

Characterization of conjugated linoleic acid isomers in Iberian wild red deer

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Abstract

Conjugated isomers of linoleic acid (CLA) occur naturally in ruminant fats, although information on the CLA isomeric profile in venison is scarce. The objective of this study was to evaluate the CLA content of wild Iberian red deer from *Montado* (savannah-like pastures where cork and holm oaks are the predominant trees). Twenty adult wild Iberian red deers shot during the morning period, were selected. Sampling was performed during afternoon, by removing the *psaos major* muscles, which were transported under refrigeration to the laboratory. After trimming, samples were frozen (-20 °C) until analysis. The methyl esters of CLA isomers were individually separated and quantified by HPLC. Venison had a total CLA contents of 2.04±0.77 mg/g of lipids and 18.2±7.1 mg/kg of meat (mean ± SD), with the following isomeric distribution (% of total CLA): t12,t14 (5.09%), t11,t13 (3.41%), t10,t12 (2.80%), t9,t11 (1.53%), t8,t10 (3.87%), t7,t9 (4.29%), t6,t8 (2.56%), c/t12,14 (1.86%), t11,c13 (1.60%), c11,t13 (6.19%), t10,c12 (2.85%), c9,t11 (49.53%), t8,c10 (3.16%), t7,c9 (5.53%), c9,c11 (5.72%). The *Montado* venison showed a particular CLA isomeric profile, with considerably lower percentage of c9,t11 isomer, than is currently reported in other ruminant meats (75 to 90% of total CLA).

Introduction

The Portuguese *Montado* is an agro-silvo-pastoral system characteristic of the Portuguese southern province of Alentejo and the bordering western councils of Ribatejo and southern councils of Beira-Baixa provinces [1, 2].

The Portuguese *Montado* closely resembles the Spanish *Dehesa*, and both constitute examples of land-use systems well adapted to the environmental restrictions of the Mediterranean region, characterised by low edaphic and climatic potential [3, 4]. *Montado* land has been managed, for several decades, as an agro-silvo-pastoral system, but nowadays significant areas of this ecosystem are being converted into rural tourism or big game hunting reserves. Together with cork exploitation, they support the economic viability of the land, offering simultaneous preservation of the *Montado* ecosystem biodiversity and the landscape structure [2].

The red deer (*Cervus elaphus*) is one of the most appreciated big game hunting trophies in Europe. The Iberian red deer (*Cervus elaphus hispanicus*) is well adapted to the *Montado* ecosystem, and represents an important resource to Portuguese big game hunting reserves. In Portugal, venison is a surplus product from the big game hunting industry, which is promoted as gourmet meat due to its unique gamey flavour. Venison nutritional profile (lean meat, low fat and low cholesterol) [5], also attracts meat consumers, principally the health-conscious consumers.

Conjugated linoleic acid (CLA), a collective term to all the geometric and positional isomers of linoleic acid (C18:2n-6), exerts positive effects on cancer, cardiovascular disease, diabetes, body composition, immune system and bone health. CLA occurs naturally in food, especially in ruminant-derived fat, presenting an increase value for ruminant's meat [6], as venison.

However, little information is available regarding venison nutritional quality, and there is no available information concerning CLA content and isomeric profile in wild Iberian red deer from *Montado*. Therefore, it was this study's purpose the evaluation of CLA content and isomeric profile in wild Iberian red deer from *Montado*.

Material and methods

Twenty wild adult Iberian red deers (ten female and ten male), shot during a battue in the morning period, were selected for the study. The *psaos major* muscles were collected from the cadavers during the afternoon, immediately after the sanitary inspection. The muscles were transported under refrigeration (+5°C.) to the laboratory, stored under refrigeration and processed on the day after. All meat samples were

trimmed of connective, adipose tissue and blood coagulum 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. [7]. Total and individual CLA isomer contents in meat were determined based on the external standard technique (using 18:2c9,t11, 18:2t10,c12, 18:2c9,c11 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 as gravimetric contents (mg/kg muscle and mg/g fat) or as a percentage of the sum of identified CLA isomers (% total CLA).

Results and discussion

CLA is naturally found in ruminant meat or derived food products, like milk and butter. Red deer is a ruminant, therefore it was expected to possess significant amounts of CLA in its meat. Considering the many factors that significantly influence the CLA total content and isomeric profile, it was of obvious interest the characterization of *Montado* venison, during the hunting season.

Venison had a total CLA content of 2.04 ± 0.77 mg/g of lipids and 18.2 ± 7.1 mg/kg of meat (mean \pm SD), which is below the CLA content found in lamb (4.3-19.0mg/g of lipids), but in the range of values for beef (1.2-10 mg/g of lipids) [6]. Venison displayed the following CLA isomeric distribution (% of total CLA): t12,t14 (5.09%), t11,t13 (3.41%), t10,t12 (2.80%), t9,t11 (1.53%), t8,t10 (3.87%), t7,t9 (4.29%), t6,t8 (2.56%), c/t12,14 (1.86%), t11,c13 (1.60%), c11,t13 (6.19%), t10,c12 (2.85%), c9,t11 (49.53%), t8,c10 (3.16%), t7,c9 (5.53%), c9,c11 (5.72%). The CLA isomeric profile found in *Montado* venison is particularly different from the profile that is usually found in other ruminant meats. Major differences found between the isomeric profiles are associated with the significantly lower percentage of the c9,t11 isomer found in venison (49.5% of total CLA) than has been previously reported in other animal and dairy products, in which the c9,t11 isomer accounted for 75 to 90% of total CLA [8].

Differences between venison and other ruminants in total CLA contents and CLA isomeric potential can be dependent of three major factors: 1) genetics; 2) feeding behaviour and 3) feeding availability during the winter season. Genetic differences between domestic ruminants and deer are expected. Such differences could be responsible for lower activity of the $\Delta 9$ -desaturase, which is responsible for desaturation of trans-vaccenic acid (18:1,t11) [9, 10]. The feeding behaviour may also be responsible for differences found in both CLA total content and isomeric profile, since the red deer feeding behaviour, classified as intermediate feeder (with different degrees of browser and grazer depending of food availability) [11-13], is quite different from the feeding behaviour of the domestic ruminant species (grazers), which should influence the CLA synthesis in the rumen. The feed availability during the winter season may be also an important factor influencing both CLA total content and isomeric profile, since acorns and mast are important feeding resources during the autumn and winter seasons. Their high energy content may be responsible for a decreased rumen pH, which modulates important changes in the rumen bacterial population [14].

Conclusions

This study as allowed us to confirm the presence of considerable amounts of CLA in venison, but the CLA isomeric profile shows pronounced differences from other ruminant meats, which may result from multifactorial causes that require further research.

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