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Meat lipid profile of suckling goat kids from certified and noncertified production systems

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ABSTRACT

The objective of this work was to provide information regarding the intramuscular lipid composition of goat kid meat from three certificated varieties (Minho-PGI, Barroso-PGI Transmontano-PDO) and one noncertified cabrito obtained from an intensive dairy farm. The results disclose the distinctive lipid profile of each cabrito variety. Certified cabrito varieties displayed lower total lipid content (1.0 *versus* 1.9 g/100 g of meat), but higher contents of total cholesterol (61 *versus* 48 mg/100 g meat). SFA and MUFA represented prime fatty acid groups in all cabrito varieties, being responsible for 42.4 and 41.6% of total fatty acids. Certified cabrito varieties displayed twice the total PUFA content (23 *versus* 11% total fatty acids) and more than the triple content of *n*-3 PUFA (8 *versus* 2.5% total fatty acids) of noncertified variety. Certified cabrito varieties presented higher content of α-tocopherol. Significant differences between cabrito varieties were observed in total CLA content and all 10CLA isomers.

1. Introduction

In Mediterranean Europe, particularly in Spain and Portugal, there is an important demand for meat from young goats (suckling goat kids), often slaughtered near 60 days of age (Arias and Alonso, 2002; Marichal et al., 2003; Teixeira and Delfa, 1993). In Portugal, consumption of goat meat occurs predominantly in the form of suckling goat kids (4–6 kg carcasses, up to 3 months of age). This consumption is concentrated on Christmas and Easter and other major popular festivities (Santos et al., 2007). Goat kid meat is regarded as a traditional product with high edible quality, because of these attributes it becomes the most expensive meat of the market around major festivities. Goat kid meat is simultaneously considered a delicacy and a red meat with excellent nutritional value (Boza and Sanz Sampelayo, 1997), such attributes are responsible for a growing demand among the European Union (EU) member states and also in USA (Ringdorfer, 2001; Leidner, 1998).

Portuguese traditional goat husbandry has been oriented into a dual production purpose, meat (light weight carcasses) and milk. Meat from suckling goat kids, named as cabrito, the youngest classification of goat carcasses (King et al., 2004), has been, until recently, the prime objective of goat farms, whence milking was performed solely after kids culling and used for the production of traditional goat cheese. This production system was well adapted to natural resources without the need of concentrate feeding. Nowadays, goat husbandry, in Portugal, is changing rapidly. The desertification of rural areas, the abandonment of agricultural practices along with the hardness of shepherd's life make it quite difficult to find new shepherds, particularly to work with goats. This tendency for change in goat husbandry has been slow down by the European Union policies oriented to promote extensive production systems and by the market request for traditional goat products.

Protected designation of origin (PDO), and protected geographical indication (PGI) are quality labels certified by European Union legislation (Commission regulation EEC No. 1107/96), and are expected to present unique quality and organoleptic characteristics. Since 1996 the EU has granted fresh goat kid meat from suckling goat kids with 5 quality labels in Portugal: 1 with the PDO (cabrito Transmontano-PDO) and 4 with the PGI (cabrito das TerrasAltas do Minho-PGI; cabrito do Barroso-PGI; cabrito da Gralheira-PGI and cabrito da Beira-PGI). The three certified cabrito varieties included in this study are all produced in the extreme North mountainous region of Portugal, they enclose two different native goat breeds, which can be used either in purebred or in crossbred with each other. Different cabrito varieties are representative

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of a single geographic area and together they enclose 7 districts, 42 councils and 215 goat flocks, all raised in accordance with the specifications of each certification label.

The goal of this work was to provide information regarding the intramuscular lipid composition, comprising total lipid content, total cholesterol content, vitamin E content, fatty acid composition and CLA isomeric profile of cabrito from 3 certificated varieties (cabrito das TerrasAltas do Minho-PGI, cabrito do Barroso-PGI and cabrito Transmontano-PDO) and one noncertified cabrito obtained from an intensive dairy farm. The influence of different cabrito varieties on the nutritional value of the intramuscular fat content was also assessed. In addition, the usefulness of meat fatty acids and CLA isomers as chemical markers for the discrimination of certified and noncertified cabrito varieties was also evaluated.

2. Material and methods

2.1. Animals and meat samples

Animals used in this study were slaughtered in a commercial slaughterhouse in the week before Easter (April month). Four different cabrito varieties were selected to the study, 3 certified and one noncertified varieties were sampled. Sampling was conducted by the research team that received the required information and support from both the Certification and Production entities. The cabrito varieties were: the cabrito Transmontano-PDO (Transmontano-PDO); the cabrito das TerrasAltas do Minho-PGI (Minho-PGI), the cabrito do Barroso-PGI (Barroso-PGI) and the Saanen cabrito from a goat dairy farm (noncertified). The animals from Transmontano-PDO, the Minho-PGI and Barroso-PGI were purebred Serrana, purebred Bravia and Serrana × Bravia F1 crossbreed, respectively, while the noncertified cabrito were purebred Saanen (Table 1).

