Meat Science 99 (2015) 99–103

Contents lists available at ScienceDirect

Meat Science

journal homepage: www.elsevier.com/locate/meatsci

Immune-spaying as an alternative to surgical spaying in Iberian × Duroc females: Effect on carcass traits and meat quality characteristics

Rafael Gamero-Negrón [a], José Sánchez del Pulgar [b,*], Jesús Ventanas [a], Carmen García [a,*]

[a] Food Technology, Facultad de Veterinaria, UEx, Campus Universitario s/n, 10003 Cáceres, Spain
[b] Food Quality and Nutrition Department, IASMA Research and Innovation Centre, Fondazione Edmund Mach, Via E. Mach, 38010 San Michele all'Adige (Tn), Italy

ARTICLE INFO

Article history:
Received 16 January 2014
Received in revised form 31 July 2014
Accepted 13 August 2014
Available online 23 August 2014

Chemical compounds studied in this article:
Oleic acid (PubChem CID: 445639)
Palmitic acid (PubChem CID: 985)
Estearic acid (PubChem CID: 5281)
Linoleic acid (PubChem CID: 5280450)
Palmitoleic acid (PubChem CID: 445638)
Linolenic acid (PubChem CID: 5280934)
Myristic acid (PubChem CID: 11005)
Arachidonic acid (PubChem CID: 444899)

Keywords:
Immunocastration
Castration
Iberian pigs
Meat quality
Fatty acid profile

ABSTRACT

The aim of this study was to assess the effect of immune-spaying on production traits and meat quality characteristics of fresh loin (*longissimus dorsi*) by comparing 3 groups of Iberian × Duroc females ($N = 12$ per batch): surgically spayed, immune-spayed and entire females. Carcass traits and physicochemical parameters, including fatty acid profile, were investigated. The only carcass trait significantly affected by castration was the ham fat thickness, where both immune-spayed and surgically spayed females showed higher values against entire females (57 ± 9.5 mm, 62 ± 2.5 mm and 51 ± 10.1 mm, respectively; $p < 0.05$). Furthermore, there were no significant differences in the quality parameters of fresh meat. These results are important regarding animal welfare, since in Europe, there is a plan to voluntarily end the surgical castration of pigs by 2018. Therefore, with an adequate vaccination protocol, immune-spaying might represent a good alternative to surgical spaying. The reliability of immune-spaying over long periods should be evaluated.

1. Introduction

Surgical castration without anesthesia is the most common practice to control boar taint (Fredriksen et al., 2009) as well as aggressive and sexual behavior, both in males and females, throughout the rearing period and in the pre-slaughter period. In Europe, female castration is only allowed in Spain for pigs farmed outdoors, with prolonged analgesia and anesthesia (Real Decreto 1221/2009, 2009). This fact depends on the peculiarities of the production system of Iberian pigs: a sacrifice to heavy weights (>150 kg) and raised under free-range conditions, which can cause unwanted pregnancies (Gómez-Fernández, Horcajada, Tomás, Gómez-Izquierdo, & Mercado, 2013). Moreover, in Europe, there is a plan to voluntarily end surgical castration of pigs by 2018 (FVE; Federation of Veterinarians of Europe, 2009; PIGCAS, 2009).

