

Effect of grass species on efficiency of nitrogen utilisation in Holstein-Friesian dairy cows

E. J. Kim, M. R. F. Lee, N. Ellis, R. Sanderson, N. D. Scollan, R. J. Dewhurst
 Institute of Grassland and Environmental Research, Aberystwyth, United Kingdom
 Email: eun-joong.kim@bbsrc.ac.uk

Introduction Rapid breakdown of herbage proteins in the rumen and inefficient capture of nitrogen (N) by the rumen microbial populations are a major source of N loss and pollution in pasture-based ruminant agriculture. Degree of cell damage during mastication and ingestion varies between grass species with consequences for release of cell contents (protein, sugars and lipids) into the rumen (Kim *et al.*, 2008). Consequently, grazing cattle on different grass species may provide an opportunity to manipulate N efficiency. The purpose of this study was to compare N utilisation efficiency by dairy cattle grazing grass species differing in chemical and morphological characteristics.

Materials and methods Twelve multiparous Holstein-Friesian cows in mid-lactation (with similar milk yields, profiles and stage of pregnancy) were grazed on three forage plots; timothy (TIM; cv. Promesse), perennial ryegrass (PRG; cv. AberDart) or tall fescue (TF; cv. Excella). All animals received 4 kg of dairy concentrate daily. Pairs of cows were allocated to treatment at random in a replicated 3×3 Latin square design. Each measurement period comprised 2 weeks preceded by 3 weeks grazing a standard pasture. At the end of each measurement period chemical composition of the herbage was assessed and herbage intake was estimated using enclosure cages (Lee *et al.*, 2001). Milk yield was recorded throughout the measurement period. Milk samples and spot urine samples were taken during each milking on the final two days. Milk samples were analysed for fat and protein, and N and purine derivatives (PD) were determined in urine. Effects of grass species were examined by analysis of variance with cow pair and period treated as random effects.

Results The N, neutral detergent fibre (NDF) and water-soluble carbohydrate (WSC) contents of TIM, PRG and TF were quite variable between measurement periods (Table 1). Herbage intake estimates were consistently lower for TF.

Table 1 Chemical composition (g/kg DM) of forages and estimated herbage intake (kg DM/d)

	TIM			PRG			TF		
	Period 1	Period 2	Period 3	Period 1	Period 2	Period 3	Period 1	Period 2	Period 3
N	17.2	13.4	25.6	15.2	13.1	23.0	18.7	15.9	22.2
NDF	541	691	520	518	569	492	507	591	567
WSC	156	65	78	342	172	194	186	138	114
DMI	17.7	18.0	19.1	24.5	18.8	16.5	17.3	13.9	13.2

Yields of milk and milk protein were lower ($P < 0.05$) for TF but there was no difference in milk fat output amongst forage treatments (Table 2). Urinary PD:creatinine ratio, an index of rumen microbial protein synthesis, was lower for TF ($P < 0.05$). Relative urinary N output (urine N / creatinine), although not significantly different between forages, was numerically higher for TF.

Table 2 Milk production and N utilisation

	TIM	PRG	TF	SEM [#]	P
Milk yield (kg/d)	22.3	23.3	20.4	0.48	0.005
Milk protein (g/day)	793	796	682	20.8	0.007
Milk fat (g/day)	892	917	883	21.2	0.528
Urinary PD : Creatinine (mmol/L : mmol/L/kg W ^{0.75})	456	439	370	18.1	0.023
Urinary N : Creatinine (g/kg : mmol/L/kg W ^{0.75})	172	176	185	8.9	0.612

[#]; 8 degrees of freedom for error

Conclusions Tall fescue supported lower milk yield and milk protein production than either PRG or TIM. This effect was associated with lower intake of TF but also reduced microbial protein synthesis in the rumen which may in part be linked to differences in the extent of release of nutrients during mastication and ingestion (Kim *et al.*, 2008). Overall, cows grazing TF pasture showed lower efficiency of N utilisation with approximately 27-40% more urine N per kg of milk protein, despite relatively similar protein content of the different cultivars when averaged across the study.

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References

- Kim, E.J., Lee, M.R.F., Ellis, N., Sanderson, R., Scollan, N.D. and Dewhurst, R.J. 2008. Effect of grass species in the release of cell components of freshly cut forage during mastication and ingestion. Proceedings of British Society of Animal Science, 32.
- Lee, M.R.F., Jones, E.L., Moorby, J.M., Humphreys, M.O., Theodorou, M.K., MacRae, J.C. and Scollan, N.D. 2001. Animal Research. 50, 441-449.