Meat and fat quality of unweaned lambs as affected by slaughter weight and breed

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Article Info

Article history:
Received 2 September 2008
Received in revised form 24 February 2009
Accepted 27 May 2009

Keywords:
Weaning
Fatty acid
Grazalema Merino
Churra Lebrijana

Abstract

Sixty-four male lambs of two Southern Spanish breeds, a dairy breed (Grazalema Merino) and a meat breed (Churra Lebrijana), were used to study the effects of slaughter weight and breed on meat traits and intramuscular and subcutaneous fat composition. Lambs were reared following a traditional production system without weaning and slaughtered when live weight reached 12 kg (suckling) or 20 kg (light). Meat from suckling lambs of both breeds had lower fat and myoglobin contents, and was more tender and had higher scores for sustained juiciness in the sensory analysis. Fat from light lambs had lower C12:0 and C14:0 levels than fat from suckling lambs. Grazalema Merino meat had higher fat and ash contents, and its fat had higher conjugated linoleic acid content than Churra Lebrijana meat.

1. Introduction

Mediterranean consumers’ preference is for lamb fed either milk or mainly concentrate diets (Sañudo et al., 2007). Light carcasses from young animals are preferred, fetching high prices, due to the pale pink color, reduced amount of fat and subtle flavor of their meat (Beriain et al., 2000; Castro, Manso, Mantecón, Guirao, & Jimeno, 2005). This is why the characteristics of lamb carcasses produced in European countries of the Mediterranean region are very specific and different from most other regions. Lambs are slaughtered very young, just after weaning (between 30 and 60 days) or after a short period of fattening.

Local breeds, such as Grazalema Merino (GM) and Churra Lebrijana (CL), located in Southern Spain, have traditionally produced lambs at two different slaughter weights, sucking and light lambs, following a production system based on ewes’ milk. This non-weaning system is used to take advantage of ewes’ milk and to avoid the stress due to weaning (Vernon, 1980). The first breed, GM, is a dairy sheep breed, with an estimated mature weight of 75–85 and 40–50 kg for males and females, respectively. Milk production by GM ewes is around 500 ml/day, with 9% fat (Molina et al., 2002). CL breed is a meat breed with estimated mature weight of 65–80 and 35–48 kg for males and females, respectively. Milk production by CL ewes is around 300 ml/day (Romero, 2007).

The traditional production system under which Mediterranean lambs from local breeds are raised would meet the consumer requirements. However, there is little information about the effect of these management systems on the meat quality of light lambs produced in Mediterranean areas (Santos-Silva, Bessa, & Santos-Silva, 2002). Therefore, the aim of this work was to study the quality traits of meat and fat from sucking and light lambs from two sheep breed types (dairy and meat) in their traditional production systems, without weaning.

2. Materials and methods

2.1. Animal management

Sixty-four male lambs from single birth litters were selected for the study. Sixteen animals of each breed were raised up to 12 kg live weight (suckling lambs slaughtered after weaning) and sixteen to 20 kg live weight (light lambs slaughtered after short period of fattening) (Table 1) using the same traditional system without weaning. Suckling lambs only consumed ewe milk. Light lambs were not weaned, but had access to concentrate ad libitum from 45 days after birth. Lambs were confined at all times and allowed to suckle when ewes were not grazing. The nutritional composition of the commercial concentrate (barley, corn and soya) consumed by lambs was 18% protein, 2.5% fat, 4% cellulose and 6.5% ash. The diet of the ewes was composed of local pastures when available and the same commercial concentrate (barley, corn and soya) (15.5% protein, 2.3% fat, 6.8% cellulose and 6.7% ash) and cereal straw was provided ad libitum. Both breeds were reared in the same area (southwestern Spain), therefore the composition and availability of pastures was similar for all the sheep.

