Prediction of individual methane emission by dairy cattle from milk mid-infrared spectra

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Introduction

- CH_4 → 12 years
- CO_2 → 100 years
- CH_4 warming potential 20 X CO_2
- Methane produced by ruminants

  → 15% of the world-wide emissions (P. McCaughey)

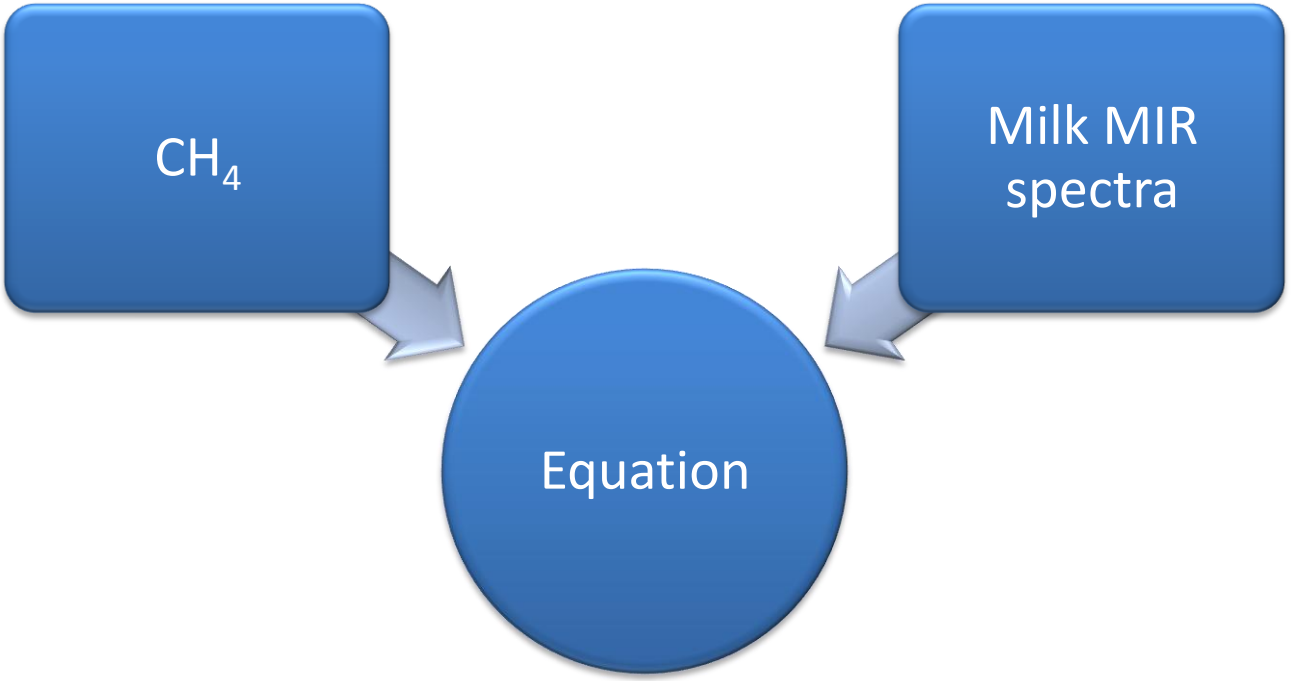
- 1 cow → 100 kg of CH_4/year

Objectives

- Reduce CH_4 emissions from cows
  - Environment
  - Breeders
- Find a quick, easy and individual method
- Mid Infrared Spectroscopy on individual milk

Objectives

- Equations of prediction for CH_4



SF_6 Method

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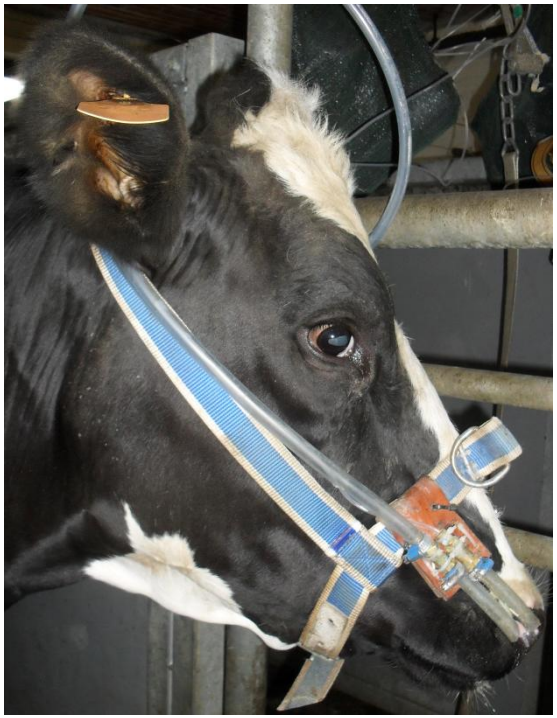

