Effect of raw sunflower seeds on goat milk production in different farming systems

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ABSTRACT: Aim of this study was to test the effect of raw sunflower seeds on goat milk production. Two farms with different farming systems (intensive and semi-intensive) participated to the trial. In each farm about 60 mid-lactation Alpine goats were divided in two groups during spring-summer time. A diet containing 5-6% of sunflower seeds on DM basis was compared with a control diet in a change-over design. In the semi-intensive farm milk yield of goats fed sunflower was 3.46 kg/d compared to 3.58 kg/d of goats fed control diet, whereas in the intensive farm milk yield was 4.60 kg/d *vs* 4.66 kg/d. Fat content increased significantly from 2.99% to 3.23% only in the intensive farm. The research in the intensive farm investigated also milk and cheese fatty acids composition. Medium and short chain fatty acids (C8-C16) content dropped and long chain fatty acids content increased when sunflower was added. In conclusion raw sunflower seed inclusion in dairy goat diets can be useful, in order to limit the inversion of fat and protein percentages in milk.

Key words: Goat, Milk, Farming system, Sunflower seed.

INTRODUCTION – Goats adapt themselves to different farming systems: extensive, semi-intensive and intensive. In the last years many authors observed a depression of milk fat content during spring and summer, especially in high yielding goat breeds (Kessler, 2004). Diet can modify milk fat content and quality. Two dietary factors are mainly involved: the supply and the nature of fiber sources and lipids contents. The addiction of rumen-protected lipids is effective in order to reduce risks of low milk fat content. Dietary lipids supplementation, as whole crude oilseeds, may also indeed change fatty acids composition of milk, that is one of the most important factors influencing technological and nutritional quality of goat milk (Chilliard *et al*. 2003). The aim of this work was to study the effects of raw sunflower seed supplementation on milk yield and composition, and in particular on milk fat content and fat composition.

MATERIAL AND METHODS – The trial was conducted in two different farms with different rearing systems: the first one (S) was a semi-intensive farm with 5 months/year of turned pasture, the second one (I) was an intensive farm. In spring-summer time the herds of each farm (62 and 52 mid-lactation Alpine goats in the S and in the I farms, respectively) were divided in two groups and a different diet was given to each group. Feed intake was about 2.5-3 kg/goat/d. The trial was divided in two periods, with change-over experimental design. In the S farm DMI from pasture was 30%, estimated as the difference between the voluntary DMI (estimated with the model proposed by Sauvant *et al.*, 1991) and the DMI from forage and concentrate supplementation. In the S farm the control diet (SC) contained 3% of soybean meal, that was substituted for 6% of whole sunflower seeds (160g/goat/d) in the experimental diet (SS). SS diet had an higher fat content but a lower protein content than SC diet (EE: 4.25% *vs* 2.69%; CP: 15.7% *vs* 14.9% on DM basis). In the I farm the experimental diet (IS) had an higher ether extract content than the IC diet (5.5% *vs* 3.7%) due to the inclusion of 5 % (on DM basis) of whole sunflower seeds (150 g/goat/d). IS and IC diets had the same protein content (CP=15.2%). Individual milk yield was measured and sampled eight times a month to determine fat, protein, lactose and urea content in accordance to the recommendations of the ASPA (1995). Milk somatic cell count was expressed as Linear Score (LS). In the I farm, 6 goats for each group were selected to determine milk fatty acids composition by gas chromatography analysis, in accordance with the method proposed by Christopherson and Glass (1969). Moreover milk of the two selected groups was used separately to make cheese in order to determine cheese fatty acids composition of the two groups. Cheese was also sensory evaluated by a discriminating/qualitative panel-test (ISO6558). Milk data were analyzed by ANOVA using the GLM procedure of SAS (2000). Because of deficiency of data from cheese gas chromatography, only descriptive statistics are reported for these results.

Table 1. Milk yield and composition of the groups of goats fed different diets.

Farm		Semi-intensive				Intensive			
		Control (SC)	Sunflower (SS)	ES	*P*	Control (IC)	Sunflower (IS)	ES	*P*
Milk yield	kg/d	3.58	3.46	0.028	**	4.66	4.60	0.026	ns
Milk fat	%	2.93	3.01	0.025	ns	2.99	3.23	0.016	***
Milk protein	%	3.22	3.24	0.008	ns	3.38	3.39	0.004	ns
Lactose	%	4.33	4.36	0.005	***	4.57	4.62	0.005	***
Urea	mg/dl	41.76	40.01	0.393	*	36.69	36.39	0.298	ns
4% FCM	kg/d	2.98	2.90	0.026	ns	3.94	4.04	0.013	**
Fat/protein		0.91	0.93	0.008	ns	0.89	0.95	0.050	***
Linear Score		5.20	5.20	0.050	ns	5.41	5.31	0.047	ns

* = $P<0.05$; ** = $P<0.01$; *** = $P<0.001$; ns=not significant.

