Italian Journal of Animal Science

ISSN: (Print) 1828-051X (Online) Journal homepage: https://www.tandfonline.com/loi/tjas20

Intramuscular fatty acid composition in beef from Aosta cattle breeds

A. Brugiapaglia, G. Destefanis, E. Zanardi & M. T. Barge

To cite this article: A. Brugiapaglia, G. Destefanis, E. Zanardi & M. T. Barge (2007) Intramuscular fatty acid composition in beef from Aosta cattle breeds, Italian Journal of Animal Science, 6:sup1, 406-408, DOI: 10.4081/ijas.2007.1s.406

To link to this article: https://doi.org/10.4081/ijas.2007.1s.406

Published online: 15 Mar 2016.

Intramuscular fatty acid composition in beef from Aosta cattle breeds

A. Brugiapaglia[1], G. Destefanis[1], E. Zanardi[2], M. T. Barge[1]

[1] Dipartimento di Scienze Zootecniche. Università di Torino, Italy
[2] Dipartimento di Produzioni Animali, Biotecnologie Veterinarie, Qualità e Sicurezza degli Alimenti. Università di Parma, Italy

Corresponding author: Alberto Brugiapaglia. Dipartimento di Scienze Zootecniche. Facoltà di Agraria, Università di Torino. Via Leonardo da Vinci 44, 10095 Grugliasco, Torino, Italy - Tel. +39 011 6708573 - Fax: +39 011 6708563 - Email: alberto.brugiapaglia@unito.it

ABSTRACT: The aim of this research was to compare fat quality of three categories of the Aosta cattle breeds by fatty acid composition. Samples of *longissimus thoracis et lumborum* from 12 calves, 11 young bulls and 11 cows of Aosta Red Pied and Black Pied were bought at retail. Fatty acids content showed in most cases, except for C18:1, significant differences between the three categories. Veal calves had the lowest proportion of SFA and highest of PUFA, therefore they had the best PUFA/SFA ratio but the worst n-6/n-3 ratio due to the highest proportion of C18:2n-6. Besides veal calves was healthier by having best atherogenicity and thrombogenicity indices. Black Pied young bulls, in comparison to Red Pied young bulls, showed a significant lower proportion of C10:0, C18:1, and a significant higher proportion of C18:2n-6, C18:3n-3 and C20:4n-6. Consequently they had a significant lower MUFA content but a higher PUFA content therefore a significant better PUFA/SFA ratio.

Key words: Fatty acids composition, Beef, Commercial categories, Aosta red pied and black pied.

INTRODUCTION – The Aosta Red Pied (RP) and Black Pied (BP) are autochthonous breeds reared for milk production which is above all transformed into the typical "Fontina" cheese. Recently, the "Assessorato Agricoltura e Risorse Naturali" of the Aosta Valley Region considered exploiting the breeds also for meat production. The meat could be marketed with a quality certification mark and could assure farmers a higher income, important for survival in the mountains areas. Therefore a research project was set up to evaluate the meat quality of the Aosta cattle breeds. The aim of this research, which is part of a larger research study, was to compare fat quality of retail beef samples from three commercial categories of the Aosta cattle breeds by fatty acid (FA) composition.

MATERIAL AND METHODS – Samples of *longissimus thoracis et lumborum* (LTL) from three categories, 12 calves (VC; 6 RP+6 BP), 11 young bulls (YB; 6 RP+5 BP) and 11 cows (C; 5 RP+6 BP) of RP and BP were bought at retail. Little information was available on the background of these animals, but VC were fed on milk replacers, YB on grass, hay, straw and concentrate and C on a forages diet. The mean age of the animals was 6, 17, 47 months and the mean live weight was 210, 434, 448 kg for VC, YB and C respectively. Meat fat content was determined by Soxhlet method (AOAC, 1990). Intramuscular FA composition was carried out on total lipids extracted according to Folch *et al.* (1957) after methyl-esterification in presence of boron trifluoride as catalyst (AOAC, 1990). Recovered fatty acid methyl esters (FAME) were analysed using a HP 6890 Agilent Technologies gas chromatograph equipped with a capillary fused silica column HP INNOWax 30m, 0.25-mm i.d. with a 0.25-□m polyethylene glycol stationary phase, a split-splitless injector and a flame ionisation detector. Intramuscular fatty acids were expressed as a proportion of total FAME (w/w, %). Atherogenic (AI) and thrombogenic (TI) indices were calculated according to Ulbricht and Southgate (1991). Data were analysed using a nested design model with category as factor and breed as factor within each level of category (SPSS Inc., Chicago, IL).

