Influence of sex and castration of females on growth performance and carcass
and meat quality of heavy pigs destined for the dry-cured industry

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ABSTRACT: Crossbred pigs (n = 240) from Pietrain × Large White sires mated to Landrace × Large White dams, with an average age of 100 d (60.5 ± 2.3 kg of BW), were used to investigate the effects of sex and slaughter weight (SW) on growth performance and on carcass and meat quality characteristics. There were 6 treatments arranged factorially, with 3 classes (intact females, IF; castrated females, CF; and castrated males, CM) and 2 slaughter weights (114 and 122 kg of BW). Each of the 6 combinations of treatments was replicated 4 times, and the experimental unit was a pen with 10 pigs. Castrated males and CF ate more feed, grew faster, and had more carcass backfat depth and fat thickness at the gluteus medius muscle but lower loin yield than IF (P < 0.05). In addition, CF and CM had more intramuscular fat (P < 0.05) and less linoleic acid content in the subcutaneous fat (P < 0.01) than IF. Pigs slaughtered at 122 kg of BW had lower ADG (P < 0.05), decreased G:F (P < 0.05), and more gluteus medius fat than pigs slaughtered at 114 kg of BW (P < 0.05). It was concluded that CF and CM had similar productive performance and meat quality characteristics when slaughtered at the same age, and that castration of females improved ADG and increased weight and fat content of primal cuts with respect to IF. Therefore, castration of females is recommended in pigs destined for the dry-cured industry because of the beneficial effects on quality of the primal cuts.

Key words: carcass trait, gilt castration, growth performance, slaughter weight, pork quality

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INTRODUCTION

Spain is the primary producer of dry-cured hams and shoulders in the world, with a total production of 251,345 t in 2005 (Resano et al., 2006). Fat content, fatty acid profile of the fat, and size and pH of the primal cuts affect water migration, and consequently the rate and extension of the ripening process and the acceptability of the cured products (Ruiz-Carrascal et al., 2000; Bañón et al., 2003b). The dry-cured industry requires primal cuts within a narrow range of weight and subcutaneous fat contents and with a high level of intramuscular fat to improve uniformity and quality of the end products.

An increase in slaughter weight (SW) from the current 100 kg of BW to 120 kg of BW or more has been recommended to fulfill the requirements of the dry-cured industry (Latorre et al., 2004). However, an increase in BW requires greater age at slaughter, and the castration of males to avoid boar taint is needed. In addition, intact females (IF) slaughtered at heavy BW might reduce feed intake and growth in the last period of fattening because of estrous. Therefore, IF require longer fattening period than castrated males (CM) when slaughtered at 120 kg of BW or more. Carcasses are also fatter for CM than for IF; consequently, water losses of primal cuts during ripening are lower for CM (Gou et al., 1995). Castration of females reduces the negative effect of estrous on growth (Zeng et al., 2002) and increases the fatness of primal cuts, improving the quality of dry-cured products. However, the use of castrated females (CF) is not a common practice because of animal welfare concerns, the risk of surgery infection, and the increase in cost. To our knowledge, the influence of gilt castration on the performance and carcass quality of modern strains of white pigs remains unstudied. The aim of this research was to investigate the effect of castration of gilts on growth performance, carcass traits, and meat quality of pigs destined for the dry-cured industry when slaughtered at 2 different ages.

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MATERIALS AND METHODS

Animal Welfare

All the experimental procedures used in this study were approved by the Ethics Committee of the University of Madrid and were in compliance with the Spanish guidelines for the care and use of animals in research (Boletín Oficial del Estado, 2005).

Husbandry and Growth Performance

Crossbred CM (n = 80), IF (n = 80), and CF (n = 80) of 100 ± 3 d of age (60.5 ± 2.3 kg of BW) were used. All pigs were the progeny of Pietrain × Large White sires (GenExcel, Erin, France) and Landrace × Large White dams (Copese S. A., Segovia, Spain). Males were castrated at 5 ± 3 d of age, and females were ovariectomized at 60 ± 3 d of age. Upon arrival at the experimental farm, pigs were randomly allotted to 24 groups of similar initial BW within sex and SW. There were 6 treatments arranged factorially, with 3 classes (CF, IF, and CM) and 2 SW (114 and 122 kg of BW). Each of the 6 combinations of treatments was replicated 4 times and the experimental unit was a pen with 10 pigs.

