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Effect of IGF-II (insulin-like growth factor-II) genotype on the quality of dry-cured hams and shoulders

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ABSTRACT

The aim of this study was to investigate the effect of the paternal allele (homozygous AA and heterozygous AG) of the IGF-II gene on the fat content, fatty acid composition and sensory characteristics of dry-cured hams and shoulders. The effects were more evident in the subcutaneous fat thickness than in the intramuscular fat (IMF) content, and in the dry-cured hams rather than the dry-cured shoulders. Subcutaneous fat thickness was significantly higher in AG dry-cured hams and shoulders; however, IMF content was only significantly higher in AG dry-cured hams. These effects produce changes in fatty acid composition and sensory characteristics when comparing both batches of each product, but the behavior differed with the type of product. Sensory characteristics were similar in both batches of dry-cured hams in spite of the differences in IMF content. Nevertheless, AG dry-cured shoulders showed higher scores in most of the attributes evaluated, despite the IMF content being similar between batches.

1. Introduction

Quality of dry-cured meat products is influenced by the content and composition of the fat. In the last decades, pig selection has been directed toward lean animals, for both economic and nutritional reasons. However, dry-cured ham and shoulder production requires raw materials with higher fat content (Ruiz, Ventanas, Cava, Andrés, & Garcia, 2000). There are three main strategies to achieve this goal; feeding strategies, slaughter at advanced weight and/or age, and the use of breeds with a higher fatness degree. Usually, pig breeders make use of combinations of these three possibilities.

Genetic selection has been traditionally performed based on phenotypic traits. However, recently, understanding of the genes directly involved in fat deposition and metabolism has increased. This knowledge allows refining of phenotypic selection with a marker assisted one. IGF-II is the gene for which the largest influence on fat infiltration has been described. A mutation in the IGF-II gene was described as being responsible of 15–30% phenotypic variation in muscle mass and 10–20% of the variation in backfat thickness (Jeon et al., 1999; Nezer et al., 1999).

IGF-II is especially interesting for pig breeders for its imprinted nature (Van Laere et al., 2003) which results in the expression in the offspring of only male transmitted alleles. This allows IGF-II selection only in the sire line and makes its use much simpler. The mutation described by Van Laere et al. (2003), has been shown to be present in Duroc males bred for cured meat production (Carrodeguas et al., 2005). Its effects on meat and carcass fattening, and also on ham conformation and fat content has been demonstrated in a Duroc × Landrace/Large White cross (Burgos et al., 2012), but not known is its effects on dry-cured products. The aim of this work was the study of the effect of IGF-II on the quality of dry-cured hams and shoulders derived from this same cross to provide additional information to help pig breeders improve the quality of the raw material used for cured meat production.

2. Material and methods

2.1. Animals and sample collection

25 AA and 25 AG animals selected from animals genotyped by Burgos et al. (2012) were used. Animals were raised under conditions established by the PDO (Protected Designation of Origin) "Jamón de Teruel" (Latorre, Mocé, & Fernández, 2005). They were slaughtered between 115 and 130 kg and one ham and shoulder from each animal were processed under the same conditions following PDO "Jamón de Teruel" specifications (BOA, 2011).

2.2. Sample treatment

Conformational measurements were carried out in each product: weight, length, perimeter and width. Next, with an electric saw, two transverse cuts to each piece were made, so the portion used included

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a large number of muscles (Figs. 2 and 3). To always take the same portion of sample the tip of the dry-cured ham and shoulder was taken as the reference, making the first cut 9 cm from the tip and the second at 15 cm, in the dry-cured hams, and at 12 cm in the dry-cured shoulders (Fig. 1). These cuts allowed visualization and measurement of the subcutaneous fat and lean thickness in each anatomical location (proximal and distal) (Figs. 2 and 3).

For the sensory analysis random slices from the main muscles of each product were used (*Semitendinosus*, *Semimembranosus* and *Biceps femoris* from dry-cured ham and *Brachiocephalicus* from dry-cured shoulder). The rest of sample was minced and homogenized, without subcutaneous and intermuscular fat, to carry out the rest of the analysis.