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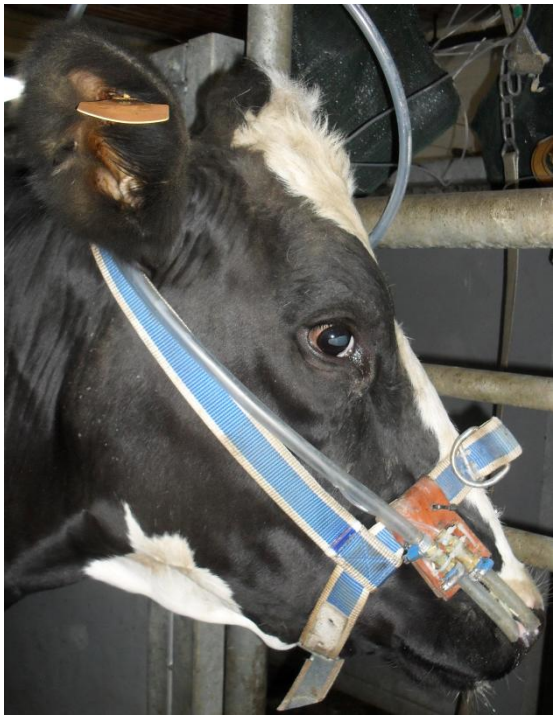

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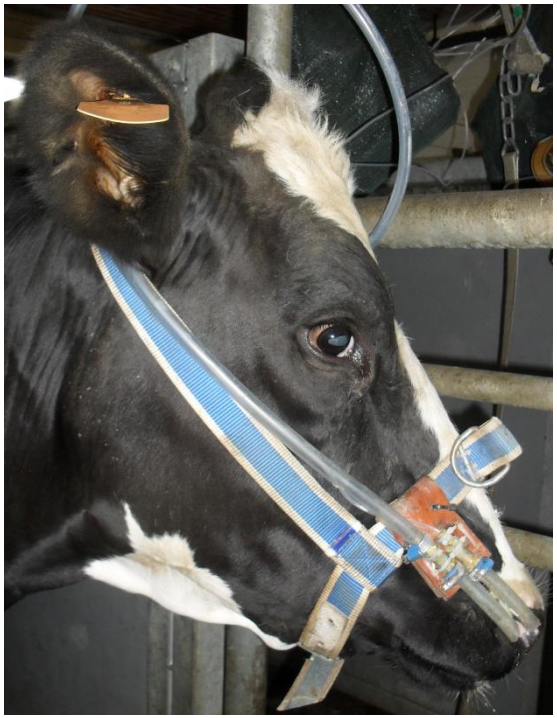

$$Q_{CH_4} = \frac{C_{CH_4} - C^b_{CH_4}}{C_{SF_6} - C^b_{SF_6}} Q_{SF_6} \frac{MW_{CH_4}}{MW_{SF_6}}$$

Johnson K. et al., 1994

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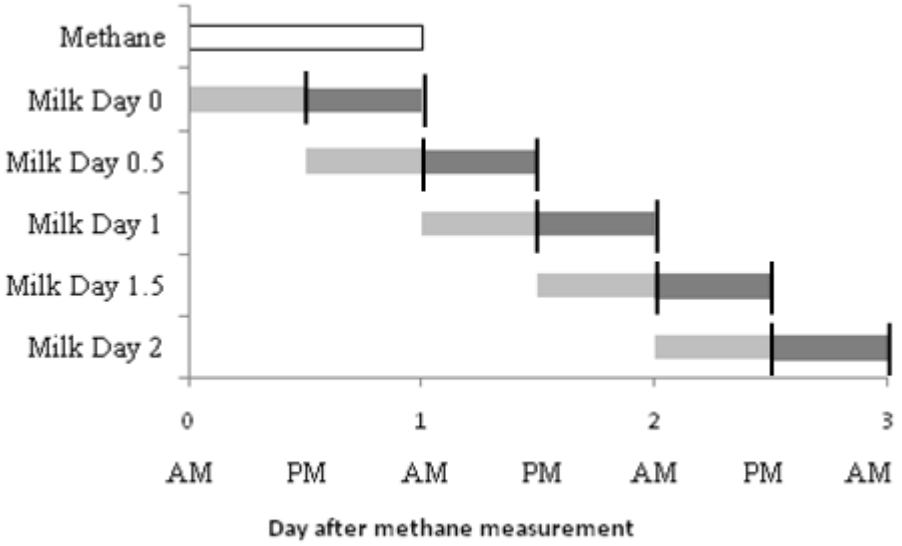
Experimentations

- 2 experimentations
  - 2 groups : similar stage and number of lactation, milk production
  - different diets by group
    - High/low starch content

