The effect of forage species on kinetics of large and small particles in dairy cows

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Introduction

Fibre can be divided into indigestible and potentially digestible neutral detergent fibre (iNDF and pdNDF, respectively) which have different properties. On the other hand, ruminal particles can be divided into escapable and non-escapable. In this experiment, we used particle size as an indicator of the escapability of the particles.

Rumen evacuation technique with wet sieving and iNDF determination can be used to estimate passage rate (k_p) of iNDF and kp and digestion rate (k_d) of pdNDF for both escapable and non-escapable ruminal pools.

Grass and legume forages differ in digestion and passage kinetics due to different histological characteristics. Therefore, this experiment was conducted to compare ruminal pool sizes and digesta kinetics of small and large particles in dairy cows fed grass or red clover silage diets.

Materials and Methods

2-period change over design with 2 cows was performed using rumen evacuation and faecal crab sampling. Experimental silages were prepared from timothy-meadow fescue and red clover swards. The silages were supplemented with dietary concentrate (0.45 of DM intake). Ruminal contents were evacuated at 6 and 12 h after feeding on d 14 and 21 of each experimental period, respectively.

The samples were divided into large (LP, >1.25 mm) and small (SP, 1.25-0.038 mm) particles by wet sieving. To determine iNDF concentration, 1.0 g sample of DM was incubated for 12 d in the rumen of two cows. The pdNDF concentration was calculated as NDF–iNDF. All the calculations are described by Huhtanen *et al.* 2007 Anim. Feed Sci. Technol., 133: 206-227

Latin square split-plot model was used to analyse the data (SAS PROC Mixed), where the treatment and particle size were considered as the main and sub plots, respectively. Orthogonal contrasts were used to compare the effects.

Results

Ruminal iNDF content was higher in large particles and lower in small particles of red clover compared to those of grass silage diet ($P < 0.05$ for interaction of forage species and particle size; Table 1). Ruminal pdNDF content in both large and small particles of red clover was smaller than those of grass silage diet.

Passage rates (k_p) of iNDF and pdNDF increased with decreasing particle size for both treatments ($P < 0.01$). Particle breakdown rate tended to be slower for red clover compared to grass silage diets ($P < 0.10$).

Digestion rate (k_d) of pdNDF was not different between LP and SP of grass and red clover silage diets.

Table 1. Ruminal pools of dry matter (DM), indigestible fibre (iNDF) and potentially digestible fibre (pdNDF), and ruminal rates of passage (k_p), particle breakdown (k_r) and digestion (k_d) of large (LP) and small (SP) particles of dairy cows fed grass or red clover silage based diets

	Grass silage		Red clover silage			Orthogonal contrasts [2]		
	LP	SP	LP	SP	SEM [1]	S	P	S × P
Ruminal pool, kg								
DM	3.96	4.05	4.26	3.09	0.607	†	*	*
iNDF	1.35	1.49	1.94	1.13	0.267	ns	†	*
pdNDF	2.24	1.88	1.76	1.08	0.247	**	**	*
iNDF kinetics								
k_p, h^{-1}	0.0057	0.0522	0.0106	0.0522	0.00354	ns	**	ns
k_r, h^{-1}	0.0477		0.0227		0.00244	†	-	-
$k_r (k_r + k_p)^{-1}$	0.89		0.68		0.03120	ns	-	-
pdNDF kinetics								
k_p, h^{-1}	0.0047	0.0389	0.0117	0.0477	0.00336	†	**	ns
k_d, h^{-1}	0.0422	0.0409	0.0425	0.0289	0.00460	ns	ns	ns
$k_d (k_r + k_p + k_d)^{-1}$	0.44	0.51	0.55	0.38	0.02061	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