Comparison of conjugated linoleic acid (CLA) content in milk of ewes and goats with the same dietary regimen

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RIASSUNTO – Comparazione del contenuto in acido linoleico coniugato (CLA) nel latte di pecore e di capre con stesso regime alimentare – *Campioni individuali di latte sono stati prelevati nei mesi di aprile e di maggio da 20 pecore e da 20 capre, mantenute con lo stesso regime alimentare. Il contenuto in CLA nel mese di Aprile, quando la razione era basata prevalentemente sul pascolo, è stato significativamente superiore nelle pecore rispetto alle capre (2,15* vs *0,64 g/100 g di grasso). A maggio, in corrispondenza del peggioramento quanti-qualitativo del pascolo, l'aumento delle dosi di concentrato nella razione, ha ridotto in maniera marcata le differenze nel contenuto in CLA nel latte delle due specie (0,84* vs *0,79 g/100 g di grasso nel latte di pecora e di capra, rispettivamente).*

KEY WORDS: ewe, goat, milk fat, CLA

INTRODUCTION – Milk fat is an important source of potential anticarcinogens named conjugated linoleic acid (CLA). The c9, t11-CLA is the major isomer and it is produced by ruminal hydrogenation of linoleic acid that leads first to vaccenic (11t-18:1) and finally to stearic acid (18:0). An alternative CLA pathway is related to the action of the mammary Δ9-desaturase enzyme on 11t-18:1. Diet is considered the main factor that influence the CLA concentration in milk fat. Differences in CLA content of sheep (Antongiovanni *et al.*, 2002) and goats milk (Nudda *et al.*, 2002) have been hypothesized, but results are difficult to compare due to different experimental condition in which the trials are carried out. The aim of this work is to compare the composition of milk fatty acids and CLA content in goats and sheep maintained in the same environmental condition and dietary regimen.

MATERIAL AND METHODS – Individual milk samples from evening milking were collected twice (in April and May) from 20 goats and 20 ewes located in the same flock of North Sardinia. Goats and sheep grazed on same pasture (8 hours/day) plus a concentrate supplementation of 0.2 kg/d in April for both species and in amount of 1 kg/d for goats and 0.5 kg/d for ewes, according to production level of animals, in May. Individual milk samples were analyzed for fat and protein contents (IRMA, Milkoscan 605). Milk and feeds fatty acids were determined by GC as the methyl ester derivatives, after trans-esterification with KOH in methanol. The fatty acids methyl ester (FAME) were separated on capillary column CB-Fame CP-select (100 m x 0.32 mm i.d., 0.25-μm film thickness), and quantified using C19:0 as internal standard. The injector and FID temperatures were 255° C. The column programmed temperature was 75°C for 1 min, then raised to 165°C at a rate of 8°C/min, maintained for 35 min, and finally increased to 210°C at a rate of 5.5°C/min. The split ratio was 1:40 and He was the carrier gas with a pressure of 37 psi. The identification of FAME were performed by comparing the relative retention time with reference to individual standards (Sigma Chemical). The amount of fatty acids were expressed as grams of FAME per 100 gram of fat. ANOVA was carried out on FAMEs concentration using month and species as fixed factors. Relationship between CLA (c9, t11-18:2) and t11-18:1 were estimated.

RESULTS AND CONCLUSIONS – The grass pasture was characterized by higher C18:3 and lower C18:2 concentration in comparison with concentrates (Table 1). Milk composition and FAMEs concentration of milk fat from the p.m. milking are presented in Table 2.

Table 1. The composition of concentrate and grass pasture.

	Concentrate		Pasture	
	April	May	April	May
DM, %	88.04	88.07	18.41	27.58
CP, % of DM	17.43	16.64	14.71	10.88
NDF, % of DM	35.12	34.75	50.42	56.78
EE, % of DM	4.07	4.65	2.65	2.25
FAME, g/100 g of fat				
C16:0	4.47	3.52	3.37	2.61
C18:0	0.56	1.1	0.26	0.31
C18:1	5.52	5.30	0.63	0.98
C18:2	9.82	12.56	2.76	2.76
C18:3	0.76	1.52	15.75	7.74

Table 2. Fatty acids composition of caprine and ovine milk fat.

