EXTENDED LACTATION IN DAIRY COWS

- THE REPROLAC PROJECT

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MORE LACTATION – HIGHER EFFICIENCY?

A typical DK cow is productive only 50% of its life:

- **Calving**: 26 mo of age
- **Lactating**: 27 mo (appr. 2.5 lactations)
- **Dry**: 4 mo
- **Culling**: 57 mo of age

Is extended lactation (EL) a solution?
BENEFITS AND CHALLENGES OF EL

- Milk production and persistency of lactation
- Milk quality
- Reproduction (poster 16)
- Lifetime performance and longevity (poster 14)
- Herd level effects and efficiency (Theater 3 / Poster 17)
THE REPROLAC PROJECT

- **Aim**: to develop a new strategy for milk production that improves productivity, animal welfare as well as the economy of the farmer

- **Intensive “on station” study** with two feeding strategies in support of EL

- **Extensive study on 4 private farms with** short and long lactations within farm
MILK PRODUCTION AND PERSISTENCY
YIELD HAS INCREASED – PERSISTENCY?

Holstein cows parity ≥ 2

Kristensen, 2015
LACTATION CURVE IS PLASTIC

- 10 mo lactation
  - Pregnancy

- 16 mo lactation
  - Milking freq
  - Diet Energy
  - Diet Protein

Month

Milk yield

Calving

AI

AI
EFFECT OF PREGNANCY

Milk yield, kg/d

Weeks from calving

Pregnancy: reduced MY by 2.6 kg/day

AI

Start of last trimester

All parities

Christiansen et al. 2005
Nørgaard et al. 2008, ANIMALc
2x VERSUS 3x MILKING

Wall and McFadden., 2008
Calving interval:
"  12 mo
18 mo

Milking freq
"  +   2 x
IS 305-D LACTATION MANAGEMENT STILL OPTIMAL?

- Production ” or ↑ with EL (Arbel et al. 2008)
- Profitability ↑ with EL (Arbel et al. 2008)
- Efficiency expected to ↑ with EL
- Welfare concerns reg. dry-off at high yields (Zobel et al., 2015)
# REPROLAC: 4 PRIVATE FARMS WITH EL

<table>
<thead>
<tr>
<th></th>
<th>Herd 1</th>
<th>Herd 2</th>
<th>Herd 3</th>
<th>Herd 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual cows</td>
<td>157</td>
<td>93</td>
<td>154</td>
<td>132</td>
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<tr>
<td>Lactations</td>
<td>480</td>
<td>181</td>
<td>434</td>
<td>284</td>
</tr>
<tr>
<td>Breed</td>
<td>Holstein</td>
<td>Holstein</td>
<td>Crosses</td>
<td>Jersey</td>
</tr>
<tr>
<td>Feeding system</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kg ECM /ann. cow</td>
<td>12,315</td>
<td>10,209</td>
<td>7,842</td>
<td>7,849</td>
</tr>
<tr>
<td>Planned CI, mo</td>
<td>13 / 16</td>
<td>14 / 17</td>
<td>15 / 18</td>
<td>13 / 16</td>
</tr>
</tbody>
</table>

Lehmann, 2016
ECM per feeding day is maintained

- Primiparous cows
- Multiparous cows

Kg ECM per feeding day

- Cl ≤ 13
- 13 < Cl ≤ 15
- 15 < Cl ≤ 17
- 17 < Cl ≤ 19
- Cl > 19

Calving interval (Cl), mo.

Lehmann et al., 2016. JDS
2ND LACTATION YIELD INCREASE WITH CI

First parity calving interval (CI), mo.

Lehmann et al., 2016, JDS
LATE LACT. YIELD: 45 DAYS BEFORE DRY OFF

Kg ECM / day

<table>
<thead>
<tr>
<th>Calving interval, mo</th>
<th>1st lactation</th>
<th>2nd lactation</th>
<th>Later lactations</th>
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</thead>
<tbody>
<tr>
<td>CI ≤ 13</td>
<td>a</td>
<td>a</td>
<td>a</td>
</tr>
<tr>
<td>13 &lt; CI ≤ 15</td>
<td>a</td>
<td>a</td>
<td>b</td>
</tr>
<tr>
<td>15 &lt; CI ≤ 17</td>
<td>a</td>
<td>b</td>
<td>bc</td>
</tr>
<tr>
<td>17 &lt; CI ≤ 19</td>
<td>a</td>
<td>c</td>
<td>cd</td>
</tr>
</tbody>
</table>

Lehmann et al., 2016, JDS
# Culling

<table>
<thead>
<tr>
<th>Parity</th>
<th>1. parity</th>
<th>Older</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactation length</td>
<td>Short</td>
<td>Long</td>
</tr>
<tr>
<td>Culled, %</td>
<td>21</td>
<td>19</td>
</tr>
</tbody>
</table>

