



Manipulating diet nitrogen content to reduce urine nitrogen excretion in lactating dairy cows

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Background

- ◆ Nitrogen excretion from faeces and urine of livestock is a significant source of pollution to ground and surface water
 - EU Nitrates Action programme sets up a limit for manure N application (170 kg/ha)
- ◆ Manure N is also a significant source for ammonia and N₂O emissions
 - GHG from manure management in dairy cows in Northern Ireland - 18% (14 to 21%) of total GHG within farm gate
- ◆ Increasing N utilisation efficiency can
 - Increase production efficiency of cattle
 - Reduce environmental footprint of cattle production systems

- ◆ **Objective:**

To evaluate effects of diet N content on urine N excretion in lactating dairy cows

Material and Methods 1

- ◆ Data used were obtained from 470 Holstein-Friesian lactating cows in 26 diet digestibility studies undertaken at this Institute
- ◆ Animals were of various:
 - Genetic merits: low to high
 - Parity: 1 to 9
 - Age: 25 to 124 months
 - Days in milk: 16 to 422
- ◆ 38 cows were offered grass silage-only diets and remaining cattle (n = 432) given grass silages with various proportions of concentrates (294 to 876 g/kg DM)



Material and Methods 2

- ◆ All animals were offered experiment diets *ad libitum* for at least 28 days, with all measurements undertaken during the final 6 days of each experimental period
- ◆ Measurements included:
 - Feed intake - silage and concentrates
 - Performance - Live weight, body condition score and milk yield and composition
 - Total collection of faeces and urine
- ◆ Linear regression technique was used to develop relationships between diet N content and N excretion in faeces and urine with experimental effects removed



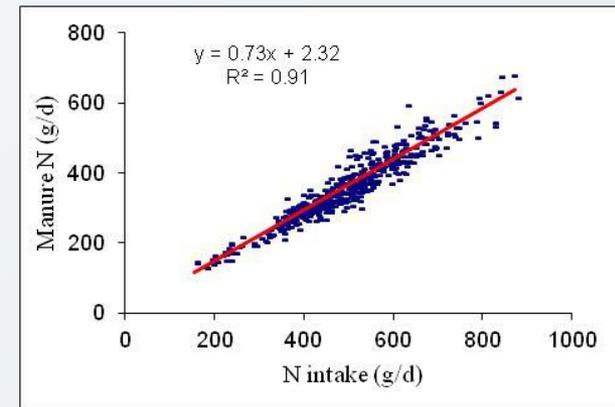
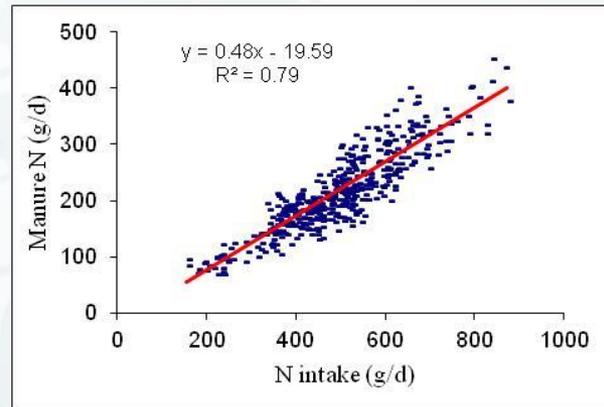
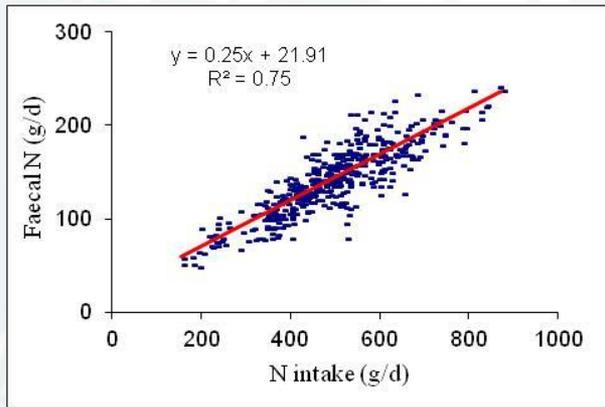
Animal and Feed data

Animal and feed data				
	Mean	s.d.	Minimum	Maximum
Live Weight (kg)	567	66.1	385	781
Body condition score	2.57	0.45	2.00	4.25
DM intake (kg/d)	16.5	3.01	7.5	24.3
ME intake (MJ/d)	200	38.7	87	320
Milk yield (kg/d)	21.6	6.70	6.1	49.1
ME content (MJ/kg DM)	12.0	0.65	10.1	13.7
N content (g/kg DM)	29.3	3.86	17.1	40.6

N intake and output

N intake and output (g/d)				
	Mean	s.d.	Minimum	Maximum
N Intake	489	127.4	155	874
Faecal N output	142	36.4	48	241
Urine N output	216	69.0	70	452
Milk N output	109	33.2	24	231
Retained N	23	31.9	-103	128

