Livestock Science 122 (2009) 349–353

Contents lists available at ScienceDirect

Livestock Science

journal homepage: www.elsevier.com/locate/livsci

Short communication

Milk yield and composition of lactating Comisana ewes fed total mixed rations containing nitrogen sources with different ruminal degradability

V. Tufarelli *, M. Dario, V. Laudadio

Department of Animal Health and Welfare, Faculty of Veterinary Medicine, University of Study of Bari, Strada Provinciale per Casamassima, km 3, 70010 Valenzano (Ba), Italy

ARTICLE INFO

Article history:
Received 25 June 2008
Revised 20 August 2008
Accepted 27 August 2008

Keywords:
Ewe
Rumen degradable protein
CNCPS
Digestibility
Milk performance

ABSTRACT

The objective of this study was to examine the effects of pelleted total mixed rations (PTMR) containing two crude protein (CP) levels and N sources with different ruminal degradability on milk yield and composition of lactating ewes. The experiment, which lasted 14 weeks, was conducted during the spring and summer of 2007 and used 80 multiparous Comisana ewes in mid-lactation, reared in permanent stabling. A 2×2 factorial design was used, with ewes receiving two levels of CP (low 15.5% CP and high 17.5% CP) and two type of N sources with different rumen degradable protein (low and high) for each dietary treatment: (1) high-degradable protein diet (17.5% CP) composed by soybean meal, sunflower meal and urea (HPHD), (2) low-degradable protein diet (17.5% CP) included only corn gluten meal (HPLD), (3) high-degradable protein diet (15.5% CP) composed by soybean meal, sunflower meal and urea (LPHD), and (4) low-degradable protein diet (15.5% CP) included only corn gluten meal (LPLD). In order to evaluate in vivo digestibility of PTMRs, four adult rams were placed in metabolic cages and their individual faeces and urine were collected. In the performance trial, ewe milk yield was recorded daily and Individual milk samples were analysed weekly for milk composition and to determine milk renneting parameters. The 17.5% CP diets led to better nutrient apparent digestibility coefficients and had positive effects on milk production than the 15.5% CP diets. Similar results were obtained for corn gluten meal diets, compared to diets containing soybean meal, sunflower meal and urea. Data showed that corn gluten meal diets have had a positive effects on milk fat ($P<0.05$), but not on milk protein, lactose and renneting parameters. All ewes gained weight during the experimental period, but the body weight change was not significant among treatments. Our findings indicate that an increase in rumen undegradable protein (RUP) content does not negatively affect nutrient digestibility of sheep rations and milk yield and composition.

1. Introduction

In Mediterranean countries, ewes are often fed with total mixed rations featuring low quantity of roughage, and high amounts of concentrates and by-products. The source of dietary crude protein and energy given to dairy animals significantly influence the utilization of N and energy in the rumen and the flow of nutrients to the small intestine (Sahoo and Walli, 2008). To achieve this goal research has been largely focused on the use of high undegradable protein sources in order to increase milk quality (Santos et al., 1998).

The quantity and degradability of dietary protein affects rumen fermentation (Nocek and Russell, 1988), which ultimately affects net efficiency of absorbed nutrients (Gabler and Heinrichs, 2003).

The NRC (2001) classifies dietary crude protein into two components, rumen degradable protein (RDP) and rumen undegradable protein (RUP), each of which possesses separate and distinct functions. RDP is the sum of protein fractions (Sniffen et al., 1992) with degradation and passage rates as noted in the NRC (2001). Optimum utilization of

* Corresponding author. Tel.: +39 080 544 39 16; fax: +39 080 544 39 25.
E-mail address: tufarelliv@libero.it (V. Tufarelli).

1871-1413/$ – see front matter © 2008 Elsevier B.V. All rights reserved.
doi:10.1016/j.livsci.2008.08.012

dietary crude protein requires selection of complementary feed protein sources that provide the types and amounts of RDP that will meet, but not exceed, the N requirement of rumen microbes. Efficient utilization of dietary protein is of importance due to economic and environmental concerns.

Many feeding studies have been conducted with sheep to determine their requirements and dietary utilization. However, there are fewer diet evaluation systems for sheep than there are for cattle and they are often less developed, based on simpler approaches, and biologically more empirical than the cattle systems (Cannas, 2000; Cannas et al., 2004). None of the sheep diet formulation systems except INRA (1989) was designed for use with dairy sheep.

The Cornell Net Carbohydrate and Protein System (CNCPS) is a diet evaluation and formulation system developed for use in diverse animal, feed and environmental production situations for all classes of beef, dairy, and dual purpose cattle (Fox et al., 2004). The ability of the CNCPS structure to account for differences in feeds of diverse characteristics fed at different levels of intake, widely varying animal characteristics, and environmental effects led us to consider its modification to provide a more robust sheep model there are fewer diet evaluation systems for sheep than there are for cattle and they are often less developed, based on simpler approaches, and biologically more empirical than the cattle systems (Cannas, 2000).

