



Effects of dietary protein concentration on energetic efficiency and methane emission in lactating dairy cows

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Introduction

- ◆ **Methane emissions from dairy cattle is a considerable source of greenhouse gases. There is increasing interest in developing mitigation strategies for methane emissions from cattle**
- ◆ **A series of studies have been undertaken at AFBI to examine effects of dietary protein source and concentration on milk production, energy and N utilisation efficiencies and fertility in dairy cows**
- ◆ **The present study reported effects of dietary CP concentration on energetic efficiency and methane emission in lactating dairy cows**

Experimental Design

- ◆ A large continuous design study (47 first and 40 multi-lactation Holstein dairy cows) was undertaken with 3 dietary CP concentrations (180, 150 and 120 g/kg DM) from week 1 to 44 of lactation
- ◆ Three mixed diets each contained (DM basis) 55% concentrates and 45% forage (60% grass silage and 40% maize silage)
- ◆ During early (70 to 90 days), mid (150 to 170 days) and late (230 to 250 days) lactation, the same 4 cows and 4 heifers from each treatment were transferred to metabolism units for 8 days, with measurements of feed intake and faeces and urine outputs during the final 6 days.
- ◆ Animals were then housed in calorimeter chambers for 3 days, with gaseous change measured during last 2 days
- ◆ Data reported were obtained from the digestibility and chamber measurements and analysed as a one way ANOVA, with experimental period as block

Results (1)

Effects on dietary CP levels on DM intake and milk production

	Diet CP contents (g/kg DM)			s.e.	Sig.
	120	150	180		
Total DM intake (kg/d)	16.5	18.4	19.5	0.43	***
Milk yield (kg/d)	20.6	26.1	28.3	0.94	***
Milk fat (g/kg)	42	40	40	1.4	
Milk protein (g/kg)	34	35	36	0.9	
Milk lactose (g/kg)	47	46	46	0.8	
Live weight (kg)	554	536	536	13.4	

Results (2)

Effects on dietary CP levels on energy intake and outputs

	Diet CP contents (g/kg DM)			s.e.	Sig.
	120	150	180		
GE intake (MJ/d)	301	340	363	7.8	***
Faecal energy (MJ/d)	85	94	94	2.6	*
Urine energy (MJ/d)	12	13	14	0.3	***
Methane energy (MJ/d)	20	20	22	0.6	
Heat production (MJ/d)	125	132	143	3.1	***
Milk energy (MJ/d)	64	80	86	2.4	***
Energy balance (MJ/d)	-5	1	4	3.0	

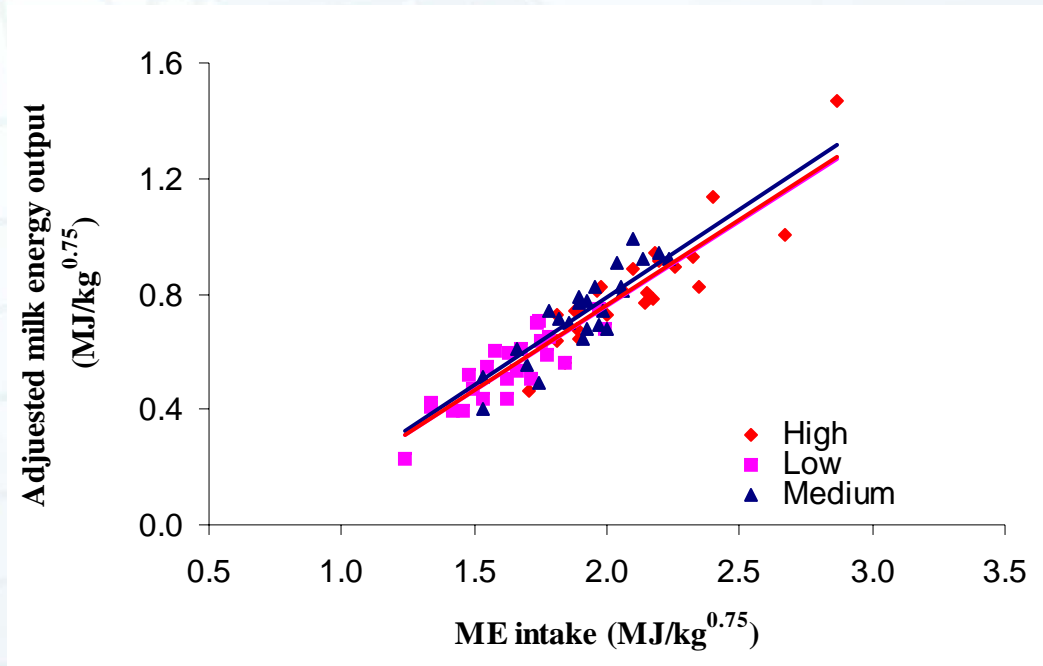
Results (3)

Effects on dietary CP levels on energy utilisation efficiency

	Diet CP contents (g/kg DM)			s.e.	Sig.
	120	150	180		
ME/GE	0.61	0.63	0.64	0.004	***
HP/ME	0.68	0.62	0.62	0.011	***
Milk E/ME intake	0.35	0.38	0.37	0.009	
E balance/ME intake	-0.04	0.00	0.02	0.015	
k₁	0.55	0.58	0.56	0.013	

Results (4)

Effects on dietary CP levels on the relationship between ME intake and milk energy output adjusted to zero energy balance



		R ²	ME _m MJ/kg ^{0.75}
Low CP	$E_{(0)} = 0.589 \text{ MEI} - 0.42$	0.73	0.71
Medium CP	$E_{(0)} = 0.605 \text{ MEI} - 0.42$	0.77	0.71
High CP	$E_{(0)} = 0.591 \text{ MEI} - 0.42$	0.80	0.71

Results (5)

Effects on dietary CP levels on methane emission

	Diet CP contents (g/kg DM)			s.e.	Sig.
	120	150	180		
CH₄ output (l/d)	508	513	549	16.0	
CH₄/DM intake (l/kg)	31	28	28	0.8	*
CH₄/milk yield (l/kg)	26	21	20	1.1	**
CH₄-E/GE intake	0.07	0.06	0.06	0.002	**

Conclusions

- ◆ Reducing dietary CP concentration significantly decreased feed intake and milk production, but had no effects on energy partitioning between milk and body tissue or efficiency of ME use for lactation.
- ◆ Increasing dietary CP concentration from 120 to 150 g/kg DM significantly reduced methane emission as a proportion of DM intake, GE intake and milk yield, but further increasing dietary CP concentration to 180 g/kg DM had no effect