Material & Methods

**Background**

- Enteric methane (CH₄) emissions of cows
  - Common bio-chemical pathways with acetate & butyrate
- Milk fatty acids (FA) from acetate & butyrate
  - Potential predictors of CH₄
- Association between CH₄ emissions & milk FA changes through the lactation
  - Still unclear

**Data**

- Prediction of CH₄ emissions (g/d) & groups of milk FA contents (g/dL of milk) from milk mid-infrared (MIR) spectra
  - ≥ 5 records/cow
  - ≥ 20 cows/ herd
- 243,260 MIR spectra collected between January 2007 and January 2014
- From 5 to 305 days in milk (DIM)
- 33,850 first-parity Walloon Holstein cows from 630 herds
- Pedigree file: 109,975 animals

**Model**

- Bivariate random regression test-day models
  - MIR CH₄ & 1 group of FA
  - Resolved using REMLF90 (Misztal, 2012)

\[ y = Xb + Q(Wh + Zp + Za) + e \]

where

- \( y \) = Vector of observations
- \( b \) = Vector of fixed effects
  - Herd x test-day
  - Classes of lactation stage
  - Gestation stage x lactation stage
  - Lactation stage x age at calving x season of calving
- \( h \) = Vector of herd x year of calving random effects
- \( p \) = Vector of permanent environmental random effects
- \( a \) = Vector of additive genetic random effects
- \( Q \) = Covariate matrix for 2nd order Legendre polynomials
- \( X, W \ & Z \) = Incidence matrices
- \( e \) = Error

**Objective: Estimation of genetic correlations between CH₄ emissions & FA contents in milk throughout the lactation**

**Results**

- Heritabilities of studied traits & genetic correlations of FA with CH₄

<table>
<thead>
<tr>
<th>Trait</th>
<th>( h^2 )</th>
<th>Averaged daily genetic correlation with CH₄</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIR CH₄ (g/d)</td>
<td>0.24</td>
<td>/</td>
</tr>
<tr>
<td>SFA (g/dL of milk)</td>
<td>0.40</td>
<td>0.29</td>
</tr>
<tr>
<td>MUFA (g/dL of milk)</td>
<td>0.19</td>
<td>0.00</td>
</tr>
<tr>
<td>PUFA (g/dL of milk)</td>
<td>0.29</td>
<td>0.12</td>
</tr>
<tr>
<td>UFA (g/dL of milk)</td>
<td>0.20</td>
<td>0.04</td>
</tr>
<tr>
<td>SCFA (g/dL of milk)</td>
<td>0.39</td>
<td>0.29</td>
</tr>
<tr>
<td>MCFA (g/dL of milk)</td>
<td>0.41</td>
<td>0.25</td>
</tr>
<tr>
<td>LCFA (g/dL of milk)</td>
<td>0.17</td>
<td>0.15</td>
</tr>
</tbody>
</table>

\( h^2 \) = heritability; SFA = Saturated FA; MUFA = Monounsaturated FA; PUFA = Polyunsaturated FA; UFA = Unsaturated FA; SCFA = Short-chain FA; MCFA = Medium-chain FA; LCFA = Long-chain FA

**Evolution of genetic correlations between MIR CH₄ groups and of FA**

- Positive correlations between CH₄ and SFA, SCFA & MCFA
- Low correlations in early lactation and high after for SCFA & correlations more stable across DIM for SFA & MCFA
- Negative correlations between CH₄ and UFA & LCFA in early lactation & increasing afterward to become positive

Conclusions

- Genetic correlations between CH₄ production & milk FA vary according to lactation stage of the cow
- Need to take into account this fact when predicting CH₄ emissions from milk FA contents