*Journal of Animal and Feed Sciences, 13, Suppl. 1, 2004, 681–684*

# Fatty acid profile of lamb *semitendinous* muscle and perirenal adipose tissue from two different genotypes*

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ABSTRACT

The objective of this study was to determine the fatty acid composition of *semitendinous* muscle and perirenal adipose tissue of Sarda and crossbred Mouflon × Sarda lambs. Lambs were slaughtered at 40 days of age. Fatty acid composition was similar for S×S and crossbred SxM lambs. n-6/n-3 PUFA ratio was 2.30 in pure lambs and 2.90 in crossbred. In ST muscle of SxS lamb, index of atherogenicity was 0.95 and index of thrombogenicity was 1.01; in crossbred IA was 0.87 and IT was 1.01. Both genotypes were characterized by a FA profile appropriate in relation to their contribution to health.

KEY WORDS: lamb, meat, fatty acids, composition

## INTRODUCTION

Ovine meat production in Sardinia is based, nearly exclusively, on milk-fed lambs slaughtered at few weeks of age. This is due to different reasons such as economics and genetics. Indeed the commercial value of meat does not repay the milk used to product it and Sarda lambs tend to accumulate fat depots early. Moreover, traditionally in Italy, as in many countries of the Mediterranean Basin, lambs are slaughtered very young. Considering the growing demand for alternative meats, different strategies can be tried to improve meat quality. Among the quality parameters, lipids are important for their biological and organoleptic

* Supported by the Amministrazione Provinciale di Nuoro (Italy)
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properties (Berra and Rapelli, 1987). Moreover, some lipid fractions are believed to be linked with the incidence of coronary heart disease (CHD). Ulbricht and Southgate (1991) indicate some SFA (C12:0, C14:0 and C16:0) as atherogenic and some SFA as thrombogenic (C14:0, C16:0 and C18:0). Moreover, they indicate polyunsatured fatty acids (PUFA) of the n-6 (linoleic) and n-3 (linolenic) series, and monounsatured fatty acids (MUFA) as dietary factors protective against CHD. The same authors suggest an index of atherogenicity (IA) and thrombogenicity (IT) as a measure for nutritional evaluation of fat. Other authors consider more appropriate the poliunsatured/satured FA ratio (P/S) and n-6/n-3 PUFA ratio (Department of Health, 1994; Santos-Silva et al., 2002). In order to assess the fatty acid composition of *semitendinous* (ST) muscle and perirenal (PR) adipose tissue in milk-fed lambs, a trial was carried out on two different genotypes.

## MATERIAL AND METHODS

In total twenty lambs were used in the trial, i.e. 10 Sarda (S × S) and 10 crossbred Mouflon (*Ovis g. musimon*) × Sarda (M× S). The animals suckled, without supplementation with solid feed, until slaughter at 40 days of age. The fatty acid composition of ST muscle and PR adipose tissue was determined after extraction of total lipids (Bligh and Dyer, 1959) and methylation with trimethylclorosilane (TMCS: Macherey-Nagel). Fatty acids methyl esters (FAME) were analysed on a Perkin Elmer Gas Chromatograph Mod. 8500, equipped with a flame ionization detector (FID). Separations were performed using a Varian SP 2430 capillary column (50 m × 0.25 mm i.d.) and the following conditions: carrier gas, helium at 10 ml/min flow; injector temperature, 220°C; detector temperature 270°C; the temperature program employed was: 120°C for 5 min, 5°C/min for 20 min, 229°C for 5 min, 5°C/min for 5 min, 245°C for 3 min FAME standards Supelco and Matreya for determining retention times, Human Plasma Lipid FAME mix (Matreya) for response factors. The data obtained were submitted to Student t test, after angular conversion.

## RESULTS

The results for fatty acids (FA) composition of *M. semitendinous* (ST) and perirenal adipose tissue (PR) are presented in Table 1. Satured fatty acid composition was not significantly affected by genotype. S× S subjects showed, in the intramuscular fat, higher percentages ($P<0.01$) of pentadecanoic (C15: 0) acid and a lower proportion of C18:3 n-6 (linolenic acid) ($P<0.05$), C20:2 (eicosadienoic acid) ($P<0.05$) and C22:3 (docosatrienoic acid) ($P<0.01$) than M× S lambs. C18:1 (oleic acid), C18:2 (linoleic acid) and C18:3 n-3 were not affected by genotype. As far as PR adipose tissue is concerned, Sarda lamb showed higher

(P<0.01) percentages of C16:1 (palmitoleic acid) and lower percentages of C18: 3 n-6 (P<0.01) and C20:4 (arachidonic acid) (P<0.05). A lower percentage of n-6 fatty acids (P<0.05) was found in the S×S group.

