The degradation of *Rhinanthus minor* (yellow rattle) *in vitro*

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Introduction *Rhinanthus minor* is a facultative hemiparasitic plant of the Scrophulariaceae family native to the British Isles. It is typically found in meadows associated with a high floristic diversity, but it can also be found in pasture, where it is susceptible to heavy grazing. Containing the iridoid glycoside rhinanthin ($C_{29}H_{52}O_{20}$), *R. minor* is strongly suspected of being poisonous, but it is not clear how harmful this is to livestock (Long 1924). Through parasitism, particularly of the grasses, *R. minor* is also associated with a loss of grazing. Consequently, the presence of *R. minor* in a sward is often viewed negatively. However, through reductions in productivity of grasses, *R. minor* may have a role in the restoration of species-rich grasslands. As a result, the probability of cattle consuming *R. minor* might be expected to increase. This paper aims to evaluate the degradation of *R. minor* and discusses the implications of *R. minor* inclusion in the diet.

Materials and methods Samples of hay (consisting of mainly *Lolium perenne*) and *R. minor* were dried, milled to pass a 2mm screen and mixed to give five levels of inclusion. (Table 1). The roots and a portion of stem were removed from *R. minor* to provide a sample similar to that which grazing cattle may consume. Fermentation and degradation characteristics of the combinations were examined using the *in vitro* Reading Pressure Technique (Mauricio *et al*., 1999). Four replicates of 1 g (+/-10mg) substrate per flask and 90ml buffer were prepared. Flasks were sealed and stored overnight (16 h at 20°C), then raised to 39°C prior to inoculation. Rumen fluid obtained pre-feeding was strained through a double layer of muslin and 10 ml added to each flask. Headspace gas pressure measurements were taken up to 48 h post inoculation. Fermentation residues were recovered after 48 hours incubation by filtering the flask contents through tared Gooch sintered glass crucibles (porosity 1) under a light vacuum. *In vitro* dry matter degradation (*i*DMD) was then calculated. Predicted *i*DMD values for R25, R50 and R75 were generated using weighted values obtained from the randomised pairing of R0 and R100 observed *i*DMD values. One-tailed t-tests were used to identify significances of difference between observed and predicted *i*DMD values as affected by the *R. minor* content of the substrate mix.

Table 1. Sample composition

Sample	Hay (mg g^{-1})	*R. minor* (mg g^{-1})
R0	1000	0
R25	750	250
R50	500	500
R75	250	750
R100	0	1000

Figure 1. Gas production kinetics

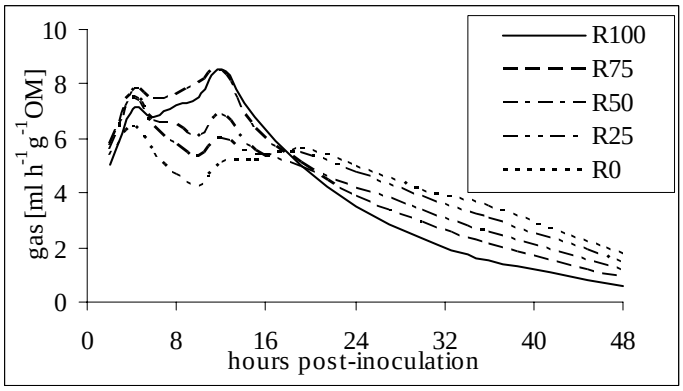

Table 2. Mean predicted and observed *i*DMD values

Sample	observed *i*DMD g g^{-1}	predicted *i*DMD g g^{-1}	*P* <
R0	0.610	-	-
R25	0.603	0.592	n.s.
R50	0.598	0.573	0.01
R75	0.576	0.555	0.05
R100	0.537	-	-

Results Rates of gas production for combinations of hay and *R. Minor* are shown in Fig 1. Highest initial rates of fermentation were observed with those combinations containing the greatest proportion of *R. minor* and are associated with the microbial fermentation of cell contents, whilst later onset of gas production represents the fermentation of the cell wall. Hay is known to ferment relatively slowly due to its higher fibre content, thus showing the ability of this method to describe fermentation. Degradation of hay was found to be greater than that of rattle when offered alone, although the actual *i*DMD values are significantly ($P<0.01$ and $P<0.05$) higher than the predicted results at R50 and R75 levels of inclusion in the diet (Table 2).

At inclusions of *R. minor* greater than 50%, the mean observed *i*DMD values decreased. This may indicate that levels of inclusion of *R. minor* above 50% may be toxic to the mixed rumen microflora. Biomass can contribute up to 42.8% when sown at 1000 seeds m^{-2} into a newly established *Lolium perenne* sward (Westbury & Dunnett *unpublished*), therefore, it is unlikely that distribution of *R.minor* at this level will have a detrimental effect on mixed rumen microflora. However, *R. minor* is typically observed in transient patches within swards, forming dense populations and problems may occur with grazing of these areas. There could also be potential difficulties should *R. minor* from localised areas be included in hay destined for ruminant feed.

Conclusions *R. minor* appeared to enhance the degradation at 48 hours of the diets examined, to a greater extent than expected, indicating a possible interaction between the two substrates. It is unclear why this may have occured, one possibility being that the nutrients contributed by *R. minor* enhanced growth of certain species of micro-organisms.

References Long, H.C. (1924) Plants poisonous to livestock. Cambridge University Press, Cambridge, UK.

Mauricio, R.M., Mould, F.L., Dhanoa, M.S., Owen, E., Channa, K.S. and Theodorou, M.K. (1999) A semi-automated *in vitro* gas production technique for ruminant feedstuff evaluation. *Animal Feed Science and Technology* **79**: 321-330.