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Small Ruminant Research 55 (2004) 135–140
Small Ruminant Research
www.elsevier.com/locate/smallrumres

Feeding behaviour of Comisana rams as affected by crude protein level of concentrate

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Received 12 June 2003; received in revised form 12 December 2003; accepted 16 January 2004

Abstract

Two groups of 10 Comisana rams at maintenance were fed hay and two concentrates characterized by different CP levels (20% H and 13% L). During two experimental periods, two types of hay were given: a poor-quality mixed hay from a weedy vetch and barley sward, and a good-quality sorghum hay. Dry matter intake was higher with the low-quality hay (on average: 2494.7 g per day versus 2133.1 g per day). The protein level of concentrates gave rise to different reactions in the animals in relation to the type of hay administered: with the mixed hay, no significant differences in intake were observed between the two groups (2505.0 and 2484.5 g per day, respectively, for H and L groups); with the sorghum hay, the group receiving the higher protein concentrate significantly reduced intake (2094.3 g per day versus 2171.9 g per day; $P < 0.05$). The variations in intake caused by the two concentrates and the two hays did not result in similar variations in the ram performance.

Keywords: Rams; Intake; Crude protein; Concentrate; Hay

1. Introduction

The administration of a concentrate may cause a substitution effect on forage intake. The variation in forage intake for unit of supplement administered is related to numerous variables linked to the characteristics of the forage and the supplement (Dulphy, 1978). In previous research with lactating dairy ewes at pasture (Avondo et al., 1997, 2000), we found that CP level of concentrate significantly influences feeding behaviour: as protein level of supplement increases, herbage intake or selectivity for plant parts richer in CP decreases. For these reasons we have proposed a simple model to predict herbage intake including, among variables, the grams of CP administered with the supplement, instead of the grams of DM, as the latter parameter was correlated to a lesser extent with herbage intake (Avondo et al., 2002). Studies have demonstrated that a sort of "nutritional wisdom" can act to induce the animals to eat adequate levels of CP to meet their requirements (Kyriazakis and Oldham, 1993; Forbes, 1995; Forbes and Mayes, 2002).

Knowledge on feeding behaviour of rams derive from studies on genetic types, environmental conditions and feed characteristics at times very different from the Mediterranean dairy sheep system. Farmers generally manage the rams with barren ewes or replacement lambs, regardless of their actual needs (Rassu et al., 2002). In this regard the need for intake

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doi:10.1016/j.smallrumres.2004.01.006

data or estimation models that derive from local trials has been highlighted (Elsen et al., 1988; Mahouachi et al., 2003).

The aim of this study was to evaluate the effects of different CP levels of concentrate on feed intake and selective behaviour of Comisana rams at maintenance.

2. Materials and method

2.1. Animals and experimental procedures

Two groups of 10 Comisana rams at maintenance, aged 4–5 years, were used (mean BW: 82.3 ± 5.95 kg). The rams were housed in individual pens and fed according to the following scheme—group L: 300 g concentrate at low CP content (13% DM) and 3 kg hay; group H: 300 g concentrate at high CP content (20% DM) and 3 kg hay. The concentrate components are reported in Table 1. The trial began on 6 July and was carried out in two distinct experimental periods lasting 21 days each, both preceded by a 15-day pre-experimental period; in the first period a low-quality mixed hay from a weedy vetch and barley sward was used; in the second period a good-quality sorghum hay was used. During the pre-experimental periods, the rams were fed with 3 kg mixed hay or sorghum hay (respectively in the first and in the second period) and with 150 g of each concentrate. The hays, chopped for 15 min, were given mixed with the concentrate.

2.2. Measurements and analysis

Individual intake was measured daily. Weekly the rams were weighed and body condition was recorded on a 5-point scale (1 = thin to 5 = obese) (Russel et al., 1969). During the two experimental periods, for each group, three mean samples of each feed administered and three mean samples of the residues were taken every 10 days. All the feed samples analyzed for fat, CP, ash (AOAC, 1984), structural carbohydrates (Van Soest et al., 1991) and DOM using pepsin and cellulase from *Thrichoderma viride* (Dowman and Collins, 1982).

The data from each experimental period were analyzed using one-way least-squares analysis with CP level of concentrate as main effect.

3. Results

The 15 min chopping caused a reduction in hay length, with mean values, for both types of forage, about 8 cm.

