Use of the milk MIR spectra with a lactation stage specific model to predict CH_4 emitted by dairy cows

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Valorisation of Agricultural Products Department
Agricultural Product Technology Unit
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Context : Methane produced by ruminants

- Greenhouse gas + loss of gross energy intake (6 to 12%)

- Sources of variation of CH_4 emissions - genetics
  - diet
  - management

→ Possibility to mitigate CH_4 emissions

→ Before reducing it is necessary to study the link between those levers and methane emissions

→ Development of a technique that allows large scale studies

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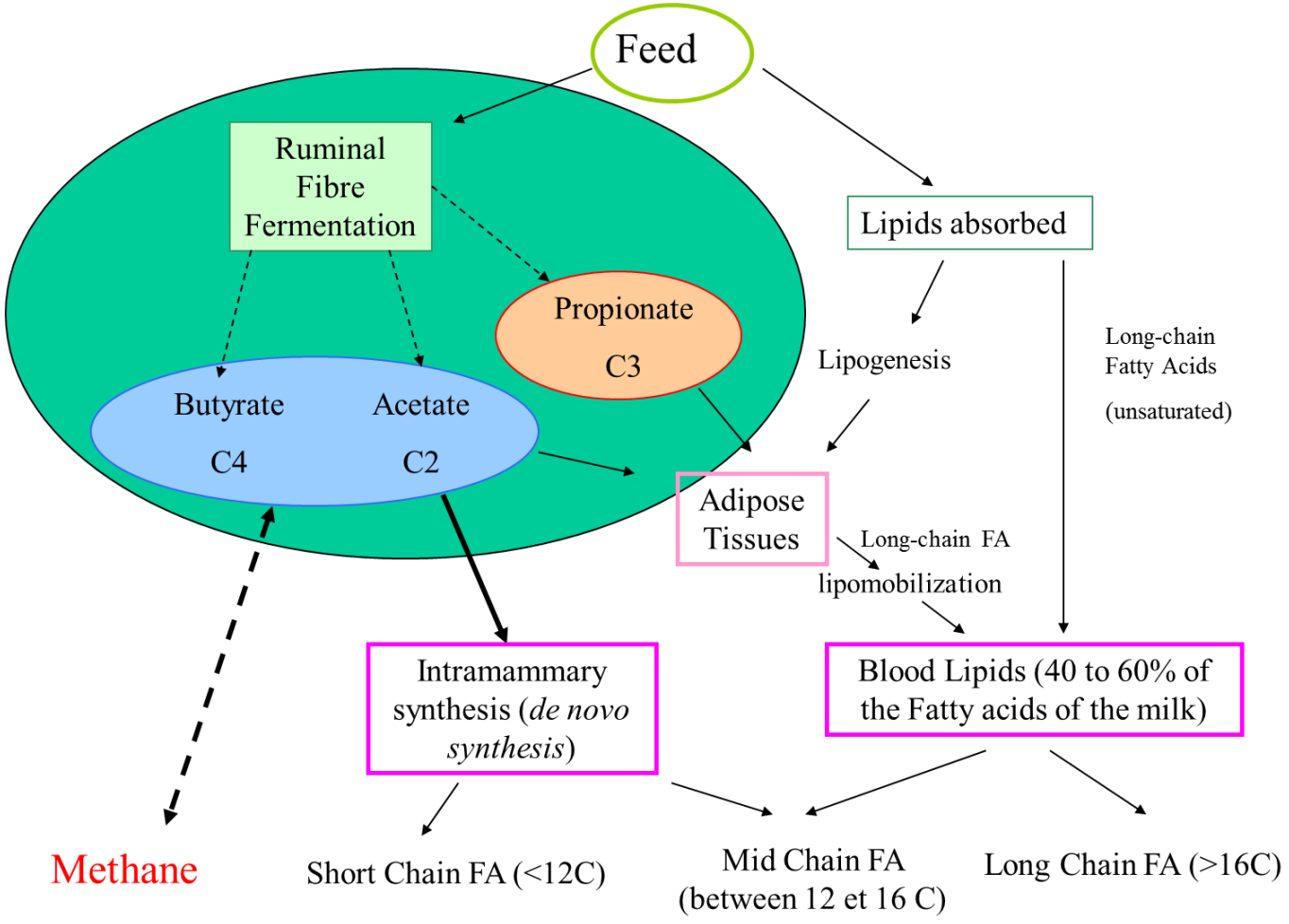
Context :

