Synchronisation of energy and protein degradation in the rumen to improve nitrogen utilisation by dairy cattle

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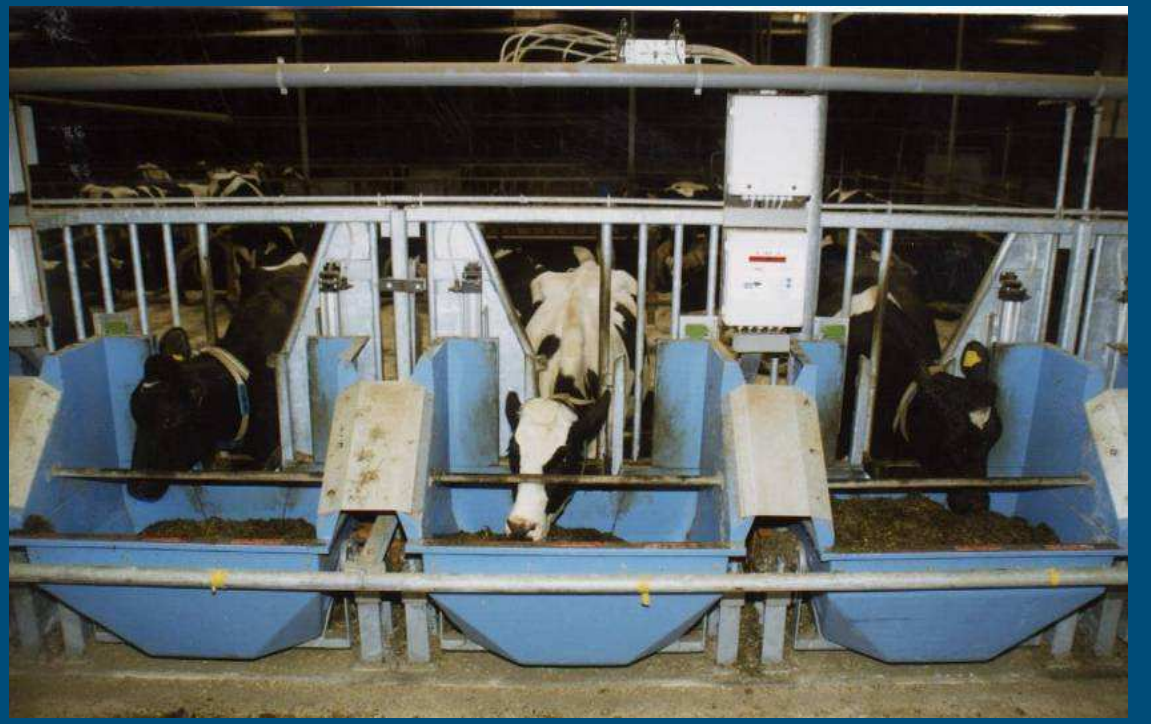
Our objective

- Study the effect of degradation rate of FOM on:
  - feed intake
  - performance
  - N utilisation



Experiment with double Latin-square design (I)

- 32 animals (8 primiparous + 24 multiparous)
  - DIM ≥ 50 at start of the experiment
- Four experimental periods (replicated twice)
  - Each period: 2 wk adaptation + 1 wk measurements
- Each replicate had a different ratio of grass silage : corn silage (GC) in the basal diet
  - GC3:2 = ratio 3:2 (on a DM basis)
  - GC1:4 = ratio 1:4 ,,
  - Some formaldehyde treated soybean meal included in the basal feed mixtures (1.75 and 2.35 kg/d resp.)