The hay administered in the two experimental periods differed highly in terms of chemical-nutritive characteristics (Table 1). In the first period a mixed hay was administered with CP and NDF content at 7.3

Table 1
Chemical composition of hays and concentrates, and concentrate ingredients

	Low-protein concentrate	High-protein concentrate	Mixed hay	Sorghum hay
Chemical composition				
DM (%)	87.6	87.3	83.1	73.2
CP (%DM)	13.3	19.8	7.3	13.1
NDF (%DM)	25.2	29.1	72.5	59.5
Lignin (%DM)	2.7	3.6	3.9	3.4
IVDOM[a] (%DM)	76.8	75.8	54.5	59.1
Concentrates ingredients (%)				
Maize meal	36.0	21.0		
Barley meal	38.0	28.0		
Wheat bran	8.0	8.0		
Soybean meal	–	22.0		
Carob meal	8.5	8.5		
Brewers grain	5.0	8.0		
Mineral and vitamin supplement	4.5	4.5		

[a] IVDOM: in vitro DOM.

Table 2
Mean daily intake (g per day) of Comisana rams

	Group L (low protein)	Group H (high protein)	Significance	S.E.D.
First experimental period				
DM	2484.5	2505.0	NS	47.0
CP	203.9	220.7	**	2.3
NDF	1687.5	1689.6	NS	33.8
Second experimental period				
DM	2171.9	2094.3	*	36.1
CP	307.1	318.1	**	2.1
NDF	1172.8	1134.8	NS	24.9

and 72.5%, respectively. In these feeding conditions, the concentrate protein level did not cause significant changes to DMI (Table 2). CP intake was obviously greater in the group receiving the 20% protein concentrate.

In the second period a sorghum hay was administered, characterized by a higher qualitative level than the previous hay, as indicated by the higher CP percentage and the lower NDF content (respectively, 13.1 and 59.5%). The DMI was higher in the group receiving the 13% CP concentrate ($P < 0.05$), whereas, as in the first period, CP intake was higher in the group receiving the 20% concentrate ($P < 0.01$). However, the difference between groups in protein intake was less compared to the previous hay (11.0 g versus 16.8 g).

Major differences in intake were observed between the two experimental periods; intake was on average 2.5 kg with the mixed hay and 2.1 kg with the sorghum hay. Fig. 1 shows DM intake trend during the experiment. It is possible to note that, within the third day of each pre-experimental period, rams stabilized the intake level of the new hay administered. In particular, during the first pre-experimental period, the animals rapidly increased their intake of the mixed hay from, on average, 2200 to 2500 g of DM. On the contrary, during the second period, rams decreased intake levels of the sorghum hay from, on average, 2500 to 2100 g of DM.

All animals demonstrated a good selective capacity with regards to the feed administered. Residues left in the trough were poor in CP and relatively rich in lignin (on average, CP: 5.02 and 5.68%; lignin: 7.69 and 5.8%, respectively, in the first and second period). This resulted in a consistent improvement of the diet

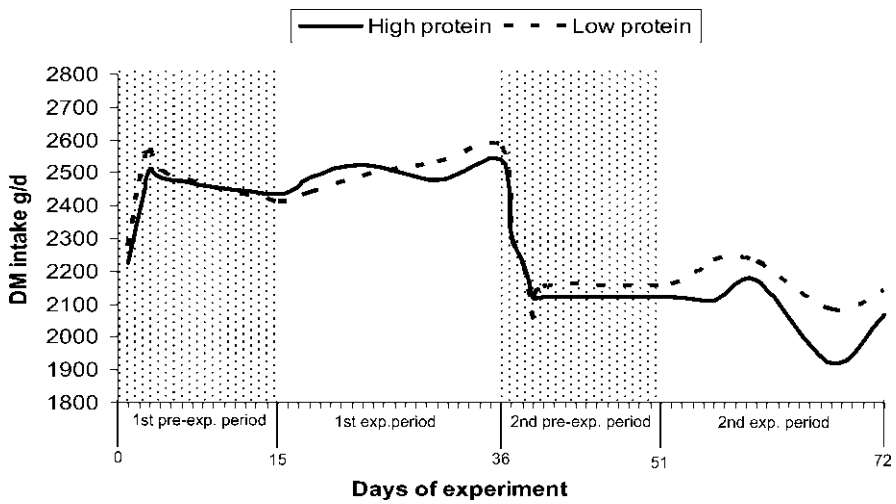

Fig. 1. DM intake of Comisana rams during the two pre-experimental and experimental periods.

Table 3
Chemical composition of given and selected diets

	Given diet		Selected diet	
	Group L (low protein)	Group H (high protein)	Group L (low protein)	Group H (high protein)
First experimental period				
DM (%)	83.5	83.5	84.2	84.7
CP (%DM)	7.9	8.5	8.2	8.8
NDF (%DM)	68.0	68.4	67.9	67.4
Lignin (%DM)	3.8	3.8	3.3	3.5
IVDOM[a] (%DM)	56.6	56.5	57.8	55.6
Second experimental period				
DM (%)	74.5	74.5	76.4	77.2
CP (%DM)	13.1	13.8	14.1	15.2
NDF (%DM)	55.8	56.3	54.0	54.2
Lignin (%DM)	3.3	3.4	3.0	3.0
IVDOM[a] (%DM)	61.0	60.8	62.3	62.4

[a] IVDOM: in vitro DOM.

selected by the animals, compared to that administered (Table 3). Taking into account that the more the chemical composition of selected diet differs from supplied diet, the more intense is selective activity, we found that sorghum hay caused higher selectivity than mixed hay.

