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The effects of male and female immunocastration on growth performances and carcass and meat quality of pigs intended for dry-cured ham production: A preliminary study

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ABSTRACT

A total of 48 Duroc × (Landrace × Large White) pigs, 24 males and 24 females, with 85 ± 3 d of age were used to study the effect of sex and immunocastration on growth performances and carcass and pork quality. There were 4 experimental treatments; surgical castrated males (SCM), immunocastrated males (ICM), entire females (EF) and immunocastrated females (ICF). The surgical castration had been carried out in 12 males when were 5 ± 3 d of age. The immunocastration consisted in two vaccinations with Improvac®, in 12 boars and in 12 gilts, at the beginning of the trial and 28 d later (45.4 and 70.6 kg body weight as average, respectively). Pigs were intended for dry-cured ham elaboration; therefore, heavy body weight (126 kg and 167 d of age as average) and a minimum of carcass fat depth (20 mm) were required. During the overall period (from days 0–82), SCM were less efficient converting feed into gain than the rest of the treatments ($P=0.049$). At slaughter, ICM were heavier than SCM and ICF with EF being intermediate ($P=0.05$) and ICF were fatter, as much at 10th rib ($P=0.05$) as at level of *Gluteus medius* muscle ($P=0.043$), than EF with males (SCM and ICM) in an intermediate position. As a consequence, EF had the leanest carcasses ($P=0.048$) and 25% of them were rejected for lack of fatness vs 0% in the other treatments ($P=0.02$). Pork from ICF was redder (higher a*) than that from ICM ($P<0.001$) and meat from SCM showed a more intense color (higher C*) ($P=0.03$) and tended to have lower level of oxymyoglobin ($P=0.061$) and metmyoglobin ($P=0.082$) than that from EF. The intramuscular fat content was not affected. The inmunocastration of males or females had limited influence on major fatty acids of subcutaneous or intramuscular fat. It can be concluded that immunocastration could be interesting in pigs intended for dry-cured ham elaboration because in males improved the feed conversion ratio with no penalization of carcass or meat quality, in comparison to surgical castration, and in gilts increased backfat thickness of carcass reducing to 0% the rejections at slaughterhouse for lack of fatness.

1. Introduction

In Spain, the dry-cured ham industry requires a minimum of carcass weight (86 kg) and of fat thickness over the *Gluteus medius* muscle (m. GM; 20 mm) and a maximum of C18:2n-6 proportion in subcutaneous fat (12% and 15% in fresh and cured pieces, respectively) to guarantee the adequate processing and end quality (Daza et al., 2012). Taking into account these considerations, some studies have concluded that barrows would be preferred to gilts for that aim (Peinado et al., 2008, 2011). In fact, Latorre et al. (2008, 2009) detected that around 30% of carcasses were rejected at slaughterhouse, mainly due to the lack of fatness, being all gilts. Moreover, it has been demonstrated that pork from barrows has higher intramuscular fat content than that from gilts (Rodríguez-Sánchez et al., 2011, 2014) which is desirable because of its beneficial effects on eating quality (Fernández et al., 1999).

For all of that, strategies to increase backfat thickness and intramuscular fat proportion in gilts are being studied such as the surgical castration. This method of castration has been practiced in males for centuries to prevent the boar taint and aggressive behavior with higher body fatness as a collateral effect (Barton Gade, 1987; Meier-Dinkel et al., 2015). In females, a similar impact in fatness has been observed (Peinado et al., 2011, 2012). However, currently in Spain, surgical castration is only permitted in males, with a plan to voluntarily end it in the EU in 2018 by animal

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welfare reasons (PIGCAS, 2009), and exceptionally in females, when are reared outdoor to avoid pregnancies by wild boars, using prolonged analgesia and anesthesia (Boletín Oficial Estado, 2009).

In this context, the immunocastration is being evaluated as possible substitute to physical castration. Its effects in males have been widely studied (Pauly et al., 2009; Fábrega et al., 2010; Gispert et al., 2010; Morales et al., 2011; Font i Furnols et al., 2012, 2016), with some controversial results, but the information about its use in females is really limited and focused in autochthonous breeds. So Gómez-Fernández et al. (2013) concluded that the immunocastration could be an interesting economical alternative, in Iberian gilts, to the surgical castration because improved growth performances and had a clear positive influence on pig welfare. Daza et al. (2014) carried out a small trial using commercial gilts with no conclusive results. Although it reported that immunocastration increased fatness, the slaughter was carried out with different BW (130 and 124 kg for immunocastrated and intact females, respectively) which could have affected those variables. The objective of the present experiment was to evaluate the effects of immunocastration of males and females in productive performances and carcass and meat quality when are intended for elaboration of dry-cured ham.

