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# Comparison of pork quality from pure and crossbred Iberian pig

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**Abstract.** The Iberian (IB) Pig Breed is the most important Mediterranean swine type, both in population size and economic importance. Most of IB pork is consumed as cured products. However, the consumption of fresh meat has recently increased. Due to the increasing demand of fresh meat, in 2007, a new National Quality Standard (NQS) was published in Spain to regulate the production and marketing of products derived from IB pig carcass, including for first time fresh meat. This Quality Standard included two genetic product types in Iberian pork production: Iberian purebreed pork and Iberian x Duroc crossbreeding pork. In fact, Iberian x Duroc (50%) is the most common Iberian crossbreeding pig found in the meat market included in NQS. We have studied the main meat quality parameters of tenderloin (*psoas major* muscle) and *serratus ventralis* muscle, which are the most expensive meat cuts for fresh consumption, from those two genetic pig groups. Meat from IB pig showed different characteristics of that from crossbred pigs. However, more differences were observed in tenderloin than in *serratus ventralis* muscle. Tenderloin from crossbred pigs had lower water holding capacity, intramuscular fat and PUFA contents, and higher SFA content than tenderloin from Iberian purebred pigs. *Serratus ventralis* muscle from crossbred pigs had lower myoglobin content than *serratus ventralis* from IB purebred pigs, but no important differences were observed in other meat quality parameters.

**Keywords.** Meat quality – National Quality Standard – Iberian Pig.

***Comparaison de la qualité de la viande entre la race Ibérique pure et croisée avec Duroc***

***Résumé.*** *Le porc Ibérique (IB) est la race porcine de type méditerranéen la plus importante, autant pour ses effectifs que pour son importance économique. La majorité des produits ibériques sont consommés sous forme de produits secs. Toutefois, la consommation de viande fraîche a augmenté récemment. En raison de la demande accrue de viande pour la consommation, en 2007 a été publiée une nouvelle norme de qualité pour réguler la production et le commerce des produits ibériques, incluant pour la première fois la viande fraîche. Dans cette norme de qualité existent deux types génétiques : produits de porcs purs Ibériques et produits de porcs croisés entre Ibérique et Duroc ; le produit croisé à 50% est le croisement le plus fréquent concernant la commercialisation, inclus dans la norme de qualité. Nous avons étudié les principales caractéristiques de qualité de la viande de l'aloyau (Psoas major) et du muscle Serratus ventralis, qui sont les viandes les plus chères, pour ces deux types génétiques. La viande de pur Ibérique a des caractéristiques différentes de celle des porcs croisés. Cependant, il y a plus de différences dans l'aloyau que dans le muscle Serratus ventralis. L'aloyau des porcs croisés a une moindre capacité de rétention d'eau CRA, une moindre infiltration de graisse intramusculaire, ainsi que des teneurs plus faibles en graisse et acides gras polyinsaturés PUFA, et supérieures en acides gras saturés SFA par rapport à la viande de pur Ibérique. Le muscle Serratus ventralis de porcs croisés contient moins de myoglobine que la viande provenant d'Ibérique pur, mais aucune différence significative n'a été trouvée pour les autres paramètres de qualité de la viande.*

***Mots-clés.*** *Qualité de la viande – Normes de qualité – Porc ibérique.*

# I – Introduction

The Iberian pig breed is the most important Mediterranean swine type, both in population size and economic importance. Traditionally, most of Iberian pork is destined to become dry-cured products. However, the consumption of several fresh meat cuts has recently increased, reaching high prices. Due to the increasing demand of fresh meat cuts, in 2007, a new National Quality Standard (NQS) for Iberian products was published in Spain to regulate the production and marketing of products derived from Iberian pig carcass, including for first time fresh meat, instead of dry-cured products only (dry-cured ham, dry-cured shoulder and dry-cured loin) (RD 1469/2007, of November 2). From the point of view of racial origin, that NQS included two genetic product types into Iberian pork production: Iberian Purebred pork and Iberian x Duroc crossbreeding pork. In fact, Iberian x Duroc (50 %) is the most common Iberian pork production found in the meat market included into the NQS. However, into NQS in adapting to Council Directive 88/661/EEC of December 19, the label "Iberian Purebred Pork" is restricted only to the Iberian products from livestock registered in the Studbook, which is a fraction of the total breed. As a result, products from Iberian pigs not registered in the Studbook are sold along with products from Iberian x Duroc crossbreeding, which are labelled as "Iberian" into NQS, without a commercial differentiation between these in the market. This creates a permanent discussion about the appropriateness of the explicit commercial differentiation of products from Iberian x Duroc crossbreeding.

