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Diet effects on dairy manure nitrogen excretion and cycling

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Introduction The amount and forms of (nitrogen) N excreted by ruminant livestock and post excretion manure N cycling are highly influenced by what is fed. For example, the relative amount of urinary N, faecal endogenous N of microbial and gut origin, and faecal undigested feed N is affected by how much dietary fibre and secondary compounds (e.g., tannins, polyphneolics) are consumed. Each manure N component has a different propensity for loss; for example via ammonia (NH_3) volatilisation (Misselbrook *et al*., 2004), leaching, and cycles differently in the soil-plant continuum (Powell, 2003). We evaluated dairy diet effects on amount and forms of manure N excreted and post excretion cycling of manure N from different diets after application to soil.

Materials and methods Holstein cows were fed different levels of crude protein (CP), fibre, corn silage, alfalfa silage, alfalfa haylage, and tannin-containing forages [alfalfa, birdsfoot trefoil low tannin (BF-T-Low) and birdsfoot trefoil high tannin (BF-T-High)] for the principal purpose of evaluating diet impacts on milk production and composition. At the end of each lactation trial, 3-4 cows per diet were fitted with indwelling catheters and urine and faeces were collected separately at *ca* 8 h intervals between two daily milkings for a total of 60-96 h. Diet impacts on NH_3 volatilisation (Table 1) were evaluated by recombining urine and faeces in the ratios they were excreted, applying their fresh or stored slurries to the surface of soils contained in laboratory chambers, and measuring NH_3 trapped in acidic solution over 48 hours. Diet impacts on soil N cycles (Figure 1) were evaluated by applying faeces from different CP-fibre-silage-haylage diets to potted soil at a rate of 350 kg N/ha and oats and sudangrass were grown in succession for 135 d.

Table 1 Predicted maximum cumulative NH_3 loss from fresh and stored slurries from different dairy diets on silt loam soil

Trial type	Trial components	Slurry type	
		Fresh	Stored
		% applied N volatilised	
CP level	13.6%	31b	12b
	19.4%	68a	29a
Forage	Alfalfa	31a	30a
tannin	BF-T-Low	33a	23b
type	BF-T-High	25b	19b

within each trial, values with different letters are significantly different (P<0.05)

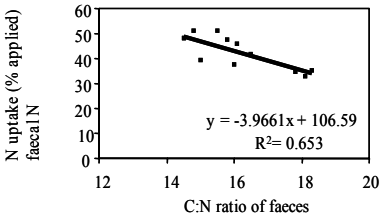

Figure 1 Relationship between C:N ratio of faeces and net plant uptake in silt clay loam (each data point = one diet)

Results Most observed diets had no impact on milk production but affected the amount, relative N partitioning, and composition of urine and faeces (data not shown). Fresh and stored slurry from the low CP diet had less than one-half the NH_3 loss than slurries from the high CP diet (Table 1). Fresh slurry derived from BF-T-High had less NH_3 loss than slurry from alfalfa or BF-T-Low diets. Stored slurry from BF-T-High and -Low diets had less NH_3 loss than slurry derived from alfalfa. Diets had significant impact on C:N ratios of faeces. As faecal C:N ratio increased, net N mineralisation and N uptake by oats and sudangrass decreased (Figure 1).

Conclusions The amount of CP and type of forage fed to lactating dairy cows had significant impacts on NH_3 loss. Diets also impacted faecal C:N ratios which apparently affected faecal N mineralisation in soil and subsequent plant N uptake. Diets could be formulated to meet nutritional requirements of high producing dairy cows and produce excreta less susceptible to environmental loss.

References

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