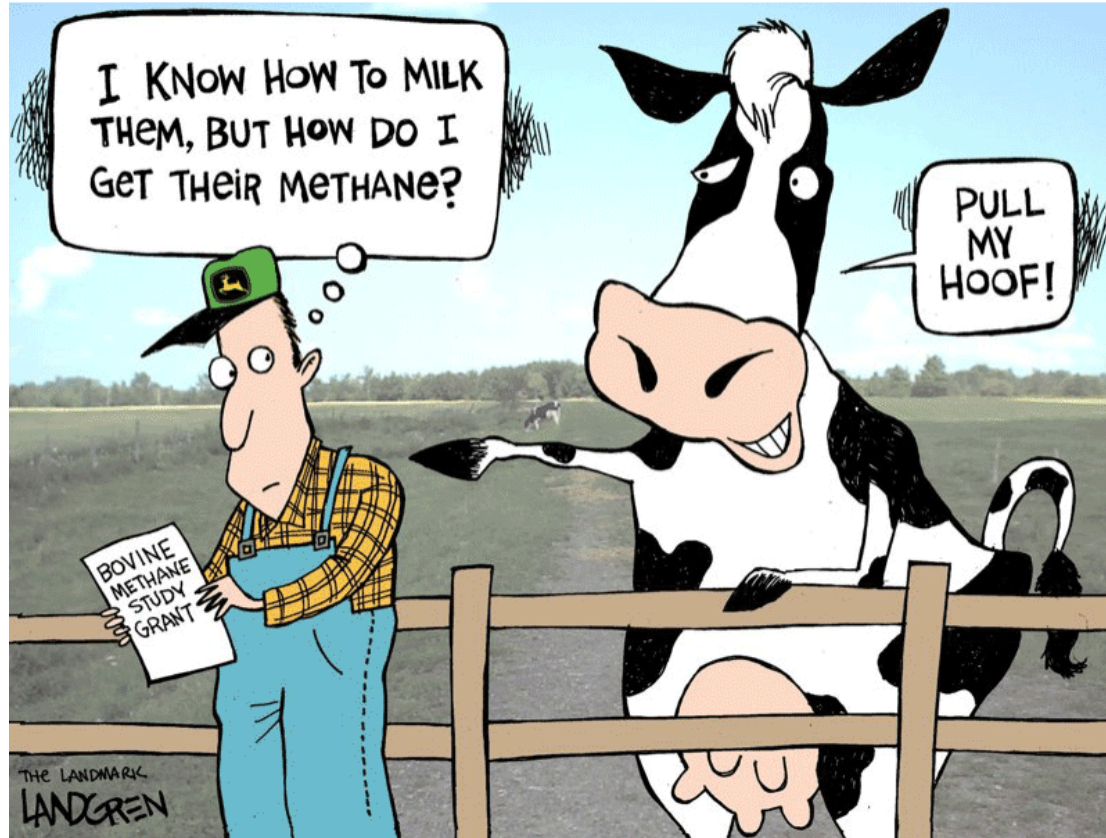

Heritability for enteric methane emission from Danish Holstein cows using a non-invasive FTIR method

Jan Lassen and Peter Løvendahl

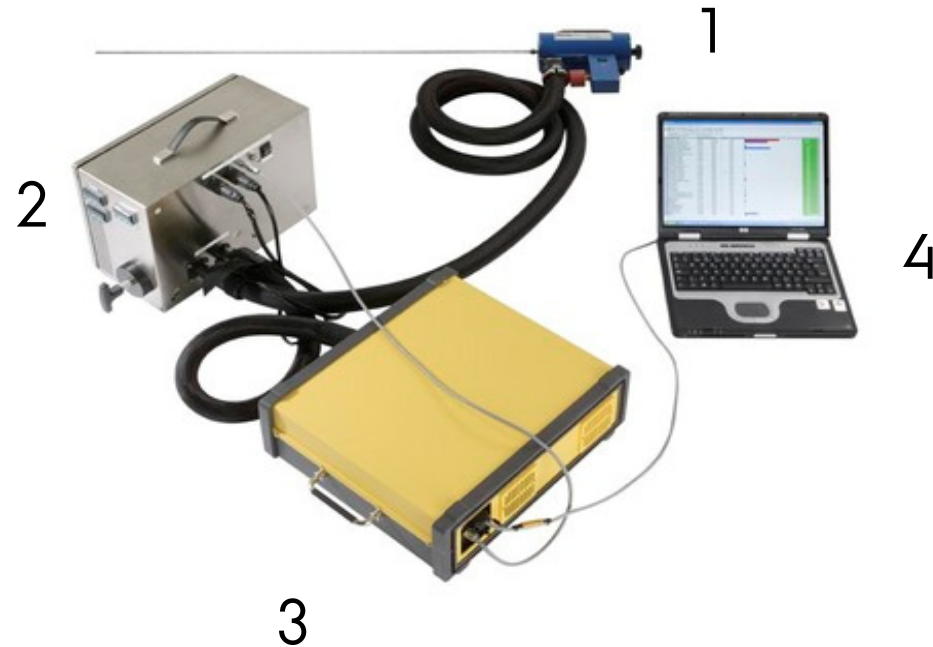
Quantitative Genetics and Genomics Centre
Department of Molecular Biology and Genetics
Aarhus University, Denmark



Measuring methane for genetic analysis

- › Precise measurements in large numbers...
- › Respiration chambers has limitations
- › Useful phenotype for the farmer

