Milk fat composition measured by MIR Spectroscopy as an indicator of ketosis status in dairy cows
A preliminary study

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**INTRODUCTION**

Ketosis: *definition*

Energy balance $<< 0$  
Glycogen (liver) not available to cover energy requirements

Adipose tissue mobilisation ($\beta$-oxidation)

Fatty acids (C18:0, C18:1) => liver => ketone bodies (aceto-acetate, $\beta$-OH)

When long/high starvation => ketosis
Ketosis occurs at the beginning of lactation (0-6 weeks)

Two levels of ketosis:
- Subclinical ketosis
- Clinical ketosis
  - Type 1 ketosis
  - Type 2 ketosis (hepatic steatosis)

Health consequences: fertility, mastitis, ...

Ketosis diagnosis mainly based on blood and milk parameters (ketone bodies)
OBJECTIVE

The recent development of FA composition measurement by Mid-InfraRed Spectroscopy (MIRS) may help in diagnosing ketosis, as it is well known FA profile is linked to ketosis metabolic status.

Our objective was to assess if FA composition measured by MIRS may help in diagnosing ketosis in dairy cows.
MATERIAL & METHODS

6 dairy farms

Visual diagnosis by 2 vets
Glycemia & β-OH (Optium Xceed® test / blood sample)

16 healthy cows (HC) and 11 ketotic cows (KC)

**Milk**
Fat, protein and urea contents, somatic cell count, FA profile (by MIRS)

**Blood**
NEFA, acetate, propionate, minerals, insuline, serum-amyloid A, haptoglobin, thyroxin
MATERIAL & METHODS

Effects of metabolic status on blood and milk parameters
  - ANOVA (proc glm) : 2 factors => farm & metabolic status

Test of FA profile as an help in diagnosing ketosis
  - Decision trees
## Animal performance

### RESULTS

<table>
<thead>
<tr>
<th></th>
<th>Healthy cows</th>
<th>Ketotic cows</th>
</tr>
</thead>
<tbody>
<tr>
<td>n=</td>
<td>16</td>
<td>11</td>
</tr>
<tr>
<td>DIM</td>
<td>70</td>
<td>31</td>
</tr>
<tr>
<td>Milk yield, kg/d</td>
<td>34.5</td>
<td>33.0</td>
</tr>
<tr>
<td>Fat content, g/kg</td>
<td>43.8</td>
<td>56.5</td>
</tr>
<tr>
<td>Protein Content, g/kg</td>
<td>29.1</td>
<td>29.2</td>
</tr>
<tr>
<td>Fat/protein</td>
<td>1.52</td>
<td>1.96</td>
</tr>
<tr>
<td>Urea content, mg/kg</td>
<td>358</td>
<td>279</td>
</tr>
</tbody>
</table>

Results in accordance with literature

Confirm diagnosis
### RESULTS

**Blood parameters**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Healthy cows</th>
<th>Ketotic cows</th>
</tr>
</thead>
<tbody>
<tr>
<td>n=</td>
<td>16</td>
<td>11</td>
</tr>
<tr>
<td>Glycemia, g/l</td>
<td>0.45</td>
<td>0.30</td>
</tr>
<tr>
<td>β-OH, mmol/L</td>
<td>0.88</td>
<td>3.15</td>
</tr>
<tr>
<td>NEFA, mmol/L</td>
<td>0.33</td>
<td>0.61</td>
</tr>
<tr>
<td>Urea, mmol/L</td>
<td>7.69</td>
<td>5.94</td>
</tr>
<tr>
<td>Thyroxin, nmol/L</td>
<td>47.8</td>
<td>32.3</td>
</tr>
</tbody>
</table>

Results in accordance with literature (Michaux, 2008; Veenhuisen, 1991)
## RESULTS

### Milk FA profile

<table>
<thead>
<tr>
<th>% FA</th>
<th>Healthy cows</th>
<th>Ketotic cows</th>
</tr>
</thead>
<tbody>
<tr>
<td>n=</td>
<td>16</td>
<td>11</td>
</tr>
<tr>
<td>C16:0</td>
<td>29.7</td>
<td>22.9</td>
</tr>
<tr>
<td>C18:1</td>
<td>28.3</td>
<td>34.7</td>
</tr>
<tr>
<td>MUFA</td>
<td>29.4</td>
<td>37.2</td>
</tr>
<tr>
<td>PUFA</td>
<td>5.70</td>
<td>5.54</td>
</tr>
<tr>
<td>C18:0</td>
<td>13.7</td>
<td>16.4</td>
</tr>
<tr>
<td>AGMI+C18:0-C16:0</td>
<td>13.4</td>
<td>30.7</td>
</tr>
</tbody>
</table>
RESULTS

Decision tree

Total = 27 cows
n = 16 healthy
n = 11 ketotic

C16:0 ≥ 24.34 %

Total = 15 cows
n = 14 healthy
n = 1 ketotic

C16:0 < 24.34 %

Total = 12 cows
n = 2 healthy
n = 10 ketotic

Fat/Protein ≥ 1.31

Total = 10 cows
n = 0 healthy
n = 10 ketotic

Fat/Protein < 1.31

Total = 2 cows
n = 2 healthy
n = 0 ketotic
CONCLUSION

- Milk FA profile by MIRS can help in diagnosing ketosis
- Routine FA analysis can give a risk factor of ketosis
- Small database used => further studies needed to validate these indicators
- Ketosis detection at the beginning of lactation
  - Rapid treatment
  - Adaptation of ketosis prevention in farms
Thank you for your attention.