Pigs were housed in flat-deck pens (3.25 × 2.47 m) in an environmentally controlled barn and had free access to pelleted barley-wheat-soybean meal diets and water throughout the trial. Diets were formulated to meet or exceed the requirements of pigs for each age (NRC, 1998). The composition and the estimated (Fundación Española para el Desarrollo de la Nutrición Animal, 2003) or determined nutrient value of the diets (AOAC International, 2000) are shown in Table 1. Live BW per pig and feed consumption per pen were recorded at 0, 31, 73, and 87 d of the trial, and these data were used to calculate ADG, ADFI, and G:F per replicate. Once the preplanned SW treatment average was achieved, all the pigs belonging to each SW group (114 or 122 kg) were slaughtered on the same day.

Handling, Slaughtering, and Carcass Traits

At preplanned SW (average of 114 kg of BW and 173 d of age or 122 kg of BW and 187 d of age, according to experimental treatment) pigs were individually weighed and transported 85 km to a commercial slaughter plant (Alfrese S.A., Segovia, Spain), where they were rested for 12 h with full access to water, but not to feed. The pigs were then electrically stunned (225 to 380 V/100 A for 5 to 6 s), exsanguinated, scalded, skinned, and eviscerated according to standard commercial procedures, and the carcasses were split down the center of the vertebral column. Hot carcass weights were recorded and used to calculate dressing percentage. The carcasses were then blast chilled at 2°C (1 m·s⁻¹) for 2 h. At 45 min postmortem, carcass length from the caudal edge of the symphysis pubis to the cranial edge of the first rib, ham length from the cranial edge of the symphysis pubis to the hock joint, ham circumference at its widest, fat thickness over the thinnest point at the gluteus medius muscle (GM), and backfat depth (BF) between the 3rd and 4th from the last ribs on the midline of the carcass (skin included) were measured on the left side of each carcass by using a flexible ruler with a precision of 0.5 mm. At 45 min and 24 h postmortem, the pH of the left ham was measured in the semimembranous muscle by using a Crison 507 portable pH meter equipped with a glass electrode (model no. 52-00, Crison Instruments S.A., Barcelona, Spain).

Carcasses were fabricated according to the simplified EC-reference method (Brunscheid et al., 1990) and the weight of hams, shoulders, and loins was measured at 2 h postmortem. Hams and shoulders were then suspended in the air for 24 h at 4°C. Five carcasses from each replicate were chosen at random before the arrival of the pigs at the slaughter plant, and a 300 ± 15-g section of LM was excised at the level of the last rib from the left side of the carcass, weighed, vacuum-packaged, and frozen at −20°C for 50 d until subsequent analyses. In addition, subcutaneous fat samples, comprising all fat layers, were obtained from these carcasses at 10 cm from the coccyx and were used to determine the fatty acid (FA) profile with a gas chromatograph (Perkin-Elmer Autosyst-XL, Boston, MA) equipped with a flame-ionization detector. The method-
Diameter and 15-mm depth. At 24 h postmortem, hams and shoulders were weighed again. The difference between weights measured at 2 and 24 h postmortem was divided by the 2-h weight to estimate cold shrinkage. At 48 h postmortem, hams and shoulders were trimmed of external fat and weighed to calculate trimmed ham and shoulder yields.

**Meat Quality Traits**

To measure meat quality traits, LM samples were obtained from 5 carcasses of each replicate, thawed in vacuum-package bags for 24 h at 4°C, removed from packages, blotted dry, and weighed. Thawing losses were calculated by dividing the difference in weight between the fresh and thawed samples by the initial fresh weight. Additionally, objective measures of pork color were determined on thawed chops after a 20-min bloom period. Samples were analyzed with a calibrated CM 2002 colorimeter (Minolta Camera, Osaka, Japan) by using illuminant D65, 10° Standard Observer, and the Commission International de l’Eclairage (1976) color scale. The colorimeter was previously calibrated with a pure white color according to the manufacturer’s recommendations, and the average of 3 random readings was used to measure lightness (L*), redness (a*), and yellowness (b*). Additionally, the chroma \( c^* = (a^{*2} + b^{*2})^{1/2} \) values were calculated.

