Predicting methane emissions of individual grazing dairy cows from spectral analyses of their milk samples

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Data

- 93,888 individual methane spot measures (>2 minutes)
- 384 lactations from 277 dairy cows

Methane

\[
\begin{align*}
&n \geq 20 \\
&n \geq 10 \\
&0 \\
&n \geq 10 \\
&+6 \\
\end{align*}
\]

AM & PM Milk sample
- Yield & composition
- Spectrum
- Days post calving

AM only
PM only
AM+PM
AM&PM
Approach

Four fold cross-validation

One farm out

Methane = \int (\text{spectrum}, \text{days in milk}, \text{yield}, \text{fat\%}, \text{protein \%})

Partial least squares or neural networks
Results

• $\mu = 323.4$ g/d
• $\sigma = 75.2$ g/d
• Average of 30 spot measures to ±6 days
  • 111 minutes
• Repeatability = 28%

• Little difference
  • AM v PM, neural networks v partial least squares
• Flanking 6 days > previous 6 days > subsequent 6 days
• Holstein > Jersey > Crossbreds
## Results

<table>
<thead>
<tr>
<th>Experiment</th>
<th>RMSE (g/d)</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>34.39</td>
<td>0.69</td>
</tr>
<tr>
<td>2</td>
<td>37.04</td>
<td>0.58</td>
</tr>
<tr>
<td>3</td>
<td>36.76</td>
<td>0.71</td>
</tr>
<tr>
<td>4</td>
<td>37.44</td>
<td>0.55</td>
</tr>
<tr>
<td>5</td>
<td>41.10</td>
<td>0.65</td>
</tr>
<tr>
<td>6</td>
<td>37.26</td>
<td>0.68</td>
</tr>
<tr>
<td>7</td>
<td>40.55</td>
<td>0.62</td>
</tr>
<tr>
<td>8</td>
<td>35.71</td>
<td>0.68</td>
</tr>
</tbody>
</table>

Methane = AM + PM + yield + days post calving
### Results

<table>
<thead>
<tr>
<th>Model</th>
<th>No spectra</th>
<th>With spectra</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectra</td>
<td></td>
<td>0.55 (0.07)</td>
</tr>
<tr>
<td>DIM</td>
<td>0.32 (0.13)</td>
<td>0.55 (0.06)</td>
</tr>
<tr>
<td>Yield</td>
<td>0.10 (0.18)</td>
<td>0.64 (0.05)</td>
</tr>
<tr>
<td>Composition</td>
<td>0.32 (0.13)</td>
<td>0.57 (0.06)</td>
</tr>
<tr>
<td>DIM + yield</td>
<td>0.52 (0.10)</td>
<td>0.64 (0.06)</td>
</tr>
<tr>
<td>DIM + composition</td>
<td>0.41 (0.10)</td>
<td>0.55 (0.06)</td>
</tr>
<tr>
<td>Yield + composition</td>
<td>0.32 (0.07)</td>
<td>0.62 (0.05)</td>
</tr>
<tr>
<td>DIM + yield + composition</td>
<td>0.54 (0.09)</td>
<td>0.64 (0.05)</td>
</tr>
</tbody>
</table>
Conclusions

• OK predictions of methane from milk samples
  • Good enough???
  • Needs more validation

• Add to the pipeline of predictions from milk samples

• What to do with the results?