We have studied the main meat quality parameters of tenderloin (*psoas major* muscle) and *serratus ventralis* muscle from those two genetic groups (Iberian Pig and Iberian x Duroc crossbreeding) labelled as "Iberian" into the NQS, due to the importance of these muscles in the Spanish fresh meat market, being actually the most expensive meat cuts of Iberian pork for fresh consumption.

The aim of this study was to compare the meat quality parameters between Iberian and Iberian x Duroc crossbreeding pork, currently undifferentiated in the Spanish market.

# II – Materials and methods

## 1. Preliminary genetic analysis

In order to verify the racial origin of the selected pigs (Iberian and Iberian x Duroc pigs), a preliminary genetic study was conducted. This study was carried out on 25 animals, 15 assigned to Iberian Pig breed and 10 assigned to the Iberian x Duroc crossbreeding. All the animals were genotyped for several SNP of the MC1R and IGF2 genes using RT-PCR. These genes, following the methodology developed by the MERAGEM research group, can be used to differentiate Iberian pig breed from other breeds such as Duroc breed and Iberian x Duroc crossbreeding. In fact, this methodology is officially used by AECERIBER to ensure racial purity of the boars and sows registered in the Studbook, through an agreement with MERAGEM research group.

## 2. Animal management

Twenty-five castrated male pigs were used for this meat quality study, 15 from Iberian breed and 10 from Iberian x Duroc crossbreeding. All pigs were reared under regular semi-extensive management. Iberian and crossbred piglets were weaned at 49-56 days and fattening started at an age of about 12-13 weeks.

## 3. Sampling, carcass and meat quality analysis

The pigs were slaughtered when they reached the commercial live weight (150-170 kg; 10-12 months of age), and they were stunned according to the specifications outlined in the Spanish legislation. All measures (pH, weight percentages of moisture, ash, fat and protein, water

holding capacity, Warner Bratzler shear force, muscle brightness and colour indices, concentration of myoglobin, and total fatty acids) were determined using standard methods.

### 4. Statistical analysis

Meat quality data were analyzed with the Statistica 7.0 for Windows statistical package (StatSoft, 2007). A general lineal model was used to determinate the significance of the effects of the different racial origins on meat quality traits. Carcass weight was fitted as a lineal covariate.

## III – Results and discussion

### 1. Genetic analysis

Regarding the genotypes obtained from the study of the DNA molecular markers for the two analyzed genes (MC1R and IGF2) in the sampled animals, we must note that all animals preliminarily assigned to the Iberian pig breed showed the expected characteristic genotypes. On the other hand, all animals preliminarily considered Iberian x Duroc crossbreeding at 50 %, showed heterozygous genotypes (with a characteristic allele from Iberian Pig Breed and the other allele from Duroc Breed, for the two analyzed genes). Therefore, these results confirm a correct sampling of the selected animals.

### 2. Meat quality analysis

No differences between genetic groups ($P$>0.05) were observed for pH 24 h in analyzed carcass. The values ranged from 6.09 to 6.14 and from 6.07 to 6.11, in tenderloins and *serratus ventralis* muscles, respectively. These values were similar to those observed for tenderloin by Morcuende *et al.* (2007) and for *semimembranosus* muscle by Serrano *et al*. (2008).

Chemical composition and texture traits of tenderloins and *serratus ventralis* muscles from Iberian and crossbred pigs (Iberian x Duroc crossbreeding) are shown in Table 1. The shown values are similar to those reported by other authors for *longissimus dorsi* muscle of Iberian pigs (Estévez *et al.,* 2003; Cava *et al.,* 2004). Significant differences between Iberian and crossbred pigs were observed for protein, intramuscular fat, moisture and ash contents, as well as for water holding capacity in tenderloins. However, differences between the two analyzed genetic groups were observed only for protein content in *serratus ventralis* muscle. No differences ($P$ > 0.05) between Iberian and crossbred pigs were found for shear force in neither of the two studied muscles.