The lambs were slaughtered in an EU accredited slaughterhouse. Carcasses were chilled at 4 °C for 24 h, weighed, and pH...
(pH 24 h) was measured in longissimus dorsi muscle with a pene-
trating glass electrode on a hand-held Crison pH/mv-506 meter.
Degree of fatness (1-low; 4-high) was assessed by two trained
assessors, using the EU photographic standards for carcasses under
13 kg effective in Spain (Reglamento CEE no. 461/93). Each level of
the EU scale was divided in three sub-levels in order to discern
small differences in the degree of fatness (1 = 1−, 2 = 1 [very
scarce], 3 = 1+, 4 = 2−, 5 = 2 [scarce], 6 = 2+, 7 = 3−, 8 = 3 [medium],
9 = 3+). 10 = 4−, 11 = 4 [important] and 12 = 4+. Subcutaneous fat
thickness (SFT) was measured with a digital callipers at the point
of intersection located 4 cm from the spine and 4 cm behind the
last rib of the left side of the carcass, according to the method of
Boccard and Dumont (1955). Samples from subcutaneous (SC) fat
were collected in the slaughterhouse within the first hour post-
mortem, vacuum packed and frozen at −20 °C. For intramuscular
(IM) fatty acid composition (longissimus dorsi pars thoracis, T3–
T5), meat quality parameters (longissimus dorsi pars thoracis, T5–
T13) and sensory analysis (longissimus dorsi pars lumborum), lon-
gissimus dorsi muscle samples were collected 24 h post-slaughter
from the left side of carcasses, vacuum packed and aged at 2 °C
for 72 h.

2.2. Meat quality parameters

After ageing for 72 h, total percentages of protein, moisture and
ash were determined according to AOAC methods (AOAC, 1990).
The protein content was measured by the block digestion method
(UNE 55-020), the moisture content was determined by drying at
102 °C for 24 h (ISO R-1442) and ashing was determined by heat-
ing to 550 °C for 24 h (ISO R-936). Fat percent was measured ac-
cording to the Soxlet method (ISO R-1443) using a Foss Tectar
AB Soxtest 2050 ( Stable Microsystems, UK).

Water holding capacity (WHC) was determined by duplicate in
fresh meat (5 g) following the method of Grau and Hamm (1953)
and expressed as percentage of expelled water. Warner–Bratzler
(WB) texture meat analysis was performed as in Campo et al.
(2000). The samples (T10–T13) were cooked in a water bath at
75 °C until the internal temperature reached 70 °C, using a TA-
XT2 texture analyzer ( Stable Microsystems, UK). Samples (n = 5
per muscle) of 1 cm² on cross section were cut with muscle fibers
parallel to the longitudinal axis of the sample. Shear force was as-
essed in warm meat using a WB device, shearing until breaking
the samples.

CIE L’ab’ color coordinates were measured on the surface of
longissimus dorsi muscle after cutting a slice and blooming for 1 h
using a spectrophotometer Minolta CM-2500d. The L’, a’ and b’
values were recorded using the standard illuminant D65 and 10°
standard observer. Myoglobin (Mb) concentration in longissimus dorsi
muscle was measured as described by Hornsey (1956), and ex-
pressed as ng Mb/g of fresh meat.

2.3. Fatty acid composition

Fatty acids of IM and SC fat depots were analyzed following the
method described by Aldai, Osoro, Barron, and Nájera (2006),
which has been reported to be highly effective for PUFA analysis
(Juárez et al., 2008). Separation and quantification of the fatty acid
methyl esters was carried out using a gas chromatograph (GC, Var-
ian Star 3400CX, Varian Associates Inc., California, USA) equipped
with a flame ionization detector and fitted with a BPX-70 capillary
column (120 m, 0.25 mm i.d., 0.2 µm film thickness, SGE, Austra-
lia). Tricosanoic acid methyl ester (C23:0 ME) at 10 mg/ml was
used as an internal standard. Individual fatty acids were identified
by comparing their retention times with those of an authenticated
standard fatty acid mix Supelco 37 (Sigma Chemical Co. Ltd., Poole,
UK). Identification of the isomers of conjugated linoleic acid (CLA)
cis9–trans11, cis11–trans13 and trans10–cis12 was achieved by
comparing retention times with those of another authenticated
standard mix (Sigma Chemical Co. Ltd., Poole, UK). Fatty acids were
expressed as a percentage of total fatty acids identified and
grouped as follows: saturated (SFA), monounsaturated (MUFA)
and polyunsaturated (PUFA). PUFA/SFA ratio was calculated.