Myoglobin content was measured in 2 minced slices of meat from each chop with a Beckman DU-640 spectrophotometer (Beckman Instruments, Fullerton, CA) by the method of Hornsey (1956), as modified by Boccard et al. (1981). Briefly, a 5-g sample of minced LM was placed into an extraction vessel with 20 mL of acetone and 1 mL of water and stirred for 30 s with a glass rod. Afterward, 0.5 mL of 12-M HCl was added, and the suspension was kept in a sealed vessel overnight in the dark. The sample was then filtered and absorbance of the filtrate was measured at 510 nm. Each slice was evaluated twice and the values obtained were averaged. The concentration of myoglobin (mg·g⁻¹ of fresh muscle weight) was obtained by multiplying the absorbance reading by the factor 8.816 obtained by calibration (Boccard et al., 1981).

The muscular fat (MF), CP, and moisture content of the loins were determined by using a near-infrared transmittance meat analyzer (Infratec 1265, Tecator, Höganäs, Sweden). The samples were not trimmed free of intermuscular fat and connective tissue. Therefore, the measurement of MF included both the intermuscular and intramuscular fat. The monochromator contained a 50-W tungsten lamp and a diffraction grating that created monochromatic light. The measured spectra were separated in the range from 800 to 1,100 nm. The chops were minced and distributed in the cup ring equipped with a plastic bottom plate, with a 100-mm diameter and 15-mm depth.

Drip loss was determined by using 15-mm-thick LM slices from each thawed chop. After weighing, the slices were placed over a metallic net in a hermetic plastic cage at 4°C for 24 h without application of any external force. Afterwards, the samples were reweighed, and the difference between the weights of the slice before and after conservation in the cooler were divided by the initial weight to determine drip loss.

Cooking loss was determined by the method described by Honikel (1998). Briefly, a LM slice was taken from each chop, weighed (80 ± 5 g), placed in a plastic bag, and cooked to an internal temperature of 70°C in a 75°C water bath (Precisterm, J.P. Selecta S.A., Barcelona, Spain). Internal temperature was monitored during cooking with a handheld temperature probe (Hanna Instruments, Woonsocket, RI). Cooked samples were allowed to cool at 15°C for 30 min, blotted dry, and weighed. The difference between pre- and post-cooking weights was divided by the precooked weight to calculate cooking loss percentage. Samples were then cut parallel to the long axis of the muscle fibers into rectangular cross-section slices, 10 × 10 × 30 mm in length (Guerrero et al., 1999). Slices (8/chop) were sheared perpendicular to the fiber orientation with the V-shaped blade of a Warner-Bratzler shear force device attached to a texture meter (TA-XT2, Stable Micro Systems, Surrey, UK) equipped with a 5-kg load cell and with a crosshead speed of 6 mm·s⁻¹.

**Statistical Analyses**

Data were analyzed as a completely randomized design with treatments arranged factorially, using the GLM procedure (SAS Inst. Inc., Cary, NC). The model included sex, SW, and their interaction as main effects. The experimental unit for growth performance and carcass data was a pen with 10 pigs, whereas for pork quality measures and FA profile the experimental unit was based on the average of 5 chops or 5 fat samples obtained from 5 pigs sampled at random within each pen. Initial BW of the pigs was used as a covariate for growth performance data analysis. Means were computed and separated by a t-test. An α level of <0.05 was classified as a significant difference, and an α level from 0.05 to 0.10 was classified as a tendency. No sex × SW interactions were detected for any growth, carcass, or meat trait measured; therefore, only main effects are reported.

**RESULTS**

**Growth Performance**

Castrated females and CM had similar ADFI, ADG, and G:F ratio throughout the experiment (Table 2). From the beginning of the trial to 73 d (60 to 114 kg of BW), CF and CM grew faster and ate more feed than IF (\( P < 0.05 \)), but no significant differences among classes were found for the G:F ratio. From 73 to 87 d...
classes were found for pH45, pH 24, or shrink loss of IF, CF, and CM. In addition, no differences among length and circumference of the ham were similar for hams or shoulders. Carcass yield, carcass length, and differences among classes were found for weight or yield than for CF and CM (7.2 vs. 6.9%; P < 0.05) than carcasses from IF. Loin yield was greater for IF, and had a decreased G:F ratio (0.294 vs. 0.309; P < 0.05) compared with pigs slaughtered at 122 kg of BW (703 vs. 737 g; P < 0.01) and fatter (24.5 vs. 21.6 cm for BF, P < 0.05) and grew faster (743 vs. 675 g·d−1; P < 0.05) than IF, but no differences were found for G:F (P > 0.05). On the other hand, pigs slaughtered at 122 kg of BW grew slower (703 vs. 737 g·d−1; P < 0.05) and had a decreased G:F ratio (0.294 vs. 0.309; P < 0.05) compared with pigs slaughtered at 114 kg of BW.

