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Influence of the method of conservation of lucerne on ruminal degradability. I. Dry matter

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SUMMARY – The aim of this experiment was the evaluation of the rumen degradation of the dry matter of lucerne kept as hay or dehydrated. Samples from three alternate cuts and two phenological stages per cut were collected at a cultivated lucerne plot at Bujaraloz (Zaragoza) in 1998. Samples were submitted to a haymaking or dehydration process. The kinetics of degradation of dry matter was determined by the technique of nylon bags using three rams provided with a rumen cannula. The results obtained were adjusted to the curve $y = A + B (1 - e^{-Ct})$. The effective degradability (ED) was calculated for a passage rate (k) of 3.7%/h with the equation ED = A + (B C)/(C + k). Significant differences were obtained between cuts and phenological stages for the ED. However, no significant differences were obtained between both conservation methods for any parameter of the degradation kinetics and ED of dry matter.

Key words: Hay, dehydrated, rumen degradation, cut, phenological stage.

RESUME – *"L'influence de la méthode de conservation de la luzerne sur la dégradation de la matière sèche dans le rumen". L'objectif de cette expérience a été l'évaluation de la dégradation dans le rumen de la luzerne conservée sous forme de foin ou déshydratée. On a pris des échantillons de trois coupes et deux stades phénologiques par coupe sur une parcelle de luzerne cultivée à Bujaraloz (Zaragoza) en 1998. Les échantillons ont été soumis à un procédé de fenaison ou de déshydratation. La cinétique de dégradation de la MS a été déterminée par la technique de sachets de nylon en utilisant trois béliers avec des fistules ruminales. Les résultats obtenus on été ajustés à la courbe* $y = A + B (1 - e^{-Ct})$*. La dégradation effective (ED) a été évaluée pour un taux de passage (k) de 3,7%/h avec l'équation ED = A + (B C)/(C + k). On a obtenu des différences significatives (P < 0,05) entre coupes et stades phénologiques pour la ED. Cependant on n'a pas trouvé de différences significatives entre les deux méthodes de conservation, pour aucun paramètre de la cinétique de dégradation ni la ED de la matière sèche.*

Mots-clés : *Foin, déshydratation, dégradabilité de la matière sèche, coupe, stade phénologique.*

Introduction

Hay-making has been the traditional conservation method for lucerne cultivated in the Ebro Valley, though in the last years the quantity of dehydrated forage has been higher than hay-making (Ben-Chabanne and Delgado, 1998). Among the advantages attributed to the dehydration, we can mention the following ones: culture intensification, diversification of the forage use and independence from the climatic conditions (Llorca *et al.,* 1998). However, there are no studies comparing the quality of the lucerne kept by different methods under Mediterranean conditions.

The aim of this work is to compare the influence of two methods of lucerne conservation in three cuts (spring, summer and autumn) and at two phenological states (10% and 50% bloom) on rumen degradability of dry matter (DM).

Materials and methods

This study was carried out in an irrigated lucerne plot (cultivar Aragón) in the second year of growing, at Bujaraloz (Zaragoza) during 1998. Half of the plot was devoted to collecting hay samples and the forage obtained from the remaining part was submitted to a dehydration process. It was incorporated into a hot air current at 500ºC for at least 5 minutes. The hay-making process consisted of drying by sunshine under natural conditions until the sample reached a maximum of 20% humidity.

The plot was cut six times a year according to the traditional lucerne management in the area. Samples were taken from the second (spring), fourth (summer) and sixth (autumn) cuts at two phenological states: early boom and full bloom (except the last cut where samples were only taken in the vegetative state, for plants did not give flowers).

Following the hay-making and dehydration processes, two bales from each cut (700 kg), one of hay lucerne and the other one dehydrated, were taken to the laboratory for tests of *in sacco* dry matter degradability. These tests were carried out with three four-year-old castrated rams (Fleichchaff Rasa Aragonesa) provided with a rumen cannula, 62 kg average weight and adapted to a ration composed of 70% lucerne hay and 30% concentrate (barley and a mineral-vitamin complement).

The *in situ* technique (Mehrez and Orskov, 1977) was applied for the determination of the DM degradability. Bags containing forages were incubated in the animals' rumen with two repetitions per ram and per incubation time. The bags were left in the rumen for 2, 4, 8, 16, 24 and 48 hours. Afterwards, they were washed and dried in a oven at 60ºC.

Results obtained were fitted to the equation proposed by Orskov and McDonald (1979) $y = A + B (1 - e^{-Ct})$. Parameters A, B and C were estimated individually for each animal by a nolinear regression. The adjustment of the kinetics values of rumen degradation to that equation was made by the procedure NLIN from the SAS statistical package (1998). The effective degradability (ED) of the DM was calculated for a rumen outflow rate (k) of 3.7%/h (Alvir *et al.*, 1998) by the equation DE = A + [(B C)/(C + k)].