2.4. Sensory analysis

The samples designated for sensory analysis (whole longissimus
dorsi pars lumborum aged for 72 h) were wrapped in aluminum foil,
after removing external fat, and cooked at 200 °C in a double plate
grill until the internal temperature reached 70 °C. Each cooked
steak was trimmed of external fat, cut into 2 × 2 cm² samples
and served warm to a 12 member trained taste panel. The panelists
used a 10 point hedonic scale to evaluate the samples for tender-
ness (1-extremely tough, 10-extremely tender), initial and sus-
tained juiciness (1-extremely dry, 10-extremely juicy), chewiness
(1-non-chewy, 10-extremely chewy) and lamb flavor intensity
(1-no aroma, 10-very intense) (AMSA, 1995).

2.5. Statistical analysis

The statistical analysis was performed using SPSS 12.0S for
Windows (SPSS Inc., 2003). In the analysis of variance the breed
and slaughter weight effects and the interaction between breed
and slaughter weight were included. Single animals were consid-
ered as experimental units. Linear correlations were calculated between lamb flavor and
C18:0 and C18:2 fatty acid content in IM and SC fat depots.

3. Results and discussion

Breed had no effect on carcass weight and pH values (Table 1) of
GM and CL lambs (P > 0.05). As expected, carcasses of heavier

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Table 1
Carcass trait mean values of Grazalementa Merino (GM) and Churra Lebrigiana (CL) suckling and light lambs.

<table>
<thead>
<tr>
<th>Suckling</th>
<th>Light</th>
<th>Breed (B)</th>
<th>Slaughter weight (W)</th>
<th>B × W</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

Sig.: Significant differences; NS (non-significant); P > 0.05; SEM: standard error of mean; SFT: subcutaneous fat thickness. Fatness degree: 1 = 1−, 2 = 1 (very scarce), 3 = 1+, 4 = 2−, 5 = 2 (scarce), 6 = 2+, 7 = 3−, 8 = 3 (medium), 9 = 3+, 10 = 4−, 11 = 4 [important] and 12 = 4+.

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lambs had higher values for degree of fatness due to the development of tissues in young animals (Beriaun et al., 2000). SFT (P < 0.01) and degree of fatness were greater (P < 0.05) for GM vs. CL. However, an interaction was observed in fat accumulation between the breeds, and breed had no effect for light lambs. Differences between breeds in the rate of fattening has been previously reported (Galil, 1979; Sañudo et al., 1997). Therefore it seems that GM fatten at a higher rate than the CL.

Chemical characteristics of longissimus dorsi muscle are shown in Table 2. Quality traits of meat from GM and CL lambs showed similar values to those reported elsewhere by other authors for other breeds with similar slaughter weights and production systems (Priolo, Micol, Agabriel, Prache, & Dransfield, 2002; Pérez, Maino, Tomic, Mardones, & Pokniak, 2002; Santos-Silva et al., 2002; Sañudo et al., 1997). Protein, ash and moisture contents in meat were not affected by the slaughter weight (P > 0.05). However, meat from light lambs had higher (P < 0.001) IM fat percentage than that from suckling lambs (Table 2). The increase in IM fat content in heavier lambs has been reported by other authors (Beriaun et al., 2000; Díaz et al., 2005; Kempest, 1980). GM protein content was higher (P < 0.01) than that of the meat breed (CL) lambs in both slaughter weights. Meat from the dairy breed (GM) lambs had higher (P < 0.01) IM fat and ash contents (P < 0.05) and lower moisture percentage (P < 0.01) than that from CL lambs. The higher fatness degree and IM fat content in GM lambs may be due to the higher milk production of GM ewes, which is rich in fat.