RESULTS AND DISCUSSION – Table 1 shows milk production of goats in the two farms. In the semi-intensive farm goats fed the control diet (SC) had an higher milk yield (3.58 *vs* 3.46 kg/d; $P<0.01$) than goats fed the sunflower diet (SS); this is in accordance with Chilliard *et al*. (2003) for mid-late lactation goats. Dietary treatment did not affect significantly milk fat and protein content, even if these components were slightly higher with the SS diet. Maybe these results depended on low fat content of sunflower seeds used in this farm (29.6% *vs* 39.2% in I farm). On the other hand fat/protein ratio didn't dramatically fall like usually during spring-summer period (0.91 SC *vs* 0.93 SS). In the intensive farming system milk yield was not affected by the supplementation of the diet with sunflower seeds: average milk yield was 4.60 kg/d for both groups of goats. Milk fat content was significantly higher with IS diet in respect to control diet (3.23% *vs* 2.99%; $P<0.001$). These results confirm the findings of previous studies about the use of rumen-protected fats in goat diets in order to increase milk fat content (Brown-Crowder *et al.*, 1997; Perez *et al.*, 2001). Milk protein content was not statistically different between treatments, indicating that sunflower seeds utilization did not affect microbial activity in the rumen.
As reported by Schmidely et al. (2004), feeding long chain unsaturated fatty acids seems to cause inhibition of de novo mammary fatty acids synthesis. To confirm this theory, milk from goats fed sunflower diet had a significantly lower content of

Table 2. Effect of the supplementation of the diet with sunflower seeds on Milk Fatty Acids Composition.

		diet						diet			
		Control	Sunflower	ES	*P*			Control	Sunflower	ES	*P*
C4:0	%	1.55	1.71	0.025	***	C18:1	%	22.57	25.34	0.149	***
C6:0	%	1.66	1.70	0.022	ns	C18:2	%	5.03	5.25	0.039	***
C8:0	%	2.87	2.76	0.028	**	C18:3	%	0.73	0.64	0.006	***
C10:0	%	10.77	9.62	0.104	***	C18:2c	%	0.58	0.56	0.013	ns
C12:0	%	5.20	4.33	0.052	***	C18:1/C16:0		1.05	1.30	0.009	***
C14:0	%	10.31	8.99	0.069	***	saturated[1]	%	69.54	66.79	0.165	***
C16:0	%	21.51	19.59	0.075	***	unsaturated[1]	%	30.46	33.21	0.165	***
C16:1	%	0.81	0.78	0.010	ns	MUFA	%	24.11	26.75	0.150	***
C18:0	%	13.15	15.89	0.174	***	PUFA	%	6.34	6.45	0.040	ns

* = $P<0.05$; ** = $P<0.01$; *** = $P<0.001$; ns=not significant.

[1]includes also fatty acids present in low percentage: saturated C9:0; C11:0; C13:0;C14:0;C15:0; C16:0;C17:0; unsaturated C10:1; C12:1; C14:1 C15:1; C17:1.

medium and short chain fatty acids (C8-C16) than the others, whereas long chain fatty acids (stearic, oleic and linoleic acids) increased (P<0.001), as shown in Table 2. Considering that IS diet was higher in oleic and linoleic acids than IC diet, the increase of stearic acid could be explained by ruminal biohydrogenation; that could demonstrate that sunflower seed fats were not completely rumen-protected. Cheese fatty acids composition reflected milk fatty acids profile: cheese from goats fed sunflower seeds showed an increase in oleic and stearic acids and a decrease in fatty acids from C4 to C16 (Table 3). First period panel-test results showed a 99% significant difference between cheeses from the two treatments (perceived by 6 tasters out of 19) (ISO/WD 6558, 2001). During the second period no significant difference was perceived.
These results suggest that the use of raw sunflower seed can limit the low fat content of goat milk during spring-summer time. Long chain fatty acids content increases in milk and cheese from goats fed sunflower, inducing changes in cheese quality.

Table 3. Effect of the supplementation of the diet with sunflower seeds on Cheese Fatty Acids Composition.

		diet						diet			
		Control	Sunflower	ES	*P*			Control	Sunflower	ES	*P*
C4:0	%	1.86	0.078	1.77	0.198	C18:1	%	19.08	0.339	24.15	1.450
C6:0	%	2.01	0.014	1.84	0.191	C18:2	%	4.34	0.559	5.19	0.318
C8:0	%	3.20	0	2.94	0.219	C18:3	%	0.62	0.049	0.67	0.021
C10:0	%	12.42	0.071	10.62	1.054	C18:2c	%	0.46	0.021	0.52	0.014
C12:0	%	5.66	0.092	4.56	0.495	C18:1/C16:0		0.85	0.019	1.23	0.104
C14:0	%	10.92	0.057	9.28	0.856	saturated[1]	%	73.96	0.325	68.03	1.704
C16:0	%	22.27	0.092	19.60	0.474	unsaturated[1]	%	26.03	0.339	31.96	1.704
C16:1	%	0.78	0.042	0.79	0.035	MUFA	%	20.60	0.290	25.58	1.393
C18:0	%	13.13	0.368	15.28	1.980	PUFA	%	5.43	0.629	6.38	0.311

[1]includes also fatty acids present in low percentage: saturated C9:0; C11:0; C13:0;C14:0;C15:0; C16:0;C17:0; unsaturated C10:1; C12:1; C14:1 C15:1; C17:1.

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