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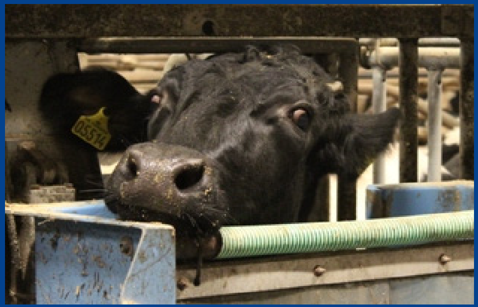
Effect of reduced dietary protein and concentrate:forage ratio when cows enter deposition phase

Lene Alstrup, Lone Hymøller and Martin R. Weisbjerg
Animal Science, AU Foulum



Background

- Focus on environmental impact (↓protein ↓N)
- ↑energy supply ↑microbial protein synthesis
- Demands for energy change with stage of lactation
  - Mobilization of body reserves ↑energy for milk production
  - Deposition phase ↑energy for reproduction and weight gain

Research question

- Is it possible to
  - ↓ concentrate to forage ratio
  - ↓ crude protein supply
  - for lactating dairy cows in deposition WITHOUT negative affect on milk production

Experiment – Facilities

› Automatic registration with Insentec boxes and AMS

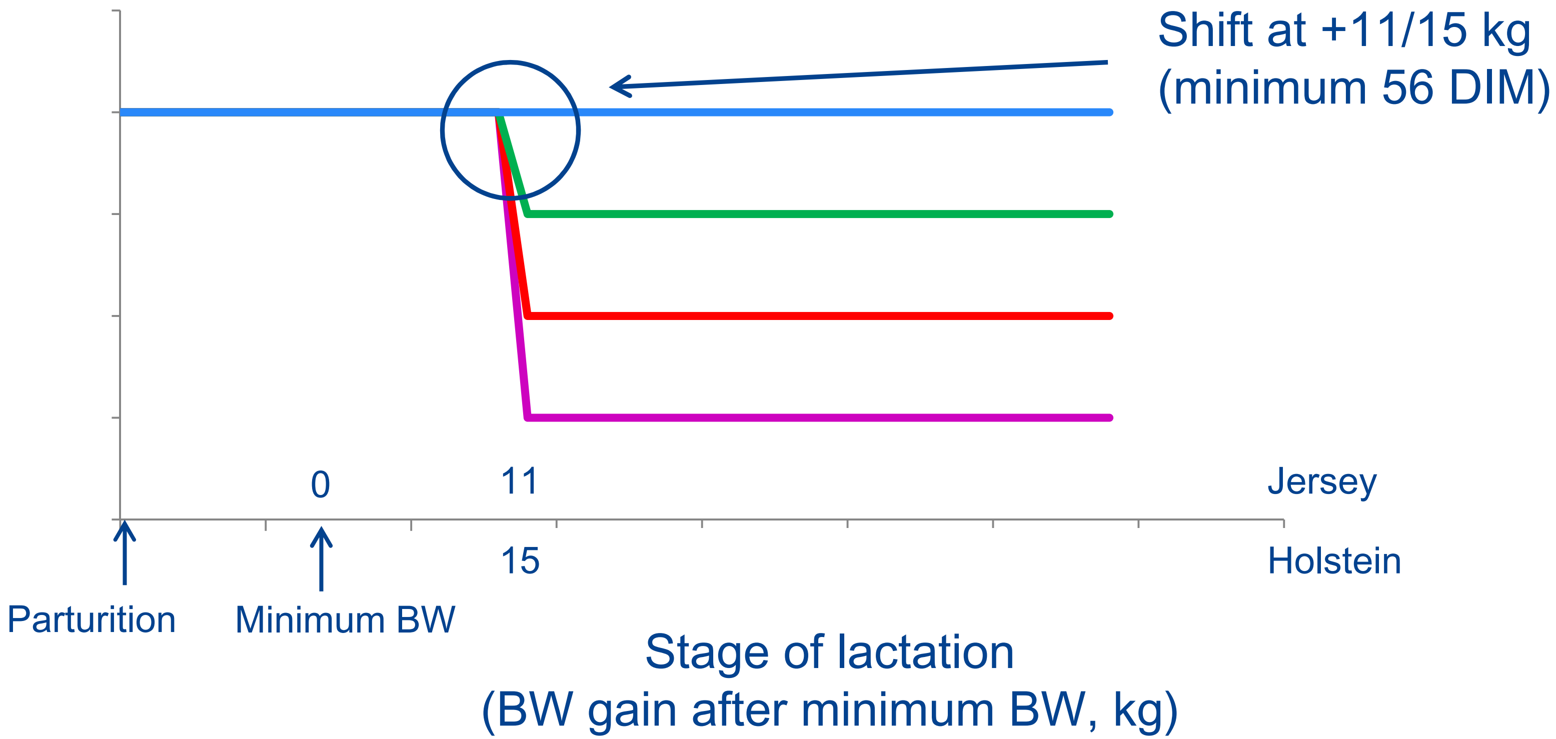
Experiment – Animals

› Runned for 16 months
› Cows entered exp. at calving

› 61 Danish Jersey cows
› 107 Danish Holstein cows

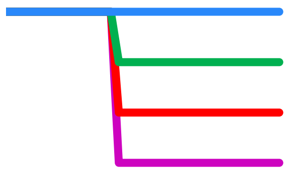
Four feeding strategies

Reduction in energy (concentrate:forage ratio) and protein



Experiment – Feeding strategies

› Four strategies:

	Normal protein (NP, 16% CP)	Low protein (LP, 14% CP)
High C:F ratio (HC, 40:60)	HC-NP	HC-LP
Low C:F ratio (LC, 30:70)	LC-NP	LC-LP

Experiment – Feeding strategies

- Forage in mixed ration
  - 50% grass clover silage and 50% maize silage
  - Low C:F ratio ⟶ replacing barley and beet pulp with the forage mixture

- Concentrate in mixed ration
  - 16% CP ⟶ including soybean meal + ↑ rape seed meal

- + 3 kg concentrate in milk robot

Composition of rations

	High C:F (HC)		Low C:F (LC)	
	NP	LP	NP	LP
Composition, % of DM				
Barley	9.0	11.6	3.5	6.0
