Fibre degradation rate of perennial ryegrass varieties measured using three techniques: *in situ* nylon bag, *in vivo* rumen evacuation and *in vitro* gas production

H.Z. Taweel[1], B.M. Tas[1], B.A. Williams[1], A. Elgersma[2,3], J. Dijkstra[1] and S. Tamminga[1]
[1]Animal Sciences Group, Animal Nutrition, P. O. Box 338, 6700 AH, Wageningen, The Netherlands, Email: Hassan.taweel@wur.nl, [2]Plant Sciences Group, Crop and Weed Ecology, Wageningen University, P. O. Box 430, 6700 AK, Wageningen, The Netherlands, [3]University of Ghent, Belgium

Introduction In Western Europe, perennial ryegrass is the most widely used grass species for grazing cattle, because of its high productivity, palatability and nutritive value. However, the low dry matter intake (DMI) of perennial ryegrass pasture has been identified as a major factor limiting milk production of high producing dairy cows. Altering the chemical, physical and mechanical characteristics that contribute to its low DMI through grass breeding and the choice of variety may be a way forward in trying to maximise its DMI. This study aimed to examine whether perennial ryegrass varieties differ in their NDF degradation rates (kd_{NDF}).

Materials and methods The samples for the nylon bag and gas production measurements originated from an indoor feeding experiment, in which six diploid varieties of perennial ryegrass were fed to six high producing rumen-cannulated dairy cows using a double 3 × 3 Latin square design. In this experiment, NDF clearance rate (Kcl_{NDF}) and kd_{NDF} of each variety were estimated using two rumen evacuations separated by a 12-h period of feed deprivation. For the *in situ* measurements, freeze-dried grass samples were chopped to a 1-cm length, weighed into nylon bags and incubated in the rumen for 2, 4, 8, 12, 24, 48 and 336 h. For the *in vitro* gas measurements, freeze-dried grass samples were ground to pass a 1-mm sieve and incubated with inoculum from grass-fed cows for 72 hours using an automated gas production system. The resulting gas curves were fitted using the two-phase logistic model.

Results The *in situ* NDF degradation kinetics parameters (undegradable fraction (U), potentially degradable fraction (D) and rate of degradation (kd)) did not differ significantly among varieties, which was in agreement with the *in vivo* and *in vitro* data (Table 1). On average, the U-fraction of NDF was around 14 % and the D-fraction around 86 % with a degradation rate of around 2.5 %/h for all varieties. The three techniques showed that the different varieties used in this study did not differ significantly in their NDF degradation rates and characteristics. Moreover, the three techniques showed that there was a small range of less than 1 %/h in the NDF degradation rate. On average, the *in situ* and the *in vivo* estimates of kd_{NDF} were similar at around 2.5 %/h, whereas the *in vitro* gas production estimates were much higher at around 6.0 %/h. The coefficient of variation (SD/mean) of estimating kd_{NDF} was similar for the *in situ* and the *in vitro* techniques (8 %) and was lower in comparison to that of the *in vivo* technique (32 %).

Table 1 NDF degradation characteristics of six varieties of ryegrass measured *in situ*, *in vivo* and *in vitro*

	Variety								
Variable	cv1	cv2	cv3	cv4	cv5	cv6	Mean	SD[1]	P
	In situ nylon bag[2]								
U_{NDF}, %	14.2	13.8	12.5	13.7	14.5	14.5	13.9	1.4	0.3
D_{NDF}, %	85.8	86.2	87.5	86.3	85.5	85.5	86.1	1.4	0.3
kd_{NDF}	2.5	2.4	2.5	2.5	2.7	2.4	2.5	0.2	0.2
	In vivo rumen evacuations [3]								
kcl_{NDF}	5.4	5.9	5.7	5.3	4.9	5.1	5.4	0.9	0.2
kd_{NDF}	2.7	2.4	2.7	2.4	2.5	2.0	2.5	0.8	0.4
	In vitro gas production [3]								
Gas, ml	57	57	53	55	60	59	57	3.9	0.2
kd_2	6.5	5.9	5.9	5.7	6.6	6.0	6.1	0.5	0.3
Lag, h	4.6	5.4	4.9	5.3	4.2	4.6	4.8	0.6	0.2

kd_{NDF} is the degradation rate and kcl_{NDF} is the clearance rate, both expressed as %/h; kd_2 is the degradation rate of the second phase calculated from the gas production curves in %/h

Conclusions The different varieties used in this study did not differ significantly in their kd_{NDF}. Moreover, the difference between the fastest degrading variety and the slowest one was less than 1.0 %/h. This suggests that perspectives for choosing varieties with fast degrading fibre as a mean to improve pasture DMI is very limited.