

Effects of the IGF-II genotype on chemical characteristics of dry-cured Iberian ham

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Abstract— Insulin-like growth factor-II (IGF-II) is an important quantitative trait nucleotide (QTN) that significantly decreases the subcutaneous fat deposition in pigs, and could have important effects in other physicochemical parameters, important in dry-cured Iberian ham. In this study the main components and the fatty acids profile of the intramuscular fat of 25 dry-cured Iberian hams from pigs with different genotypes for IGF-II were analyzed. Neither the main component (water, fat, protein and salt) contents nor fatty acid composition of the IMF were significant different between the dry-cured hams from Iberian pigs expressing the A or G allele for IGF-II.

Keywords— IGF-II, Dry-cured Iberian ham, Fatty acids.

I. INTRODUCTION

During the last years the pig's genetic studies had focused on the quantitative trait genes. Recently, a new quantitative trait nucleotide (QTN), located in the regulatory sequence of the insulin-like growth factor-II (IGF-II) gene was discovered [1]. This mutation causes an increase in the expression of IGF-II mRNA, and this has a positive effect on muscle growth and the size of the hearth, and a negative effect on subcutaneous fat deposition [2-8]. Furthermore, Nezer et al. [3] found that this QTN, as occurs in human and mouse, is imprinted and exclusively expressed from the paternal allele.

Iberian ham is an expensive Spanish dry-cured ham produced from Iberian pigs, characterized by a long ripening process (420-720 days for the whole process), allowed by its high intramuscular fat (IMF) content [9], and with an excellent consumer acceptance. The effect of IGF-II on the IMF content is not yet clear, but, as said above, it has an important effect decreasing the subcutaneous fat deposition.

So, the aim of the present study was to check the influence of different genotypes for the IGF-II on the chemical composition of the dry-cured Iberian ham.

II. MATERIAL AND METHODS

A. Samples

To carry out this study 25 dry-cured Iberian hams from the Protected Designation of Origin *Dehesa de Extremadura* were selected, 10 of them expressing the G allele for IGF-II (ancestral allele) and 15 expressing the A allele (mutant allele). From each ham, a portion of the *Biceps femoris* muscle was taken. Moisture was measured, and then the rest of the muscle piece was vacuum packaged and kept at -80°C for further analysis.

B. Physicochemical analysis

Moisture and sodium chloride contents were determined in the *Biceps femoris* according to AOAC methods [10]. Two replicates of each sample were analysed and the mean value was used in the data analyses. Salt content was determined by extracting the sodium chloride with ethanol (40%) and the two Carrez reagents. Then, the sodium chloride content of the extract was measured using the method described by Volhard [10].

Protein content was measured in the *Biceps femoris* muscle using the method described by Kjeldahl [12].

Intramuscular fat (IMF) content was measured by extracting the fat with chloroform:methanol [11]. Solvent (chloroform) was removed using a rotary vacuum evaporator and residual chloroform by evaporation under a stream of nitrogen.

The fatty acid composition of IMF was determined by gas chromatography of the fatty acid methyl esters synthesized using sodium methylate and methanolic hydrogen chloride, as described by Cava et al. [13]; 0.1µl of the fatty acid methyl ester solution was injected in an Agilent 6890N chromatograph (Agilent, Avondale, USA) equipped with an on-column injector, a flame ionisation detector (FID) and a 60m x 0.32 mm x 0.25µm capillary column Supelcowax 10 (Supelco, USA). Conditions were as follows: oven temperature 220°C isothermal for 75min, injector and detector temperature 230°C, and flow rate of the carrier gas

(nitrogen) 1.8ml/min. The identification of the fatty acids was done by matching the sample's retention times with the retention times of standard fatty acids analyzed in the same chromatographic conditions.

Table 1 Results of the physical-chemical analysis (mean \pm standard deviation) of dry-cured Iberian ham from pigs expressing G or A genotype, and statistical significance from an ANOVA.

| | G | A | <i>p</i> |
|--------------------------|------------------|------------------|----------|
| Moisture (%) | 44,85 \pm 1,78 | 44,61 \pm 2,62 | 0,810 |
| IMF (%) ^a | 9,47 \pm 3,03 | 10,80 \pm 3,88 | 0,369 |
| Protein (%) ^a | 60,25 \pm 7,39 | 60,73 \pm 4,91 | 0,848 |
| NaCl (%) ^a | 5,13 \pm 1,16 | 5,65 \pm 1,37 | 0,328 |

a: Percentage expressed in dry-matter

III. RESULTS AND DISCUSSION

Physical-chemical characteristics of dry-cured Iberian hams from pigs expressing different alleles for the IGF-II gene were analyzed. Table 1 shows the percentage of the major constituents of the ham muscle (moisture, proteins, intramuscular fat –IMF– and salt). These percentages are similar to the results from other authors [14-16]. As shown in table 1, no significant differences were found in these parameters between the hams from pigs expressing the ancestral allele (G) and from pigs expressing the mutant one (A). These results agree with previous studies, because IGF-II gene seems to have no effects in these parameters [4, 6-8].

