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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 79-83

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SUMMARY – Two total mixed rations (TMR) were used to study the voluntary intake and milk performance on Murciano-Granadina goats during the whole lactation. The TMR were isoenergetic 15 MJ/kg dry matter (DM) and the level of crude protein on DM basis was 16%. The two sources of protein tested were soybean and sunflower meals. Diets were balanced in nutrients and 6 groups of 6 goats were made and three of them were fed with the TMR with soybean meal added and the other three groups with sunflower meal. Live weight, milk yield in previous and current lactation were taken into account in order to make homogenous groups. Voluntary intake was recorded in each group every day and goats were weighed once a week. No significant differences were found between diets for voluntary dry matter intake (DMI) (1.7 and 1.8 kg/d as an average of the whole lactation and for soybean and sunflower respectively). Milking was recorded in each group once a week and milk samples were conducted in the lab for chemical analysis. No significant differences were found between diets for milk production (2.38 and 2.2 kg/d as average of the whole lactation and for soybean and sunflower respectively). For chemical characteristics no significant differences were found between diets and the average values obtained were 5.6 and 3.8% for fat and protein respectively. According to the results obtained in the present study the use of soybean and sunflower meal in the TMR did not affect performance on goats during lactation.

Key words: Goat, intake, lactation, sunflower, soybean.

RESUME – *"Effet de deux sources de protéines sur les performances de la chèvre Murciano-Granadina au cours de la lactation". Deux rations complètes (RC) ont été utilisées dans cette expérience pour étudier l'ingestion volontaire d'aliments et la production et la composition du lait chez la chèvre Murciano-Granadina pendant toute la lactation. Les RC utilisées étaient isoénergétiques (15 MJ/kg matière sèche, MS) et isoprotéiques (16% de la matière sèche). Les deux sources de protéine utilisées étaient des tourteaux de soja et de tournesol. Les rations étaient équilibrées pour tous les nutriments. Dans notre étude, nous avons établi 6 groupes de 6 chèvres chacun. Trois groupes étaient nourris avec la ration complète contenant le tourteau de soja et les 3 autres nourris avec la RC contenant le tourteau de tournesol. Le poids vif et la production laitière de la lactation précédente ont été pris en compte pour rendre les groupes homogènes. L'ingestion volontaire a été enregistrée tous les jours tandis que le poids vif a été contrôlé toutes les semaines. Nous n'avons pas observé de différences significatives entre les deux rations complètes sur l'ingestion volontaire de la matière sèche (les valeurs moyennes sur toute la lactation ont été de 1,7 et 1,8 kg/j pour le soja et le tournesol respectivement). La production de lait et sa composition chimique ont été déterminées toutes les semaines. Nous n'avons pas observé de différences significatives entre les deux RC pour la production de lait (2,38 et 2,20 kg/j en moyenne sur toute la lactation pour le soja et le tournesol respectivement). La composition chimique n'a pas été significativement différente entre les laits de chèvres recevant les deux rations complètes (les valeurs moyennes du taux butyreux : 5,6% et du taux protéique : 3,8%). Les données obtenues dans cette étude montrent que l'utilisation du tourteau de soja ou de tournesol comme source protéique dans des rations complètes pour des chèvres n'affecte pas les performances laitières des animaux tout au long de la lactation.*

Mots-clés : *Chèvre, ingestion, lactation, tournesol, soja.*

Introduction

For the arid and semi-arid Mediterranean zones and according to the CAP, it is recommended a semi-extensive livestock being in this sense very appropriated the goat species. The Murciano-Granadina goat is well adapted to the hot and dry conditions of the semi-arid areas of the south-east of Spain (Falagán *et al*., 1995). In the south of Spain, there is an attempt of development of goat milk production by intensification. Actually, due to more and less limited rangeland availabilities during the year there is a decrease of production, which is an obstacle to this objective of intensification. The solution of bringing important quantities of concentrates in the diet used during the past few years has

driven to metabolic diseases. Besides, the total mixed rations (TMR) used for dairy cows are likely to solve these difficulties (Owen, 1984). With TMR system the concentrates are diluted with forage and over-consumption of concentrates may be avoided. So, TMR is an alternative to provide a balanced diet and avoid drastic changes of ingredients.

On the other hand, south-east of Spain is characterized by a high number of agro-industry plants, and a lot of by-products are available to use for feeding ruminants and incorporate in a TMR. The source of protein is an important topic as well. As practical recommendation, under drought conditions in the south-east of Spain, both sunflower and soybean meal are sources of vegetable protein recommendable for using on TMR to fed dairy goats. In order to choose the appropriate source of protein, two protein sources will be studied: sunflower meal from Spanish origin and soybean meal from EEUU origin.

The subject of this trial was to study the intake and milk performance in Murciano-Granadina dairy goats when two sources of protein were incorporated to the TMR.

