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López Gallego F., López Parra M.M., Picón Sánchez F.

in

Rubino R. (ed.), Morand-Fehr P. (ed.).
Production systems and product quality in sheep and goats

Zaragoza : CIHEAM
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 46

2001
pages 121-125

Effect of different feed patterns on milk and cheese yield and composition in sheep extensive systems

F. López Gallego, M.M. López Parra and F. Picón Sánchez
Servicio de Investigación y Desarrollo Tecnológico, Apartado 22, 06080 Badajoz, Spain

SUMMARY – Extensive systems of merino sheep in Extremadura are based on grazing but with a supplement during the three critical productive periods. The effect of this supplementation on merino milk and cheese production has been studied. The milk production potential is related to grazing during lactation and to supplementation at milking. Milk production increases in relation to grazing with protein-energetic supplementation in winter-spring and energetic diet in autumn. Similar answers were observed in the composition of milk and in the cheese yield with these diets in relation to pasture.

Keywords: Merino, milk, cheese, supplementation, grazing.

RESUME – *"Effet de différents modèles alimentaires sur la production de fromage et de lait en systèmes ovins extensifs". Les systèmes extensifs d'élevage des brebis Mérinos sont basés sur le pâturage mais avec une supplémentation dans les moments productifs les plus critiques. L'effet de la supplémentation sur la production du lait et de fromage Mérinos a été étudié. La capacité laitière est en rapport avec le pâturage pendant l'allaitement et avec la supplémentation pendant la traite. La production de lait de traite augmente par rapport au pâturage avec supplémentation protéique/énergétique pendant l'hiver-printemps et énergétique pendant l'automne. Des réponses semblables sont observées sur la composition du lait et le rendement fromager en utilisant ces supplémentations mentionnées par rapport au pâturage.*

Mots-clés : *Mérinos, lait, fromage, supplémentation, pâturage.*

Introduction

The merino sheep in the Autonomous Community of Extremadura counts with 2.7 million of breeding animals. Sheep production in Extremadura is estimated annually in 26.5 thousand million of ptas. It is made up by 67 million of tonnes of meat and 4.5 thousand tonnes of milk dedicated to the production of traditional ewe cheese which is included in the 7 thousand tonnes of artesanal cheese in the national background. "La Serena" cheese is the one with the greatest production and guarantee of origin, whose characteristics provide it with a high economic value. This justifies the milking of the Merino as complementary rent in meat production systems.

The extensive systems of the merino ewe under the particular agro-environmental conditions in Extremadura are based on the use of the agropasture resources through grazing. The seasonal and annual variability of these resources conditions its feeding offer versus the nutritional requirements of the flock (Escribano *et al*., 1996). Under such conditions these systems need to be supplemented with proper diets to complement the seasonal offer and its nutritional values.

To reach this purpose, it has been arranged on one hand, to incorporate winter fodder, Westerworld Ray-grass (*Lolium multiflorum*) in autumn-winter when there is scarce grazing, and on the other hand, to incorporate supplementation with concentrates during the time of maximum nutritional requirements of the animal (pregnancy and lactation).

In the most characteristic periods of these systems: spring and autumn, the effect of this supplementation was analysed on milk production milked after weaning; likewise after weaning this effect was also analysed on the body condition of the ewes.

Material and methods

In a traditional wooded dehesa in Extremadura which belongs to the Research and Technological

Development Service, researchers have worked with 130 adult merino ewes in the trial of spring and with 70 ewes in the one of autumn. The ewes were divided into three lots of supplementation at milking after weaning. After grazing the three lots were supplied daily (Table 1) with BD = basic diet, ED = energetic diet (low protein/energy relation) and PD = protein diet (high protein/energy relation).

Table 1. Diet composition and pasture of ewes at milking†

	Date	DM (%)	CP (%)	CF (%)	DC (g/ewe/day)
Spring: Weaning mean date – 15th February (6th week of lactation); Ray-grass grazing – from 21st February to 12th June; Pasture grazing – continuous					
Ray-grass	February	22	11	19	
Pasture	March	17	16	25	
Ray-grass	June	71	7	34	
Pasture	June	81	8	32	
BD	Feb-Jun	88	21	6	100 Cf
ED	Feb-Jun	86	15	5	100 Cf + 200 Ba
PD	Feb-Jun	86	26	5	100 Cf + 140 Ba + 60 So
Diet 0	Nov-Dec				120 Cf + 80 Ba
Diet 1	Jan-Feb				500 Cf + 400 Pa
Autumn: Weaning mean date – 12th October (6th week of lactation); Pasture grazing – continuous					
Pasture	October	75	6	33	
Pasture	January	13	16	22	
BD	Oct-Jan	91	18	8	250 Cf
ED	Oct-Jan	87	16	5	250 Cf + 400 Ba
PD	Oct-Jan	87	23	5	250 Cf + 280 Ba + 120 So
Diet 0	Jul-Aug				400 Ba
Diet 1	Sep-Oct				400 Ba + 200 Av