Link between milk constituents and eructed methane

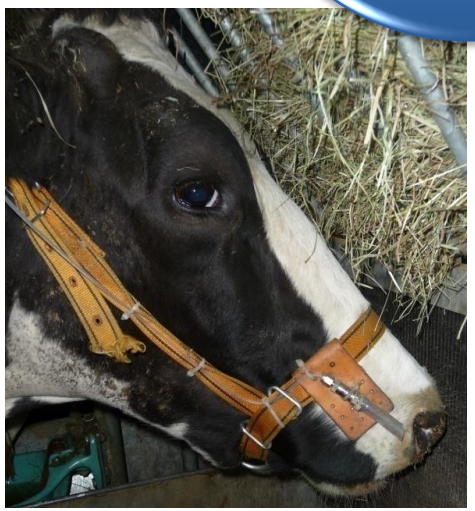


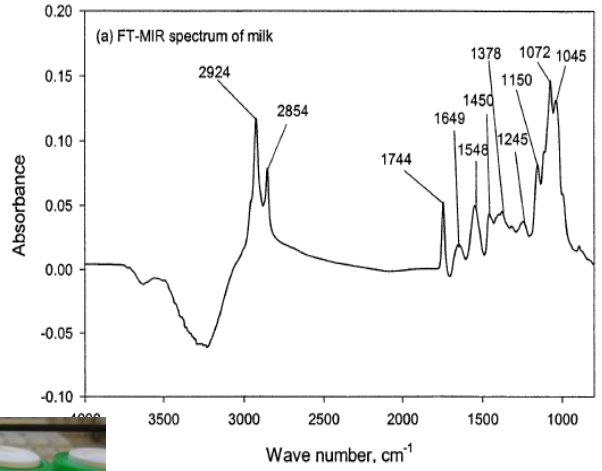
Principle

CH_4

MIR milk spectra

Equation





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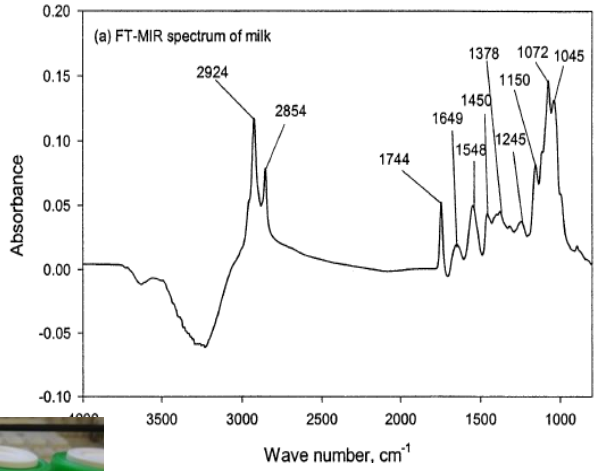
Principle

CH_4

MIR milk spectra

Equation



Animal (2012), **6:10**, pp 1694–1701 © The Animal Consortium 2012
doi:10.1017/S1751731112000456

animal

Potential use of milk mid-infrared spectra to predict individual methane emission of dairy cows

F. Dehareng[1*†], C. Delfosse[1*], E. Froidmont[2], H. Soyeurt[3,4], C. Martin[5], N. Gengler[3,4], A. Vanlierde[1] and P. Dardenne[1]