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Experiment with double Latin-square design (II)

- FOM2 at four levels
  - FOM2 = OM fermented in the first 2 h after feed ingestion
  - FOM2 levels were set by choice of compound concentrate
- Two compound concentrates with contrasting FOM2
  - "Low" 175 g FOM2/kg (level 1)
  - "High" 358 g FOM2/kg (level 4)
  - Intermediate levels (level 2 and 3) achieved by mixing these two concentrates
  - Compound concentrate fed with transponder controlled feeders

Design: FOM2 at four levels: 1, 2, 3 and 4

GC ratio	Period / Cow	wk 1-3	wk 4-6	wk 7-9	wk 10-12
GC 3:2	A1, B2, C8, D4	2	1	4	3
	A6, B8, C6, D2	1	3	2	4
	A5, B1, C1, D1	3	4	1	2
	A3, B4, C7, D3	4	2	3	1
GC 1:4	A2, B5, C5, D7	4	3	2	1
	A8, B6, C4, D8	2	4	1	3
	A7, B7, C3, D6	1	2	3	4
	A4, B3, C2, D5	3	1	4	2

Compound feed ingredients

		GC3:2		GC1:4	
	FOM2	Low	High	Low	High
Sugar beet pulp		209	0	127	0
Palm kernel expeller		200	0	200	0
Corn gluten feed		178	0	131	0
Soy hulls		167	0	175	0
Copra expeller		70	21	46	5
Vinasses		53	5	53	0
Lupine		25	0	104	5
Cane molasses		20	111	20	120
Citrus pulp		7	384	5	260
Canola meal solvent extract		2	160	4	193
Soybean meal solvent extract		0	61	48	116
Wheat		0	226	0	263
Miscellaneous		69	32	87	38

Compound feed characteristics

	GC3:2		GC1:4	
FOM2	Low	High	Low	High
NE_{lac} (MJ)	6.5	6.5	6.5	6.5
DVE_{1994} (g/kg)	90	90	105	105
DVE_{2010} (g/kg)	92	98	107	113
FOM (g/kg)	456	593	450	581
FOM2 (g/kg)	178	358	175	358

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DVE = true protein digested in small intestine

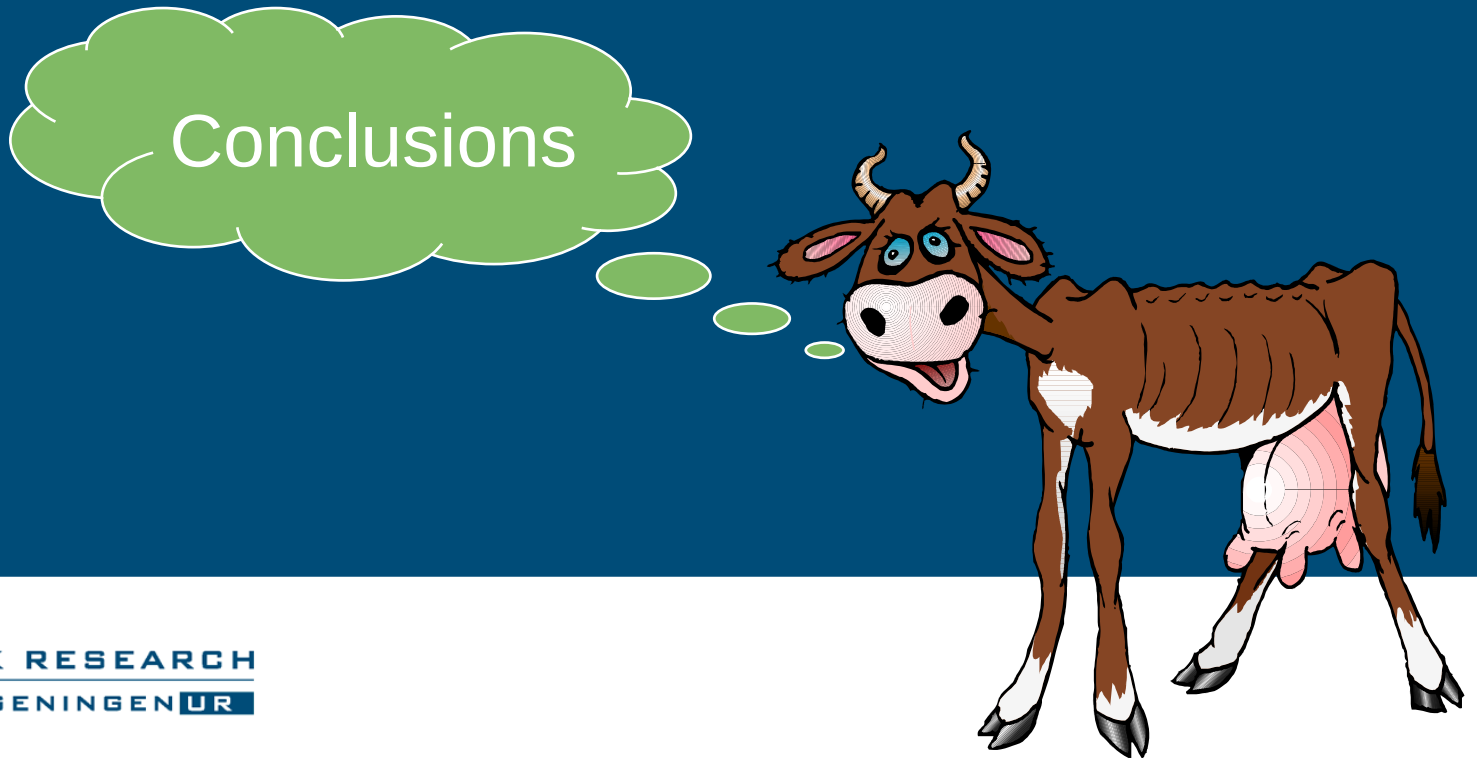
Intake (day^{-1})