Lehmann, unpubl.
ON STATION EXPERIMENT

62 Holstein cows

Enter the experiment 2 months before calving
- Dry off pen
- Dry off diet

At calving

45 Multiparous & 17 primiparous

Feed bins

At 8 months

1 AMS

Insemination

16 months lactation

AIM
### Feeding strategies

<table>
<thead>
<tr>
<th>% DM</th>
<th>LD diet</th>
<th>HD diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>4.3</td>
<td>4.0</td>
</tr>
<tr>
<td>Wheat</td>
<td>-</td>
<td>15.8</td>
</tr>
<tr>
<td>Rapeseed Cake</td>
<td>17.2</td>
<td>15.8</td>
</tr>
<tr>
<td>Sugar beet pulp</td>
<td>8.6</td>
<td>7.9</td>
</tr>
<tr>
<td>Concentrates AMS</td>
<td>10.7</td>
<td>9.9</td>
</tr>
<tr>
<td>Grass/clover silage</td>
<td>31.1</td>
<td>23.7</td>
</tr>
<tr>
<td>Corn silage</td>
<td>27.9</td>
<td>22.2</td>
</tr>
<tr>
<td>E, MJ NEL/kg DM</td>
<td>7.49</td>
<td>7.81</td>
</tr>
</tbody>
</table>

Smaller difference of MJ NEL/kg DM: 4% instead of planned 10% units
### REPROLAC – YIELD AND PERSISTENCY

#### Parity

<table>
<thead>
<tr>
<th></th>
<th>1. parity</th>
<th>Older</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kg milk per lactation</td>
<td>13,746</td>
<td>15,799</td>
</tr>
<tr>
<td>Kg milk per milking day</td>
<td>29.7</td>
<td>34.5</td>
</tr>
<tr>
<td>Milking frequency (AMS)</td>
<td>2.5</td>
<td>3.2</td>
</tr>
</tbody>
</table>

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**Figures:**

- **Graph a:**
  - Multiparous HD-LD
  - Multiparous LD-LD
  - Treatment effect
  - Parity effect

- **Graph b:**
  - Primiparous HD-LD
  - Primiparous LD-LD
  - Interaction effect
Persistency

![Graph showing the slope of ECM (kg/d) over DFS (days from service). The graph compares multiparous HD-LD, multiparous LD-LD, primiparous LD-LD, and primiparous HD-LD. The shift in HD-LD is shown to be less than in LD-LD.]

Gaillard et al., 2016

-0.16
-0.12
-0.08
-0.04
0
1E-16
0 50 100 150 200 250 300 350

Slope of ECM, kg/d

DFS

Multiparous HD-LD
Multiparous LD-LD
Primi parous LD-LD
Primi parous HD-LD
MILK QUALITY
ON STATION: MILK COMPOSITION

Aim: Investigate the quality of milk produced during extended lactation in relation to mid lactation

Milk sample collection:
- **P1**: 140 to 175 DIM
- **P2**: 280 to 315 DIM
- **P3**: 385 to 420 DIM

Maciel et al. 2016
## ON STATION: MILK COMPOSITION

<table>
<thead>
<tr>
<th>Composition</th>
<th>Lactation period</th>
<th>SEM</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P1</td>
<td>P2</td>
<td>P3</td>
</tr>
<tr>
<td>Milk solids</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lactose, %</td>
<td>4.81&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.75&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.73&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Fat, %</td>
<td>3.68&lt;sup&gt;c&lt;/sup&gt;</td>
<td>4.11&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.35&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Protein, %</td>
<td>3.28&lt;sup&gt;c&lt;/sup&gt;</td>
<td>3.62&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.81&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Casein, %</td>
<td>2.53&lt;sup&gt;c&lt;/sup&gt;</td>
<td>2.76&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.93&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Casein:protein, %</td>
<td>77.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>76.3&lt;sup&gt;b&lt;/sup&gt;</td>
<td>76.8&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Maciel et al. 2016
### ON STATION: MILK COMPOSITION

<table>
<thead>
<tr>
<th>Composition</th>
<th>Lactation period</th>
<th>SEM</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dialyse conductivity, mS/cm</td>
<td>P1: 4.71</td>
<td></td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>P2: 4.81</td>
<td></td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>P3: 4.72</td>
<td>0.06</td>
<td>NS</td>
</tr>
<tr>
<td>pH</td>
<td>P1: 6.71</td>
<td></td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>P2: 6.72</td>
<td></td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>P3: 6.73</td>
<td>0.01</td>
<td>NS</td>
</tr>
<tr>
<td>Chloride, mg/L</td>
<td>P1: 875.3</td>
<td>17.3</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>P2: 907.4</td>
<td></td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>P3: 922.8</td>
<td></td>
<td>**</td>
</tr>
</tbody>
</table>

Note: Significance codes: NS (not significant), * (significant), ** (highly significant).

