

PASSAGE RATE AND TOTAL CLEARANCE RATE OF DIGESTA FROM THE RUMEN OF COWS FED GRASS SILAGES

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Introduction

In roughage diets the main part of the carbohydrates are structural carbohydrates. The regulation of feed intake and the influence of the "structure" of the feed is not a well known mechanism.

The intake capacity of an animal is determined by rumen volume and retention time of the feed in the rumen. The decrease of the feed volume in the rumen depends on digestion rate and rate of passage to the omasum, of which the latter may be limited by the rate of particle size reduction through rumination.

An experiment was performed to study clearance rate of digesta from the rumen as related to intake and composition of the feed.

Materials and Methods.

Two grass silages, from the same field, were harvested at different growth stages, resulting in a different crude fibre content. These silages were fed ad libitum to four rumen fistulated dry cows in a cross over design. The cows were offered feed twice a day, at 7.00 and 19.00 h. Leftovers were removed at 9.00 and at 7.00 h.

Feed organic matter (om) intake was recorded per day.

On Monday at 6.00 hours 300 g of Cr-NDF (0.2-1 mm, \pm 5% Cr) was introduced into the rumen as a marker for passage rate of the particulate fraction from the rumen.

Rumen evacuations were done for five days; four days twice a day with a five hour interval, and the fifth day once early in the morning without feeding them the night before (0.5, 1.5, 2.5, 3.5, 5.5, 6.5, 7.5, 8.5 and 22.5 h after feeding). The rumen contents were weighed and sampled.

Faeces were collected on Tuesday, Wednesday and Thursday from 8.00 till 20.00 h.

In dried rumen and faecal samples the concen-

tration of Cr was determined using atomic absorption spectrophotometry.

Passage rate of Cr and clearance rate of om were estimated directly in the rumen from the decline in the different pool sizes according to the following model.

$$P_t = P_0 * e^{-kt}$$

in which

P_t = rumen pool (om, Cr) at time t

P_0 = rumen pool (om, Cr) at feeding and introduction of the marker, respectively

k = fractional rate constant

t = hours after feeding (om), or hours after introduction of Cr-NDF (Cr)

Faecal excretion curves were estimated according to the same model using Cr-concentration instead of pool size.

TABLE 1. COMPOSITION OF THE GRASS SILAGES (%)

	Silage H	Silage L
Dry matter (DM)	62	56
In the DM		
Ash	9.1	11.3
Crude fibre (CF)	29.2	25.3
Crude protein (CP)	15.2	21.0

Results and discussion

Intake was higher for silage H than for silage L (table 2). The amount of silage needed to cover the energy requirements of the cows was lower for silage L than for silage H.

Rumen contents were at all times higher for silage H than for silage L (table 3), probably because of a higher intake.

TABLE 2. VOLUNTARY INTAKE OF ORGANIC MATTER (OM) OF THE TWO SILAGES (kg/day)

	OM ¹
Silage H	10.1 ± 0.8 ^a
Silage L	9.1 ± 0.6 ^b

¹ means ± SD
a,b super script (p < 0.01)

TABLE 3. RUMEN CONTENTS (kg AND kg OM) AT DIFFERENT TIMES AFTER FEEDING, FOR THE TWO GRASS SILAGES

Time after feeding	Silage H	
	kg ¹	OM ¹
0.5	95.6 ± 6.2	9.4 ± 1.0
1.5	97.0 ± 8.7	9.3 ± 0.9
2.5	94.1 ± 2.7	9.0 ± 0.3
3.5	92.8 ± 7.4	8.2 ± 1.0
5.5	94.6 ± 12.8	8.2 ± 1.3
6.5	93.9 ± 12.0	7.6 ± 0.9
7.5	88.8 ± 8.2	7.3 ± 0.5
8.2	85.5 ± 9.0	6.8 ± 0.9
22.5	66.0 ± 6.4	4.1 ± 1.1

Time after feeding	Silage L	
	kg ¹	OM ¹
0.5	95.8 ± 6.7	8.4 ± 0.9
1.5	93.9 ± 12.2	8.2 ± 1.0
2.5	90.5 ± 5.4	7.2 ± 0.6
3.5	89.0 ± 5.3	7.4 ± 0.9
5.5	82.5 ± 4.3	6.6 ± 1.0
6.5	80.3 ± 10.2	6.2 ± 1.0
7.5	80.2 ± 8.1	6.0 ± 0.5
8.5	76.6 ± 8.9	5.9 ± 0.6
22.5	60.2 ± 7.7	3.4 ± 0.4

¹ means ± SD

No difference between silages was found for rumen organic matter clearance (%/h) (table 4). The passage rate of the Cr-NDF (%/h) was higher

TABLE 4. CLEARANCE RATE OF ORGANIC MATTER FROM THE RUMEN AND PASSAGE RATE OF Cr-NDF (%/h) MEASURED DIRECTLY IN THE RUMEN (Cr-NDF, RUMEN) OR INDIRECTLY FROM THE FAECAL EXCRETION CURVES (Cr-NDF, FAECES)

Silage	Organic matter ¹	Cr-NDF ¹ rumen	Cr-NDF ¹ faeces
H	3.85 ± 1.14	4.46 ± 0.71 ^a	3.66 ± 0.44 ^a
L	4.06 ± 0.28	3.95 ± 0.45 ^b	3.32 ± 0.90 ^b

¹ means ± SD
a,b in the same column: (p < 0.05)

for silage H, and higher if estimated directly in the rumen as compared to indirectly from the faecal excretion curves. In experiments with sheep, Bosch et al. (1988) experienced the same phenomenon for the fluid phase estimated directly in the rumen or indirectly from the faecal excretion curves.

The results show that Cr-NDF does not represent the total rumen particulate contents, because passage rate can impossibly be higher than total clearance rate. The particle size of Cr-NDF was 0.2-1 mm. It is presently under investigation for which rumen particle sizes Cr-NDF of this size and specific gravity may be regarded as representative.

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(Key Words: Rumen Contents, Passage Rate, Grass Silages)

Literature Cited

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