	Goat[1]		Ewes[1]		Contrast[2], P value		
Fatty acid	Month						
	April	May	April	May	G *vs* E	Month	Inter.
Milk, g/d	2531 ^{A}	1903 ^{B}	1393 ^{A}	908 ^{B}	**	**	NS
Fat, %	3.95	4.60	6.55	7.30	**	*	NS
Protein, %	3.40	3.40	6.34	5.88	**	†	NS
FAME, g/100g of fat							
C6-C14	18.41	17.28	24.92	17.77	*	NS	NS
C16:0	21.15	21.17	17.16	18.91	**	NS	NS
C18:0	7.65	8.65	6.18 ^{a}	8.32 ^{b}	†	**	NS
C18:1 t11	0.95 ^{c}	1.29 ^{d}	3.74 ^{A}	1.32 ^{B}	**	**	**
C18:1 total	17.96 ^{A}	21.17 ^{B}	20.96	20.22	NS	†	**
C18:2	1.95	2.19	3.22 ^{A}	2.31 ^{B}	**	**	**
C18:3	0.52	0.51	0.88 ^{A}	0.62 ^{B}	**	**	**
CLA c9,t11	0.64	0.79	2.15 ^{A}	0.84 ^{B}	**	**	**

[1] Means of month within species differ (^{A,B} P < 0.01; ^{a,b} P < 0.05; ^{c,d} P < 0.10).

*[2] G = goat; E = ewes (**P≤0.01; *P≤0.05; †P≤0.10; NS not significant P ≥ 0.10).*

The CLA content was significantly higher in ewes than goats in April when the pasture dominated the diet (2.15 *vs* 0.64 g/100 g of fat; P<0.01). This difference was markedly reduced in May with the

increase of concentrate proportion in the diet (0.84 *vs* 0.79 g of CLA/100 g of fat in ewes and goats, respectively). Therefore, the difference in CLA content observed only in April suggests a different selective grazing behavior of goats in comparison with ewes grazing in the same pasture. A linear relationship has been found between CLA and t11-18:1 in milk fat both in sheep (Figure 1) and in goats (Figure 2). All coefficients were significantly different from zero. The slope, that may reflect differences in Δ9-desaturase activity, was similar to those observed in bovine (Bauman *et al.*, 1999). In conclusion, the results evidenced differences in CLA content between sheep and goats milk only when the diet consists mainly of pasture, suggesting a different selective grazing behavior of the two species.

Figure 1. Relationship between concentration of CLA (c9, t11-18:2) and 11t-18:1 in the milk fat of ewes.

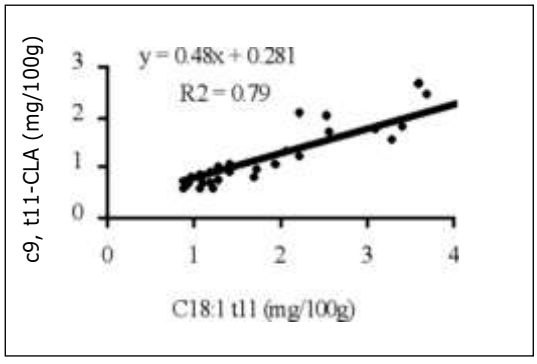
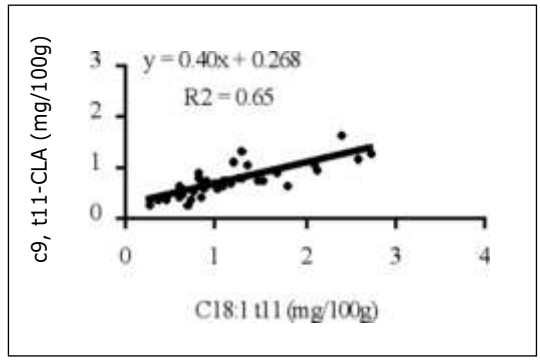


Figure 2. Relationship between concentration of CLA (c9, t11-18:2) and 11t-18:1 in the milk fat of goats.



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REFERENCES – **Antongiovanni**, M., Secchiari, P.L., Mele, M., Buccioni, A., Serra, A., Ferruzzi, G., Rapaccini, S., Pistoia, A., 2002. Ital. J. Anim. Sci. 1:55-63. **Bauman**, D.E., Baumgard, L.H., Corl, B.A., Griinari, J.M., 1999. Proc. Am. Soc. Anim. Sci.:1-15. **Nudda**, A., Battacone, G., Usai, M.G., Mele, M., Pulina, G., 2002. Proc. 15th Nat. Congr. SIPAOC:187.