Physiology of cows with divergent genetic merit for fertility traits during the transition period

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Animal Model

Established 2007-2008

- Similar genetic merit for milk production
- Divergent genetic merit for fertility
- Holstein genetics

Fertility Phenotype = Genetics + Environment

Same Management
Breeding value for fertility trait

Top 20% for fertility

Bottom 10% for fertility

Cummins et al 2012a JDS
Transition Period

• Peripartum period

• Failure to adapt to increased nutrient demands
  • Poorer production
  • Metabolic diseases
  • Compromised fertility

• Does genetic merit for fertility affect the transition period?
Materials and Methods

26 cows
- 11 Fert- enrolled
- 15 Fert+ enrolled

Managed as one group indoors

Diet
- Precalving: Grass silage, Concentrate, Straw, Minerals
- Early lactation: Grass silage, Maize silage, Concentrate, Soya
- After 5 weeks: Grazed Perennial ryegrass + Concentrate
Animal Measurements

- Uterine Cytology
- Vaginal Mucus Score
- Blood

Week: -4 -3 -2 -1 Calving 1 2 3 4 5 6 7 8

3x weekly Milk Progesterone

Daily Dry Matter Intake

Daily Milk Production
Statistical Analysis

• Repeated measures model:
  • $Y = \mu + \text{geno} + \text{parity} + \text{time} + \text{geno} \times \text{time} + \text{geno} \times \text{parity} + \text{calving date} + \epsilon$
    - Cow(geno) included as a random effect
    - AR covariance structure

• Nonparametric data:
  • Body condition score variables
  • Vaginal mucus score

• Logistic regression:
  • Binary variables
Energy Output

![Graph showing milk solids and BCS over weeks of lactation]

<table>
<thead>
<tr>
<th></th>
<th>Fert+</th>
<th>Fert-</th>
<th>SEM</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk Solids (kg/d)</td>
<td>1.89</td>
<td>1.74</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Milk Yield (kg/day)</td>
<td>24.2</td>
<td>22.3</td>
<td>0.88</td>
<td>0.08</td>
</tr>
<tr>
<td>Mean BW (kg)</td>
<td>578</td>
<td>546</td>
<td>11.1</td>
<td>0.05</td>
</tr>
<tr>
<td>Mean BCS (units)</td>
<td>2.98</td>
<td>2.75</td>
<td>0.02</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Calving BCS</td>
<td>3.12</td>
<td>2.98</td>
<td>-</td>
<td>0.14</td>
</tr>
<tr>
<td>Nadir BCS</td>
<td>2.75</td>
<td>2.45</td>
<td>-</td>
<td>0.009</td>
</tr>
<tr>
<td>BCS loss</td>
<td>-0.35</td>
<td>-0.48</td>
<td>0.06</td>
<td>0.01</td>
</tr>
</tbody>
</table>
### Energy Intake/Balance

#### DMI (kg/day)

<table>
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<th>Fert-</th>
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<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepartum</td>
<td>14.8</td>
<td>14.3</td>
<td>0.74</td>
<td>0.63</td>
</tr>
<tr>
<td>Postpartum</td>
<td>19.7</td>
<td>16.8</td>
<td>0.79</td>
<td>0.02</td>
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</tbody>
</table>

#### EB (UFL/day)

<table>
<thead>
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<th>Fert-</th>
<th>SEM</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepartum</td>
<td>6.1</td>
<td>5.5</td>
<td>0.54</td>
<td>0.45</td>
</tr>
<tr>
<td>Postpartum</td>
<td>-0.3</td>
<td>-1.2</td>
<td>0.71</td>
<td>0.37</td>
</tr>
</tbody>
</table>
Metabolic Status

**Insulin (uIU/mL)**

- **Geno:** P = 0.08
- **Geno x week:** P = 0.04

**Glucose (mmol/L)**

- **Geno:** P = 0.04
- **Geno x week:** P < 0.0001

**IGF-I (ng/mL)**

- **Geno:** P = 0.01
- **Geno x week:** P < 0.001

**Plasma NEFA (mmol/L)**

- **Geno:** P = 0.64
- **Geno x week:** P = 0.02

**Fert+**

**Fert-**
Uterine Health

<table>
<thead>
<tr>
<th>Week</th>
<th>Fert+</th>
<th>Fert-</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.9</td>
<td>2.3</td>
<td>0.31</td>
</tr>
<tr>
<td>2</td>
<td>0.9</td>
<td>2.5</td>
<td>0.003</td>
</tr>
<tr>
<td>3</td>
<td>1.1</td>
<td>2.2</td>
<td>0.04</td>
</tr>
<tr>
<td>4</td>
<td>0.4</td>
<td>1.1</td>
<td>0.09</td>
</tr>
<tr>
<td>5</td>
<td>0.4</td>
<td>1.2</td>
<td>0.08</td>
</tr>
<tr>
<td>6</td>
<td>0.0</td>
<td>1.2</td>
<td>0.06</td>
</tr>
<tr>
<td>7</td>
<td>0.0</td>
<td>0.2</td>
<td>0.26</td>
</tr>
<tr>
<td>8</td>
<td>0.0</td>
<td>0.0</td>
<td>0.74</td>
</tr>
</tbody>
</table>

Endometritis classification

<table>
<thead>
<tr>
<th>Endometritis classification</th>
<th>% Neutrophils</th>
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</thead>
<tbody>
<tr>
<td>Week 3</td>
<td>&gt; 18</td>
</tr>
<tr>
<td>Week 6</td>
<td>&gt; 10</td>
</tr>
</tbody>
</table>

P = 0.09 (Week 3)  
P = 0.04 (Week 6)
Resumption of cyclicity

% cycling by week 6

- Fert+
- Fert-

P = 0.009
Conclusions

• **Fert+ vs. Fert-**
  • Greater dry matter intake
  • More favourable metabolic status
  • Maintain greater body condition score
  • Superior uterine health
  • Earlier resumption of cyclicity

• **Implications**
  • Good fertility & milk production achievable
  • Must use sires with good daughter fertility traits
THANKS FOR YOUR ATTENTION

QUESTIONS???