The concentration of fatty acids from the IMF and the sum of the saturated, monounsaturated and polyunsaturated fatty acids concentration are presented in table 2. The most concentrated fatty acids were oleic acid (C18:1 n-7 and C18:1 n-9), palmitic acid (C16) and stearic acid (C18). These results are similar to those found in the literature [15, 16]. As shown in table 2, neither fatty acids concentration nor their sums were significant different between the hams from pigs expressing the G allele and from pigs expressing the A allele. To the best of our knowledge, there are not previous studies about the effect of the IGF-II gene in the fatty acid composition of the IMF. Nevertheless, in our laboratory recently differences in the fatty acid profile and IMF percentage comparing *Biceps femoris* muscles from dry-cured hams from white pigs with different IGF-II genotype have been found (Reina, personal communication).

Table 2 Concentration (mg/g) of fatty acids (mean \pm standard deviation) in the IMF from pigs expressing G or A genotype, and statistical significance from an ANOVA.

| | G | A | <i>p</i> |
|---------------|-------------------|---------------------|----------|
| C10 | 0.04 \pm 0.01 | 0.04 \pm 0.02 | 0,603 |
| C11 | 2.13 \pm 0.71 | 2.11 \pm 1.09 | 0,956 |
| C12 | 0.03 \pm 0.01 | 0.03 \pm 0.02 | 0,509 |
| C14 | 0.33 \pm 0.16 | 0.39 \pm 0.24 | 0,513 |
| C14:1 | 0.01 \pm 0.01 | 0.01 \pm 0.01 | 0,913 |
| C15 | 0.01 \pm 0.01 | 0.01 \pm 0.01 | 0,710 |
| C15:1 | 0.06 \pm 0.01 | 0.06 \pm 0.02 | 0,733 |
| C16 | 5.47 \pm 2.48 | 6.34 \pm 3.87 | 0,541 |
| C16:1 | 1.00 \pm 0.41 | 1.15 \pm 0.77 | 0,590 |
| C17 | 0.01 \pm 0.01 | 0.01 \pm 0.01 | 0,440 |
| C17:1 | 0.06 \pm 0.03 | 0.06 \pm 0.03 | 0,994 |
| C18 | 2.20 \pm 1.09 | 2.31 \pm 1.58 | 0,848 |
| C18:1 n-7 | 7.69 \pm 3.23 | 8.30 \pm 5.43 | 0,754 |
| C18:1 n-9 | 77.06 \pm 24.27 | 165.94 \pm 280.36 | 0,331 |
| C18:2 | 0.85 \pm 0.34 | 0.87 \pm 0.36 | 0,902 |
| C18:3 n-6 | 0.02 \pm 0.01 | 0.02 \pm 0.01 | 0,832 |
| C18:3 n-3 | 0.06 \pm 0.03 | 0.07 \pm 0.03 | 0,656 |
| C20 | 0.04 \pm 0.02 | 0.04 \pm 0.03 | 0,842 |
| C20:1 | 0.20 \pm 0.08 | 0.23 \pm 0.13 | 0,584 |
| C20:2 | 0.02 \pm 0.01 | 0.03 \pm 0.01 | 0,339 |
| C20:3 n-6 | 0.03 \pm 0.01 | 0.04 \pm 0.04 | 0,502 |
| C21 | 0.05 \pm 0.01 | 0.05 \pm 0.03 | 0,781 |
| C20:4 | 0.43 \pm 0.10 | 0.48 \pm 0.23 | 0,509 |
| C20:3 n-3 | 0.06 \pm 0.02 | 0.06 \pm 0.03 | 0,757 |
| C20:5 n-3 | 0.01 \pm 0.01 | 0.01 \pm 0.01 | 0,567 |
| C22 | 0.01 \pm 0.01 | 0.01 \pm 0.01 | 0,679 |
| C22:1 | 0.02 \pm 0.01 | 0.03 \pm 0.01 | 0,646 |
| C22:2 | 0.01 \pm 0.01 | 0.01 \pm 0.01 | 0,474 |
| C23 | 0.05 \pm 0.01 | 0.05 \pm 0.02 | 0,915 |
| C24 | 0.04 \pm 0.01 | 0.05 \pm 0.04 | 0,207 |
| C24:1 | 0.07 \pm 0.05 | 0.91 \pm 2.25 | 0,251 |
| C22:6 n-3 | 0.02 \pm 0.02 | 0.04 \pm 0.06 | 0,579 |
| Σ SFA | 10.41 \pm 4.25 | 11.45 \pm 6.46 | 0,660 |
| Σ MUFA | 86.15 \pm 27.86 | 176.57 \pm 27.98 | 0,322 |
| Σ PUFA | 1.53 \pm 0.46 | 1.63 \pm 0.60 | 0,667 |

SFA: Saturated fatty acids. MUFA: Monounsaturated fatty acids. PUFA: Polyunsaturated fatty acids.

IV. CONCLUSIONS

According to the results, it can be concluded that the IGF-II gene in Iberian pigs has not such an important effect to cause significant differences in the Iberian dry-cured ham physical-chemical characteristics.

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