As shown in Table 3, meat from light lambs’ carcasses expelled more water than suckling lambs (P < 0.001). Many authors have reported an increase in expelled water when slaughter weight is increased (Beriaun et al., 2000; Brouwer, Naude, Du Toit, Cloete, & Vosloo, 1987; Purchas, 1990). No breed effect was observed for WHC. The interaction between main effects indicated that shear force was affected by slaughter weight in meat of CL lambs only, with greater (P < 0.01) values for light vs. suckling lambs. Likewise, shear force of light lambs was similar between breeds but for suckling lambs was greater (P < 0.05) for GM than for CL.

Color characteristics of longissimus dorsi muscle of GM and CL lambs are shown in Table 4. Meat from suckling lambs was lighter (higher L*) than meat from light lambs (P < 0.001), with a greater difference for GM vs. CL lambs. Redness (a*) was greater (P < 0.01) for light compared with suckling lambs, although the difference was greater for GM than for CL lambs. Mb content was affected by slaughter weight, showing higher values for light lambs (P < 0.01). These effects have been reported previously (Beriaun et al., 2000; Díaz et al., 2003; Mittenburg, Wensing, Smulders, & Breukink, 1992) and are due to an increase in Mb content in older animals. On the other hand, CL meat was more yellow than meat from GM lambs (P < 0.001) at both weights (Table 4). Mb content was greater for GM (P < 0.001) than for CL lambs at both slaughter weights. This is due to the higher Mb content, which results in a higher a* index in dairy breeds, such as GM, than in meat breeds, such as CL (Renerre, 1986).

The fatty acid composition of IM and SC fat is shown in Tables 5 and 6, respectively. The fatty acid profiles of this study were similar to those reported by Beriaun et al. (2000), Santos-Silva et al. (2002) and Díaz et al. (2005) in lambs with high content of milk in the diet. In IM and SC fats, C12:0 and C14:0 contents were higher, and C18:3 lower than those reported by Arsenos, Kufidis, Zygoyn, Katsaounis, and Stamataris (2006) for lambs in the same slaughter weight range, due to the grass-based diet used in that study. The major fatty acids found in IM and SC fat depots were C18:1, C16:0, C18:0, C18:2 and C14:0. The cis-9–trans-11 CLA isomer, the most active isomer, ranged between 0.80% (light CL) and 1.22% (suckling GM) in IM fat, and between 1.03% (suckling CL) and 1.33% (suckling GM) in SC fat. The most abundant fatty acids in IM and SC fat from all the lamb types were SFA. In IM fat, the PUFA/SFA ratio ranged between 0.29 (suckling CL) and 0.36 (light GM). In SC fat, the PUFA/SFA ratio values ranged between 0.09 (suckling GM and CL and light GM) and 0.11 (light CL).

It is known that the fatty acid profile in lamb is affected by the slaughter weight (Beriaun et al., 2000; Okeudo & Moss, 2007). Meat (IM) fat from light lambs had lower levels of C12:0 (P < 0.01), C14:0 (P < 0.05) and SFA (P > 0.05), and higher PUFA values (P < 0.05) than meat from suckling lambs (Table 5). A breed effect on IM fatty acid composition of meat from suckling and light lambs was observed for several fatty acids. Lambs from the CL breed had lower C18:0 (P < 0.05), C18:3 (P < 0.01), cis–9–trans–11 CLA (P < 0.01), trans–10–cis–12 CLA (P < 0.05) and PUFA (P < 0.05) and higher C16:0 (P < 0.01) and C18:2 (P < 0.05) than GM lambs. Moreover, the interaction showed the slaughter weight effect for C12:0 and C18:2 was higher for IM than for CL lambs. And C18:3 values increased in fat from GM and decreased in fat from CL light lambs, compared to the values in IM fat from suckling lambs.