**Carcass Traits**

Carcasses from CF and CM were heavier (94.4 vs. 91.6 kg; P < 0.05) and fatter (24.5 vs. 21.6 cm for BF, and 21.4 vs. 17.7 cm for GM fat, respectively; P < 0.05) than carcasses from IF. Loin yield was greater for IF than for CF and CM (7.2 vs. 6.9%; P < 0.01) but no differences among classes were found for weight or yield of hams or shoulders. Carcass yield, carcass length, and length and circumference of the ham were similar for IF, CF, and CM. In addition, no differences among classes were found for pH45, pH 24, or shrink loss of primal cuts (Table 3). On the other hand, an increase in SW from 114 to 122 kg increased carcass weight (P < 0.001), GM fat (P < 0.05), and carcass length (P < 0.001), and tended to improve carcass yield (P < 0.10). However, percentage of primal cuts in the carcass and BF thickness were not affected by SW (Table 3). There was a tendency for a greater pH45 in pigs slaughtered at 122 kg of BW (P = 0.08). In addition, cold shrinkage of hams and shoulders was greater for 114-kg pigs than for 122-kg pigs (P < 0.001).

**Meat Quality Traits**

Muscular fat content was greater for CF and CM than for IF (4.6 vs. 3.9%; P < 0.05). In addition, meat from IF tended to have a greater moisture content than meat from CF (74.7 vs. 74.2%; P < 0.10), with meat from CM having an intermediate value (Table 4). Slaughter weight did not influence chemical composition of the meat. In general, sex did not affect color or myoglobin content of the meat; the only differences observed were for yellowness (b*), which was greater for CF than for CM (P < 0.05), and for lightness (L), which tended to be greater for CF than for CM (P = 0.08). In addition, b* values were greater for the heavier pigs (9.8 vs. 9.4; P < 0.05). Sex did not influence shear force or water-holding capacity of the loin, but an increase in SW increased shear force (5.25 vs. 5.69 kg; P < 0.01) and tended to reduce drip loss (1.93 vs. 1.02%; P = 0.06). In general, the FA profile of subcutaneous fat was not modified by sex or by SW. The only difference observed was for linoleic acid content, which was greater for IF than for CF and CM (14.0 vs. 13.3%; P < 0.01).

**DISCUSSION**

**Growth Performance**

The differences in productive performance between CM and IF are well known (Augspurger et al., 2002;
Table 3. The effect of sex, castration, and slaughter weight on carcass traits of pigs

<table>
<thead>
<tr>
<th>Item</th>
<th>Sex and castration1</th>
<th>Slaughter weight, kg of BW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
<td>IF</td>
<td>CF</td>
</tr>
<tr>
<td>Carcass weight, kg</td>
<td>91.6b</td>
<td>94.0a</td>
</tr>
<tr>
<td>Carcass yield, %</td>
<td>79.1</td>
<td>79.7</td>
</tr>
<tr>
<td>Backfat, mm</td>
<td>21.6b</td>
<td>24.6a</td>
</tr>
<tr>
<td>Gluteus medius fat, mm</td>
<td>17.7b</td>
<td>21.8a</td>
</tr>
<tr>
<td>Weight, kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loin</td>
<td>6.6</td>
<td>6.5</td>
</tr>
<tr>
<td>Ham</td>
<td>24.4</td>
<td>25.1</td>
</tr>
<tr>
<td>Shoulder</td>
<td>13.9</td>
<td>14.2</td>
</tr>
<tr>
<td>Primal cuts (loin + ham + shoulder)</td>
<td>44.6</td>
<td>45.5</td>
</tr>
<tr>
<td>Yield, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loin</td>
<td>7.2b</td>
<td>6.9a</td>
</tr>
<tr>
<td>Ham</td>
<td>26.6</td>
<td>26.5</td>
</tr>
<tr>
<td>Shoulder</td>
<td>15.2</td>
<td>15.1</td>
</tr>
<tr>
<td>Primal cuts (loin + ham + shoulder)</td>
<td>49.0</td>
<td>48.4</td>
</tr>
<tr>
<td>Carcass length, cm</td>
<td>85.6</td>
<td>85.4</td>
</tr>
<tr>
<td>Ham length, cm</td>
<td>34.1</td>
<td>34.3</td>
</tr>
<tr>
<td>Ham circumference, cm</td>
<td>74.5b</td>
<td>75.7ab</td>
</tr>
<tr>
<td>Semimembranosus pH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45 min</td>
<td>5.91</td>
<td>5.87</td>
</tr>
<tr>
<td>24 h</td>
<td>6.07</td>
<td>6.08</td>
</tr>
<tr>
<td>Shrink loss, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ham</td>
<td>1.12</td>
<td>1.12</td>
</tr>
<tr>
<td>Shoulder</td>
<td>1.07</td>
<td>1.03</td>
</tr>
</tbody>
</table>