RESULTS AND CONCLUSIONS – Fat content and FA composition are showed in Table 1. Fat was higher in C (2.47%) than in VC (1.55%) and YB (1.37%). Analysis of fatty acids showed in most cases, except for C18:1, significant ($P<0.05$) and highly significant ($P<0.01$) differences between the three categories. Saturated fatty acids

(SFA) for VC, YB and C were 42.72, 49.23 and 54.07% respectively. This difference is due to C16:0 whose content was the lowest in VC and the highest in C. C16:0 raises LDL serum cholesterol levels thereby increases the risk of atherosclerosis, cardiovascular disease and stroke (Grundy, 1994). C18:0 was the most abundant in YB (18.83%) followed by C (16.57%) and VC (12.44%). C18:0 effect on total cholesterol is minimal and not detrimental to human health (Judd *et al*. 2002). VC had a higher proportion of C12:0 and C14:0 than YB and C whose content was not different. C12:0 and C14:0 are responsible for raising LDL cholesterol levels in blood serum and have been shown to be strongly correlated with hearth attack. The most atherogenic is thought to be the C14:0 which has about four times the hypercholesterolemic effect of C16:0. However, the percentages of C14:0 and, in particular, C12:0 in VC are small. Monounsaturated fatty acids (MUFA) in the meat of all three categories was similar. More then 89% of

Table 1. Fat content (%) and fatty acid composition in LTL muscle (w/w, %).

	Calves	Young Bulls	Cows	Aosta Red Pied vs Aosta Black Pied		
				Calves	Young Bulls	Cows
Fat	1.55 A	1.37 A	2.47 B	NS	NS	NS
C8:0	0.01 a	0.02 b	0.02 b	NS	NS	NS
C10:0	0.05 A	0.06 A	0.09 B	NS	*	NS
C12:0	0.62 B	0.08 A	0.09 A	NS	NS	NS
C14:0	5.18 B	2.71 A	3.25 A	NS	NS	NS
C16:0	24.34 A	27.40 B	33.93 C	NS	NS	NS
C18:0	12.44 A	18.83 C	16.57 B	NS	NS	NS
C20:0	0.09 A	0.14 B	0.13 B	NS	NS	NS
SFA saturated fatty acids	42.72 A	49.23 B	54.07 C	NS	NS	NS
C14:1	0.85 B	0.46 A	0.51 A	NS	NS	NS
C16:1	3.18 b	2.62 a	3.00 ab	NS	NS	NS
C18:1	34.74	34.94	36.88	NS	*	NS
C20:1	0.29 C	0.14 B	0.10 A	NS	NS	NS
MUFA monounsaturated fatty acids	39.056	38.16	40.49	NS	**	NS
C18:2n-6	13.99 C	9.64 B	3.80 A	NS	**	NS
C18:3n-3	0.47 A	0.78 B	0.86 B	NS	**	NS
C20:2n-6	0.35 B	0.09 A	0.11 A	NS	NS	NS
C20:3n-6	0.05	-	-	NS	-	-
C20:4n-6	3.41 C	2.10 B	0.68 A	NS	**	NS
PUFA polyunsaturated fatty acids	18.23 C	12.60 B	5.44 A	NS	**	NS
PUFA/SFA	0.43 C	0.26 B	0.10 A	NS	**	NS
C18:2n-6/C18:3n-3	29.71 C	14.59 B	4.50 A	NS	NS	NS
Atherogenic Index	0.80 A	0.76 A	1.05 B	NS	NS	NS
Thrombogenic Index	1.41 A	1.80 B	2.17 C	NS	NS	NS

$^{a, b, c}$ and * = P<0.05; $^{A, B, C}$ and ** = P<0.01; NS = not significant.