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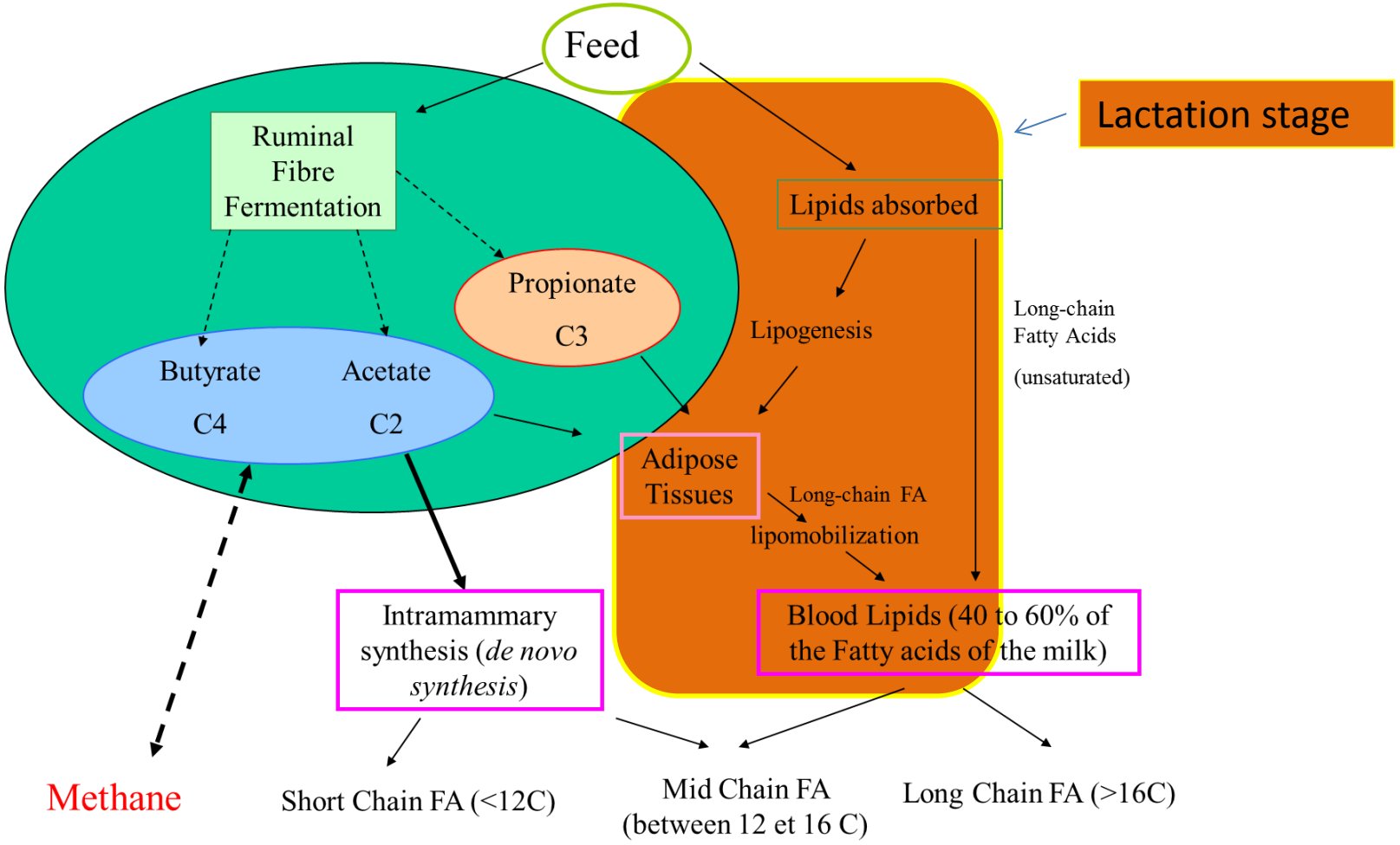
Context :

Link between milk constituents and eructed methane



Influence of lactation stage (DIM) on milk fatty acids origin an profile

J. Dairy Sci. 94:4152–4163
doi:10.3168/jds.2010-4108

Phenotypic and genetic variability of production traits and milk fatty acid contents across days in milk for Walloon Holstein first-parity cows

