

THE DUODENAL FLOW OF ORGANIC MATTER AND NITROGEN IN DAIRY COWS RECEIVING FRESH HERBAGE FERTILIZED AT TWO LEVELS OF NITROGEN

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Introduction

Protein in intensively fertilized fresh herbage is characterized by a high rate and extent of degradation in the rumen, resulting in high ammonia levels in the rumen and substantial losses of nitrogen (N) via urinary excretion (Beever and Siddons, 1986). In *in sacco* experiments the rate of degradation of crude protein of fresh herbage decreased when reducing the level of N fertilization. (Van Vuuren, unpublished).

The effect of the level of N fertilization on the N metabolism in dairy cows fed fresh herbage was studied in three animals equipped with ruminal and duodenal ("T"-piece) cannula.

Materials and Methods

The animals, Dutch-Friesian dairy cows, produced 25 kg milk at the onset of the experiment. The study was carried out in 1987 and included four experimental periods of 6 days. In periods 1 (June) and 4 (October) fresh herbage (*Lolium perenne*) was fed from a plot fertilized at a level of 494 kg N/ha/y; in periods 2 (July) and 3 (September) the herbage fed was from a plot fertilized at a level of 276 kg N/ha/y.

The animals grazed until five days before the start of the experimental period, when the animals were stalled and fed indoors, and dosed six times daily with chromium-mordanted NDR (c. 2 g/d). Herbage was harvested at 7:30 and 16:00 and was offered *ad libitum* in six (periods 1 and 2) or five (periods 3 and 4) meals per day. During milking a commercial compound feed was offered at a level of 1 kg/d.

During the experimental period herbage andorts were weighed and sampled; faeces were collected and sampled daily. During two 24h-periods ruminal and duodenal samples were taken regularly. In each 24h period six duodenal samples were

taken, by collecting c. 4 kg of duodenal digesta of which 600 g was taken to compose a 3.6 kg sample per cow per day. The remaining duodenal digesta was returned through the cannula.

All samples were lyophilized, ground and analyzed for dry matter (DM), ash and N as described by Van Vuuren et al. (1989). The flow of microbial protein was estimated using diaminopimelic acid (DAPA) as the marker. The N:DAPA ratio was estimated in lyophilized bacteria isolated from the rumen. Duodenal flow and faecal excretion were calculated based on a 100% recovery of the Cr.

Lyophilized samples of the herbage were ground to pass a 3 mm screen and incubated in nylon bags in the rumen as described by Van Vuuren et al. (1989). From the data of these incubations the proportion of herbage protein escaping rumen fermentation was predicted assuming a rate of passage of 3%/h.

Results and Discussion

The apparent digestion of organic matter (OM) was higher for the more intensively fertilized herbage (table 1). The contribution of the rumen in the OM digestion was relatively high: 80 to 90 per cent of the digestible OM disappeared before the duodenal cannula. An extensive ruminal digestion of fresh herbage was also reported by Beever et al. (1986). However our observation may have been influenced by an overestimation of the recovery of Cr in the duodenal digesta, resulting in an underestimation of the duodenal OM flow.

Lower levels of N fertilization resulted in a lower N content of the herbage (34, 28, 27 and 31 g/kg DM in periods 1 to 4 respectively), but differences were small. Because of a low DM intake in period 1, the N intake in that period was even lower than in period 2 (table 2).

The reduction of N fertilization increased the

TABLE 1. THE EFFECT OF THE LEVEL OF N FERTILIZATION (kg/ha/y) OF FRESH HERBAGE FED TO DAIRY COWS (n=3) ON THE INTAKE, DUODENAL FLOW AND FAECAL EXCRETION OF ORGANIC MATTER (kg/day).

Period	1	2	3	4
Month	June	July	Sept.	Oct.
N level	494	276	276	494
Intake	12.08 1.67	15.03 0.82	12.29 0.37	13.99 0.21 ^a
Duodenal flow	3.71 0.45	5.47 0.92	4.14 0.25	3.78 0.37
Faecal excretion	2.40 0.40	3.28 0.06	2.89 0.06	2.71 0.19
Apparent faecal digestibility	0.80 0.010	0.78 0.009	0.76 0.011	0.81 0.015
Proportion DOMADR ^b	0.86 0.043	0.81 0.065	0.87 0.029	0.90 0.043

^aStandard error of mean.

^bDOMADR = digestible organic matter apparently digested in the rumen.

proportion of feed N escaping from rumen fermentation if predicted from the nylon bag incubations. However, as the N content in the herbage decreases the absolute amount of herbage N escaping rumen fermentation may decrease. Also a higher proportion of the escaping protein will be undigestible, but the variation in the proportion of undegradable feed N was small. In period 3 the estimated duodenal flow of herbage N did not agree with the predictions based on the nylon bag studies.

Only 46 to 58 per cent of the duodenal N flow was recovered in the faeces. As the proportion of microbial protein in the duodenum varied between 64 and 73 per cent, and the digestibility of microbial protein is assumed c. 80%, this low intestinal disappearance of N may be another indication for the underestimation of the duodenal flow in our study. The underestimation of the duodenal flow of microbial N and the overestimation of OM fermentation in the rumen will result in a low efficiency of microbial protein synthesis.

Although the results of this study should be considered carefully, our data suggest that the de-

TABLE 2. THE EFFECT OF THE LEVEL OF N FERTILIZATION (kg/ha/y) OF FRESH HERBAGE FED TO DAIRY COWS (n=3) ON THE N METABOLISM (g/day)

Period	1	2	3	4
N level	494	276	276	494
Intake	443 66	457 28	365 12	497 8 ^a
Duodenal flow	248 28	358 55	256 28	270 35
Faecal excretion	127 27	149 4	124 7	145 12
Duodenal DAPA flow	7.4 0.40	11.1 1.73	8.2 0.90	8.4 0.74
N:DAPA ratio in bacteria	22.9 3.1	21.5 1.3	22.9 1.1	20.6 0.9
Microbial N (kg OMADR ^b)	21.3 6.7	25.2 5.6	23.1 2.9	17.1 2.3
Escaped feed N	0.17 0.06	0.26 0.05	0.18 0.01	0.19 0.03
<i>Nylon bag incubations:</i>				
Escaped N	0.17	0.20	0.29	0.17
Undegradable N	0.04	0.05	0.06	0.04

^aStandard error of mean

^bOrganic matter apparently digested in the rumen.

creased flow of digestible feed protein due to a reduced N fertilization, can be compensated for to some extent by an increase of the efficiency of microbial protein synthesis. A higher microbial protein production was also observed by Beever et al. (1987) when treating fresh herbage with formaldehyde in order to decrease the rate of degradation. Thus the more efficient protein synthesis may be the result of a better capture of NH₃-N by the rumen micro-organisms, due to a more gradual release of NH₃-N from the less intensively fertilized herbage.

(Key Words: Herbage, Nitrogen, Duodenal Flow).

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