Considering the high number of certified flocks in each certified variety and their distribution in different districts and several councils within a single district. The selection of flocks to be included in the study was made by the Association of Producers and the Certification entity, based on the following characteristics:

1) Defined genetic pattern: purebred Serrana (Transmontano-PDO), purebred Bravia (Minho-PGI) and Serrana × Bravia F1 crossbreed (Barroso-PGI);
2) The flocks from each variety were selected among the three counties with higher number of flocks/animals under certification;
3) The selection of a single flock from each county was based on total fulfillment with the certification guidelines and the representativeness of flock was based in larger flocks, since these are the flocks grazing great areas and feed on a great variety of natural resources;
4) Goat kids were randomly selected among those belonging to the selected flocks and send to slaughter;

Goats and goat kids from all the certified varieties shared similarities in their management, goat kids were kept in the stall from birth to slaughter, while goats stay on rangeland throughout the daily period, and were confined in the stall through the night period, for that reason, kids suckle their dams when they arrive to the stall, at evening, and during the night period and early morning, before they leave for pasture. Despite similarities, some important differences in production purposes between certified varieties should be highlighted, goats belonging to the PDO certification system are partially milked, and the milk was used for the production of another certified product (Transmontano-PDO cheese). For that reason, these goats receive supplementation in the stall, comprising cereals (rye, oats, wheat, maize) and hay. The feeding supplementation provided to these goats is also available to their kids. Goat kids from the PGI varieties had full access to their dams milk, goats received some forage supplementation on the stall comprising branches of some tree species (*Betulaceltiberica* and *Salix alba*). The noncertified cabrito variety was fed with artificial milk provided by the farm and were supplemented with weaning concentrate from the day 40 of life until slaughter.

The number of animals used, ages at slaughter and cold carcass weight are presented in Table 1. All sampled animals had slaughter age (55–65 days of life) and live weight (9–11 kg), in accordance to all certification regulations. Goat kids were slaughtered and refrigerated (4 °C) for 24 h in a commercial slaughterhouse, afterwards they were weighted to obtain the cold carcass weight and their vertebral column was cut immediately in the joint between the last thoracic and first lumbar vertebras, a second cut was done in the joint between the last lumbar vertebra and sacrum. The lumbar column and muscles associated were then transported under refrigeration (<5 °C) to the laboratory for final processing (a period no longer than 6 h of transport). The covering fat depots above *longissimus lumborum* muscles were trimmed. Subsequently both *longissimus lumborum* muscles were disaggregated from the lumbar vertebras, cut in pieces and blended in a food processor. Half of the blended meat was vacuum packed and frozen at −70 °C until analysis, while the other half was lyophilized (−60 °C and 2.0 h Pa) until constant weight, using a lyophilisator Edwards Modulyo (Edwards High Vacuum International, West Sussex, UK), maintained desiccated at room temperature, and analyzed within one month.

2.2. Analytical methods

Total meat lipids were extracted from the lyophilized meat samples (0.25 g) and measured gravimetrically, as previously described (Alfaia et al., 2006; Fritsche et al., 2000). Lipid extracts were dissolved in 1 ml of dry toluene and fatty acid methyl esters were prepared by base-catalyzed transesterification with sodium methoxide for 2 h at 30 °C. Fatty acid methyl esters were analyzed using a HP6890A chromatograph (Hewlett-Packard, Avondale, PA, USA), equipped with a flame-ionization detector (GC-FID) and a fused-silica capillary column (CP-Sil 88; 100 m × 0.25 mm i.d. × 0.20 mm film thickness; Chrompack, Varian Inc., Walnut Creek, CA, USA). The column temperature of 100 °C was held for 15 min, increased to 150 °C at a rate of 10 °C/min and held for 5 min, then increased to 158 °C at 1 °C/min and held for 30 min, and finally increased to 200 °C at a rate of 1 °C/min and maintained for 65 min. Helium was used as carrier gas. The injector and detector temperatures were held at 250 and 280 °C, respectively. Identification was accomplished by comparison of sample peak retention times with those of FAME standard mixtures (Sigma, Madrid, Spain). The methyl esters of CLA isomers were individually separated by three silver ion columns in series (ChromSpher 5 Lipids, 250 mm × 4.6 mm i.d., 5 μm particle size, Chrompack, Bridgewater, NJ, USA), using a high-performance liquid chromatography (HPLC) system (Agilent 1100 Series, Agilent Technologies Inc.) equipped with an autosampler and a diode array detector (DAD) adjusted to 233 nm. The mobile phase was 0.1% acetonitrile in n-hexane, at a flow rate of 1 ml/min, and volumes of 20 μl were injected by the autosampler. The peak identification of the individual CLA isomers was achieved by comparison of their retention times with those of commercial standards and with values published in the literature (Fritsche et al., 2000, 2001). In addition, the identity of each isomer was controlled by the typical UV spectra of CLA isomers from the DAD, in the range 190–360 nm, using the spectral analysis of Agilent Chemstation for LC 3D Systems Rev. (Agilent, 2001). The amounts of CLA isomers were calculated from their HPLC areas relative to the area of the main isomer, 18:2 *cis*-9,