Material and methods

Two commercial TMR were used to study the voluntary intake and milk performance on Murciano-Granadina goats during 5 months of lactation. Live weight, milk yield in previous and actual lactation, number of births were taken into account in order to make homogenous groups.

Ingredients and chemical composition of experimental diets are showed in Table 1. Balance of the diet was obtained using the recommended values of INRA (1988) and AFRC (1993) for energy, protein, fibre, calcium, phosphorus, sodium and chloride. The TMR were isoenergetic 15 MJ of metabolizable energy (ME)/kg dry matter (DM) and the level of crude protein (CP) on DM basis was 16%. TMR changed in the source of protein; soybean and sunflower meal because sunflower comes from Spanish production and is cheaper than soybean meal (USA origin). The diet was supplemented with a vitamin-mineral premix (5 g/kg) provided by Trouw Nutrition, SA.

Table 1. Ingredients and chemical composition of the total mixed ration

	Soybean meal	Sunflower
Ingredient (g/kg)		
Barley	90	90
Corn	150	150
Alfalfa hay	330	310
Dehydrated beet pulp (pellets)	215	175
Beet molasses	80	80
Cotton seed	70	90
Soybean meal 46	60	10
Sunflower 30 (pellets)		90
Premix†	5	5
Calculated components (g/kg DM)		
Dry matter (DM) (g/kg)	903	921
Organic matter	914	926
Ash	86	74
Crude protein	157	164
Ether extract	43	46
Crude fibre	136	204
Neutral detergent fibre	305	373
Acid detergent fibre	152	219
Gross energy (MJ/kg DM)	17	18

†Provided by Trouw Nutrition España, SA, to give (ppm or UI per kg of diet): Se 30; I 240; Co 190; Cu 1100; Fe 4200; Zn 27000; Mn 13000; S 69000; Mg 45000; vitamin A 1000000 UI; vitamin D3 280000; vitamin E 2000 ppm.

Six groups of six goats were made; 3 groups of 6 goats for soybean and 3 groups of 6 goats for sunflower. Goats were fed twice a day; 9:00 (after milking) and 15:00 with a half quantity each time. Feed intake (*ad libitum* access) and refusals were recorded for each group of goat daily. Water was free available all the time.

Chemical analyses of the diets were conducted according to methods of AOAC (1995) for DM, ash, crude fibre (CF) and CP (Kjeldahl nitrogen from diet was converted to CP by multiplying N by a factor of 6.25). DM of the TMR was determined by oven-drying at 102 $\pm$ 2°C for 24 h. The method of van Soest *et al*. (1991) was used to determine acid detergent fibre (ADF) and those of Robertson and van Soest (1981) for determining neutral detergent fibre (NDF). Different fibre fractions were determined by a Dosifiber, Selecta. Ether extract (EE) was measured after acid hydrolysis (AOAC, 1995) to recover saponified fat with a DET-GRAS, Selecta equipment, by extraction with diethyl ether.

Goats were milked out once a day and milk production of each goat was recorded weekly at each milking during the whole lactation. The chemical analysis of the milk was done by NIR technology (Muelas *et al.*, 2001).

For variance analysis and means comparison MIXED procedure of SAS (1997) was used.

Results and discussion

No significant differences were found between diets for voluntary dry matter intake (DMI): 1.7 and 1.8 kg/d as total average for soybean and sunflower meals respectively (Table 2 and Fig. 1). Similar value was obtained by Fernández (2000) (1.75 kg DMI/d, as average of 3 TMR). Aguilera *et al*. (1990) obtained a value of 1.45 kg DM/d, using Granadina goats at mid first through second lactation, and the experimental diet was a traditional diet made by alfalfa hay and barley. The value of DMI estimated when the equation of INRA (1988) was used is of 1.29 kg DMI/d, that is lower that the result obtained. This equation is based on typical French diets, based on maize silage and alfalfa hay with some concentrate supplement, and in the present experiment two TMR were used. Besides, breeding and environmental conditions were different as well.

Table 2. Average of milk performance during 5 months of lactation

	Soybean meal	Sunflower	SEM†
Dry matter intake (kg/d)	1.8	1.7	0.10
Milk production (kg/d)	2.38	2.20	0.11
Fat (%)	5.48	5.72	0.11
Crude protein (%)	3.77	3.86	0.04
Lactose (%)	4.73	4.74	0.07
Dry matter (%)	14.54	14.83	0.12

†SEM: standard error of the mean.

No significant differences were found between diets for milk production: 2.38 and 2.20 kg/d for soybean and sunflower as average of the whole lactation (Table 2 and Fig. 1). Fernández (2000) using three commercial TMR did not find significant differences. So, milk yield was not significantly different (2.07 kg/d, as average) among diets. Fernández (2000) only took into account an experimental period of 10 days.