The results were submitted to an analysis of variance according to a split-plot design where the type of conservation constituted the main plots and the cut number, the split plot. Factors such as type of conservation and cut were treated as crossed factors and the phenological state as a nested factor within cuts. Each animal was considered as a block factor.

Results and discussion

The results obtained from the analysis of variance for the soluble fraction (A), insoluble potentially degradable fraction (B), potentially degradable fraction (A + B), fractional degradation rate of the slowly degradable fraction (C) and effective degradability of the dry matter (ED) are given in Tables 1, 2 and 3.

No significant differences were found between field dried and dehydrated forage (Table 1) for ED and the potentially degradable fraction (A + B), though the conservation under dehydrated form presented higher values than hay with respect to B and lower values concerning A. Polan *et al.* (1998) also observed lower values for the quickly degradable fraction and higher values of B in lucerne silages, previously treated with heat the undegradable fraction not being affected. This phenomenon can be explained by the larger exchange of nutrients, which can take place between fraction B and A in hays in relation with dehydration (Demarquilly, 1987; Charmley and Viera, 1990). Another possible explanation would be the higher increase of fraction B from nutrients belonging in the beginning to fraction A in the dehydrated forage due to the higher temperatures reached in this process in relation to field dried. In this sense, Charmley and Veira (1990) and Polan *et al.* (1998) found higher values in the fraction of neutral detergent fibre (NDF) and acid detergent fibre (ADF) in a heated lucerne than alfalfa forage kept as hay.

Table 1. Average values of soluble fraction (A), insoluble potentially degradable fraction (B), potentially degradable fraction (A + B), fractional degradation rate (C) and effective degradability of dry matter (ED) (calculated for a passage rate of 3.7%/h) according to the conservation method applied

Conservation method	A (%)	B (%)	A + B (%)	C (%/h)	ED (%)
Field dried	41.0 a	37.5 b	79.7 a	9.4 b	63.7 a
Dehydrated	37.0 b	41.1 a	78.7 a	10.7 a	62.1 a

[a,b]Values in the same column with different superscript are different from $P < 0.05$.

Concerning the cut factor (Table 2), fractions B, A + B and ED of the dry matter proved to be highly significant, the values obtained in the sixth cut for these parameters being higher than those obtained for the remaining cuts. Alvir *et al*. (1998) also found significant differences in the different parameters of the degradation kinetics and ED of DM, suggesting the possible existence of the seasonal effect which could influence those parameters.

Table 2. Average values of soluble fraction (A), insoluble potentially degradable fraction (B), potentially degradable fraction (A + B), fractional degradation rate (C) and effective degradability of dry matter (ED) (calculated for a passage rate of 3.7%/h) according to the different cuts

Number of cut	A (%)	B (%)	A + B (%)	C (%/h)	ED (%)
2nd	39.0 a	37.7 b	77.0 b	9.2 a	61.7 b
4th	37.5 a	38.2 b	76.0 b	11.0 a	61.9 b
6th	39.5 a	44.7 a	84.5 a	10.0 a	67.0 a

[a,b]Values in the same column with different superscript are different from P < 0.05.

Regarding the phenological state (Table 3), the forage obtained when the cut was made at 10% bloom, presented higher A + B and DE values than when it was made at 50% flowering. Hoffman *et al.* (1993) also found significant differences in all the kinetics parameters of degradation of DM and DE due to the advance of the vegetative cycle, attributing the differences obtained in ED mainly to the increase of the undegradable fraction with the advance of maturity.

Table 3. Average values of soluble fraction (A), insoluble potentially degradable fraction (B), potentially degradable fraction (A + B), fractional degradation rate (C) and effective degradability of dry matter (ED) (calculated for a passage rate of 3.7%/h) according to the different phenological states within each cut

Number of cut	Phenological state	A (%)	B (%)	A + B (%)	C (%/h)	ED (%)
2nd	10%	40.8 a	37.7 a	78.7 a	9.5 a	63.8 a
	50%	37.3 a	37.8 a	75.2 b	8.8 a	59.7 b
4th	10%	38.2 a	38.5 a	77.0 a	10.8 a	63.0 a
	50%	36.7 a	37.8 a	74.2 b	11.2 a	60.8 b

[a,b]Values in the same column with different superscript are different from P < 0.05.

Conclusions

The effective degradability of the dry matter and the potentially degradable fraction of the dry matter were not affected by the lucerne conservation method.

Cuts made in autumn and at the phenological states of 10% bloom presented higher values of effective degradability and potentially degradable fraction than the cuts made in spring and summer and at 50% flowering.

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