2. Material and methods

2.1. Animal husbandry and feeding

All the experimental procedures used in the trial were in compliance with the Spanish guidelines for the care and use of animals in research (Boletín Oficial Estado, 2007). A total of 48 Duroc × (Landrace × Large White) pigs, 24 males and 24 females, with 85 ± 3 d of age (46.3 and 42.9 kg of body weight (BW), respectively) were used. All of them came from the same farm where they had previously had the same feeding and management. On arrival at the experimental facilities (El Chantre, Teruel, Spain), pigs were individually weighed, housed in a controlled environment barn and randomly allotted to 16 pens (2.30 m × 2.6 m and 30% slotted floor) of three animals each, according to the sex and BW. The study was conducted as a completely randomized design that included four experimental treatments according to the pig sex or method of castration: surgical castrated males (SCM), immunocastrated males (ICM), entire females (EF) and immunocastrated females (ICF). The surgical castration had been previously done in the origin farm in 12 males with 5 ± 3 d of age. The immunocastration consisted in two vaccines against GnRH with Improvac® (Zoetis, Madrid, Spain) and was carried out in 12 males and 12 gilts following the recommendations of the company; at days 0 and 28 of the trial (with 45.4 and 70.6 kg BW as average, respectively).

The feeding program was common for all pigs consisting in a commercial diet that included (per kg of feed): 537 g barley, 200 g wheat, 130 g rapeseed meal, 40 g sunflower meal, 40 g wheat flour, 12.5 g blended fat, 10.0 g molasses sugarcane, 13.3% calcium carbonate, 2.7 g dicalcium phosphate, 4.5 g sodium chloride, 0.6 g L-lysine 50%, 0.6 g DL-methionine 99%, 6.6 g L-threonine and 2.0 g vitamin and mineral premix. The estimated energy content (FEDNA, 2010) and the analysed nutritional composition of diet is shown in Table 1. Pigs had *ad libitum* access to pelleted diet, in a single space feeder, and water throughout the trial and were slaughtered on the same day with 167 ± 3 d of age (126 kg BW as average).

2.2. Growth performances

Individual BW was recorded at day 0 (beginning of the trial and 1st Improvac vaccine), day 28 (2nd Improvac vaccine), day 63 and day 82 (end of the trial) to calculate average daily gain (ADG). The average daily feed intake (ADFI) was calculated per pen, for the periods 0–28, 28–63, 63–82 and 0–82 d of the trial, taking into account the feed given and the orts. After, the data of ADG and ADFI per pen were used to calculate the feed conversion ratio (FCR) for the same periods.

Table 1
Nutrient composition of the diet used in the trial for pigs from 85 to 167 d of age.

	g/kg, as-fed basis
Calculated analysis[a]	
Digestible energy (MJ/kg)	13.74
Determined analysis	
Dry matter	883.3
Crude protein (N × 6.25)	139.1
Crude fiber	51.3
Crude fat	32.1
Fatty acids	
C14:0	0.29
C16:0	4.14
C18:0	1.31
C18:1n-9	4.98
C18:2n-6	16.34
C18:3n-3	2.99

[a] According to FEDNA (2010).

In addition, data of fat thickness (in mm) were taken at days 28, 63 and 82 of the trial using ultrasound RTU equipment (Kretz Technick Inc, 600V-V2.232, Sonovet, Austria). After a previous calibration according to manufacturer recommendations, measures were recorded by the same operator, on the right side of all animals, at last rib level, over the skin without clipping the hair.

2.3. Slaughter, carcass measures and sampling

The day before slaughter, feed was withdrawn 8 h and pigs were transported to a commercial abattoir (35 min transport time) using a single-decked trailer, equipped with upper hydraulic floor, with capacity for 120 pigs distributed into 8 separate compartments. The truck was driven with the 80 experimental pigs being distributed into 4 compartments only (loading density of 0.56 m^2/pig). Pigs belonging to the same treatment were allotted to the same box. At the slaughterhouse, animals were kept in lairage for 10 h, with full access to water but not to feed, and after they were electrically stunned (225–380 V/0.5 A for 5–6 s), exsanguinated, scalded, skinned, eviscerated, and split down the midline according to standard commercial procedures. The following measures were individually taken from all carcasses (12 per treatment). Hot carcass weight was recorded to calculate dressing percentage. At 45 min *postmortem*, carcass length (from the posterior edge of the *Symphysis pubis* to the anterior edge of the first rib), ham length (from the anterior edge of the *Symphysis pubis* to the hock joint) and ham perimeter (at its widest side) were measured on the left carcass side by a tape of centimeter precision. Carcass compactness was then calculated as carcass weight/carcass length. In addition, on the same carcass side, backfat thickness was measured at the level of the 10th rib and over the m. GM (skin included) using a rule of millimeter precision. The proportion of rejected carcasses was calculated using the fat thickness at m. GM (< 20 mm) as the criterion. The percentage of lean in carcass was estimated according to ZP method (Diario Oficial Unión Europea, 2012) by the following equation: lean proportion (%) = 58.89–0.821F-ZP + 0.157 M-ZP where F-ZP was the fat depth at m. GM and M-ZP was the shortest connection between the front (cranial) end of the m. GM and the upper (dorsal) edge of the vertebral canal measured also by rule.