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in

Ben Salem H. (ed.), Nefzaoui A. (ed.), Morand-Fehr P. (ed.).
Nutrition and feeding strategies of sheep and goats under harsh climates

Zaragoza : CIHEAM
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 59

2004
pages 91-93

Effect of extruded soya seed on reversion of fat and protein percentage and fatty acid composition of goat milk

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SUMMARY – Extruded soya seed was offered at 0, 10 or 20% dry matter (DM) in the diets of mid-lactating goats to assess their effect on the reversion of milk fat and protein contents that occurs in high concentrate diets, and to manipulate milk fatty acid composition. Feeding extruded soya seed increased raw milk yield and milk fat content compared to goats fed the control diet. There was no change in milk protein content. Feeding extruded soya seed reduced the ratio of saturated/monounsaturated fatty acids, and increased linoleic and linolenic acid proportions in milk fat. Incorporation of extruded soya seed in high concentrate diets prevented the reversion of the ratio of milk fat content (MFC) and milk protein content (MPC) in mid lactating goats, and it increased the nutritional value of MFC.

Key words: Milk composition, fatty acids, soya seeds, goat.

RESUME *– "Effet des graines de soja extrudées sur le pourcentage de gras et de protéines et la composition des acides gras dans le lait de chèvre". Des graines de soja extrudées sont incorporées dans la ration de chèvres laitières en milieu de lactation au niveau de 0, 10 ou 20% matière sèche (MS) pour prévenir l'inversion des taux butyreux et protéique du lait caractéristiques des rations riches en concentré, et pour manipuler la composition en acides gras du lait. Les chèvres alimentées avec des graines de soja extrudées ont une production laitière et un taux butyreux plus élevés que les chèvres recevant la ration témoin, sans modification du taux protéique. Le ratio acides gras saturés/acides gras mono-insaturés est réduit, et les pourcentages des acides linoléique et linolénique dans la matière grasse du lait sont augmentés après supplémentation par les graines. L'utilisation de graines de soja extrudées chez la chèvre en milieu de lactation prévient l'inversion des taux butyreux et protéique du lait pour des rations riches en concentrés, et améliore la valeur nutritionnelle de la matière grasse du lait.*

Mots-clés : *Composition du lait, acides gras, graines de soja, chèvre.*

Introduction

In Europe, goat farmers often have problems with low milk fat content (MFC), mostly during months of May and June, particularly when high concentrate diets are fed during mid-lactation in intensive feeding systems (see the review of Schmidely and Sauvant, 2001). In these cases, milk protein content (MPC) may be higher than MFC, which affects milk quality and cheese making properties.

Human dietary recommendations indicate the need to decrease intake of medium-chain saturated fatty acids (lauric acid C12:0, myristic acid C14:0 and palmitic acid C16:0) to reduce the frequency of cardio-vascular diseases. Moreover, an increase in the dietary intake of long-chain polyunsaturated fatty acids (particularly n-3) stimulates the immune system and it reduces the frequency of some cancers and of cardio-vascular diseases (Spector, 1999).

The nutritional value of milk fat in dairy ruminants can be improved by lipid supplementation of the diet (Chilliard *et al*., 2000). However, data obtained on goats are scarce, particularly for diets where oilseeds are included (Daccord, 1987; Gulati *et al*., 1997). Consequently, this study examined whether increasing the lipid content of diet with extruded soya seeds (SS) which is rich in linoleic acid, prevents reversion of the fat and protein percentage in milk of goats fed high concentrate diets. In addition, the composition of fatty acids (FA) in milk was studied to assess the extent of the modification of its nutritional value.

Materials and methods

Thirty-six Alpine or Saanen multiparous goats (90 ± 15 DIM) were fed *ad libitum* a control diet consisting of alfalfa hay (30% of dry matter, DM), dehydrated sugar beet pulp (20%) and concentrate (50%) fed as total mixed ration (TMR) for 4 weeks. For the next 8 weeks, goats were fed one of the 3 diets differing in the percentage of extruded SS [0 (SS0), 10 (SS10), 20 (SS20) % of DM] in TMR, substituted for soybean meal and soya hulls. The diets were iso-nitrogenous (18.2% crude protein in DM) and they had a net energy for lactation (NEl) value of 1570, 1590, and 1613 kcal/kg DM for SS0, SS10 and SS20 respectively. Their calculated ether extract contents were 1.1, 3.0 and 4.9% of DM, respectively.

Feed intake and refusals were recorded daily. The raw milk yield (RMY), the MFC and the MPC were recorded on 2 consecutive days each week throughout the trial on 36 goats, whereas fatty acid composition of MFC was studied by gas chromatography on 12 goats, 4 and 8 weeks after the start of the trial. Data were analysed using the General Linear Model (GLM) procedure of SAS for repeated measurements.