GC ratio	GC3:2				GC1:4			
FOM2 level	1	2	3	4	1	2	3	4
DM (kg)	22,3^{ab}	22,6^{b}	22,9^{b}	21,5^{a}	23,8^{b}	24,0^{b}	24,0^{b}	22,7^{a}
NElac (MJ)	150	153	155	146	161	163	163	154
DVE$_{1994}$ (g)	2181	2215	2241	2110	2384	2412	2418	2299
DVE$_{2010}$ (g)	2119	2173	2210	2109	2416	2459	2480	2378
FOM2 (g)	5121	5777	6318	6603	5768	6333	6867	7091

Milk performance and N utilisation

GC ratio	GC3:2				GC1:4			
FOM2 level	1	2	3	4	1	2	3	4
Milk (kg)	35.3	35.4	35.4	35.4	34.5	34.4	34.9	35.4
Fat (%)	4.30^{b}	4.27^{b}	4.20^{b}	4.03^{a}	4.37^{ab}	4.41^{b}	4.35^{ab}	4.23^{a}
Protein (%)	3.25^{a}	3.28^{ab}	3.30^{ab}	3.32^{b}	3.34^{b}	3.27^{a}	3.37^{b}	3.39^{b}
Fat (g)	1514^{b}	1516^{b}	1485^{b}	1438^{a}	1506	1518	1512	1492
Protein (g)	1144	1161	1166	1179	1154^{ab}	1128^{a}	1173^{ab}	1198^{b}
FPCM (kg)	36.3	36.5	36.1	35.7	36.0	36.0	36.3	36.4
Urea (mg/100 g)	21.7^{b}	21.1^{ab}	20.4^{ab}	19.4^{a}	25.3^{c}	23.4^{ab}	22.0^{a}	23.9^{bc}
N utilisation (%)	34.3^{a}	34.3^{a}	34.1^{a}	36.7^{b}	32.3^{a}	31.1^{a}	32.2^{a}	34.5^{b}

- DMI depressed with highest FOM2 level
- Milk fat % lowest at highest FOM2 level
- Milk protein increased with increasing FOM2
- FOM2 levels should not be maximized but optimized



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