Results treatment

- Average of daily Milk Spectrum (AMS)
- CH_4 // AMS day 0, 0.5, 1, 1.5 and 2



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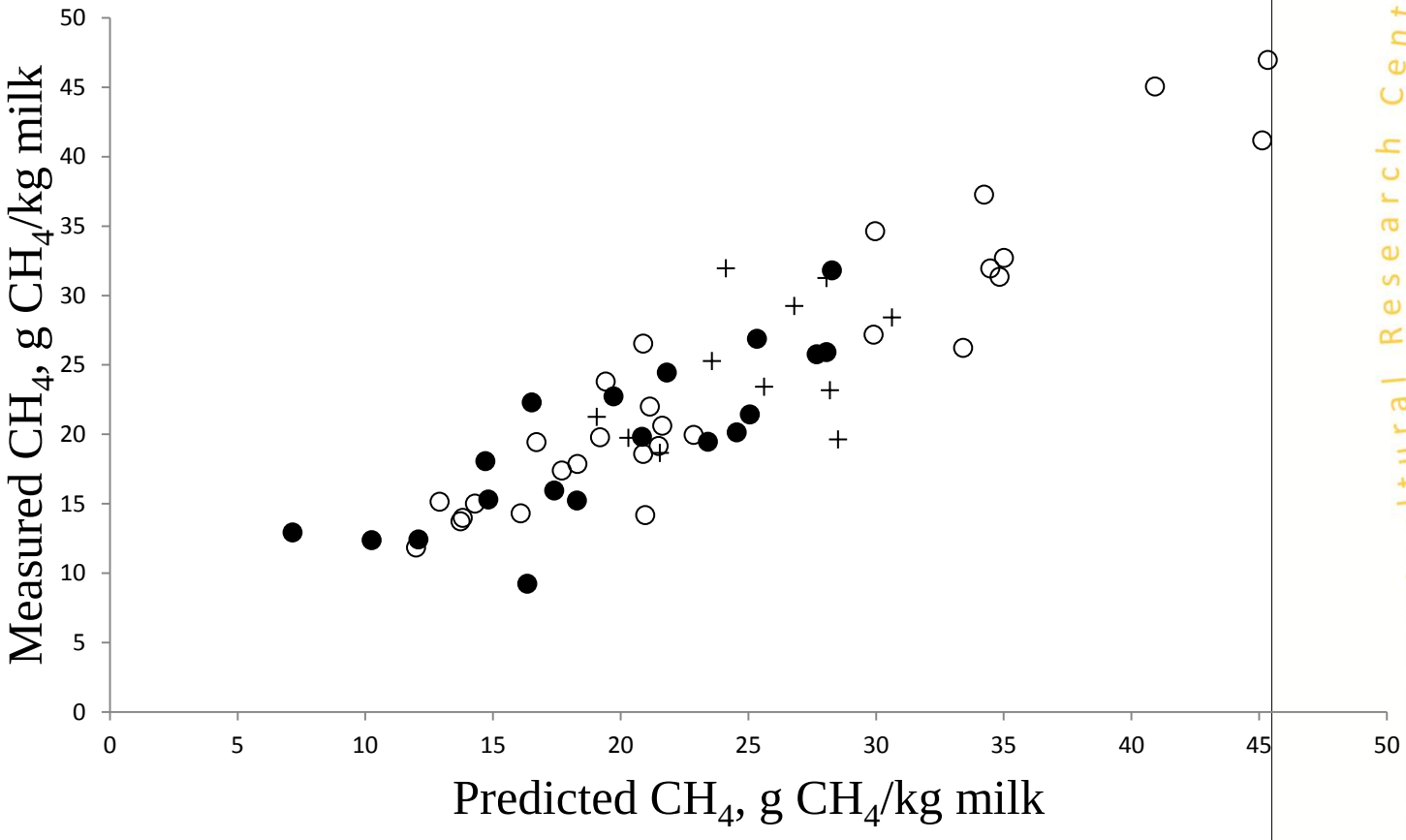
First results

- Y = g CH_4/kg Milk
- PLS : X = MIR spectra from Lactoscope, Delta Instruments (4000 – 400 cm^{-1})
- Highest R^2cv
- Smallest difference R^2c and R^2cv = 0.09

Day	N	R^2c	R^2cv	SEC	SECV	RPD
Day 0	77	0.82	0.74	3.30	3.87	1.99
Day 0.5	70	0.84	0.74	2.97	3.79	1.98
Day 1	65	0.80	0.66	3.52	4.55	1.72
Day 1.5	60	0.87	0.78	2.90	3.67	2.17
Day 2	59	0.83	0.71	3.33	4.32	1.87

First results

Jour 1,5	
N	60
R^2c	0.87
R^2cv	0.78
SEC	2.90
SECV	3.67
RPD	2.17



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First results

- Correlation between FA (GC) and CH_4
  - R^2cv = 0.65 versus 0.79 (MIR)
  - → MIR Spectra have more information

Conclusions

- Predictions of individual CH_4 emissions is feasible
- First classification
- Obtain more measurements to increase variability and equation reliability
- Validate
- Identify low emitted cows

gembloux agro bio tech

Thank you for your attention!

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