

Long Term Implications of Feeding Low Protein Diets to First Lactation Dairy Cows

C. K. Reynolds | L. A. Crompton | D. J. Humphries | A. K. Jones

Centre for Dairy Research, School of Agriculture, Policy and Development, University of Reading, PO Box 237, Earley Gate, RG6 6AR, UK

Introduction

Diet N use efficiency (NUE) for milk N production is affected by a variety of factors that determine metabolizable protein (MP) supply relative to requirement. Reduced diet crude protein (CP) concentration consistently increases NUE, but often at the expense of milk yield. While there may be clear benefits of increased NUE with lower CP diets, the longer term effects of under feeding protein on milk yield and cow health and fertility are not certain as with few exceptions data available are from experiments that have not allowed sufficient time for expression of long-term effects. Our objective was to assess longer term effects of feeding lower protein diets to first lactation dairy cows.

Materials and Methods

- Holstein heifers (n =215) assigned to one of 3 maize silage based total mixed rations (TMRs) at first calving in a randomized block experiment.
- Blocks based on body weight (BWT), body condition score (BCS), age at calving, and genetic merit.
- Diets (Table 1) formulated to contain 14, 16, or 18% CP and provide MP below (90%), at (100%), or above (104%) estimated requirements.
- Treatment diets fed from 7 days in milk (DIM) to dry-off and insemination was from 50 to 200 DIM.
- Milk yield and feed dry matter intake (DMI) were measured daily and milk composition, BWT, and BCS measured weekly.
- Weekly means analysed using Mixed Models (SAS) testing fixed effects of diet, week, and their interaction and random effects of heifer, with week as a repeated effect and age, BWT, BCS at calving, genetic merit, calving date, and days pregnant as covariates.

Table 1. Diet formulation (g/kg - DM basis).

	High Maize Silage		
	14% CP	16% CP	18% CP
Grass silage	125	125	125
Maize silage	375	375	375
Cracked wheat	150	120	90
Molassed sugar beet feed	50	50	50
Soy hulls	81	73	65
Wheat feed	106	80	54
Soybean meal	39	71	103
Rapeseed meal	39	71	103
Molasses	15	15	15
Minerals & vitamins	20	20	20

Results

- Feed DMI was greater for heifers fed 18% CP diets, but similar for 14 and 16% diets (Table 1 and Figure 1).
- Milk yield and energy corrected milk yield were lower for 14% CP diets, but similar for 16 and 18% diets.
- Milk protein concentration was lower for 14 vs 18% CP diets, whilst milk protein, fat and lactose yield were lower for 14% vs 16% and 18% CP diets.
- Milk urea concentration increased with increasing diet CP concentration, whilst diet NUE decreased.

Table 2. Milk yield, composition, and component yield.

	Diet CP			SEM	P < ¹		
	14% CP	16% CP	18% CP		Diet	Week	Inter
DMI, kg/d	20.4 ^a	21.0 ^a	21.8 ^b	0.28	0.004	0.001	0.044
Milk yield, kg/d	27.6 ^a	29.8 ^b	30.0 ^b	0.47	0.001	0.001	1.000
Milk composition, g/kg							
Fat	36.5	36.3	37.1	0.61	0.576	0.001	0.005
Protein	31.7 ^a	32.6 ^{ab}	33.0 ^b	0.38	0.043	0.001	0.576
Lactose	44.1	44.9	45.0	0.43	0.271	0.001	0.679
Urea	0.165 ^a	0.240 ^b	0.303 ^c	0.003	0.001	0.001	0.001
Milk component yield, g/d							
Fat	1026 ^a	1085 ^b	1107 ^b	16.0	0.002	0.001	0.843
Protein	895 ^a	978 ^b	986 ^b	13.2	0.001	0.001	1.000
Lactose	1257 ^a	1348 ^b	1357 ^b	21.7	0.002	0.001	1.000
Body weight	581 ^a	595 ^{ab}	609 ^b	6.3	0.009	0.001	0.001
Condition score	2.91 ^a	2.92 ^a	3.06 ^b	0.04	0.023	0.001	0.001
ECM, kg/kg DMI	1.37 ^a	1.47 ^b	1.43 ^b	0.02	0.002	0.001	0.998
NUE, %	30.9 ^a	29.4 ^b	25.5 ^c	0.42	0.001	0.001	0.387
n	72	72	71				

¹Probability for effects of dietary protein level, week of lactation, and their interaction (Inter).
a, b, c Least squares means with different superscripts differ at P < 0.05.