2.3. Fat extraction and fatty acids analysis

Intramuscular total lipids from homogenized samples were extracted and quantified according to Bligh and Dyer (1959). Fatty acid methyl esters (FAMEs) of intramuscular fat were obtained by acidic transesterification following Sandler and Karo (1992). Briefly, 15 mg of extracted lipids were placed in a glass vial together with 0.4 mg of internal standard (C13:0) and thoroughly mixed with 1 ml of sodium methylate (5 g per liter of sodium in methanol) and kept for 30 min at 80 °C in an oven. Afterwards, the sample was thoroughly mixed with 1 ml of 5% sulphuric acid in methanol and kept again 30 min at 80 °C. Finally, FAMEs were extracted with 1 ml of hexane. Hexane was evaporated to dryness under a nitrogen stream, and FAMEs were subsequently dissolved in 1 ml of hexane. Total FAMEs were analyzed using a Hewlett-Packard, HP 6890A, gas chromatograph, equipped with an on-column injector and a flame ionization detector (FID). Separation was carried out on a polyethylenglycol capillary column (Supelcowax-10, Supelco, Bellefonte, PA) (60 m length, 0.32 mm id, 0.25 μm film thickness). The gas chromatograph oven program temperature was as follows: initial temperature of 180 °C, 5 °C/min to 200 °C; 40 min at this temperature and thereafter 5 °C/min to 250 °C, and then kept for an additional 21 min. Injector and detector temperatures were 250 °C. Carrier gas was helium at a flow rate of 0.7 ml/min. Individual FAMES peaks were identified by comparison of their retention times with those of standards (Sigma, St Louis, MO). The ratio of the area of the fatty acid peak to that of the internal standard was used as the y-axis variable to prepare a calibration curve and subsequently used to determine the fatty acid concentration of the sample. Results were expressed as mg per 100 g of sample and as a percentage of each fatty acid relative to total fatty acids.

2.4. Descriptive sensory test

In order to evaluate the influence of IGF-II on the sensory characteristics, fifty dry-cured hams and thirty dry-cured shoulders were assessed by a trained panel of 12 members, using a quantitative–descriptive analysis method (QDA) (García et al., 1996; Ruiz, Ventanas, Cava, Timón, & García, 1998) for nineteen different attributes. Panelists were trained and had participated in sensory evaluation of dry-cured products for several years. Three dry-cured hams or shoulders from different batches (two AA and one AG or two AG and one AA) were evaluated in each season. The sample order was randomized within the sessions. Two thin slices (1.0–1.5 mm) of each dry-cured ham or shoulder were given to the panelist. At least one slice containing 1 cm of subcutaneous fat was given to each panelist. Slices were obtained using a commercial slicing machine and immediately served on glass plates to the panelist. Both the slices and the plates were at room temperature (20–23 °C). A glass of water of about 200 ml at 12 °C was provided to each assessor. All sessions were done in a four booth sensory panel room at 22 °C equipped with white fluorescent lighting. Nineteen traits of the sensory characteristics of dry-cured hams and shoulders, grouped in appearance of the fat (yellowness and pinkness), appearance of the lean (redness, brightness and marbling), texture of the fat (hardness and fluidness), texture of the lean (hardness, dryness, juiciness and pastiness), odor (odor intensity), taste (saltiness, sweetness, bitterness) and flavor (flavor intensity, after taste, cured flavor and rancid flavor) were assessed by the panelists using a 10 cm unstructured line, ranging from less (0 cm) to more (10 cm). The sensory traits, their definitions and extremes are explained in several works (Fulladosa, Serra, Gou, & Arnau, 2009; García et al., 1996; Ruiz et al., 1998). FIZZ Network (version 1.01: Biosystemes, France) program was used for the sessions and the recording data obtained. The mean of all panelist scores for each attribute of each dry-cured ham and shoulder was calculated to perform the statistical analysis.

2.5. Statistical analysis

Treatment of anomalous data was carried out using Grubbs test (Grubbs, 1969), recommended by ISO rules. The effect of IGF-II was

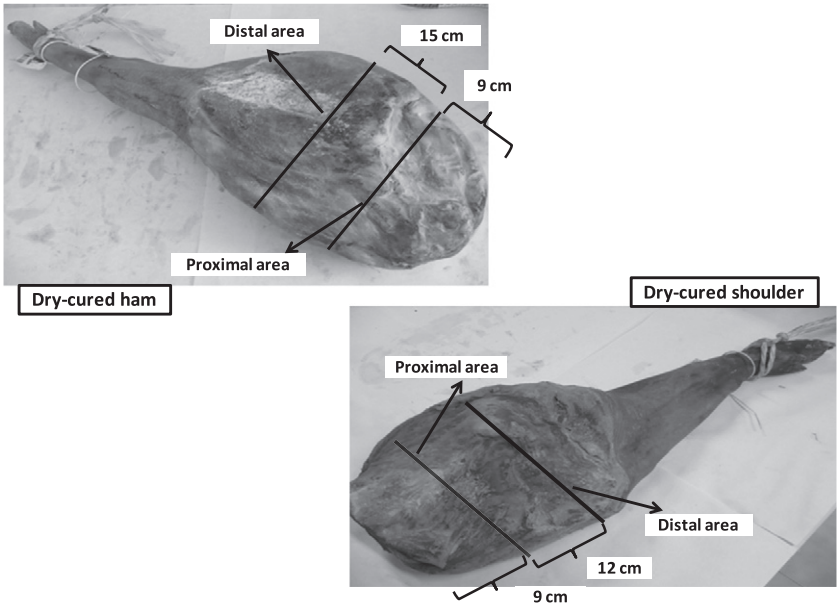

Fig. 1. Scheme of sampling in the dry-cured ham and dry-cured shoulder and area selected to study the effect of IGF-II expression.