A survey on the milk fatty acid composition of forty dairy sheep flocks in Sardinia

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ABSTRACT: A survey was carried out to monitor milk fatty acid (FA) composition during two years (2003 and 2004) on forty dairy sheep flocks, fed pasture based rations, in 5 macro pedoclimatic areas of Sardinia, featured by different i) soil type, (granitic, G; basaltic, B and alluvial, A) ii) average annual rainfall (low, L, 500-600 mm/year; high, H, 600-800 mm/year). Milk FA profile was strongly influenced by year. In particular milk linolenic acid (LN), CLA (conjugated linoeic acid) and PUFA (polyunsaturated fatty acids) levels increased (by 25, 30 and 14%, respectively, $P<0.01$) whereas the atherogenicity index (AI) decreased (by 8%, $P<0.01$) in all areas in 2004 as compared with 2003. Pedoclimatic area affected milk fatty acid composition ($P<0.01$). In both years milk from AL farms showed the highest levels of LN, CLA and PUFA. AI was lower in BH and GH in year 2003 and in BH, AH and GL in 2004.

Key words: Dairy sheep, Milk FA, CLA.

INTRODUCTION – Feeding management is the mainly influencing factor of milk FA profile (Jensen, 2002). As observed by Stanton *et al*. (1997), the level of beneficial FA could be increased through grass supply depending, amongst other factors, by forage species as shown by Jahreis *et al*. (1997) in dairy cattle and by Addis *et al*. (2005) in dairy sheep. Since consumers are increasingly aware of health aspects, enhancing beneficial components in milk (e.g. PUFA) could result in premium prices by dairy processors (Elgersma, 2006). Preliminary study restricted to a small area of Sardinia (Cabiddu *et al*., 2007) indicated that when sheep flocks graze legume based pastures, milk CLA and PUFA levels are usually strongly enhanced. In Sardinia a large proportion of the total area devoted to dairy sheep farming is represented by pasture, which vary in botanical composition and production depending on soil and climatic features. The objective of this survey was to characterize milk FA profile in representative areas of the region featured by different pedoclimatic characteristics.

MATERIAL AND METHODS – The survey was carried out during years 2003-2004 on a total of 40 dairy sheep farms located in 5 macro pedoclimatic areas: AH, BH, GH in north and AL and GL in south of Sardinia (Table 1). The main characteristics of the farms in both years are summarized in Table 1. The farms were characterised by the same sheep breed but different pasture botanical composition, supplementation levels, and grazing managements. Samples of bulk milk from each dairy sheep farm were collected monthly from January to July, and fatty acid composition, inclusive of CLA (cis9, trans11) was determined (Murphy *et al*.,1990; Chin *et al*., 1992). Aterogenicity index was calculated as suggested by Chilliard *et al*., 2003. All data were analysed by GLM with pedoclimatic area (PA) sampling month (SM), and their interaction as fixed effects. Treatments means were separated by t test for multiple comparisons.

Table 1. Characteristics of the farms in the different pedoclimatic areas involved in the survey.

	Pedoclimatic areas				
	AL	AH	BH	GL	GH
Soil type	alluvial	alluvial	basaltic	granitic	granitic
Annual average rainfall (mm)	500-600	600-700	700-800	500-600	600-700
N° farms	6	6	13$	10	4
Year 2003					
Stocking rate (ewe/ha)	7.7	7.8	4.4	3.4	9.7
Concentrate supplementation (kg/head day)	0.32	0.57	0.53	0.37	0.68
Legume-based forage (% productive area)	54	36	41	32	66
Year 2004					
Stocking rate (ewe/ha)	8.7	9.1	5.6	4.3	12.7
Concentrate supplementation (kg/head day)	0.28	0.36	0.40	0.29	0.68
Legume-based forage (% productive area)	56	42	11£	30	81

$One farm which did not provide all data was discarded from the analysis; £ Most of the productive land represented by natural pasture (66%).

RESULTS AND CONCLUSIONS – In 2004 the average rainfall in the region was higher than in 2003 (Servizio Agrometereologico della Sardegna) resulting in an increase of pasture availability. As a consequence milk FA profile was strongly influenced by year in particular LN, CLA and PUFA increased by 25, 30 and 14%, respectively whereas AI decreased by 8% in all areas in 2004 as compared with 2003 (P<0.01). Overall FA profile was strongly influenced by SM similarly to the previously quoted survey (Cabiddu *et al.*, 2003). As reported in Table 2, during 2003 milk LN, CLA and PUFA levels were higher in AL, whereas AH was characterised by lowest level of these fatty acids. MUFA level and AI were higher and lower, respectively in GH and BH than AL and AH. As shown in Figure 1a, the trend of milk CLA content decreased along the season, as commonly observed by different authors. On the other hand, in all

Table 2. Effects of pedological origin (PA) sampling month (SM) and their interaction on FA content (% of total FA) of milk sheep.