†DM: dry matter; CP: crude protein; CF: crude fibre; DC: diet composition; Cf: commercial feed for ewes at production; Ba: barley; So: soya; Oa: oats; Pa: pellet of alfalfa; Diet 0: pregnancy diet (45 days pre-lambing); Diet 1: lactation diet (from lambing to weannig).

The annual rainfall registered (30 years average, 503 mm) in the period of time related to both trials (Sep 95-96) as well as the respective availability of pastures and ray-grass are 650 mm, 2250 and 8000 kg dry matter per ha (Table 2).

Table 2. Rainfall and temperature†

Month	R	m	Month	R	m
Sep. 95	6.5	14.8	May 96	5.5	11.2
Oct. 95	13.4	14.5	Jun. 96	2.5	16.2
Nov. 95	120.2	11.7	Jul. 96	0.0	18.1
Dec. 95	150.8	8.5	Aug. 96	0.0	16.4
Jan. 96	249.6	8.3	Sep.96	37.8	14.8
Feb. 96	21.1	6.6	Oct. 96	49.6	11.8
Mar. 96	61.9	7.7	Nov. 96	82.5	9.5
Apr. 96	21.9	9.9	Dec. 96	177.2	8.8

†R: rainfall (mm); m: mean minimum temperature (°C).

The milk production potential at particular moments of lactation is estimated with double injection of oxytocin (2 UI). Weekly milk recording and individual analysis of different milk samples were carried out.

Results and discussion

The seasonal difference regarding milk production (Table 3) is due to the persistence and to higher daily yields of milked milk, a 33% higher as average in spring. It is noticed that daily yields is higher during most of the milking, in the protein diet (PD/BD:+12%) with 32 litres in spring and in the energetic diet (ED/BD:+24%) with 15 litres in autumn. At the end of milking close to drying (June for the spring milking and January for the autumn one) the productions are kept by modifying the energetic level of the diet, increasing it in spring (ED) and reducing it in winter (BD).

Table 3. Potential production and daily milk yield of Merino sheep†

Spring	Week of lactation												Per (120 d)	Pr (120 d)	Mym (120 d)
	2	4	7				13			23					
	PP	PP	PP	MY	FC	PC	MY	FC	PC	MY	FC	PC			
Mean	1247	1164	405	410	7.8	6.3	260	5.9	5.7	139	10.2	7.0	161	28.3	236
BD	1260	1182	384	402	7.9	6.2	240	6.2	6.0	130	10.3	7.2	161	27.4	229
ED	1211	1132	389	397	7.7	6.3	257	5.2	5.3	153	11.1	7.2	161	25.8	215
PD	1256	1168	460	436	7.7	6.4	295	6.1	5.7	135	9.19	6.4	161	31.8	265
Autumn	Week of lactation												Per (75 d)	Pr (75 d)	Mym (75 d)
	2	4	7				13			17					
	PP	PP	PP	MY	FC	PC	MY	FC	PC	MY	FC	PC			
Mean	1230	1026	502	508	8.6	5.8	186	8.1	5.9	171	8.5	6.9	119	13.3	177
BD	1170	1067	431	436	9.2	5.8	186	8.2	5.9	238	8.8	6.9	119	12.3	164
ED	1266	1042	556	584	7.9	5.7	230	7.5	5.9	120	5.3	4.2	119	15.3	203
PD	1245	982	508	497	8.6	5.7	149	8.6	6.0	149	8.5	8.3	119	12.4	165

†PP: potential production (cm^3/ewe/day); MY: daily milk yield (cm^3/ewe/day); FC: fat content (%); PC: protein content (%); Per: lactation persistence days; Pr: total milk litres per ewe; Mym: mean daily production at milking (cm^3/ewe/day); d: milking days.

These results at production, and even in the milk composition, are related to the evolution of the body conditions in each period (Table 4). The energetic surplus is dedicated to recover body fat or to produce milk, during the protein pasture in the end of spring (ED) and during the energetic pasture in winter (BD). The ewes weights after lambing were a 10% higher as average in January than in September, but the body condition is similar in both seasons.