Therefore, the objective of this study was to examine the effects of pelleted total mixed rations (PTMR) on milk yield and composition of lactating ewes containing two CP levels and N sources with different ruminal degradability formulated according to CNCPS.

2. Materials and methods

2.1. Animals, diets and milk yield trial

The experiment was conducted in the spring and summer (April–August of 2007) for 14 weeks and involved 80 multiparous lactating Comisana ewes that had lambed in winter (February). The experiment included two weeks of adaptation to the diet followed by 12 weeks of feeding the four experimental diets. At lamb weaning (42 ± 3 days after parturition), ewes were divided into four groups of 20 each, balanced for age, parity, time of lambing, number of lambs suckled, body weight (55 ± 0.7 kg, mean $\pm$ SE) and milk yield and composition. The animals were dewormed before start of the experiment and maintained under strict hygiene and uniform management. Groups were housed in four 100 m^2 pens inside a pre-fabricated building. Each pen was provided with a 200 m^2 outdoor paddock. Fresh water was provided ad libitum to all the animals twice a day at 10:30 and 16:00 h.

Four pelleted total mixed rations (PTMR) were formulated in order to be isocaloric and to provide two crude protein levels (17.5% and 15.5% CP, as fed basis) and N sources with different ruminal degradability of protein (Table 1) so as to meet the nutritional requirement (NRC, 1985). Treatments were: (1) high-degradable protein diet (17.5% CP) composed by soybean meal, sunflower meal and urea (HPHD), (2) low-degradable protein diet (17.5% CP) included only corn gluten meal (HPLD), (3) high-degradable protein diet (15.5% CP) composed by soybean meal, sunflower meal and urea (LPHD), and (4) low-degradable protein diet (15.5% CP) included only corn gluten meal (LPLD). Experimental diets contained N sources with different rumen degradable protein and different content in protein fractions according to CNCPS (Sniffen et al., 1992; Licitra et al., 1996), that were obtained by substituting soybean meal, sunflower meal and urea with corn gluten meal (Table 2). Each ewe was offered 2 kg/day (as fed basis) of total mixed ration split in three equal meals a day (06.00, 12.00 and 18.00 h). Ewes were milked twice daily (07.00 and 19.00 h) using pipeline milking machines. Body weights (BW) of ewes were recorded at the beginning and at the end of the experimental period.

Table 1
Ingredient composition of experimental diets fed to lactating Comisana ewes.

	Diets			
	17.5% CP		15.5% CP	
	HPHD	HPLD	LPHD	LPLD
Ingredients (%)				
Corn	25.50	21.00	25.50	22.00
Durum wheat straw	20.00	20.00	20.00	20.00
Durum wheat bran	19.30	23.80	25.45	29.80
Corn gluten meal (60% CP)	–	14.00	–	9.80
Soybean meal (44% CP)	13.20	–	9.20	–
Dehydrated alfalfa	7.50	7.50	7.50	7.50
Sunflower meal (28% CP)	5.00	–	3.00	–
Dehydrated beet pulp	3.00	7.60	3.00	5.00
Calcium carbonate	2.00	2.20	2.00	2.20
Molasses cane	2.00	2.00	2.00	2.00
Dicalcium phosphate	1.20	1.10	1.20	0.90
Urea (46% N)	0.50	–	0.35	–
Mineral–vitamin premix [a]	0.40	0.40	0.40	0.40
Sodium chloride	0.40	0.40	0.40	0.40

[a] Supplied per kg of diet: vitamin A 13,500 IU; vitamin D_3 2,700 IU; vitamin E 13.5 mg; vitamin B_1 8.44 mg; Vitamin B_2 5.06 mg; Vitamin B_6 2.02 mg; D-pantothenic acid 6.75 mg; vitamin PP 21.93 mg; vitamin B_{12} 0.01 mg; Co 0.51 mg; Fe 67.5 mg; I 1.65 mg; Mn 40.5 mg; Se 0.07 mg; Zn 101.3 mg.

2.2. Digestibility trial

Nutrient apparent digestibility of experimental diets was measured in metabolic cages equipped with separate feeders, automatic watering trough and a system for the separate collection of faeces and urine. Four castrated Comisana rams of 68 ± 3.8 kg live weight were used. Each animal received the four pelleted TMR in four different periods, without repeating any treatment within the same period, following a 4×4 Latin-square design. Each period consisted of 14 days of adaptation to diet in individual stalls with a concrete floor, 2 days of adaptation to metabolic cages, and 5 days of faeces collection (Givens et al., 2000). After 7 days of adaptation period, the digestibility of the PTMR, were offered simultaneously to the four animals. Seven days of adaptation period was used after each change, which lasted 7 days too. The rams were fed twice daily, at 7:00 and 19:00 h. Offered diets and refusals were recorded daily and composite samples, pooled on an individual animal basis at the end of each collection period, were dried at 105 °C for 24 h to determine DM intake. Another sample of the diet was ground in a hammer mill with a 1 mm size screen and stored until analysis. Faeces were collected daily and weighed and 0.20 of the total daily excretion was dried at 70 °C for 48 h and pooled on an individual animal basis at the end of the collection period.