**Table 1. Proximate composition and texture traits of tenderloins and *serratus ventralis* muscles from Iberian and crossbred Iberian pigs**

| | **Tenderloin** | | | ***Serratus ventralis*** | | |
|---|---|---|---|---|---|---|
| | **Iberian** | **Crossbreed** | **Sig.** | **Iberian** | **Crossbreed** | **Sig.** |
| Protein (%) | 21.95 ± 0.366 | 19.84 ± 0.457 | ** | 19.54 ± 0.508 | 17.98 ± 0.635 | * |
| IMF (%) | 4.41 ± 0.328 | 3.93 ± 0.446 | * | 4.19 ± 0.341 | 4.47 ± 0.401 | ns |
| Moisture (%) | 72.95 ± 0.354 | 75.19 ± 0.442 | ** | 71.40 ± 0.390 | 71.37 ± 0.488 | ns |
| Ash (%) | 1.33 ± 0.037 | 1.06 ± 0.046 | *** | 1.22 ± 0.032 | 1.18 ± 0.040 | ns |
| WHC (%) | 16.23 ± 0.728 | 12.24 ± 0.909 | ** | 11.95 ± 0.777 | 12.90 ± 0.971 | ns |
| WBSF (kg/cm$^2$) | 4.51 ± 0.183 | 5.02 ± 0.229 | ns | 5.51 ± 0.358 | 4.76 ± 0.447 | ns |

IMF: intramuscular fat; WHC: water holding capacity; WBSF: Warner-Brätzler shear force.
Sig.: significant differences (ns: $P \geq 0.05$; *: $P < 0.05$; **: $P < 0.01$; ***: $P < 0.001$).

Physicochemical colour parameters (brightness, colour indices and myoglobin content) between Iberian and crossbred pigs of tenderloin and *serratus ventralis* muscle are shown in Table 2.

**Table 2. Physicochemical colour parameters of tenderloins and *serratus ventralis* muscles from Iberian and crossbred Iberian pigs**

| | **Tenderloin** | | | ***Serratus ventralis*** | | |
|---|---|---|---|---|---|---|
| | **Iberian** | **Crossbreed** | **Sig.** | **Iberian** | **Crossbreed** | **Sig.** |
| *L** | 30.91 ± 0.618 | 38.39 ± 0.772 | *** | 33.64 ± 0.460 | 38.62 ± 0.575 | *** |
| *a** | 14.48 ± 0.481 | 10.29 ± 0.601 | *** | 14.18 ± 0.378 | 10.37 ± 0.473 | *** |
| *b** | 12.82 ± 0.296 | 6.70 ± 0.370 | *** | 12.67 ± 0.385 | 8.64 ± 0.481 | *** |
| Mb (mg/100g) | 4.92 ± 0.152 | 3.25 ± 0.190 | ******* | 5.29 ± 0.126 | 3.84 ± 0.158 | ******* |

*L**, *a** and *b**: muscle brightness and colour indices (CIE, 1976); Mb: myoglobin.
Sig.: significant differences (***:*P*<0.001).

The most significant differences between Iberian and crossbred pigs were found in these meat quality parameters. The redness value (*a**), as well as the myoglobin content, were higher (P < 0.001) in muscles from Iberian pigs, while the brightness (*L**) was lower (P < 0.001) in muscles from Iberian than in muscles from crossbred pigs. These data are in accordance with previous studies (Fernández *et al.,* 1999; Estévez, *et al.,* 2003). Iberian pigs have been reported to have higher concentration of oxidative fibres in muscles than less rustic breeds such as Duroc (Serrano *et al.,* 2008). Since muscles from Iberian pigs have more heme pigments (and therefore more iron) than muscles from crossbred pigs, muscles from Iberian pigs have higher redness value and less brightness than muscles from crossbred pigs. These result in an intense dark red colour.