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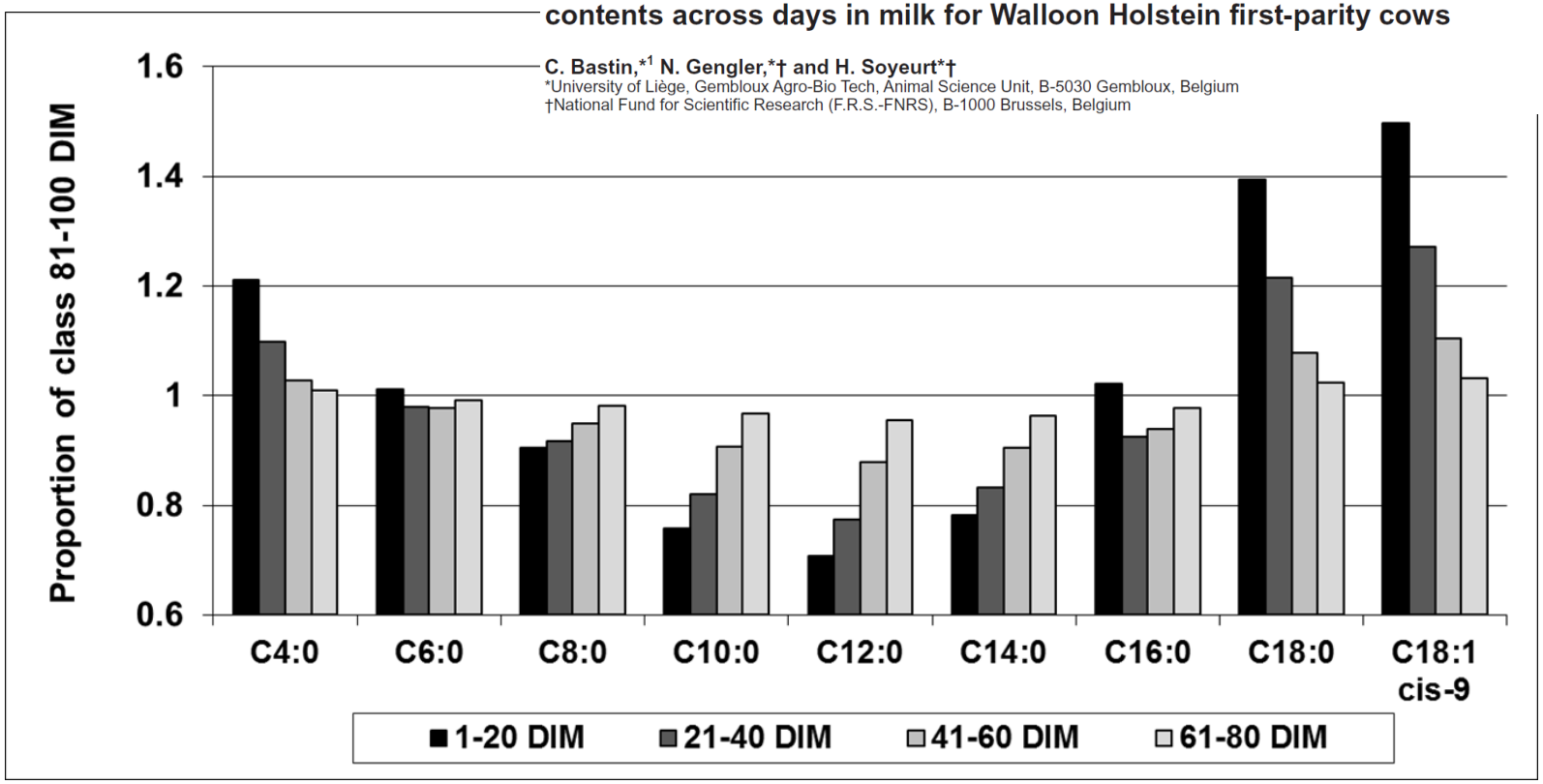
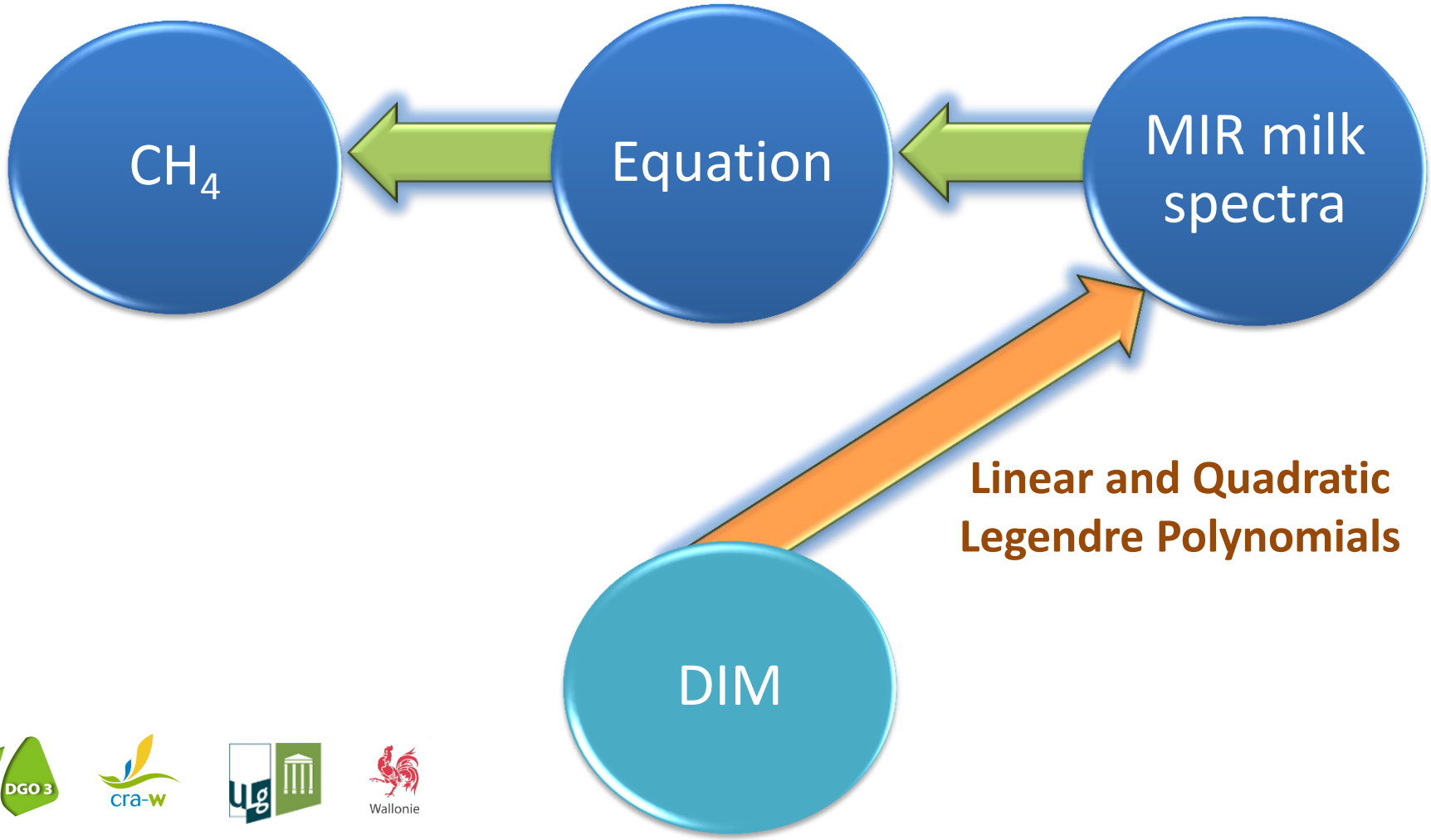


