LIPID CLASSES AND FATTY ACID PROFILES OF THE SUBCUTANEOUS AND INTRAMUSCULAR FAT DEPOTS IN HOLSTEIN FRIESIAN AND PYRENEAN CATTLE

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I. INTRODUCTION

Beef lipid composition is a matter of great concern to all segments of the value chain; it can affect both quality and product consumption [1]. Early-weaned, Holstein Friesian cull heifers and young bulls are commonly used for meat production in the Mediterranean countries. The Pyrenean cattle is marketed for beef production under the Protected Geographical Indication (PGI) “Ternera de Navarra” (Navarra Veal). The lipid composition of Pyrenean beef has not been previously reported. The aim of this work was to document the lipid classes and fatty acid (FA) composition of the subcutaneous (s.c) adipose tissue and longissimus muscle (LM) intramuscular lipids (IML) in bulls and heifers of the Pyrenean and Holstein Friesian breeds slaughtered at contemporary market ages.

II. MATERIALS AND METHODS

Thirty Pyrenean (beef-type; 15 bulls and 15 heifers) and 28 Holstein Friesian (dairy-type; 15 bulls and 13 heifers) calves were reared under standardized North Spanish production livestock systems. Details of the cow-calf operation and animal handling were previously described by Alzueta [2]. Both breed type groups were slaughtered at around 380 d of age and at 450 to 500 kg live weight following standard procedures. After chilling for 24 h at 3ºC, the *L. dorsi* was removed from the left side of each carcass, and 2-cm-thick steaks were removed for chemical analyses. After 48 h *post mortem*, the 10th rib was removed and dissected to estimate the gross carcass composition (fat/lean ratio) gravimetrically; after dissection, total fat from s.c adipose tissue and from LM tissue of the 10th rib joint was determined (ISO 1443, 1973). The 6th rib joint was removed for the extraction and analysis of lipid classes [cholesterol (C), cholesterol esters (CE), triacylglycerols (TAG) and phospholipids (PL)], and the determination of FA composition of s.c. adipose tissue and IML of LM [3]. Chemical analyses were performed in triplicate. The SPSS software v. 11.5 [4] was used for running analysis of variance (ANOVA), mean separation (Tukey’s test) and correlation tests between the fat/lean ratio and the PL and C fractions.

III. RESULTS AND DISCUSSION

At slaughter, the hot carcass weight (HCW) of heifers (Pyrenean= 247.6 kg; Holstein Friesian = 229 kg) was lower ($P \leq 0.001$) than that of bulls (Pyrenean= 340 kg; Holstein Friesian = 260.4 kg). There were no significant differences ($P \geq 0.05$) between breeds in the amount of fat in the 10th rib (241 g).When HCW was used as a covariate, the results indicated that Holstein had a greater amount of adipose tissue than Pyrenean. The fat/lean ratio was affected by the interaction Breed x Sex; the Holstein Friesian heifers showed the highest value ($P \leq 0.001$).

The s.c. adipose tissue from Pyrenean heifers had higher ($P < 0.05$) PL and C fraction values, and a lower TAG/PL ratio ($P < 0.05$) than s.c. adipose tissue from Holstein Friesian heifers, which reflected the higher

proportion of the storage component (TAG) compared to the lower membrane component (PL) of the adipocytes of the dairy breed; this could be directly related to the higher fat/lean ratio of the Holstein Friesian heifers. For IML, significant variation due to breed was only found within the heifer group: Holstein Friesian heifers had higher fat/lean ratio ($P < 0.05$), higher TAG content ($P < 0.05$), and a higher TAG/PL ratio ($P < 0.05$) than IML of Pyrenean heifers. Heifers exhibited a higher TAG/PL ratio than bulls in both lipid depots. However, the TAG fraction did not differ ($P > 0.05$) between sexes in s.c. adipose tissue. For IML, the increased TAG deposition of Pyrenean heifers as compared to Pyrenean bulls resulted in lower PL values. In IML, the TAG levels were affected by breed ($P < 0.05$) and sex ($P < 0.01$). TAG contents were higher in the Holstein Friesian group, an earlier-maturing dairy breed. The breed x sex interaction was significant for most of the individual FA in s.c. adipose tissue; the opposite was observed in IML, which can be explained by the higher fatness level of Holstein Friesian heifers as compared to Pyrenean heifers. Higher values for the saturated fat (SFA) in s.c. lipids and IML were found in the Holstein Friesian breed ($P < 0.05$), except for Holstein Friesian bulls, that had lower SFA in IML; conversely, higher polyunsaturated fatty acids (PUFA) percentages in both lipid depots were observed in the Pyrenean cattle ($P < 0.05$), even though the breeds had similar PL contents. The most notable contrasts in the composition of FA between depots correspond to the highest SFA content in the s.c. adipose tissue of Holstein Friesian heifers and the highest PUFA in the IML of Pyrenean bulls. PUFA content in the Pyrenean IML was represented mainly by 18:2n-6, 18:3n-3, 18:3n-6, 20:3n-6 and 20:4n-6. In s.c. adipose tissue, PUFA with larger differences between breed types were the 18:3n-3, 20:3n-6, and 22:6n-3, showing higher values in the Pyrenean bulls than in Holstein Friesian bulls. When the n-6/n-3 ratio is taken into account (Pyrenean bulls = 43.78 vs. Pyrenean heifers = 26.04; Holstein Friesian bulls = 41.29 vs. Holstein Friesian heifers = 28.71), the significant differences between sexes ($P < 0.01$) indicate that the higher PUFA content of IML of bulls was accompanied by a larger increase in n-6 PUFA as compared to n-3 PUFA, and a positive correlation was observed between total PUFA and n-6 PUFA ($r = 0.50$; $P < 0.01$).

CONCLUSIONS

The lipid composition of s.c. adipose tissue and LM in cattle is influenced by the breed and sex of the animal. This in turn defines the tissue development patterns and the gross composition of the carcass (fat/lean ratio), which are closely related to differences in lipid composition (TAG/PL ratio and FA composition). Late-maturing, beef-type Pyrenean cattle produced and marketed in the northern region of Spain clearly are the leaner breed in this study, particularly for bulls. Besides that, the Pyrenean breed showed the highest concentration of n-3 PUFA in both s.c and IML.

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