SC fat of suckling lambs had higher C12:0 (P < 0.05) and lower C18:0 (P < 0.05) than fat from light lambs (Table 6). Concentrations of C12:0 (P < 0.01), C14:0 (P < 0.01), C18:3 (P < 0.01), cis–9–trans–11 CLA (P < 0.05) and SFA (P < 0.01) were greater and those of C18:1 (P < 0.01), C18:2 (P < 0.01) and MUFAs (P < 0.05) lower for GM than for CL lambs. Differences in C12:0, C14:0 and C18:0 levels were greater for CL than for GM. This interaction also explained the differences observed for C18:1, C18:2 and C18:3 fatty acids. Likewise, for GM the C18:1 level was higher and those of C18:2 and C18:3 were lower for light vs. suckling lambs, with opposite differences for CL.

The differences observed between suckling and light lambs may be partially explained by the production system. Lambs stay with the ewes until they reach the slaughter weight. Light lambs are not weaned, but they have access to concentrate from 45 days after birth. Even if milk and concentrate intakes were not recorded, depending on ewe milk production (different for each breed), the lambs need different levels of concentrate supplementation to meet their energy needs. Higher milk intake will lead to higher fatness degree and higher levels of SFA present in dam’s milk, as

Table 2
Chemical characteristics (%) mean values of longissimus dorsi muscle of Grazailema Merino (GM) and Churra Lebrijana (CL) suckling and light lambs.

<table>
<thead>
<tr>
<th></th>
<th>Suckling</th>
<th>Light</th>
<th>Breed (B)</th>
<th>Slaughter weight (W)</th>
<th>B × W</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GM (n = 16)</td>
<td>CL (n = 16)</td>
<td>GM (n = 16)</td>
<td>CL (n = 16)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protein</td>
<td>20.50</td>
<td>19.78</td>
<td>20.97</td>
<td>19.66</td>
<td>**</td>
<td>NS</td>
</tr>
<tr>
<td>Fat</td>
<td>1.75</td>
<td>1.58</td>
<td>2.46</td>
<td>2.08</td>
<td>**</td>
<td>***</td>
</tr>
<tr>
<td>Ash</td>
<td>1.14</td>
<td>1.05</td>
<td>1.18</td>
<td>1.09</td>
<td>**</td>
<td>NS</td>
</tr>
<tr>
<td>Moisture</td>
<td>76.65</td>
<td>77.52</td>
<td>76.50</td>
<td>77.60</td>
<td>**</td>
<td>NS</td>
</tr>
</tbody>
</table>

Sig.: Significant differences; NS (non-significant): P > 0.05; SEM: standard error of mean.

** P < 0.05.
*** P < 0.001.
Of the other hand, light lambs showed lower levels of those SFA due to the incorporation of concentrate to the diet. The sensory characteristics of the longissimus dorsi muscle samples are presented in Table 7. For both slaughter weights, CL meat had higher scores for tenderness (P < 0.01) and juiciness (P < 0.05) and had less lamb flavor (P < 0.001) compared with GM meat. The effects on tenderness confirm the results of the texture analysis. The sensory analysis of meat from suckling lambs had higher sustained juiciness than meat from light lambs, similar to that reported by Schönfeldt et al. (1993) and Martínez-Cerezo, Sañudo, Medel, and Olleta (2005). Sañudo et al. (2000) observed that C18:0 levels in IM and SC fat were related to lamb flavor. In our study, the higher C18:0 fatty acid content in IM fat from GM lambs (Table 5) seemed to compare well with an increase in the lamb flavor value obtained in the sensory analysis, even if the differences in C18:0 levels were not high. However, the correlation between lamb flavor and C18:0 content of SC fat was positive and significant (0.521; P < 0.05), while no interaction (P > 0.05) was observed for the same traits in IM fat. On the other hand, we have observed these effects, as shown by the interaction between lamb flavor and C18:2 content in IM fat (Table 5). We have observed these effects, as shown by the interaction between lamb flavor and C18:2 content in IM fat (Table 5). We have observed these effects, as shown by the interaction between lamb flavor and C18:2 content in IM fat (Table 5). We have observed these effects, as shown by the interaction between lamb flavor and C18:2 content in IM fat (Table 5).

Table 3
Water holding capacity (WHC) and shear force (WBSF) mean values of longissimus dorsi muscle of Grazalema Merino (GM) and Churra Lebrijana (CL) suckling and light lambs.