Prediction of N output



- ◆ N intake is an accurate predictor for N excretion in urine and faeces of lactating dairy cows

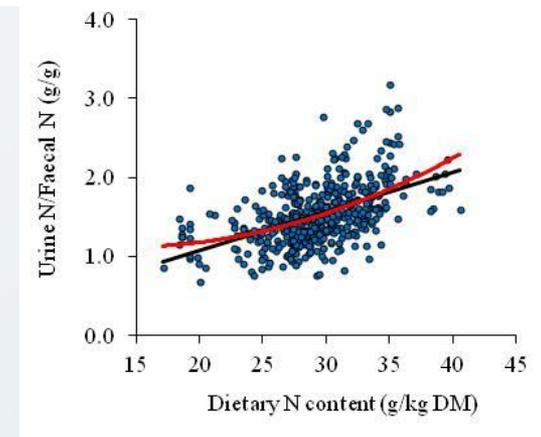
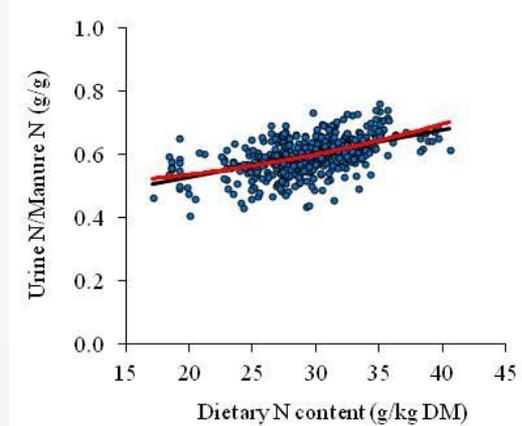
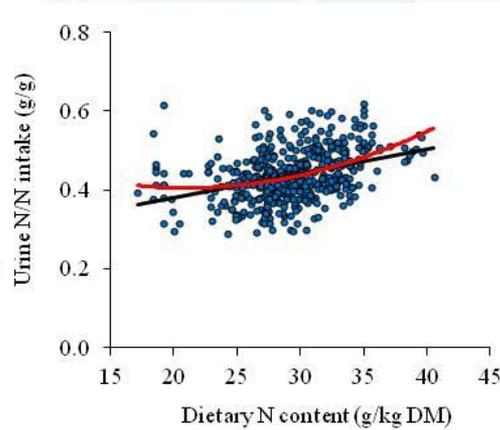
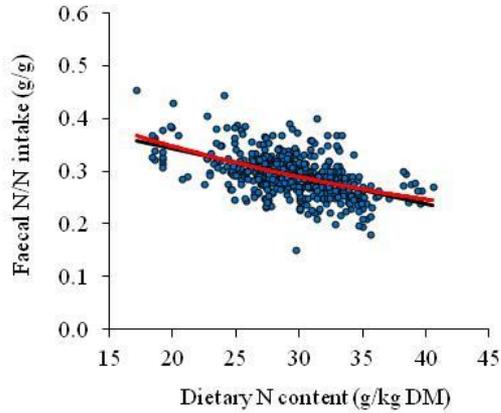
Correlation coefficients (r values) in relationships between N output and diet N content

Correlation coefficients (r values) in linear relationships between N output and diet N content

	Faecal N / N intake	Urine N / N intake	Milk N / N intake	Urine N / Manure N	Urine N / Faecal N	Faecal N / Manure N
N Intake/DM intake	-0.50	0.37	-0.34	0.50	0.50	-0.50
N intake/GE intake	-0.47	0.33	-0.28	0.46	0.45	-0.46
N intake/DE intake	-0.28	0.28	-0.20	0.32	0.31	-0.32
N intake/ME intake	-0.28	0.34	-0.23	0.36	0.35	-0.36

- ◆ Dietary N content is positively related to urine N excretion rates, but negatively related to N output rates in faeces and milk

Relationships between N output and diet N content



- ◆ Increasing dietary N content increases urine N excretion rate, but reduces faecal N output rate

Equations to predict N excretion rates using diet N content

Relationships between N excretion rates (g/g) and diet N content (g/kg DM)	
Equations	r ²
Urine N/N Intake = 0.0057 N content + 0.269	0.37
Faecal N/N Intake = -0.0068 N content + 0.491	0.45
Urine N/Manure N = 0.0086 N content + 0.345	0.47
Urine N/Faecal N = 0.0571 N content - 0.131	0.48

Conclusions

- ◆ N intake is an accurate predictor for N excretion in urine and faeces of lactating dairy cows
- ◆ Increasing diet N content can reduce faecal N/N intake, but increase urine N/N intake, urine N/faecal N and urine N/manure N
 - Feeding dairy cows with high N diets can change the N output pattern towards excreting more N into urine
- ◆ Manipulating diet N content is an effective approach to increase N utilisation efficiency and reduce environment footprint in dairy production
 - For grazing cattle, urine N output is a considerable source for nitrate pollution and ammonia and nitrous oxide emissions

THANK YOU!