Rape seed meal	7.0	3.0	7.0	3.0
Soybean meal	2.0	0.0	2.0	0.0
Beet pulp	7.5	10.6	1.5	4.5
Grass clover silage	30.0	30.1	36.0	36.2
Maize silage	31.0	31.1	36.5	36.7
Vitamin and mineral mix	1.0	1.0	1.0	1.0
Concentrate, AMS	12.5	12.6	12.5	12.6

RESULTS

Results

- No interaction between breed x CFR x CP
  - Except for { CP intake, N efficiency }
- Only results from Holstein will be shown

Feed intake (wk 9-30)

Item	Rations				P-values		
	HC-NP	HC-LP	LC-NP	LC-LP	CFR	CP	CFR x CP
Change week	10.7	10.1	10.4	10.4	0.60	0.76	0.50
Total DMI, kg/d	21.0	20.2	20.8	19.8	≤ 0.01	≤ 0.01	0.56
Crude protein, kg/d	3.28	2.81	3.32	2.82	0.26	≤ 0.001	0.49
NEL, MJ/kg of DM	7.50	7.45	7.38	7.33	≤ 0.001	≤ 0.001	0.60

Milk yield and composition (wk 9-30)

	Rations				P-values		
Item	HC-NP	HC-LP	LC-NP	LC-LP	CFR	CP	CFR x CP
ECM yield, kg/d	31.8	29.3	31.2	29.3	0.59	≤ 0.001	0.35

Milk yield and composition (wk 9-30)

	Rations				P-values		
Item	HC-NP	HC-LP	LC-NP	LC-LP	CFR	CP	CFR x CP
ECM yield, kg/d	31.8	29.3	31.2	29.3	0.59	≤ 0.001	0.35
Milk protein, %	3.65	3.62	3.63	3.60	0.24	0.29	0.94
Milk fat, %	4.22	4.32	4.31	4.42	0.28	0.94	0.84
Lactose, %	4.91	4.92	4.90	4.90	0.56	0.22	0.64
Protein:fat	0.88	0.85	0.85	0.83	≤ 0.01	≤ 0.05	0.61

Milk yield and composition (wk 9-30)

	Rations					P-values		
Item	HC-NP	HC-LP	LC-NP	LC-LP		CFR	CP	CFR x CP
ECM yield, kg/d	31.8	29.3	31.2	29.3		0.59	≤ 0.001	0.35

Milk yield and composition (wk 9-30)

	Rations				P-values		
Item	HC-NP	HC-LP	LC-NP	LC-LP	CFR	CP	CFR x CP
ECM yield, kg/d	31.8	29.3	31.2	29.3	0.59	≤ 0.001	0.35
Milking frequency, milkings/d	2.2	2.1	2.2	2.2	0.14	0.41	0.68
Energy efficiency, kg ECM/MJ NEL	0.202	0.195	0.204	0.201	≤ 0.001	0.64	0.77
N efficiency	0.33	0.35	0.32	0.34	0.81	≤ 0.001	0.79