<table>
<thead>
<tr>
<th>Breed (B)</th>
<th>Slaughter weight (W)</th>
<th>B × W</th>
</tr>
</thead>
<tbody>
<tr>
<td>GM (n = 16)</td>
<td>CL (n = 16)</td>
<td>GM (n = 16)</td>
</tr>
<tr>
<td>WHC (%)</td>
<td>17.08</td>
<td>15.75</td>
</tr>
<tr>
<td>WBSF (kg/cm²)</td>
<td>5.43</td>
<td>3.90</td>
</tr>
</tbody>
</table>

Sig.: Significant differences; NS (non-significant): P > 0.05; SEM: standard error of mean.

* P < 0.05.
** P < 0.01.
*** P < 0.001.

Table 4
Color traits mean values of longissimus dorsi muscle of Grazalema Merino (GM) and Churra Lebrijana (CL) suckling and light lambs.

<table>
<thead>
<tr>
<th>Breed (B)</th>
<th>Slaughter weight (W)</th>
<th>B × W</th>
</tr>
</thead>
<tbody>
<tr>
<td>GM (n = 16)</td>
<td>CL (n = 16)</td>
<td>GM (n = 16)</td>
</tr>
<tr>
<td>L*</td>
<td>45.10</td>
<td>42.22</td>
</tr>
<tr>
<td>a*</td>
<td>7.35</td>
<td>7.65</td>
</tr>
<tr>
<td>b*</td>
<td>9.78</td>
<td>13.20</td>
</tr>
<tr>
<td>Mb (mg/g)</td>
<td>3.09</td>
<td>1.61</td>
</tr>
</tbody>
</table>

Sig.: Significant differences; NS (non-significant): P > 0.05; SEM: standard error of mean; Mb: mg Myoglobin/g fresh meat.

* P < 0.05.
** P < 0.01.
*** P < 0.001.

Table 5
Main fatty acid composition (percentage by weight of total fatty acids) mean values of longissimus dorsi muscle intramuscular fat of Grazalema Merino (GM) and Churra Lebrijana (CL) suckling and light lambs.

<table>
<thead>
<tr>
<th>Breed (B)</th>
<th>Slaughter weight (W)</th>
<th>B × W</th>
</tr>
</thead>
<tbody>
<tr>
<td>GM (n = 16)</td>
<td>CL (n = 16)</td>
<td>GM (n = 16)</td>
</tr>
<tr>
<td>C12:0</td>
<td>0.92</td>
<td>0.93</td>
</tr>
<tr>
<td>C14:0</td>
<td>6.36</td>
<td>6.27</td>
</tr>
<tr>
<td>C16:0</td>
<td>21.65</td>
<td>22.27</td>
</tr>
<tr>
<td>C16:1</td>
<td>1.74</td>
<td>1.61</td>
</tr>
<tr>
<td>C17:0</td>
<td>0.88</td>
<td>0.82</td>
</tr>
<tr>
<td>C18:0</td>
<td>15.41</td>
<td>14.70</td>
</tr>
<tr>
<td>C18:1</td>
<td>37.10</td>
<td>36.73</td>
</tr>
<tr>
<td>C18:2</td>
<td>6.88</td>
<td>7.43</td>
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<tr>
<td>C18:3</td>
<td>0.85</td>
<td>0.79</td>
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<tr>
<td>c9–t11 CLA</td>
<td>1.22</td>
<td>0.88</td>
</tr>
<tr>
<td>c11–t13 CLA</td>
<td>0.03</td>
<td>0.04</td>
</tr>
<tr>
<td>t10–c12 CLA</td>
<td>0.06</td>
<td>0.04</td>
</tr>
<tr>
<td>C20:4 n6</td>
<td>3.69</td>
<td>3.14</td>
</tr>
<tr>
<td>SFA</td>
<td>46.49</td>
<td>46.30</td>
</tr>
<tr>
<td>MUFA</td>
<td>40.39</td>
<td>39.61</td>
</tr>
<tr>
<td>PUFA</td>
<td>14.47</td>
<td>13.35</td>
</tr>
<tr>
<td>PUFA/SFA</td>
<td>0.31</td>
<td>0.29</td>
</tr>
</tbody>
</table>

Sig.: Significant differences; NS (non-significant): P > 0.05; SEM: standard error of mean; SFA: saturated fatty acids; MUFA: monounsaturated fatty acids; PUFA: polyunsaturated fatty acids; CLA: conjugated linoleic acid.