Maciel et al. 2016
CHEESE-MAKING PROPERTIES

Coagulation time

Gel firmness

Yield

Maciel et al. 2016
SENSORY QUALITY

- No effect of diet
- Most parameters unaffected
- Changes were mainly related to increased fat and protein

Maciel et al. 2016
REPRODUCTION

See also poster # 23018
Activity during estrus

Daily activity, mov/h

Estrus number postpartum

- Estrus
- Normal

+17 mov/h during estrus

46%

68%
ESTRUS: YIELD AND MILKING FREQUENCY

![Graph showing milking frequency and daily milk yield around estrus](image-url)
REPROLAC – ESTRUS AND MILK YIELD

Milk yield, kg/d

<table>
<thead>
<tr>
<th>Estrus no</th>
<th>BEFORE ESTRUS</th>
<th>DURING ESTRUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>38</td>
<td>36</td>
</tr>
<tr>
<td>8</td>
<td>32</td>
<td>34</td>
</tr>
</tbody>
</table>

LOSS: 0.56 KG MILK PER ESTRUS

Gaillard et al., 2016
**Pregnancy Rates**

- **PL** = Previous 10 mo
- **EL** = Extended 16 mo
- **FL** = Following 10 mo

No differences in pregnancy rates between the groups.

- Few animals: n = 62
- n = 62
- n = 38
SUM UP

- Milk production is maintained at high level ✓
- Milk quality is the same or slightly improved ✓
- Increased activity due to estrus ✓ - problem ?
- Reproduction unaffected ✓ Poster 16
- Lifetime performance and longevity Poster 14
- Herd level effects and efficiency Theater 3 / Poster 17
REPROLAC

Extended lactation in dairy production in favour of climate, animal welfare and productivity
BCS AT THE CALVING FOLLOWING EL

<table>
<thead>
<tr>
<th>CI ≤ 13</th>
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<th>15 &lt; CI ≤ 19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herd 1</td>
<td>3.25</td>
<td>3.75</td>
<td>3.25</td>
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<tr>
<td>3.75</td>
<td>3.75</td>
<td>3.75</td>
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<tr>
<td>3.25</td>
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<tr>
<td>3.25</td>
<td>3.75</td>
<td>3.75</td>
<td>3.75</td>
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<tr>
<td>Herd 2</td>
<td>3.25</td>
<td>3.75</td>
<td>3.25</td>
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<td>3.75</td>
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<tr>
<td>Herd 3</td>
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<td>3.25</td>
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<tr>
<td>Herd 4</td>
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<td>3.25</td>
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<td>3.75</td>
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</tbody>
</table>

Lehmann, 2016
Fig. 1. Average daily yield of energy corrected milk (ECM) during the first experimental lactation in herd 2 (40% primiparous, 60% multiparous) for cows managed for 12- (——) or 18- (---) month calving intervals.

Bertilsson et al., 1997
Proportion of cows still milking during a 670-d lactation

Kaplan-Meier survival curves

Cheese-making properties

 CFR and G’max ↑ from P1 to P3
 Wet and dry curd yield ↑ with P1 to P3
 RCT ↓ in late lactation

= 100 g of milk protein = same curd yield
 No changes in curd moisture

Maciel et al. 2016
IS 305-D LACTATION MANAGEMENT STILL OPTIMAL?

• Production = or $\uparrow$ with EL (Arbel et al. 2008)
• Profitability $\uparrow$ with EL (Arbel et al. 2008)
• Efficiency expected to $\uparrow$ with EL
• Welfare effects of dry-off at high yields (Zobel et al., 2015)
YIELD HAS INCREASED – PERSISTENCY?

Is 305-d lactation management still optimal?

• Production \( \uparrow \) or \( \uparrow \) with EL (Arbel et al. 2008)
• Profitability \( \uparrow \) with EL (Arbel et al. 2008)
• Efficiency expected to \( \uparrow \) with EL
• Welfare effects of dry-off (Zobel et al., 2015)

Kristensen, 2015
## Production data
- Daily DMI, MY, LW
- BCS every 2 weeks
- Milk fat, protein, lactose & cells every week + ECM and EB (input – output) calculations

## Physiological data
- Weekly plasma NEFA, BHBA, glucose, urea, uric acid, insulin, IGF-1 from week 1 to 36
- Progesterone in milk

## Reproduction data
- Hourly activity
- Estrus behavior
- Pregnancy rates and number of AI per pregnancy