the MUFA found in Aosta cattle beef was C18:1. Available evidence indicates that while most SFA raise serum cholesterol concentration the C18:1 does not (Denke, 1994). C16:1 was higher in VC and lower in YB. C16:1 is beneficial in reducing LDL cholesterol, fat deposition in blood vessels and blood clot formation (Grundy, 1994). Polyunsaturated fatty acids (PUFA) ranged from 5.44% in C to 18.23% in VC. This difference is explained by the fact that in the YB and C the PUFA are hydrogenated in the rumen. C18:2n-6 represented about 77, 76 and 70% of total PUFA in VC, YB and C respectively. VC showed the highest concentration of C18:2n-6 (13.99%) probably due to the presence of high concentration of this acid in milk diets. YB finished on concentrate had a 2.5 times higher concentration of C18:2n-6 than C fed on a forage diet. These results can be explained by the fact that C18:2n-6 is the major fatty acid in cereals and oil seeds used in concentrate diets whereas grass lipids in grass based diets are major sources of C18:3n-3. A higher proportion of C18:3n-3 was found in YB (0.78%) and C (0.86%) than in VC (0.47%). The relatively high concentration of C18:3n-3 of C might depend on their being kept on pasture prior to slaughtering and this fatty acid is abundant in fresh forage and pasture. With regard to this, meat of grazing animals contains significantly more n-3 fatty acids than does the meat of animals fed conserved forages or grain. According to Dhiman (1999) the high content of n-3 fatty acids may be beneficial to human health. C18:2n-6 and C18:3n-3 are very important plant fatty acids that can be transformed into CLA by bacteria in the rumen. CLA have a positive effect by reducing cardiovascular risk, are anti-carcinogenic, reduce body adipose tissue and enhance the immune system (Mulvihill, 2001). C20:4n-6 ranged from 0.68% in C to 3.41% in VC. C20:4n-6 promotes inflammation that is an important protective response when one is injured (Fallon and Enig, 1996). PUFA/SFA ratio in YB was higher than in C, reflecting the higher amounts of PUFA observed in the meat of the former. It could be due to differences in feed, age, and amount of fat. VC showed the best PUFA/SFA ratio due to the highest proportion of PUFA and the lowest of SFA. Appreciable amounts of C18:2n-6 and scarce of C18:3n-3 in VC increase n-6/n-3 ratio, which is less acceptable from a health point of view. It is well known that PUFA n-3 have a wide range of functional and structural roles on the organism: anti-atherogenetic, anti-inflammatory and anti-thrombosis (Cocchi, 1999). The AI was markedly lower in VC and YB and TI was lowest in VC. The higher proportion of PUFA n-6 recorded in VC and YB are associated with the lower AI. The highest proportion of C18:3n-3 in C was neither able to counterbalance the negative effect of the most important thrombogenic fatty acids, such as C14:0, C16:0 and C18:0 nor improve TI which was more favourable in VC. As regards the two breeds, no differences were found in VC and C. On the contrary in YB the BP, in comparison to RP, showed a significant lower proportion of C10:0, C18:1 ($P<0.05$) and a significant higher proportion of C18:2n-6, C18:3n-3 and C20:4n-6 ($P<0.01$). Consequently BP had a significant lower content of MUFA (35.16 *vs* 41.17%) but a higher content of PUFA (16.97 *vs* 8.24%) therefore a significant better PUFA/SFA ratio (0.36 *vs* 0.16). In conclusion commercial category of the animals and breed, within young bulls category, can cause significant differences in the fat content and in the intramuscular FA composition.

REFERENCES – **AOAC**, 1990. Official Methods of Analysis, 15th ed., Association of Official Analytical Chemists, Arlington, VA, USA. **Cocchi,** M., 1999. Animal Products and human health. Recent progress in animal production sci.,vol.1, 27-39. **Denke**, M.A. 1994. Role of beef and beef tallow, an enriched source of stearic acid, in a cholesterol-lowering diet. Am. J. Clin. Nutr. 60, 1044S-9S. **Dhinam,** T.R., 1999. Factors enriching CLA concentration in ruminant food product. IFT Annual Meeting Technical Program Abstracts. 82-84, 237. **Fallon**, S., Enig, M.G. 1996. Tripping lightly down the prostaglandin pathways. Price-Potterger Nutr. Foundation health J. 20, 3, 5-8. **Folch**, J., Lees, M., Sloane-Stanley, G.H., 1957. A simple method for the isolation and purification of total lipids from animal tissues. J. Biol. Chem., 226, 497-500. **Grundy**, S.M. 1994. Influence of stearic acid on cholesterol metabolism relative to other long-chain fatty acids. Am. J. Clin. Nutr. 60 (suppl), 986S-90S. **Judd**, J.T., Baer, D.J., Clevidence, B.A., Kris-Etherton, P., Muesing, R.A., Iwane, M., 2002. Dietary cis and trans monounsaturated and saturated FA and plasma lipids and lipoproteins in men. Lipids, 37, 2, 123-31. **Mulvihill**, B., 2001. Ruminant meat as a source of conjugated linoleic acid (CLA). British Nutrition Foundation. Nutrition Bulletin, 26, 295-299. **Ulbricht**, T.L.V., Southgate, D.A.T., 1991. Coronary heart disease: seven different factors. Lancet, 338, 985-992.