Feed efficiency and methane emissions in dairy cattle: Overview of the current recording

Adrien Butty¹, A. Wilson¹, C. Richardson¹, F. Miglior¹,², C. Baes¹

¹CGIL - University of Guelph; ²Canadian Dairy Network, Guelph, Ontario, Canada
Continuous growth in demand for high quality milk protein (+238% in Asia in last 30 years)

Increasing awareness of environmental impact from dairying

Rising dairy farm input costs where feed represents more than 50% of operation costs
Feed efficiency & methane emissions are two traits difficult to measure:
- expensive recording methods
- strongly fluctuate from minute to minute

⇒ No mass/routine recording possible
⇒ Traditional genetic evaluation impossible

but...

use of genomics makes accurate estimation of breeding values for these traits possible!
ICAR Feed & Gas Working Group

• Working Group within the International Committee for Animal Recording

• Gather people from 8 countries
  Benoit Rouillé (F)     Nina Krattenmacher (D)
  Raffaella Finocchiaro (I)    Jan Lassen (DK)
  Phil Garnsworthy (UK)    Filippo Miglior (CA)
  Birgit Gredler (CH)     Jennie Pryce (AU)

• Aims to:
  - create an overview of the current data status for FE & ME
  - facilitate the standardization of recording DMI & CH₄
  - enhance international collaboration, technically and methodologically
ICAR Feed & Gas Working Group

• Working Group within the International Committee for Animal Recording

• Gather people from 8 countries
  Benoit Rouillé (F)          Nina Krattenmacher (D)
  Raffaella Finocchiaro (I)  Jan Lassen (DK)
  Phil Garnsworthy (UK)      Filippo Miglior (CA)
  Birgit Gredler (CH)        Jennie Pryce (AU)

• Aims to:
  - create an overview of the current data status for FE & ME
  - facilitate the standardization of recording DMI & CH₄
  - enhance international collaboration, technically and methodologically
The survey

1. Data and Recording Methods for Feed Intake and Methane Emissions
   - Materials/Methods used
   - Recorded parameters
   - Duration, repetition of measurements, ...

2. Selection Goals for Methane Emissions and Feed Intake Traits
   - Trait definition used, phenotype source(s)
   - Model composition, methodologies, ...
   - Status of evaluation for the traits
The survey

1. Data and Recording Methods for Feed Intake and Methane Emissions
   - Materials/Methods used
   - Recorded parameters
   - Duration, repetition of measurements, ...

2. Selection Goals for Methane Emissions and Feed Intake Traits
   - Trait definition used, phenotype source(s)
   - Model composition, methodologies, ...
   - Status of evaluation for the traits
1. Data and Recording Methods for Feed Intake and Methane Emissions

Respiration Chambers

Laser Methane Detector

Sulfur Hexafluoride ($\text{SF}_6$)

Headbox

GreenFeed System by C-Lock Inc.
The survey

1. Data and Recording Methods for Feed Intake and Methane Emissions
   - Materials/Methods used
   - Recorded parameters
   - Duration, repetition of measurements, ...

2. Selection Goals for Methane Emissions and Feed Intake Traits
   - Trait definition used, phenotype source(s)
   - Model composition, methodologies, ...
   - Status of evaluation for the traits
# 2. Selection Goals for Methane Emissions and Feed Intake Traits

## Feed efficiency

<table>
<thead>
<tr>
<th>Definition</th>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Matter Intake (g / day)</td>
<td>Direct improvement possible</td>
<td>Lowering of production level and loss of appetite</td>
</tr>
<tr>
<td>Feed conversion efficiency (kg Milk / kg Feed)</td>
<td>Well understood by farmers</td>
<td>Ratio trait, strongly linked to production</td>
</tr>
<tr>
<td>Production efficiency (kg Milk / kg BW)</td>
<td>Fits interests of the farmers</td>
<td>Ratio trait, strongly linked to production</td>
</tr>
<tr>
<td>Residual feed intake (DMI observed – DMI predicted)</td>
<td>Include corrections for correlated traits</td>
<td>Inversed values &amp; higher complexity make it hard for farmers</td>
</tr>
</tbody>
</table>

Modified from Yvette de Haas, 2015
## 2. Selection Goals for Methane Emissions and Feed Intake Traits

### Methane emissions

<table>
<thead>
<tr>
<th>Definition</th>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methane production (g/day)</td>
<td>Direct improvement possible</td>
<td>Lowering of production level and feed intake</td>
</tr>
<tr>
<td>Methane intensity (g/kg DMI)</td>
<td>Well understood by farmers</td>
<td>Ratio trait</td>
</tr>
<tr>
<td>Methane yield (g/kg milk or g/kg BW)</td>
<td>Fits interests of the farmers</td>
<td>Ratio trait</td>
</tr>
<tr>
<td>Residual methane production (g observed – g predicted)</td>
<td>Include corrections for correlated traits</td>
<td>Inversed values &amp; higher complexity make it hard for farmers</td>
</tr>
</tbody>
</table>

modified from Yvette de Haas, 2015
1. Data and Recording Methods for Feed Intake and Methane Emissions
   - Materials/Methods used
   - Recorded parameters
   - Duration, repetition of measurements, ...

2. Selection Goals for Methane Emissions and Feed Intake Traits
   - Trait definition used, phenotype source(s)
   - Model composition, methodologies, ...
   - Status of evaluation for the traits
Phenotype sources:
• Direct measurement
• Predicted phenotypes
  – using Milk MIR data
  – predict ME using FE data?
• Combination of both information sources
  – how well do these data can be merged?

Methodology:
• Single-step approach
• Estimation of marker effects and prediction of DGV

Inclusion in breeding goal:
• Which traits will have less weight in the breeding goal?
  – all proportionally?
  – less weight only on production traits?
The survey

1. Data and Recording Methods for Feed Intake and Methane Emissions
   - Materials/Methods used
   - Recorded parameters
   - Duration, repetition of measurements, ...

2. Selection Goals for Methane Emissions and Feed Intake Traits
   - Trait definition used, phenotype source(s)
   - Model composition, methodologies, ...
   - Status of evaluation for the traits
Feed efficiency is already applied

• Australia: Feed Saved Breeding Values
  – similar residual feed intake
  – expressed in kg DM
  – allows a BV for which higher values are better
  – introduced in April 2015

• The Netherlands: Dry Matter Intake Breeding Values
  – expressed in kg DM
  – implemented also in the Better Life Efficiency Index
  – introduced in April 2016
## Current answers status

<table>
<thead>
<tr>
<th></th>
<th>Invited</th>
<th>Total takers</th>
<th>Complete responses</th>
<th>Partial responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Data collection</td>
<td>120</td>
<td>19</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>2. Selection objectives</td>
<td>118</td>
<td>5</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

To participate contact us at: buttya@uoguelph.ca

Special acknowledgement to Cesare Mosconi