→ Influence the relationship between MIR spectra and CH_4 prediction

Inclusion of DIM information in methane equation



Material and Methods

- 532 reference data : milk MIR spectrum // enteric CH_4 (SF_6)

  → A maximum variability is needed

  - Belgium (CRA-W) and Ireland (Teagasc – Moorepark)
  - 165 cows
  - Lactations : 64 x 1st, 43 x 2nd , 58 x 3rd or +
  - Holstein, Jersey and Cross-breed (Hol x Jer)
  - Different diets : basic diet enriched in - maize
    - fresh grass
    - linseed

    classic total mixed ration
    starch morning, fiber evening
    grassland

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Material and Methods

- Legendre polynomials have been adapted depending on the lactation stage to take into account the expected metabolic status of the cow.

- First derivatives of milk MIR spectra are multiplied by :

  - 1 (**constant**)
  - modified **linear** Legendre polynomial
  - modified **quadratic** Legendre polynomial

Vary for each spectra according to the DIM of the linked cow

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Equations to predict CH_4 from MIR milk spectra

Equation (g/day)	N	SD	R^2c	R^2cv	SEC	SECV
$CH_{4\ (DIM)}$	532	129	0.74	0.70	66	70

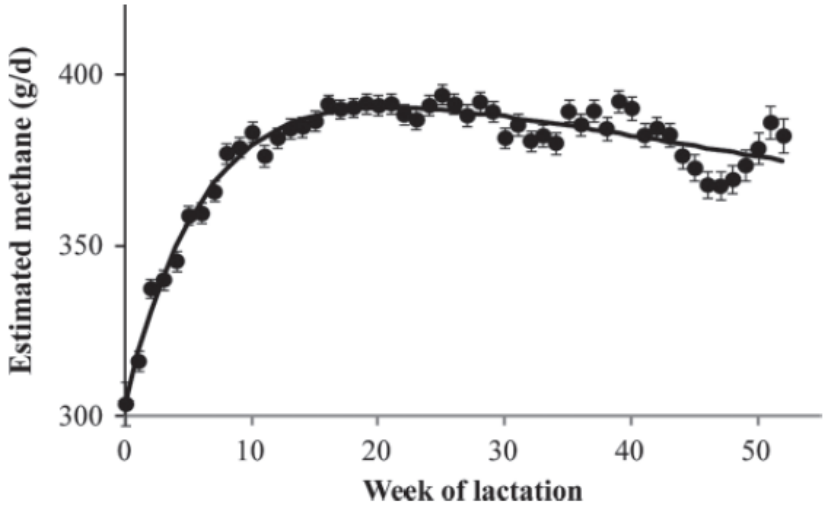
N = number of observations; SD = standard deviation; R^2c = calibration coefficient of determination; R^2cv = cross-validation coefficient of determination; SEC = calibration standard error; SECV = cross-validation standard error

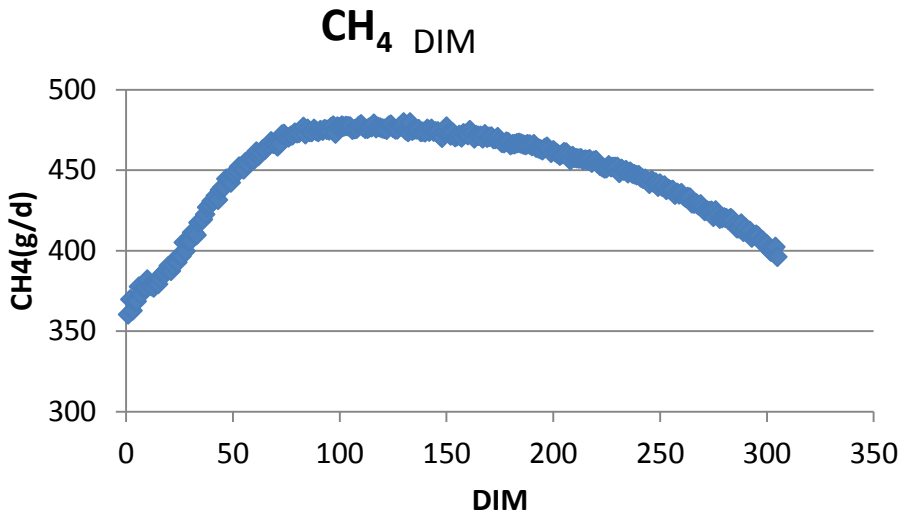
Equations to predict CH_4 from MIR milk spectra