	Pedoclimatic areas					Effects		
	AL	AH	BH	GL	GH	PA	SM	PA*SM
Year 2003								
Linoleic acid (LA)	2.61 ^{B}	2.61 ^{B}	2.98 ^{A}	2.57 ^{B}	3.12^{A}	**	**	Ns
Linolenic acid (LN)	1.57 ^{A}	0.99 ^{C}	1.18 ^{B}	1.27 ^{B}	1.03 ^{C}	**	**	Ns
CLA cis 9 trans 11	2.04 ^{A}	1.38 ^{C}	1.68 ^{B}	1.79 ^{B}	1.83 ^{AB}	**	**	Ns
PUFA	6.22 ^{A}	4.98 ^{C}	5.84 ^{B}	5.63 ^{B}	5.99 ^{AB}	**	**	ns
MUFA	24.71 ^{C}	24.92 ^{C}	27.15 ^{A}	26.05 ^{B}	27.61^{A}	**	**	ns
AI	2.31 ^{AB}	2.41 ^{A}	2.08 ^{C}	2.24 ^{B}	2.04 ^{C}	**	**	ns
Year 2004								
Linoleic acid (LA)	2.77 ^{A}	2.35 ^{B}	2.93 ^{A}	2.54 ^{B}	3.00 ^{A}	**	**	**
Linolenic acid (LN)	1.94 ^{A}	1.39 ^{CD}	1.74 ^{B}	1.51 ^{C}	1.27 ^{D}	**	**	**
CLA cis 9 trans 11	2.50 ^{A}	2.23 ^{B}	2.65 ^{A}	2.11 ^{B}	2.26 ^{B}	**	**	**
PUFA	7.21 ^{A}	5.97 ^{C}	7.33 ^{A}	6.17 ^{BC}	6.53 ^{B}	**	**	**
MUFA	25.29 ^{B}	27.72 ^{A}	27.46 ^{A}	27.73 ^{A}	26.65 ^{A}	**	**	**
AI	2.10 ^{A}	1.93 ^{B}	1.86 ^{B}	1.94 ^{B}	2.10 ^{A}	**	**	**

*A,B,C, means with unlike superscripts within row differ according to P value indicated; ** indicate, P<0.01.*

pedoclimatic areas, a drop of milk AI was observed (Figure 1b) at the end of the season parallel to the increase of MUFA level (data not shown). During 2004, BH and AL areas were characterised by higher levels of CLA, and PUFA in milk (Table 2). The CLA level was particularly high in AL during spring (interaction PA*SM, P<0.01 Figure 1a), possibly due to the delayed availability of legumes-based annual forage crops in AL as compared with BH, where natural pastures were the main feeding source. Also BH showed a high level of CLA, because of most of the productive land in this area is represented by natural pasture. MUFA were higher and AI was lower in AH, BH, and GL than in the other pedoclimatic areas. In conclusion pedoclimatic areas, encompassing mainly different pasture composition and feeding management, affected milk fatty acid composition (P<0.01). In both years milk from AL farms showed the highest levels of LN, CLA and PUFA. The levels of the variables under study (CLA and PUFA from one hand, MUFA and AI to the other) chosen as proxy of milk healthiness are dynamic and tend to be complementary. In fact the drop of CLA and PUFA milk fat content at the end of season is counterbalanced by a higher level of MUFA and hence low AI value.

Figure 1a. Trend of milk CLA

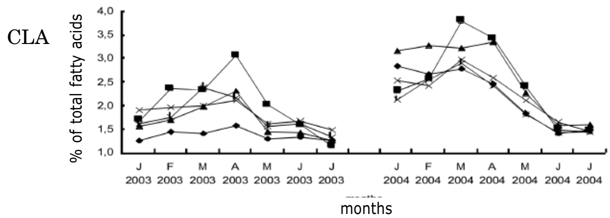
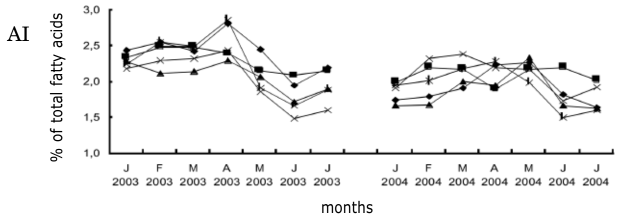


Figure 1b. Trend of atherogenicity index



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