Recently, a vaccine against the gonadotrophin releasing factor (Improvac®, Pfizer Animal Health) has been approved for use in more than 60 countries including Australia, New Zealand, Brazil, Mexico, Switzerland and the EU, and offers a more welfare-friendly alternative to surgical castration (Thun, Gajewski, & Janett, 2006). Additionally, research has shown that immune-castrated pigs show less aggressive and sexual behavior (Cronin et al., 2003; Fabréga et al., 2010), and are found to have fewer skin lesions compared to entire males (Rydhmer, Lundstrom, & Andersson, 2010), therefore offering a welfare advantage. Improvac® has no intrinsic hormonal or chemical activity (Dunshea et al., 2001). Successful immunization with Improvac® requires two doses of the vaccine to be given at least 4 weeks apart, and the second dose must be administered 4–6 weeks before slaughter (Dunshea et al., 2001). Until now, studies on immune-spaying of pigs have focused on the response in a short period after vaccination, from the second injection to slaughter (4–6 weeks). However, it is not always practical to vaccinate heavy pigs, especially if they are group-penned (Einarsson, 2006). Therefore, longer time between the second injection and slaughter is desirable. To make this time increase possible, the long-term effects of vaccination with Improvac® should be studied in females, as they have been studied in males (Einarsson, Andersson, Wallgren, Lundström, & Rodriguez-Martinez, 2009; Zamaratskaia et al., 2008). In

* Corresponding authors.
E-mail addresses: jsapuri@hotmail.com (J. Sánchez del Pulgar), cgarciag@unex.es (C. García).

http://dx.doi.org/10.1016/j.meatsci.2014.08.005
0309-1740/

these studies, the success of vaccination has been reported up to 22 weeks after the booster injection. Despite this fact, several authors (Claus, Rottner, & Rueckert, 2008) have reported a variable resumption of testicular function between 10 and 24 weeks. Nevertheless, in another study performed on Iberian females, gilts were slaughtered at 68 weeks of age and 32 weeks after the last vaccination, where it was observed that immune-spayed females showed smaller weights of both ovaries and uteri than entire ones (Hernández-García et al., 2013).

Surgical spaying of pigs has a negative impact on animal welfare and production characteristics such as average daily gain, feed intake and feed conversion ratio compared with immune-spayed females (McCauley et al., 2003; Oliver, McCauley, Harrell, Suster, & Dunshea, 2003). Both studies showed an improvement in growth of gilts with Improvac®. In addition, a significant increase in production efficiency was observed in immune-spayed females (from the second vaccine dose) with respect to surgically spayed and entire females (Gómez-Fernández et al., 2013). Besides, immune-spayed females reach the suitable sacrifice weight (>150 kg) two weeks earlier than the other batches (Gómez-Fernández et al., 2013). Carcasses from castrated pigs are also fatter than those from entire animals (Gispert et al., 2010; Pauly, Spring, O'Doherty, Ampuero Kragten, & Bee, 2009) and for this reason they could be more suitable for manufacturing dry-cured meat products, which is important for the meat industry from a technological point of view.

On the other hand, castration could affect meat quality characteristics. The majority of meat from Iberian pigs is consumed as high-priced cured products. However, the importance of the consumption of fresh and the so-called “natural,” “bio” or “organic” meats have recently increased (Cava, Estévez, Ruiz, & Morcuende, 2003). Several studies have demonstrated that the quality of fresh meat, such as fresh loin, and meat products is mainly determined by the lipid fraction (Cava et al., 1997; Daza, Rey, Ruiz, & López-Bote, 2005; Rey, Daza, López-Carrasco, & López-Bote, 2006), pH value (Rosenvold & Andersen, 2003), color and physical–chemical composition of muscle and adipose tissues (Carrapiso & García, 2005; González & Tejeda, 2007) and antioxidant composition (González & Tejeda, 2007; Rey et al., 2006). Despite the fact that consumption of fresh Iberian pig meat (such as fresh loin) has increased in recent years, the production of Iberian pigs is mainly focused on obtaining raw meat to manufacture dry-cured meat products (Ramírez, Morcuende, & Cava, 2007). Moreover, an increase in slaughter weight increases intramuscular fat content and improves meat quality (Candek-Potokar, Zlender, & Bonneau, 1998), which benefits the production of high-quality dry-cured products.