Application of CH_4 equations on Belgian spectral database

1st lactation Holstein cows

Garnsworthy *et al.*, 2012



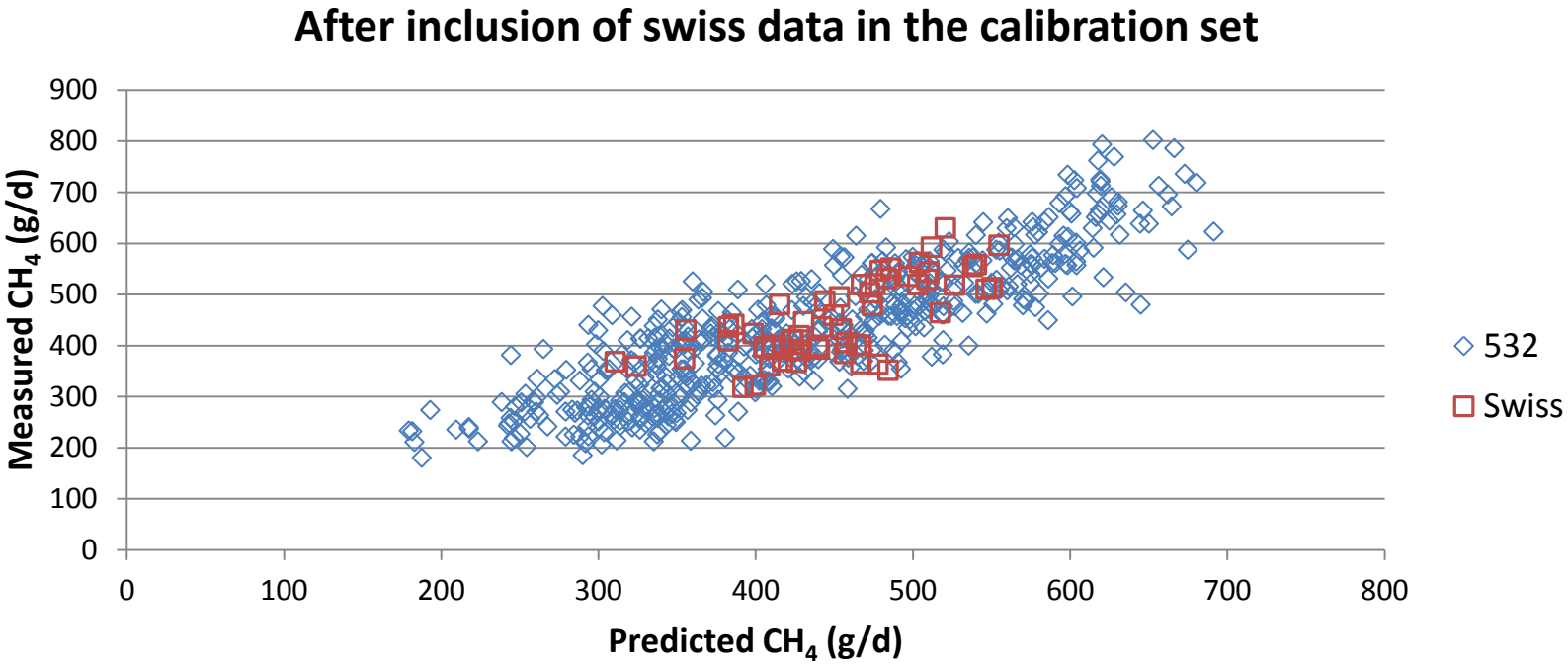


→ In accordance with literature

Firsts steps with chambers

Swiss data (ETH Zürich + Qualitas)

→ Measurement technique + breed + diets are differents



Equation (g/d)	N	SD	R^2c	R^2cv	SEC	SECV	RPD
CH_4 DIM	532	129	0.74	0.70	66	70	1.84
CH_4 DIM + Swiss data	592	125	0.74	0.70	64	69	1.81

Conclusions

- Possible to predict methane from milk MIR spectra
- Integration of DIM information seems to be a good strategy to :
  - take a better account of the metabolic status of cows
  - improve the equation
- More data are needed to - include more variability
  - cover better the beginning and the end of lactation
  - improve performance of the equation

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Hot Topic: Innovative lactation stage dependent prediction of methane emissions from milk mid-infrared spectra

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Thank you!

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