t7,c9	8.93±0.536	5.59±0.518	<0.001
c/t total	94.03±0.515	86.26±0.498	<0.001

Lamb from the T production system contains increase contents of total lipids and total CLA, this lamb lipids enclose higher amounts of CLA. Considering that both groups are constituted by young suckling lambs (pre-ruminant animals) and milk is their major source of nutrients, differences in milk composition should be responsible by differences in CLA contents and distinct isomeric profile.

The contents of total CLA in ruminant products has been shown to be positively influenced by pasture intake [7], such suggestion is in agreement with our results, since lamb produced under extensive production system has significant higher contents of total and specific CLA than lamb from the intensive production system. Differences found in CLA isomeric profile between lambs from different production systems are in agreement with recent results on cattle raised on different feeding systems [6], showing that even for suckling (pre-ruminant) lambs, extensive production system based on pasture grazing offers lamb with higher percentages of *t11,t13, t10,t12, t9,t11, t8,t10*, *t7,t9* and *t11,c13* isomers and lower percentages of *t10,c12, c9,t11* and *t7,c9* isomers than grain-fed.

The increased CLA contents found in lamb from TRADITIONAL production systems could represent an add-value to this extensive, time-demanding and less efficient production system.

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