Several studies show hardly any differences in the quality characteristics of the fresh meat from surgically castrated and immune-castrated male pigs (Aluwé et al., 2013; Font i Furnols & Gispert, 2009; Gispert et al., 2010). Nevertheless, to the best of our knowledge, there is no scientific literature about the effect of immune-spaying on quality parameters of fresh meat from Iberian females. Therefore, the aim of this study was to assess the effect of immune-spaying on production traits and meat quality of fresh loin (*longissimus dorsi*) from Iberian × Duroc females slaughtered at the same age.

2. Materials and methods

2.1. Animals

A total of 192 Iberian × Duroc pigs (Gómez-Fernández et al., 2013), 110 days old and weighing 45 kg on average, were used to test the effect of immunological spaying with Improvac® in the center ITACYL (Hontalbilla, Spain). Animals were identified and classified into three groups with the same average weight: immune-spayed females, surgically spayed females and entire females. A randomized block experimental design was used, with 48 experimental units composed of 4 animals each, 12 replicates per block and 16 replicates per treatment. The feed was the same for all females from the beginning to the end of the fattening period (Gómez-Fernández et al., 2013). Vaccination was performed twice according to the manufacturer's instructions, 4 weeks apart. Doses were injected at 60 kg (18 weeks of age) and 82.4 kg (22 weeks of age), while surgical spaying was performed close to weaning. The experimental animals were slaughtered at 8.2 months of age, 14.5 weeks after the second Improvac® doses (Gómez-Fernández et al., 2013), considering success has been reported in males being slaughtered up to 22 weeks after the booster injection (Einarsson et al., 2009; Zamaratskaia et al., 2008).

2.2. Carcass traits

The weights of hams, shoulders and loins were taken 5 hours postmortem under routine slaughterhouse procedures. The backfat thickness (BFT) and ham fat thickness (HFT) were measured in the 3rd to 4th ribs and in the subcutaneous fat beside the *gluteus medius* muscle in the carcass and ham, respectively. The yields of hams, shoulders and loins were calculated with respect to carcass weight.

2.3. Sampling and processing

The 192 (64 SF, 64 IF, 64 EF) animals were slaughtered at the abattoir of MAZAFRA (Zafra, Spain), by CO_2 stunning and exsanguination, with a live weight of 160–170 kg at 8.2 months of age. The sampling was performed with fresh loin (*longissimus dorsi*) taken randomly from each batch (64 SF, 64 IF, 64 EF) in Argal S.A. industry (Fregenal de la Sierra, Spain). Specifically, the test sample consisted of 36 randomly selected fresh loins from 36 different animals;12 samples from each of the three batches ($n = 12$). Fresh loins were properly identified to monitor traceability. Analytical samples were selected from the central region of each loin.

2.4. Chemicals

The reagents used in the chemical composition and lipid oxidation analyses were supplied by Merck (Madrid, Spain), Panreac (Barcelona, Spain) and Sigma-Aldrich (Madrid, Spain). The standards of the fatty acid methyl esters calibration solution (listed in Tables 3 and 4) were supplied by Sigma-Aldrich (Madrid, Spain).

2.5. pH

The value of pH at 24 h postmortem was measured in the muscle *longissimus dorsi* with a portable puncture pH meter (Crison mod. 507; Crison Instruments, Barcelona, Spain).

2.6. Chemical composition

Moisture and protein were determined following the official methods (AOAC, 2000). Intramuscular fat (IMF) content was analyzed following the procedure described by Folch, Lees, and Stanley (1957). The concentration of haem pigments was assayed according to Hornsey (1956). Two replicates from each sample were analyzed and the mean value was used in the data analyses.

2.7. Water-holding capacity

Water-holding capacity (WHC) was assayed as a percentage of free water following the method proposed by Irie and Swatland (1992).

2.8. Instrumental color measurement

Color measurements were made following the recommendations on color determination of the American Meat Science Association (Hunt et al., 1991). Color parameters (CIE $L^*a^*b^*$) were determined using a Minolta CR-300 colorimeter (Minolta Camera, Osaka, Japan) with