Within a row, means without a common superscript letter differ (P < 0.05).
1IF = intact females; CF = castrated females; CM = castrated males.

Latorre et al., 2004), but no data were found comparing CF with IF and CM. Our data indicate that growth performance was similar for CM and CF, and that both ate more feed and grew faster but had the same G:F as IF. Production of heavy pigs is mostly based on rearing CM and IF on the same farm, and often all the pigs are slaughtered on the same day. In consequence, the uniformity of carcasses and primal cuts is low. Our data indicate that the management of pigs, the logistics at slaughter, and carcass uniformity improve when both males and females are castrated. Furthermore, CF grew faster than IF; consequently, the length of the fattening period and the cost of production will be reduced when females are castrated. The lower ADG of IF with respect to CF might be due, at least in part, to differences in estrous behavior between them (Zeng et al., 2002). In the present trial, BF and GM fat of females increased with castration, which agrees with Bañón et al. (2003b), who compared IF and CM. However, no differences between CF and IF were observed for G:F. To our knowledge no data have been published comparing the productive performance of IF and CF.

Pigs slaughtered at 122 kg of BW had lower ADG and poorer G:F than pigs slaughtered at 114 kg of BW, which agrees with Cisneros et al. (1996) and might be explained by differences in the onset of sexual maturity of the heavy pigs and in fat deposition of the genetic lines used. Therefore, feed cost would be greater when pigs are slaughtered at a heavier BW. However, pigs slaughtered at 122 kg of BW had fatter carcasses than pigs slaughtered at 114 kg of BW, which might be beneficial for pigs destined for the dry-cured industry, because curing for optimal quality requires a relative high amount of fat (Guerrero et al., 1996).

Carcass Traits

All carcass traits studied were similar for CF and CM. Carcasses were heavier for CF than for IF; therefore, meat output and efficiency of the processing plant will increase when gilts are castrated. To our knowledge, no published work is available comparing carcass traits between IF and CF. Castration of females did not affect carcass yield, although CF had 0.6 percentage units more dressing than IF. Carcasses from CF and CM had more BF and GM fat than carcasses from IF. Our results comparing carcass traits of CM and IF agree with Nold et al. (1997) and with Candek-Potokar et al. (2002). Castration of females increases BF and GM fat, which facilitates the drying and ripening process of the meat (Candek-Potokar et al., 2002), improving the aroma and flavor of dry-cured products (Ruiz-Carrascal et al., 2000; Bañón et al., 2003a). Carcass and ham lengths were not affected by sex, which agrees with Cisneros et al. (1996). However, Leach et al. (1996) and Latorre et al. (2003a) found that carcasses of IF were longer than carcasses of CM. In the present experiment, the heavier SW of CF and CM with respect to IF might have compensated for the effect of sex on carcass and ham length. In addition, ham circumference was...
greater for CM than for IF, with CF showing an intermediate value. No data are available on measurements of carcasses and hams of CF. Loin yield of IF was greater than loin yield of CF and CM, but primal cut yield was not affected by sex. Unruh et al. (1996) and Lebret et al. (2001) found that at similar SW, IF had a greater proportion of lean cuts than CM, but no data were available for CF.

