Feeding Concentrate in Early Lactation Based on Rumination Time

EAAP, August 28, Copenhagen 2014

M. V. Byskov¹, M. R. Weisbjerg², B. Markussen³, O. Aaes¹ & P. Nørgaard⁴

1) Knowledge Centre for Agriculture, Cattle, Aarhus.
2) Faculty of Science and Technology, Aarhus University.
3) Faculty of Basic Science, University of Copenhagen.
4) Faculty of Health and Medical Science, University of Copenhagen.

Presenter
Dairy cows in early lactation

Modified from Nørgaard and Hvelplund, 2003
Individual variation between cows

- DMI varies up to 30 to 40% in the first week of lactation (Drackley, 1999)
- Milk production (Ingvartsen and Friggens, 2005)
- Mobilization - duration and magnitude (Bossen and Weisbjerg, 2005)

Genetic variation

- Ketosis or SARA
- Body condition score
- Retained placenta
- Metritis
- Difficult calving
Individual adjustment of feed composition

Individual adjustment
- Total mixed ration to all cows
- Individual feed allocation – Concentrate feeding
- Requires information on individual feed intake

Rumination time
- Is driven by intake of structural NDF fiber (Mertens, 1997)
- Indicator of feed intake?
- Rumination monitoring system (RMS)
Large variation in rumination time in early lactation

Soriani et al., 2012
Separate concentrate feeding in AMS

- Individual adjustment of feed composition
  - Separate concentrate allocation
- Automatic milk systems (AMS)
- Partially mixed ration (PMR) + concentrate feeding
- Early lactation - Concentrate stepped up at a fixed rate
  - 4 weeks for 1. parity cows
  - 2-3 weeks for later parity cows
Variation in PMR\(^1\):Concentrate ratio at different PMR intakes

**Planned**

<table>
<thead>
<tr>
<th>PMR</th>
<th>Concentrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low PMR intake/RT</td>
<td></td>
</tr>
<tr>
<td>Medial PMR intake/RT</td>
<td></td>
</tr>
<tr>
<td>High PMR intake/RT</td>
<td></td>
</tr>
</tbody>
</table>

\(^1\)Partial mixed ration

**Different sceneries**

- ↑ SARA
- ↓ Feed intake
- ↓ Milk yield

- ↑ Milk yield→
- ↑ Ketosis→
- ↓ Feed intake→
- ↓ Milk yield
Objectives

- Compare the effect on milk production in early lactating dairy cows when allocating concentrate in the step-up period according to rumination time

Hypothesis

- Reduced variation in rumination time by adjustment of concentrate:
  - High rumination time $\rightarrow$ ↑ Concentrate allocation $\rightarrow$ ↓ intake of PMR
  - Low rumination time $\rightarrow$ ↓ Concentrate allocation $\rightarrow$ ↑ intake of PMR

- Adjusting concentrate allocation in early lactating dairy cows according to rumination time results in higher milk yield
Methods:

- Experimental design: Cows in early lactation
  - Comparative study within herd
  - 3 commercial Holstein dairy herds
- Feeding:
  - Same PMR\(^1\) *ad libitum* to all cows
  - Separate concentrate feeding
    - Control – same concentrate to all cows
    - Experimental – concentrate according to RT

\(^1\)Partial mixed ration
Assigning cows to treatments according to RT on day 4-7 DIM

Calving

EXP

CON

4 – 7 DIM

Treatments

EH EM EL CH CM CL

Daily rumination time, min

Upper threshold

Lower threshold

Days in milk

Methods
Principle for rumination group

![Graph showing rumination time over days in milk with different concentrate levels.]

- **High concentrate**
- **Medial concentrate**
- **Low concentrate**

Days in milk: 1 to 17

Daily rumination time, min: 200 to 800

Experimental design
Concentrate allocation rate: multiparous cows
Number of cows in the trial groups

<table>
<thead>
<tr>
<th>Rumination early lactation</th>
<th>High</th>
<th>Medial</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rumination group</td>
<td>$E_H$</td>
<td>$C_H$</td>
<td>$E_M$</td>
</tr>
<tr>
<td>Primiparous</td>
<td>16</td>
<td>25</td>
<td>15</td>
</tr>
<tr>
<td>Multiparous</td>
<td>27</td>
<td>28</td>
<td>25</td>
</tr>
</tbody>
</table>

- Unequal distribution between rumination groups
  - Adjusted according to herd level
  - Adjusted threshold limits during trial
Statistical analysis

- Model accounting for repeated recording within cow

- Fixed effects
  - Model 1: Trial group (EXP vs. CON) Trial *DIM Trial*DIM x DIM
  - Model 2: Treatment group (C_H, C_M, C_L, E_H, E_M, E_L) treatment group × DIM and Treat*DIM × DIM
  - DIM and DIM × DIM

- Random effects
  - Cow within herd
  - Herd

- Covariate
  - Milk yield at 4 DIM
ECM yield response:
week 1 to 3 (multi)
1 to 4 (primi)

Results

<table>
<thead>
<tr>
<th></th>
<th>ECM yield, kg/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXP</td>
<td></td>
</tr>
<tr>
<td>E_H</td>
<td>26.1*</td>
</tr>
<tr>
<td>E_M</td>
<td>25.6</td>
</tr>
<tr>
<td>E_L</td>
<td></td>
</tr>
<tr>
<td>CON</td>
<td></td>
</tr>
<tr>
<td>C_H</td>
<td>34.0</td>
</tr>
<tr>
<td>C_M</td>
<td>34.1</td>
</tr>
<tr>
<td>C_L</td>
<td></td>
</tr>
</tbody>
</table>
Low concentrate allocation rate increase ECM yield in primiparous cows

![Graph showing ECM yield comparison between high and low concentrate allocation rates.](image)

### Results

<table>
<thead>
<tr>
<th></th>
<th>EXP</th>
<th>CON</th>
</tr>
</thead>
<tbody>
<tr>
<td>EH</td>
<td>26.1</td>
<td>25.7</td>
</tr>
<tr>
<td>EM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EL</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: ECM yield, kg/day*
Conclusion

Effect on differentiated concentrate allocation according to RT in early lactation

- Primiparous cows yielded higher ECM
  - In the experimental group with differentiated concentrate allocation
  - Cows fed reduced amount of concentrate

- Multiparous cows no effect
Implications

**Further testing of the method**
- Larger scale of herds and cows
- Longer period – multiparous cows
- Combine with the milk yield recording
- Continuously checking of sensors

**Further development**
- Automated system to:
  - Validate rumination time
  - Allocate concentrate according to rumination time
Acknowledgements

Project funding
Forsknings- og Innovationsstyrelsen
Knowledge Centre for Agriculture

Collaborators
Carl Ejnar Sørensen,
Karsten Poulsen
Per Pedersen
Thank you for your attention
Recording rumination time by RMS

- RMS
  - Records rumination time by a microphone
  - Regurgitation and chewing

- Data from RMS
  - Saves the data from the last 22 hours.
  - Data is downloaded from sensor to computer
  - Data displayed in min per 2-hour or 24-hour