Fat quality parameters, such as intramuscular fat content, marbling and lipid composition, are the main factors affecting consumer acceptability of Iberian fresh meat (Ruiz *et al.,* 2002). Moreover, the study of lipid composition of fat in fresh meat has acquired much importance in recent years mainly due to its correlation with cardiovascular diseases.

Relative percentages of individual fatty acids in intramuscular fat of tenderloins and *serratus ventralis* muscles (results not shown) revealed that the oleic acid (C18:1 n-9) was the most common fatty acid for both analyzed muscles in all sampled animals, followed by the palmitic (C16:0), stearic (C18:0) and linoleic (C18:2 n-6) acids. In general, no significant differences (P≥0.05) between Iberian and crossbred pigs were found for those majoritary fatty acids in each analyzed muscle, with the exception of palmitic acid (P <0.001) in tenderloin. However, significant differences were found between Iberian and crossbred pigs for smaller fatty acids in intramuscular fat from both analyzed muscles, which may have nutritional and organoleptic influences.

Due to the high variability in the results, no significant differences (P≥0.05) were found between Iberian and crossbred pigs for the fatty acid main indices in *serratus ventralis* muscle (Table 3). However, compared to crossbred pigs, Iberian pigs had higher PUFA (P <0.05), PUFA/SFA (P <0.05) and UFA/SFA (P <0.01) levels, and lower SFA (P <0.01) values of the intramuscular fat of the tenderloins. In fact, PUFA/SFA ratio of intramuscular fat of tenderloins from Iberian pigs was the only one above 0.4, the international health recommendation (Department of Health, 1994).

**Table 3. Composition of fatty acid indices of intramuscular fat of tenderloins and *serratus ventralis* muscles from Iberian and crossbred Iberian pigs**

| | Tenderloin | | | *Serratus ventralis* | | |
|---|---|---|---|---|---|---|
| | **Iberian** | **Crossbreed** | **Sig.** | **Iberian** | **Crossbreed** | **Sig.** |
| SFA | 38.24 ± 0.550 | 41.07 ± 0.687 | ** | 38.35 ± 0.476 | 38.83 ± 0.594 | ns |
| MUFA | 43.38 ± 0.679 | 44.55 ± 0.849 | ns | 50.14 ± 0.542 | 49.28 ± 0.677 | ns |
| PUFA | 18.38 ± 0.929 | 14.38 ± 1.161 | * | 11.50 ± 0.501 | 11.89 ± 0.625 | ns |
| PUFA/SFA | 0.48 ± 0.029 | 0.35 ± 0.036 | * | 0.30 ± 0.015 | 0.31 ± 0.018 | ns |
| UFA/SFA | 1.62 ± 0.036 | 1.44 ± 0.045 | ** | 1.61 ± 0.033 | 1.58 ± 0.041 | ns |
| n-6/n-3 | 10.15 ± 0.458 | 10.26 ± 0.573 | ns | 8.10 ± 0.447 | 8.58 ± 0.559 | ns |

SFA: saturated fatty acids; MUFA: monounsaturated fatty acids; PUFA: polyunsaturated fatty acids; UFA: unsaturated fatty acids; n-6/n-3: omega-6 and omega-3 fatty acid ratios (Juárez, 2009). Sig.: significant differences (ns: $P \geq 0.05$; *: $P < 0.05$; **: $P < 0.01$).

## IV – Conclusions

Tenderloins from Iberian pigs have different characteristics from that of crossbred pigs, commonly found in the Spanish meat market of Iberian products. These significant differences between Iberian and crossbred pigs in tenderloins would support a better labelling that explicitly differentiate the products from the two genetic groups. However, no meat quality differences between Iberian and crossbred pigs were found in *serratus ventralis* muscles, due to the heterogeneous characteristics and the different metabolism of these muscles compared with the tenderloins. Therefore, according to physicochemical meat quality parameters from Iberian and crossbred pig products, it appears that differences affect certain meat cuts and not the complete carcass. It would be interesting to carry out a study of the complete carcass on a higher number of animals to obtain reliable conclusions.

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