An increase in SW increased carcass yield, which agrees with Virgili et al. (2003) and Latorre et al. (2004). Pigs slaughtered at 122 kg of BW had greater GM fat than pigs slaughtered at 114 kg of BW. Therefore, the quality of dry-cured products is expected to improve with increases in SW. The pH45 and pH24 were not affected by SW, which agrees with Latorre et al. (2003a). However Cisneros et al. (1996) and Beattie et al. (1999) found that pH decreased with increases in SW. The reason for the discrepancy is not known but might be due to differences in the final BW of the pigs used. Virgili et al. (2003) observed that during chilling, postmortem metabolism was more rapid and pH decline was greater in carcasses from heavier pigs than in carcasses from lighter pigs. In the current experiment, the difference in SW between the heavier and the lighter groups of pigs was only 8 kg; therefore, no great differences in pH between the 2 groups were expected. In addition, pH24 was greater than pH45, in accordance with Serrano et al. (2008) working with IB × Duroc pigs. Feed deprivation before slaughter might reduce glycogen content of the muscle at slaughter, increasing the ultimate pH because the recovery of energy reserves from fat depots produce the synthesis of acetone and ammonia. The cold shrinkage of hams and shoulders decreased with SW, as found previously by Candek-Potokar et al. (2002). These results agree with our data on pH45 showing that the cold shrinkage was lower in samples with greater pH. The SW did not affect the percentage of lean cuts, which agrees with Albar et al. (1990) but not with Latorre et al. (2003a). Virgili et al. (2003) suggested that proportion of primal cut decreases with increasing BW because growth rate of primal cuts is lower with age than growth rate of the whole body. In addition, the small differences in SW between the 2 experimental groups might have precluded the detection of any difference.

**Meat Quality Traits**

The lack of uniformity in meat quality traits of primal cuts produced under the same conditions is one of the main problems in the dry-cured product industry. The amount of subcutaneous fat and MF and its consistency affect water migration and the rate of moisture loss during ripening, as well as many quality traits of the final product (Ruiz-Carrascal et al., 2000; Gandemer, 2002). Furthermore, pH, water-holding capacity, and

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**Table 4. The effect of sex, castration, and slaughter weight on meat quality traits of the loin and the fatty acid (FA) profile of subcutaneous fat of pigs**