The variations in intake caused by the two concentrates and the two hays did not result in similar variations in rams' performance. No significant differences ($P > 0.05$) were found in final body weights and BCS due to treatment.

4. Discussion

DM intake (mean: 86 g kg MW^{-1}) results were higher than data reported by other authors on Mediterranean rams (Alicata et al., 2002; Mahouachi et al., 2003).

The differences in intake observed in the two experimental periods would apparently seem anomalous. The poor quality of the hay caused much higher intake compared to good-quality hay. Intake levels measured with mixed hay, about 3% of ram BW, would seem rather high, considering that rams were at maintenance, and therefore with limited nutritive requirements and taking into account the intake data, considerably lower, reported by Rassu et al. (2002) for Sarda rams at similar body weights with better-quality diets.

The type of forage administered caused differences in the feeding behaviour of the rams. In fact, the protein level of the concentrate gave rise to different reactions in the animals, in relation to the type of hay administered. Whereas with poor-quality hay, the mixed hay, no intake differences were observed between the two groups, with good-quality hay the group receiving the higher protein concentrate reduced intake ($P < 0.05$).

The rams consistently demonstrated good selective capacity, that enabled them to improve diet quality with respect to the given ration. Reasons for which sheep select are diverse: some feeds are more appetizing because of the presence of substances such as particular flavours or soluble sugars (D'Urso et al., 1993); Forbes (1995) defines this selection as "hedyphagic". In other situations, especially during grazing, the facility for bite prehension can represent a determinant cause of selection (Hodgson et al., 1994). In some experimental conditions a surprising capacity to choose diet according to nutritive requirements has been shown (Kyriazakis and Oldham, 1993; Scott and Provenza, 2000). However, in any case, sheep fed indoors or at pasture, even in very diverse environmental conditions, nearly always select a diet richer in protein than the available forage, whereas the NDF level, or any other parameter related to structural carbohydrates, is not always lower with respect to the given forage. Moreover, the choice of plant parts rich in protein is more intense when poor forages are

concerned. Therefore, it would seem anomalous, in our experimental conditions, that rams, when they were fed good-quality hay, showed a higher selective behaviour compared to that with mixed hay. It is possible that the particular structure of sorghum, characterized by thick stalks, even if cut, enabled easier leaf selection by the animals, or of stalk parts that are less hard to chew. The consequence of this activity, by achieving higher protein inputs, probably set off a self-regulation mechanism for protein intake, determining an unexpected reduction in intake compared to the mixed hay. It seems that the rams reduced intake to avoid excess of protein consumption. Our results, i.e. high intake with the low CP hay and low intake with the high CP hay, seems to support the hypothesis formulated by Forbes and Provenza (2000) that ruminants can be able to self-regulate their intake, trying to prevent a "metabolic discomfort" given by an excess or a lack of nutrients. Animals could feel this metabolic discomfort during the first day of sorghum hay administration. Indeed, as often suggested (Kyriazakis et al., 1999; Provenza et al., 2003), ruminants learn to associate the post-ingestive effects of a food with its sensory properties. It can therefore be hypothesized that the animals perceived the negative effects of excessive protein input following high sorghum hay intake and that, within 3 days, they have adapted their intake to reduce metabolic discomfort. Moreover, decreasing CP level of supplement (from 15% of the second pre-experimental period to 12% given to L group during the second experimental period) intake increased again. Our results seem to be supported by results of Kyriazakis et al. (1994) who reported that growing sheep appear to regulate their protein input within a time scale of about 3–7 days.

In conclusion, two different intake control mechanisms would be hypothesized in the two experimental periods. In the first period, faced with poor-quality hay, rich in structural carbohydrates, the protein level of the concentrate does not modify intake when diet is probably poor in protein; the physical control would seem to prevail over other mechanisms, as demonstrated by the identical NDF intake levels in the two experimental groups. In the second period, with good-quality hay that nonetheless, due to its particular structure, offered ample selective opportunity, the protein level would seem to represent the intake limiting factor.

Acknowledgements

The research was supported financially by the Ministero delle Politiche Agricole e Forestali (Special Project "Ulteriore sviluppo ed evoluzione di un programma per la formulazione di razioni alimentari per ovini").

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