Real-time analyses of BHB in milk can monitor ketosis and it’s impact on reproduction in dairy cows

Jens Yde Blom
DVM, PhD
Lattec I/S
Hillerød, Denmark

Co-author:
Carsten Ridder
John M. Christensen
Christina A. Petersen
Outline of presentation

- Definitions
- Herd Navigator® – the biomodel and ketosis risk
- Ketosis in three selected herds
- Implications of subclinical ketosis for production and reproductive performance
- Conclusions
Definitions of ketosis

- Ketosis, a common disorder in cows within the first month after calving, defined by elevated levels of ketone bodies in blood (Gold Standard for ketosis), urine and milk.
- Prevalence: Vary among herds, 4-20%. Recent European study: 21.8% (11.2-36.6%) (Suthar et al. 2013)

  Clinical signs: Reduced appetite, milk yield drop, loss of weight, hypoglycemia and hyperketonemia.

- Subclinical ketosis: β-Hydroxy Butyrate (BHB) levels: Blood: ≥ 1.2 mM, milk: ≥ 0.12 mM
Reliability of milk BHB for ketosis monitoring:

Pearson's Correlation Between Blood and Milk BHB Over Time

Time window of interest

Day Relative To Feed Restriction (d = 0)

Bjerre-Harpøth et al. 2013, unpublished
Herd Navigator® is a proactive herd management system.

**Reproduction (progesterone)**
- Heat
- Pregnancy
- Reproduction disorders

**Health**
- Mastitis (LDH)
- Ketosis (BHB)

**Feed Balance (urea)**
- Detecting disproportions of protein and energy in feed ration
Ketosis monitoring: The biomodel

Nielsen et al., J. Dairy Sci., 88, 2005, 2144..
Ketosis monitoring: The output
Purpose of study, Materials and Methods

• **Purpose of study**
  ◦ Analyse prevalence of subclinical ketosis in high yielding dairy herds using Herd Navigator®
  ◦ Analyse relationships between ketosis and reproductive performance

• **Participating herds (convenience sample):**
  ◦ Herd 1 (DK): 278 cows, 4 VMS, 278 cows
  ◦ Herd 2 (NL): 2 X 10 parlour, 151 cows
  ◦ Herd 3 (CA): 2 VMS, 126 cows
  ◦ Continuous measurements of BHB and progesterone (P₄)
  ◦ Data from 2012, analysed in Herd Navigator® biomodels and graphically displayed in MATLAB®
## Prevalence of ketosis and Post Partum Anoestrus (PPA)

<table>
<thead>
<tr>
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<th>Herd 1</th>
<th>Herd 2</th>
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<tr>
<td># cows</td>
<td>278</td>
<td>151</td>
<td>126</td>
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<td>Milk yield per cow/year</td>
<td>10,900</td>
<td>8,900</td>
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<td>BHB samples per year</td>
<td>8,948</td>
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<td>% BHB samples above threshold (“BHB load”)</td>
<td>1.8</td>
<td>14.2</td>
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<td># ketosis alarms per 100 calvings</td>
<td>3</td>
<td>29</td>
<td>38</td>
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<tr>
<td># early alarms (&lt;10 DIM)</td>
<td>48 %</td>
<td>48 %</td>
<td>51 %</td>
</tr>
<tr>
<td>Start measurements for P₄, DIM</td>
<td>30</td>
<td>20</td>
<td>60</td>
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<tr>
<td># PPA alarms per 100 calvings</td>
<td>23</td>
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Cumulative incidence of ketosis alarms
Farm 1: Reproductive performance
- starting point: 1st AI

Lenght of involuntary waiting period

Cumulative % pregnant

Days from onset AI

Distribution of BHB measurements
BHB load

BHB mMol/L

0 0.1 0.2 0.3 0.4 0.5 0.6

0 10 20 30 40 50 60 70 80 90 100

Healthy
Ketosis
FolCyst
PPA

Farm 1: Reproductive performance
- starting point: 1st AI

Lenght of involuntary waiting period

Cumulative % pregnant

Days from onset AI

Distribution of BHB measurements
BHB load

BHB mMol/L

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Healthy
Ketosis
FolCyst
PPA
Farm 2: Reproductive performance
- starting point: 1st AI

Length of involuntary waiting period

Cumulative % pregnant

Days from onset AI

Distribution of BHB measurements
BHB load

BHB, mMol/L

Farm 2: Reproductive performance
- starting point: 1st AI
Farm 3: Reproductive performance

- starting point: 1st AI
Conception rates (%) for 1st AI

![Conception rates graph]

- **Healthy**: Highest conception rates for Farm 1 and Farm 3.
- **Ketosis**: Moderate conception rates for Farm 1, Farm 2, and Farm 3.
- **Folcyst**: Low conception rates for all farms.
- **PPA**: Lowest conception rates for all farms.
Conclusions

- Continuous measurements of milk BHB aid in the detection of subclinical ketosis
  - Detection long before clinical signs expect to occur: ~50 % occur before 10 DIM
  - Validate total “BHB-load” to the herd – impact on herd performance
- Conception rates in ketotic cows lower than in healthy cows at 1st AI
- Use of on-farm measurements can aid in elucidating underlying causes of reproductive failure
Thank you
We strive to keep cows flying!