* P < 0.05.
** P < 0.01.
*** P < 0.001.
Table 6
Main fatty acid composition (percentage by weight of total fatty acids) mean values of subcutaneous fat of Grazalema Merino (GM) and Churra Lebrijana (CL) suckling and light lambs.

<table>
<thead>
<tr>
<th></th>
<th>Suckling</th>
<th>Light</th>
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</tr>
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<td>1.54</td>
<td>1.06</td>
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<td>*</td>
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<td>0.98</td>
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<td>40.10</td>
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Sig.: Significant differences; NS (non-significant); P > 0.05; SEM: standard error of mean; SFA: saturated fatty acids; MUFA: monounsaturated fatty acids; PUFA: polyunsaturated fatty acids; CLA: conjugated linoleic acid.

* P < 0.05.
** P < 0.01.
*** P < 0.001.

Table 7
Sensory attributes mean values of longissimus dorsi muscle of Grazalema Merino (GM) and Churra Lebrijana (CL) suckling and light lambs.

<table>
<thead>
<tr>
<th></th>
<th>Suckling</th>
<th>Light</th>
<th></th>
<th></th>
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<td>GM (n = 16)</td>
<td>CL (n = 16)</td>
<td>GM (n = 16)</td>
<td>CL (n = 16)</td>
<td>Sig.</td>
<td>Sig.</td>
<td>Sig.</td>
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<td>Tenderness</td>
<td>6.03</td>
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<td>6.18</td>
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<td>Initial juiciness</td>
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<td>Sustained juiciness</td>
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<td>5.10</td>
<td>4.37</td>
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<td>Chewiness</td>
<td>5.05</td>
<td>5.25</td>
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<td>3.87</td>
<td>5.22</td>
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<td>**</td>
<td>0.165</td>
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</table>

Sig.: Significant differences; NS (non-significant); P > 0.05; SEM: standard error of mean; tenderness: 1-extremely tough, 10-extremely tender; initial and sustained juiciness: 1–10; chewiness: 1–10; lamb flavor: 1–10; very intense.

* P < 0.05.
** P < 0.01.
*** P < 0.001.

from concentrate than GM lambs, which obtained more energy from milk, and this modified their fatty acid profiles and flavor. This fact is confirmed by the higher levels of cis9–trans11 and trans10–cis12 CLA isomers in fat from GM lambs (Tables 5 and 6), since milk is rich in these CLA isomers (Kelsey, Corl, Collier, & Bauman, 2003). CLA fatty acids are reported to have beneficial effects on human health (Pariza, Park, & Cook, 2001). In fact, CLA levels of GM fat were similar to those reported in fat from lambs with a grass-based diet (Aurousseau et al., 2007). However, CLA levels were not affected by slaughter weight, perhaps due to the lack in ruminal activity in young animals without grass in their diets (Anderson et al., 1987).

4. Conclusions

Light lambs from non-weaning production system had a higher degree of fatness, darker and less tender meat and higher lamb flavor. Moreover, the differences between breeds such as the higher fat and SFA (C12:0 and C14:0) and CLA contents of the dairy breed lambs, and the interactions observed for several traits, may be related to differences milk intake of those lambs and/or to genetic differences in the way they synthesize and deposit fat and fatty acids. We can conclude that the differences between management systems were observed in various meat quality traits; most notably in water holding capacity, sensory traits and the amount and composition of fat.

Acknowledgements

This project was funded by the RZ03-019 INIA Spanish project and the Marie Curie Fellowship Scheme under the EU Fifth Framework. Manuel Juárez has a doctorate grant from the “Consejería de Innovación, Ciencia y Empresa” of Andalusia.

References