As regard to the milk chemical composition (Table 3), differences are observed between autumn and spring. In autumn the fat content (FC) was higher throughout milking, being at the 13th week of lactation a 37% higher. The same happens in daily yield, this relation is reversed in the phase of milking close to drying, being the FC of the milk 20% higher in spring than in autumn. Both effects (time and diets) are due to the reversed relation of the chemical composition and the milk yield produced, which is higher at the periods and with the diets already indicated.

FC is higher in the basic diet, in spring as well as in autumn, while FC and PC are higher in the protein diet in autumn with respect to the energetic diet. This is due to the low protein value of pastures at this time of the year.

From the cheese analysis carried out (Table 5), it is pointed out that the cured cheese yields obtained in autumn are higher in a 16% than the ones obtained in spring. This yield shows a greater decrease because of drying in the spring elaboration. Since the fresh cheese yield at this time is 20%

higher than in autumn and this is related to the milk chemical composition. Likewise, the fat/protein ratio of spring milk (1.24) has affected in a positive way the composition of the cheeses, in relation to the autumn cheese (1.37) which had higher fat level. This same tendency is found in other parameters studied, being the most representative ones those presented in Table 3, except for the fat which is 6% lower in spring, which is proper of the milk fat content at that time.

Table 4. Body condition and weight in merino ewes at milking

	Body condition score					Live weight (kg)	
Spring	Week of lactation						
Week	4	8	12	16	20	7	23
Mean	2.3	2.4	2.6	2.9	3.7	50.8	57.8
BD	2.2	2.3	2.5	2.8	3.4	48.0	54.8
ED	2.4	2.5	2.7	3.1	3.9	51.0	58.3
PD	2.5	2.5	2.7	3.0	3.8	53.3	60.3
Autumn	Week of lactation						
	2	6	10	14	17	6	17
Mean	2.3	2.1	2.7	3.3	3.8	47.6	54.8
BD	2.3	2.1	2.6	2.7	4.0	46.7	53.6
ED	2.2	2.1	2.7	3.1	3.4	48.1	45.8
PD	2.2	2.1	2.6	3.4	3.5	47.8	55.4

Table 5. Analyses of Merino sheep cheeses[†]

	Spring					Autumn				
	DE	FC	PC	FCY	CCY	DE	FC	PC	FCY	CCY
Mean	66.7	32.3	26.0	5.4	7.2	59.4	34.4	21.4	4.5	6.2
BD	66.8	33.0	25.7	5.5	7.3	59.6	34.4	21.0	4.3	5.8
ED	67.5	32.0	26.8	5.1	7.2	59.7	32.4	21.7	4.6	6.6
PD	65.9	31.9	25.5	5.5	7.2	58.9	36.5	21.4	4.3	5.8

[†]DE: dry extract; FC: crude fat (percentage); PC: crude protein (percentage); FCY: fresh cheese yield (l milk/kg of cheese); CCY: cured cheese yield (l milk/kg of cheese).

There are no relevant differences among the three diets tested regarding cheese yield (fresh or cured), dry extract, fat or protein. Though slight differences were found in favour of the ED in the cheese protein and therefore, according with its fat/protein ratio (1.19 in spring and 1.49 in autumn), in cheese yield, particularly the cured one, since this cheese depends mainly on the content in clotting protein (Molina, 1997). The influence of the energetic diet on cheese production confirms the same effects in the cheese composition than the ones noticed in the milk production, due to the low influence of pasture at this time, and in contrast with the effect of supplementation in the spring-summer pasture.

Conclusion

The variation in the milk yield and its chemical composition (related to the recovery of body conditions) are more intense in the PD-ED diet during milking in winter-spring (12%) and ED in autumn (24%), all this, at the same time, is related to the energetic-protein or energetic value of the pasture in winter-spring and autumn, respectively.

The spring milk shows slightly lower fat content (8% in autumn versus 6% in winter-spring), during most of the milking, reversing those values near the drying (10% in spring-summer and 8% in autumn). Generally better levels of milk fat content were noticed in the basic diet in spring as well as in autumn and the highest levels of crude protein were found in the protein diet in autumn.

The cheese yields in autumn improve 16% at cured cheese and 20% at fresh cheese, and the chemical values of these cheeses are higher in spring, except for the fat content. The energetic supplementation at grazing improves the fat/protein ratio by 8%. The fresh cheese value improves by 7% with energetic diet in spring and protein in autumn.

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