Conclusion

- No negative effect on milk yield and composition during deposition phase:
  - Substitution of concentrate in the mixed ration with high quality forage
  - Simultaneous reduction in the CP level of the mixed ration

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High-quality forage can replace concentrate when cows enter the deposition phase without negative consequences for milk production

L. Hymøller,*[1] L. Alstrup,* M. K. Larsen,† P. Lund,* and M. R. Weisbjerg*
*Department of Animal Science, and
†Department of Food Science, AU Foulum, Aarhus University, Blichers Allé 20, PO Box 50, DK-8830 Tjele, Denmark

ABSTRACT

Mobilization and deposition in cows are different strategies of metabolism; hence, the aim was to study the possibility of reducing the crude protein (CP) supply during deposition to limit the use of protein supplements and minimize the environmental impact. A total of 61 Jersey and 107 Holstein cows were assigned to 4 mixed rations in a 2 × 2 factorial design with 2 concentrate to forage ratios (CFR) and 2 CP levels: high CFR (40:60) and recommended CP [16% of dry matter (DM); HCFR-RP], high CFR (40:60) and low CP (14% of DM; HCFR-LP), low CFR (30:70) and recommended CP (16% of DM; LCFR-RP), and low CFR (30:70) and low CP (14% of DM; LCFR-LP), where RP met the Danish recommendations. Cows were fed concentrate in an automatic milking unit. After calving, cows were fed HCFR-RP until entering deposition, defined as 11 kg (Jersey) or 15 kg (Holstein) of weight gain from the lowest weight after calving. Subsequently, cows either remained on HCFR-RP or changed to one of the other mixed rations. Comparing strategies during wk 9 to 30 of lactation showed higher dry matter intake (DMI) of mixed ration on HCFR compared with LCFR and on RP compared with LP. The DMI of the concentrate was higher on LCFR than on HCFR and higher on LP than on RP, resulting in overall higher DMI on HCFR and RP than on LCFR and LP. Crude protein intakes were higher on RP than on LP and starch intakes were higher on HCFR than on LCFR. Intakes of neutral detergent fiber tended to be higher on LCFR than on HCFR. Intakes of net energy for lactation were affected by CFR and CP level, with a higher intake on HCFR and RP than on LCFR and LP. No interactions were found between CFR and CP level for any feed intake variables. Yields of milk and energy-corrected milk were higher on RP than on LP, with no difference in yield persistency after the ration change. Milk composition did not differ among strategies but the protein to fat ratio was higher on HCFR than on LCFR and tended to be lower on RP than on LP. Differences in fatty acid composition were small, and de novo synthesis was high (>60%). Energy efficiency was higher on LCFR than on HCFR and no interaction with breed or parity was found. The N efficiency was higher on LP than RP, but with an interaction with breed due to lower N efficiency in Jersey than Holstein cows on HCFR-RP but higher N efficiency in Jersey than Holstein on LCFR-LP. In dairy production, concentrate in the mixed ration can be substituted with high-quality forage during deposition without negative effects on milk yield and composition when a sufficient CP level is ensured.

Key words: forage ratio, protein level, dairy cow, environment

INTRODUCTION

Research in dairy cattle nutrition has recently focused mainly on developing tools for controlling individual feed allocation to dairy cows, for example, to support their individual requirements for energy and nutrients according to stage of lactation. However, rising prices of feedstuffs, particularly ingredients for concentrate mixtures, have strengthened interest in substituting energy-rich cereal grains with high-quality forage and optimizing the use of protein-rich supplements. Furthermore, optimizing the protein supply for dairy cattle can reduce the environmental impact by reducing the loss of N to the environment (Oldham, 1984), which has become a major focal point in dairy production (Børsting et al., 2003).

The utilization of energy and protein in ruminants is intimately linked. Even though dietary protein is utilized both for amino acids and for microbial protein synthesis in the rumen (Oldham, 1984; Broderick, 2003), the efficiency of protein utilization is dependent on the energy supply. This is because rations high in energy support microbial protein synthesis in the rumen, thereby increasing the supply of microbial protein for utilization by the ruminant (Oldham, 1984; Broderick, 2003). Oversupplying energy is uneconomical and could cause problems for ruminants through a

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[1]Corresponding author: Lone.Hymoller@agrsci.dk

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