Results and discussion

The difference in RMY between diets tended to increase during the trial with mean values of 3.50, 3.60 and 3.77, and 3.08, 3.26 and 3.60 kg/d for SS0, SS10 and SS20, respectively in weeks 4 and 8 of the trial (SS effect: $P < 0.10$; time × SS effect: $P < 0.08$). Differences in RMY were not observed by Daccord (1987) when 20% extruded SS was substituted for soybean meal in the diet of goats in early lactation. The difference in MFC between diets tended to increase during the trial with means of 36.9, 38.5 and 40.6, and 33.2, 38.1 and 39.2 g/kg, in weeks 4 and 8 (SS effect: $P < 0.03$; time × SS effect: $P < 0.07$). No effect of the level of SS on MPC was observed at any time. Consequently, differences in the MPC/MFC ratio increased during the trial (Fig. 1), with mean ratio of 0.87, 0.82 and 0.81, and 1.00, 0.85 and 0.85 in weeks 4 and 8 (SS effect: $P < 0.01$; time × SS effect: $P < 0.07$). These effects on MFC and MPC are in agreement with data reviewed by Schmidely and Sauvant (2001).

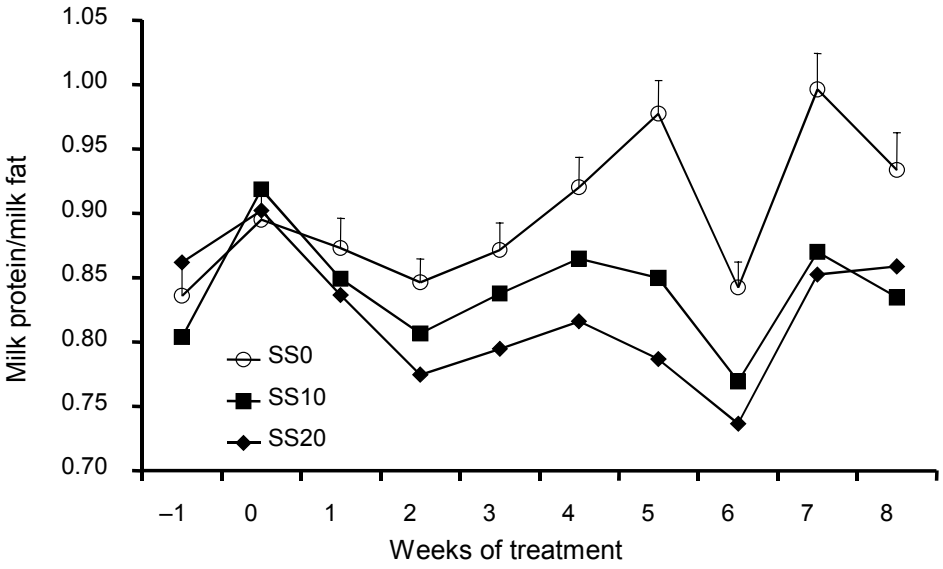

Fig. 1. Effects of percentage of extruded soya seed (SS) in diet (SS0, SS10 and SS20: 0, 10 and 20% of SS in DM) on protein/fat ratio of milk in dairy goats.

At week 8, frequencies of reversion of the ratio of fat to protein of the milk were 58, 25 and 8% in the SS0, SS10 and SS20 diets, respectively.

The ratio of saturated FA (C10 to C18) to mono-unsaturated FA (cis9-C16:1 + cis9-C18:1) in MFC increased with time for goats fed the SS0 diet, whereas it decreased with time for goats fed extruded SS. Goats fed diet SS20 diet had the lowest ratio of saturated to monounsaturated FA (Table 1).

Table 1. Effects of percentage of extruded soya seed (SS) in diet (SS0, SS10 and SS20: 0, 10 and 20% of SS in DM) on milk fatty acid composition (% fatty acids)

Time of sampling	Week 4			Week 8			
Diet	SS0	SS10	SS20	SS0	SS10	SS20	SS effect
Saturated FA/mono-unsatured FA	6.1	4.6	3.7	6.4	4.3	3.5	$P < 0.001$
Linoleic acid (% FA)	2.1	3.1	4.0	2.0	3.2	4.1	$P < 0.005$
Linolenic acid (% FA)	0.35	0.37	0.42	0.33	0.42	0.44	$P < 0.05$

Linoleic acid (cis9,12-C18:2) in MFC increased linearly with SS incorporation at week 4 and 8, resulting in a doubling of the concentration of linoleic acid between diets SS0 and SS20. Linolenic acid (cis9,12,15-C18:3) concentration was only slightly increased by incorporation SS in the diets.

Conclusion

It is possible to reverse the reversion in the ratio of MFC to MPC that is common in goats fed high concentrate diets in mid lactating, by feeding extruded SS to increase the lipid content of the diet. This was achieved without reducing MPC. Feeding SS also increased the nutritional value of the milk fat.

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