For chemical characteristics no significant differences were found between diets with soybean and sunflower, and the average values obtained were 5.72 and 5.48% for fat, 3.86 and 3.77% for CP, and 4.74 and 4.73% for lactose (Table 2 and Fig. 2). When we observe the study, no significant differences for chemical composition were obtained by Fernández (2000). The mean value obtained for fat (5.08%) and protein (3.49%) are into the range of the Murciano-Granadina standard (5.2% of fat; 3.3% of protein according to Analla *et al*., 1996), as well as the result from the present work.

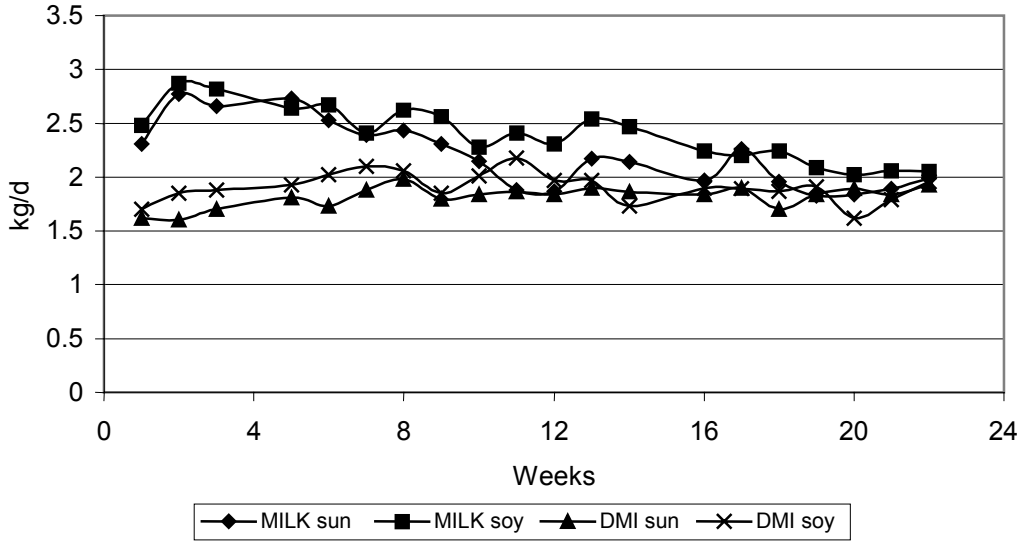

Fig. 1. Effect of diet on milk performance and dry matter intake.

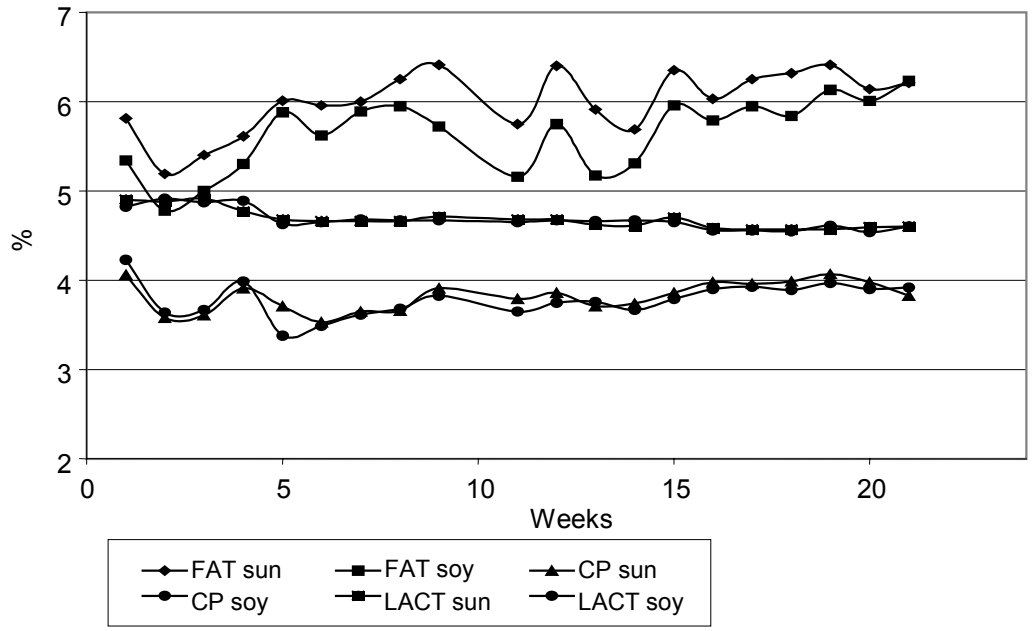

Fig. 2. Effect of diet on milk chemical composition.

According to the results obtained in the present study the use of soybean or sunflower meal into the TMR did not affect performance on goats during lactation because TMR were well balanced in nutrients. These TMR were not experimental diets, so in order to choose which source of protein is appropriate to incorporate on a balanced diet we should be guided by economical criteria.

Acknowledgement

This research was supported by FEDER funds reference 1FD1997-1010-C02-02, and in part by contract from TROUW Nutrition, NANTA.

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