

Forage species effects on particle digestion kinetics estimated by rumen evacuation or gas production technique

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Introduction

Digestion rate (k_d) of feedstuffs can be estimated *in vivo*, *in situ* or *in vitro*. The *in vitro* methods are relatively inexpensive and have typically good correlation with *in vivo* data. The objectives of this study were to compare:

- I. ruminal pool sizes and digesta kinetics of large (LP), medium (MP) and small (SP) particles in dairy cows fed grass or red clover silage diets and
- II. digestion rate of pdNDF in different particle sizes estimated by rumen evacuation or *in vitro* gas production technique.

Materials and Methods

- 2-period change over design with 2 cows using rumen evacuation and faecal crab sampling.
- Large, medium and small particles were separated (division at 1.25, 0.315 and 0.038 mm) using wet sieving technique.
- iNDF was measured using 12-d *in situ* ruminal incubation (nylon bag pore size 17 μ m).
- Calculation of particle kinetics using rumen evacuation (Huhtanen et al. 2007, Anim. Feed Sci. Technol. 133: 206-227).
- Ruminal particle fractions with different sizes were exposed to an automated *in vitro* gas production analysis (Huhtanen et al. 2008, J. Anim. Sci. 86: 651-659).
- Orthogonal contrasts were used to compare the effects.

Results

Ruminal pdNDF content was greater in all particle size fractions of grass compared to those of red clover silage diets ($P < 0.01$) and it was greater in LP compared to MP or SP of both forage species ($P < 0.01$, Table 1). Ruminal passage rate of iNDF and pdNDF increased with decreasing particle size ($P < 0.01$).

Passage rate of pdNDF in all particle fractions was faster for red clover compared to grass silage diets ($P < 0.05$). Digestion rate (k_d) of pdNDF was not different between the forage species whereas it was slower for SP compared to LP and MP of both grass and red clover silage diets.

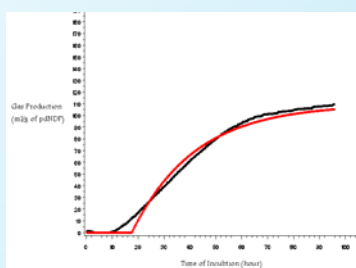
Effective k_d estimated by gas production was numerically slower for ruminal LP and MP compared to k_d of those particles estimated by rumen evacuation but for SP the opposite trend was observed even though no statistical analysis was done.

Table 1. Ruminal pools of DM, iNDF and pdNDF, and ruminal rates of passage and digestion estimated by rumen evacuation and effective digestion rate and digestibility of pdNDF estimated by *in vitro* gas production from ruminal large (LP), medium (MP) and small (SP) particles

	Grass silage			Red clover silage			SEM ¹	Orthogonal contrasts ²		
	LP	MP	SP	LP	MP	SP		S	P	S × P
Ruminal digesta, kg										
DM	4.58	2.92	1.76	5.10	1.75	1.94	0.519	ns	**	†
iNDF	1.35	1.08	0.40	1.94	0.74	0.39	0.213	ns	**	†
pdNDF	2.24	1.19	0.69	1.76	0.59	0.50	0.184	**	**	ns
pdNDF kinetics (rumen evacuation)										
Passage rate, h ⁻¹	0.0047	0.0342	0.0472	0.0117	0.0428	0.0535	0.00365	*	**	ns
Digestion rate, h ⁻¹	0.0422	0.0544	0.0182	0.0425	0.0367	0.0197	0.00549	ns	**	ns
<i>In vitro</i> gas production										
Effective										
Digestion rate, h ⁻¹	0.0312	0.0236	0.0275	0.0330	0.0244	0.0296	0.00199	ns	**	ns
Digestibility, g kg ⁻¹	695	611	658	711	620	680	21.5	ns	**	ns

¹ SEM, standard error of means, n = 2 ns, non significant; †, $P < 0.10$; *, $P < 0.05$; **, $P < 0.01$

² S, forage species (*i.e.* grass vs. red clover); P, particle size (*i.e.* large vs. small particles); S × P, Interaction of forage species and particle size



Photos: Ali Reza Bayat