TOWARDS SELECTING FOR LOW-EMITTING COWS IN DENMARK

Coralia Manzanilla-Pech
Assistant Professor

Measure and analyze individual methane emission
23/05/2023
Overview

EDITING SNIFFER DATA

METHANE PHENOTYPES

HERITABILITIES AND CORRELATIONS

FUTURE RESEARCH
READING/EDITING SNIFFER DATA
• **Baseline**: morning cleaning

• **Door sensor** -1 CH$_4$

• **Sneezers** also cause alarms

• **Smooother function** to predict cow entrance and align time
  • Holt Winters Double exponential smoother

• **Average of CH$_4$** concentration per day
Time Synchronisation – GES and AMS

Data synchronization for gas emission measurements from dairy cattle: A matched filter approach

Viktor Milkeytsch, Trine Michelle Villumsen, Peter Larendahl, Goutam Sahana
Editing steps

**Background**
- Measuring or estimating

**Creating event**
- Or visit per day

**Discard first 20 sec**
- The time it takes for gas to travel through the tube

**Discard records with less 200 sec**
- Keeping homogeneous visits

**Delete outliers**
- +/- 3 SD

**Create mean per visit per animal per day**

Our phenotype
MEASUREMENTS IN FARMS
Farms with methane measures

Records from about 7.5K cows

Currently: 14 sniffers with multiplex
Farms with methane measures

- Analyzed with first method
- Analyzed with second method
- In progress
PHENOTYPES
FROM METHANE PPM TO G/D

- Based on ratio $\text{CH}_4/\text{CO}_2$
- **Madsen et al. 2010**: $\text{CO}_2\ (L) = \frac{\text{HPU}}{21.75} \text{ kJ per L CO}_2$ produced
- **Pedersen et al. 2008**: $\text{CO}_2\ (L/d) = 180 \text{ L CO}_2/h/\text{HPU} * 24$ hours
- Where HPU (heat producing unit) = is HP/1000 watt
- **CIGR, 2002**: $\text{HPU} = 5.6 \times \text{ kg BW}^{0.75} + 22 \times \text{ kg ECM} + 1.6 \times 10^{-5} \times \text{ number of days in pregnancy}$
Other methane phenotypes

- **RMeP**
  1. Regression on MBW and DMI and fixed effects
- **RMeC**
  2. Regression on MBW and ECM and fixed effects
  3. Regression on MBW, DMI and ECM and fixed effects

**RATIO**
- Methane intensity (MeI) $g \text{CH}_4 / kg \text{ECM}$
- Methane yield (MeY) $g \text{CH}_4 / kg \text{DMI}$
PUBLISHED RESULTS
Data description

• **Research farms (Danish Cattle Research Center; DCRC-DKC)**
  • 650 Holstein cows with ~26K weekly records
  • 170 Jersey cows with ~8K weekly records

• **10 commercial farms**
  • ~2,300 Danish Holstein cows
  • ~14,000 CH₄ records

• **1,962 cows with genotypes (50k)**
Breeding for reduced methane emission and feed-efficient Holstein cows: An international response

C.I.V. Manzanilla-Pech ¹, R. Rømhold ², P. Løvendahl ¹, D. Mansan Gordo ³, G.F. Difford ⁴, J.E. Pryce ², ³, F. Schenkel ⁴, S. Wegmann ⁵, F. Miglior ⁶, T.C. Chud ⁷, P.J. Moate ⁸, ⁷, S.R.O. Williams ⁷, C.M. Richardson ², ³, P. Stothard ⁶, J. Lassen ⁹

Selecting for Feed Efficient Cows Will Help to Reduce Methane Emissions

Coralia Irene Valencia Manzanilla-Pech ¹, * Rasmus Bak Stephansen ¹, Gareth Frank Difford ⁴, Peter Lovendahl ¹ and Jan Lassen ¹, ³

Exploring phenotypes

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Random regression in research data

Genetic (co-)variation of methane emissions, efficiency, and production traits in Danish Holstein cattle along and across lactations

C.J.W. Manzanilla-Pech, F. Difford, P. Lavendahl, R.B. Stephansen, J. Lassen

Journal of Dairy Science
Available online 12 October 2022
In Press, Corrected Proof

Graphs showing trends in methane emissions and other traits over lactation weeks.
GWAS in methane

Research

Genome-wide association study for methane emission traits in Danish Holstein cattle

C.I.V. Manzanilla-Pech 1, S. B. Ørskov, G. F. Dufford 2, G. Saha 3, M. Romé 1, P. Lævenga 1, J. Lassen 3
Multitrait genomic prediction of methane emissions in Danish Holstein cattle

C.I.V. Manzanilla-Pech, A. A., D. Gordo, G.F. Difford, P. Løvendahl, J. Lassen
FUTURE GOALS AND RESEARCH
Enlarging the database: keep collecting data

- Records from ~10,000 extra cows (30 sniffers)
  - Prioritize farms with genotypes
  - Include farms with CFIT measurements

- Include all collected data for analyses
  - Genetic parameters for Jersey and RDC breeds
  - Routine genetic evaluation for Holstein and Jersey
  - Exploratory work: Crossbred animals

Picture source: VikingGenetics
Current and future work

• Improve **data quality**
  • Background, length of milking, head movement

• **Update formulas** to calculate methane production from concentration

• Investigate **different** approaches to calculate **phenotypes**

• **Automatized pipeline** from raw data to phenotype
THANK YOU FOR YOUR ATTENTION

Trine Villumsen

Jan Lassen

Viktor Milkevych

Rasmus B. Stephansen

Peter Løvendahl

Goutam Sahana