Table 1. Mean percentage values (±d.s.) of the fatty acids analysed

| | *Semitendinosus* muscle | | | | Perirenal adipose tissue | | | |
|---|---|---|---|---|---|---|---|---|
| | S×S | | M×S | | S×S | | M×S | |
| | mean % | s.d. | mean % | s.d. | mean % | s.d. | mean % | s.d. |
| C12:0 | 1.28 | 1.14 | 0.72 | 0.29 | 0.97 | 0.55 | 1.17 | 0.45 |
| C14:0 | 7.09 | 3.92 | 6.20 | 1.48 | 8.39 | 2.92 | 8.39 | 2.35 |
| C14:1 | 0.43 | 0.20 | 0.43 | 0.13 | 0.21 | 0.11 | 0.28 | 0.17 |
| C15:0 | 0.63$^{B}$ | 0.31 | 0.28$^{A}$ | 0.14 | 0.58 | 0.18 | 0.45 | 0.12 |
| C15:1 | 0.41 | 0.46 | 0.18 | 0.10 | 0.12 | 0.06 | 0.35 | 0.40 |
| C16:0 | 23.84 | 7.08 | 23.61 | 5.73 | 23.79 | 6.16 | 27.55 | 4.00 |
| C16:1 | 2.08 | 1.64 | 2.58 | 1.71 | 2.60$^{B}$ | 1.16 | 0.82$^{A}$ | 0.27 |
| C17:0 | 0.45 | 0.45 | 0.44 | 0.25 | 0.75 | 1.19 | 0.71 | 0.64 |
| C18:0 | 9.93 | 1.96 | 10.90 | 1.99 | 14.55 | 2.56 | 12.87 | 1.38 |
| C18:1 | 37.57 | 7.43 | 35.72 | 6.52 | 43.38 | 7.63 | 41.73 | 4.49 |
| C18:2 | 5.86 | 2.71 | 8.11 | 1.93 | 2.58 | 0.62 | 3.16 | 0.85 |
| C18:3 n-3 | 1.35 | 0.90 | 0.96 | 0.39 | 0.80 | 0.52 | 0.98 | 0.85 |
| C18:3 n-6 | 0.16$^{a}$ | 0.14 | 0.31$^{b}$ | 0.11 | 0.14$^{A}$ | 0.07 | 0.44$^{B}$ | 0.28 |
| C20:0 | 0.65 | 0.51 | 0.79 | 0.35 | 0.66 | 0.32 | 0.59 | 0.49 |
| C20:1 | 0.44 | 0.50 | 0.39 | 0.34 | 0.24 | 0.35 | 0.26 | 0.29 |
| C20:2 | 0.21$^{a}$ | 0.17 | 0.46$^{b}$ | 0.22 | 0.09 | 0.07 | 0.04 | 0.09 |
| C20:3 | 0.55 | 0.85 | 0.34 | 0.18 | 0.07 | 0.09 | 0.03 | 0.07 |
| C20:4 | 3.25 | 1.67 | 3.01 | 1.29 | 0.10$^{a}$ | 0.05 | 0.20$^{b}$ | 0.11 |
| C20:5 | 1.10 | 0.56 | 0.85 | 0.26 | n.d. | | n.d. | |
| C22:3 | 0.02$^{A}$ | 0.06 | 0.34$^{B}$ | 0.13 | n.d. | | n.d. | |
| C22:4 | 0.35 | 0.26 | 0.58 | 0.25 | n.d. | | n.d. | |
| C22:5 | 1.34 | 0.82 | 1.36 | 0.48 | n.d. | | n.d. | |
| C22:6 | 1.02 | 0.57 | 1.44 | 0.51 | n.d. | | n.d. | |
| SFA | 43.87 | 10.16 | 42.95 | 5.33 | 49.68 | 7.22 | 51.72 | 5.13 |
| MUFA | 40.92 | 8.03 | 39.30 | 5.71 | 46.55 | 6.99 | 43.44 | 4.36 |
| PUFA | 15.21 | 6.75 | 17.75 | 2.78 | 3.77 | 0.97 | 4.84 | 1.45 |
| n-6 | 10.37 | 4.59 | 12.81 | 2.07 | 2.97$^{a}$ | 0.74 | 3.87$^{b}$ | 0.89 |
| n-3 | 4.82 | 2.41 | 4.60 | 1.17 | 0.80 | 0.53 | 0.98 | 0.86 |

capital letters indicate significant differences for P<0.01; lower case letters for P<0.05

## DISCUSSION

The data obtained were similar to those reported in literature (Bas and Morand-Fehr, 2000; Beriain et al., 2000). For both genotypes, the value obtained for n-6/n-3 PUFA ratio (2.15 S×S, 2.78 M×S), is below the recommendations of

nutritional advisers, whose attempt is to increase the levels of n-3 PUFA in the diet, such that n-6/n-3 ratio does not exceed 4.0 (Department of Health, 1994). P/S (0.35 S× S and 0.41 M× S), is slightly below the recommended value for the diet, anyway such an index may not be an adequate way to assess the nutritional value of fat because it considers that all saturated FA induce an increase in cholesterol and ignore the effects of monounsatured FA (Santos-Silva et al., 2002). A better evaluation of the functional effects of FA on CHD may be given by the indices of atherogenicity (IA) and thrombogenicity (IT) (Ulbricht et al., 1991). In Sarda lamb ST muscle IA was 0.95, IT was 1.01; while in crossbred (M× S) IA was 0.87 and IT was 1.01. Likewise, C20:5 n-3 (EPA) and C22:6 n-3 (DHA) content in both genotypes is very higher than what has been reported for other lambs from different breeds (Sanudo et al., 2000). The importance of this datum is especially due to the evidence for biologic actions of long-chain omega-3 PUFA, such as anti-atherogenic and anti-thrombotic (Williams, 2000).

## CONCLUSIONS

Fatty acid profile of *semitendinous* muscle and perirenal adipose tissue is very similar in lambs of the two different genotypes that we considered for our investigation. ST muscle shows, compared to PR adipose tissue, a higher percentage of PUFA, as expected. Both atherogenicity and thrombogenicity indexes calculated, point out the good nutritional value of milk fed lambs' meats. In order to further increase the value of this important meat product we intend to investigate the levels of conjugated linoleic acid (CLA), which is very important for its potential health benefits, such as anti-carcinogenic properties.

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