Equipment for measuring in AMS



1. Sampling unit
2. Pump unit
3. Analyser FTIR – (GASMET DX-4000, www.gasmet.fi)
4. computer + software



Good and bad

- › High capacity
- › Non invasive
- › Potential for other gasses
- › Spot samples of biology
- › No control of breath
- › Quantification a challenge

Data on methane emission

- › 2104 cows with breath registrations from 21 herds
- › Measured over a week long period during milking (5-30 visits pr cow)
- › Measurement every 5 seconds
- › Phenotype = CH_4/CO_2
- › Weight data on 923 cows (Lely robots)
- › Feed intake on 103 cows (research farm)
- › Milk records on 2104 cows

Quantifying methane emissions

- › IPCC : PME (g/d) = **feed intake** (kg of DM/d) × 18.4 (MJ/kg of DM)/0.05565 (MJ/g) × 0.06 × {1 + [2.38 – **level of intake**] × 0.04} (de Hass et al JDS 2012)
- › Heat: l/day = 5,6***weight**^{0,75} + 22***ECM** + 1.6⁻⁵***DCC**³ * CH₄/CO₂ (Madsen et al LS 2010)
- › CH₄/CO₂ : Ratio between methane and carbondioxide (Lassen et al JDS 2012, Madsen et al LS 2010)

Phenotypic correlations

| | IPCC | Heat |
|----------------------------------|------|------|
| Heat | 0,74 | |
| CH ₄ /CO ₂ | 0,70 | 0,94 |

Genetic model

$$\text{CH}_4/\text{CO}_2 = \begin{array}{ll} \text{Mean} & \\ + \text{Herd} & \text{Fixed class} \\ + \text{Robot(Herd)} & \text{Fixed class} \\ + \text{Lact nr} & \text{Fixed class} \\ + \text{DIM} & \text{Fixed reg} \\ + \text{Wilmink DIM} & \text{Fixed reg} \\ + \text{Animal} & \text{Random} \\ + \text{Residual} & \text{Random} \end{array}$$

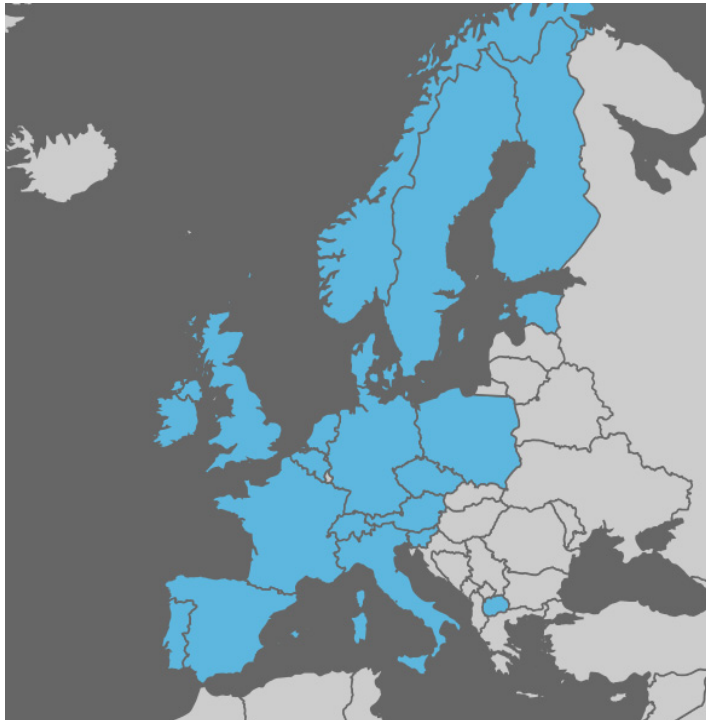
Genetic parameters

| | h^2 |
|--------------------------------------|--------------------|
| CH₄/CO₂ | 0,19 ± 0,06 |
| Heat | 0,23 ± 0,11 |
| IPCC | 0,21 ± 0,16 |

Other studies

- › Predicted methane and RFI $r_g = 0.32$ (de Haas et al., 2011)
- › Methane predicted from milk spectra $h^2 = 0.10$ (Kandel et al., 2013)

METHAGENE – EU COST ACTION



- › 4 year network project
- › Comparison of methods
- › Data base
- › Exchange of personnel
- › Workshops
- › Yvette de Haas or Jan Lassen
- › www.methagene.eu

Methane data in Europe

| Person | Country | Breed | Method | Approx # | Feed data |
|------------------|------------|-------------|-------------------|---------------|-----------|
| Yan Tianhai | UK | HOL | SF6/chamber | 1000 | X |
| Jan Lassen | DK | HOL | Sniffer | 2500 | |
| Jan Lassen | DK | HOL/JER | Sniffer | 300 | X |
| Eileen Wall | UK | HOL | Laser | 200 | X |
| Phil Garnsworthy | Ruminomics | HOL/RDC | Greenfeed/sniffer | 1000 | (X) |
| Yan Tianhai | UK | BEEF | SF6/chamber | 300 | X |
| Gilles Renand | F | BEEF | Greenfeed | 100 | X |
| Yvette de Haas | NL | HOL | Sniffer | 100 | X |
| Enyew Negussie | SF | FAY | Sniffer | 100 | X |
| Phil Garnsworthy | UK | HOL | Sniffer | 2000 | |
| Britt Berglund | Nordic | HOL/JER/RDC | Sniffer/greenfeed | 500 | X |
| Herman Swalve | D | HOL | Laser | 3000 (plan) | |
| Et al | Europe | | | 1000 | (X) |
| | | | | | |
| Total | | | | ~9000 (12000) | |

Take home message

- › Genetic component for methane emission
- › More data is needed
- › International collaboration is needed and initiated