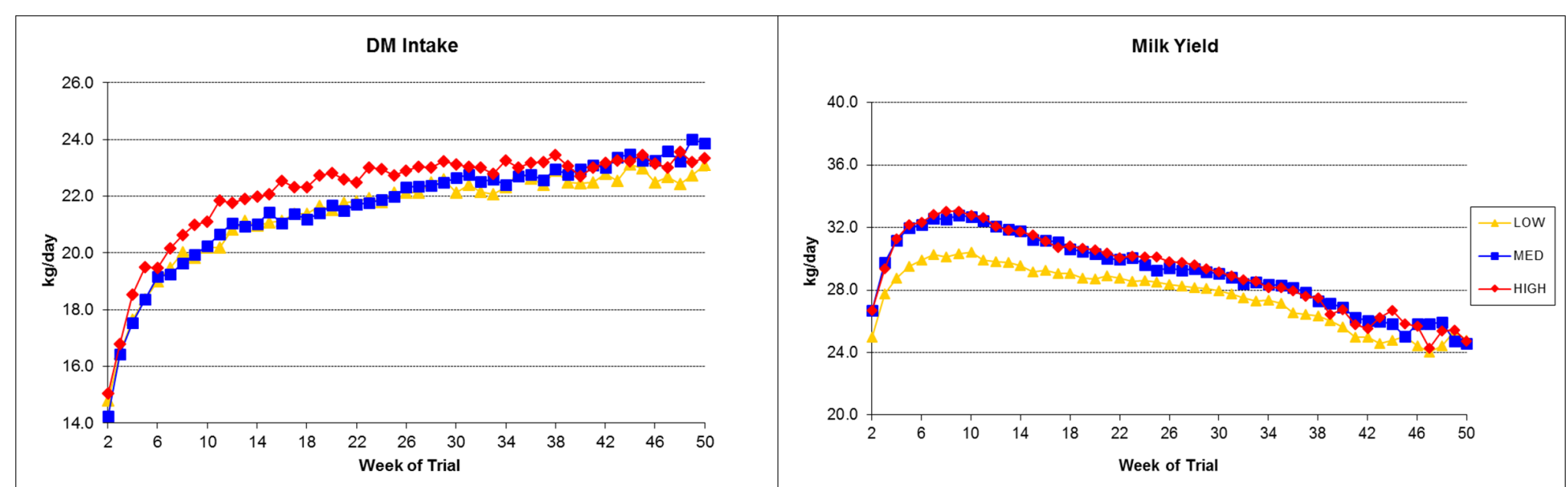


Figure 1. Dry matter intake and milk yield (n = 178 at 305 DIM).

- Heifer BWT increased with increasing diet CP concentration.
- Heifers fed 18% CP diets had higher BCS, but BCS of heifers fed 14 and 16% CP diets did not differ.

Conclusions

- Improvements in NUE with lower CP diets were apparent, but the increase in NUE when diet CP concentration was reduced from 16 to 14% was of less magnitude than when diet CP concentration was reduced from 18 to 16% CP. This in part reflects differential effects on DMI (and subsequently N intake) and milk protein yield with changing diet CP concentration, as increasing diet CP from 16 to 18% increased DMI without affecting milk protein yield. Decreases in milk protein yield observed for the 14% CP diet were less than expected.
- Greater BWT and BCS of heifers fed the 18% CP diet in part reflects greater DMI and metabolizable energy supply relative to ECM yield.
- The longer-term effects of these diets may differ with greater milk yield potential over subsequent lactations.

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Contact information

- Email: c.k.reynolds@reading.ac.uk | www.reading.ac.uk/apd/research