<table>
<thead>
<tr>
<th>Item</th>
<th>Sex and castration1</th>
<th>Slaughter weight, kg of BW</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>IF  CF  CM  SEM</td>
<td>114  122  SEM</td>
</tr>
<tr>
<td>Chemical composition, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moisture</td>
<td>74.7b  74.2a  74.4ab</td>
<td>0.15  0.06  0.12</td>
</tr>
<tr>
<td>Fat2</td>
<td>3.9b  4.6a  4.6a</td>
<td>0.20  0.05  0.16</td>
</tr>
<tr>
<td>Protein</td>
<td>21.4  21.2  21.0</td>
<td>0.11  0.11  0.09</td>
</tr>
<tr>
<td>Color parameters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lightness (L*)</td>
<td>47.9a  48.0a  46.3b</td>
<td>0.55  0.08  0.44</td>
</tr>
<tr>
<td>Redness (a*)</td>
<td>5.0  5.2  5.5</td>
<td>0.18  0.25  0.15</td>
</tr>
<tr>
<td>Yellowness (b*)</td>
<td>9.6b  9.9a  9.3b</td>
<td>0.17  0.05  0.14</td>
</tr>
<tr>
<td>Chroma3 (c*)</td>
<td>10.9  11.2  10.9</td>
<td>0.18  0.30  0.15</td>
</tr>
<tr>
<td>Myoglobin, mg/kg</td>
<td>0.58  0.65  0.63</td>
<td>0.053  0.63  0.04</td>
</tr>
<tr>
<td>Shear force, kg</td>
<td>5.55  5.60  5.27</td>
<td>0.140  0.23  0.01</td>
</tr>
<tr>
<td>Water-holding capacity, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thawing loss</td>
<td>10.2  10.3  9.1</td>
<td>0.48  0.19  0.40</td>
</tr>
<tr>
<td>Drip loss</td>
<td>1.07  1.10  1.15</td>
<td>0.073  0.71  0.06</td>
</tr>
<tr>
<td>Cooking loss</td>
<td>19.5  18.9  19.0</td>
<td>0.83  0.89  0.67</td>
</tr>
<tr>
<td>FA profile of fat, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palmitic acid (C16:0)</td>
<td>23.0  23.2  23.0</td>
<td>0.10  0.42  0.09</td>
</tr>
<tr>
<td>Stearic acid (C18:0)</td>
<td>11.9  11.8  12.1</td>
<td>0.14  0.32  0.11</td>
</tr>
<tr>
<td>Oleic acid (C18:1)</td>
<td>44.5  44.2  44.3</td>
<td>0.27  0.75  0.22</td>
</tr>
<tr>
<td>Linoleic acid (C18:2)</td>
<td>14.0b  13.4a  13.3a</td>
<td>0.15  0.01  0.12</td>
</tr>
</tbody>
</table>
color of the raw meat affect texture and color of the cured product (Guerrero et al., 1999; Tabilo et al., 1999). Therefore, the conditions of ripening should be adapted to the characteristics of the raw material to improve the uniformity of sensory qualities of the dry-cured products. No differences in MF content were found between CF and CM, but MF was greater for CF and CM than for IF. Our data agree with those of Unruh et al. (1996), Nold et al. (1999), and Latorre et al. (2003b), who compared CM and IF, but no data were available for CF. A high amount of intramuscular fat is desirable to improve the sensory properties of pork meat (Nold et al., 1997; Gandemer, 2002). Therefore, castration of females might contribute to improving the quality of dry-cured products (Serrano et al., 2008). In the current trial, the MF content in LM ranged from 3.9 to 4.6%, values that were greater than those reported for intramuscular fat (1.0 to 4.1%) by Nold et al. (1999) or Beattie et al. (1999). In our experiment, the chop samples were not trimmed free of intramuscular fat and connective tissue before analyses because both types of fat are important for the quality of dry-cured products (Timón et al., 2001). Therefore, greater levels of MF should be expected in our experiment. Meat from CF tended to be lighter and was more yellow than meat from CM, with meat from IF in an intermediate position. Nold et al. (1999) and Lindahl et al. (2001) reported that muscles from IF were darker than muscles from CM, but no data on meat color were available for CF. Tenderness of the loin was not affected by sex, which disagrees with the report by Candek-Potokar et al. (2002), who observed that hams from IF had firmer texture than hams for CM. In addition, no differences among sexes were detected in the present trial for thawing, dripping, or cooking losses, confirming previous data (Cisneros et al., 1996). The drip loss varied from 1.07 to 1.93%, values that are lower than those (5.25 to 6.89%) found by Bee et al. (2006). The reason for this discrepancy can be explained, at least in part, by the use of frozen samples after thawing in the current trial, whereas Bee et al. (2006) used fresh meat samples.

The BW at slaughter did not affect chemical composition of the loin, myoglobin content, L, a*, or c* value, or water-holding capacity of the meat, which might be due to the small difference in SW of our 2 experimental groups (114 vs. 122 kg of BW). However, the shear force of loins was lower for pigs slaughtered at 114 kg than for pigs slaughtered at 122 kg of BW, in agreement with Leach et al. (1996).

The linoleic acid content of subcutaneous fat was similar for CF and CM and lower for CF and CM than for IF, which might be explained because total fat content was lower in CF and CM than in IF. Consequently, the linoleic acid content increased when calculated as a percentage. Warnants et al. (1999) and Högborg et al. (2001) observed that fat from IF was more unsaturated than fat from CM, but no data were available for CF. An increase in the linoleic acid content reduces the consistency of subcutaneous fat and increases fat oxidation rate (Bonneau, 1998; Wood et al., 2003), which might affect the color, aroma, and flavor of end products negatively. Therefore, castration of females might improve the quality of primal cuts destined for the dry-curing industry.

The growth performance and fat content of primal cuts were greater for castrates than for IF, but no differences were found between CM and CF. Therefore, when both sexes were slaughtered at the same age, castration of females increased the uniformity of carcasses and primal cuts of pigs. In addition, an increase in SW from the current 114 kg of BW to 122 kg of BW increased fat content of carcasses and therefore improved the quality of primal cuts destined for the dry-cured industry.

LITERATURE CITED


