



# Development of Infrared reflectance spectroscopy databases for efficient livestock managements

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# Context



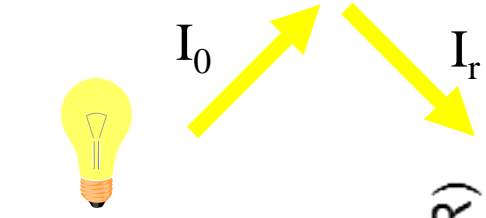
- ✓ **Strong expectance towards livestock for high quality products and services but with limited environmental impacts.**
- ✓ **Pressure on management systems as grazing systems for which consumer expectation is high.**
- ✓ **Needs of rapid and cheap methods able to characterize various organic substrates, able to provide useful information for Decision Support Tools (DST)**
- ✓ **Needs of DST to achieve:**
  - better livestock management and to obtain high food production (quality and quantity)
  - the evaluation of environmental pressure (greenhouse gazes...) at farm and system scales;
  - the monitoring of various elements as nitrogen



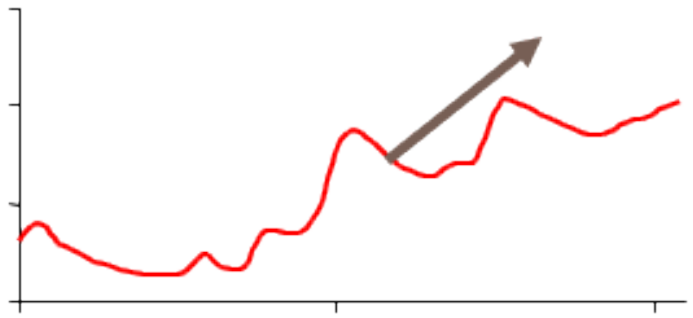
IR databases

Link between spectrum and reference values obtained

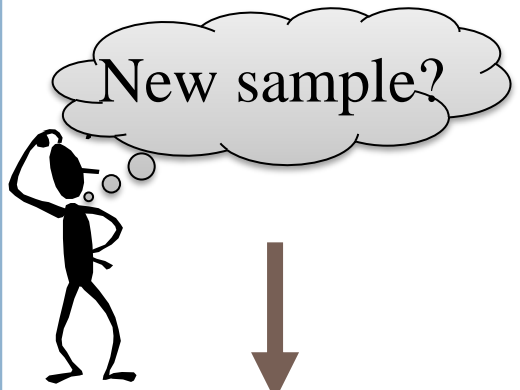
- in laboratory...chemical composition
- in experiments...digestibility, intake, CH<sub>4</sub>



Log (1/R)



IRS spectrum



IRS analyses

IR database choice

IR chemometric model choice

Easy and rapid characterisation of substrate

# Why IR databases can be used for DST?

## Availability and diversity of IR databases

coupled with classical reference measurements

- ***Tropical and temperate forages*** :
  - CP, fibres...
  - Species composition, morphological composition...
  - Digestibility
- ***Diet ingredients*** : CP, starch, fat...
- ***Faeces*** :
  - CP, fibres, ash...
  - In situ parameters as intake, digestibility, composition of intake...
- ***Milk*** :
  - Protein, fat, fatty acids...
  - Methane emission...
- ***Other organic substrates....***

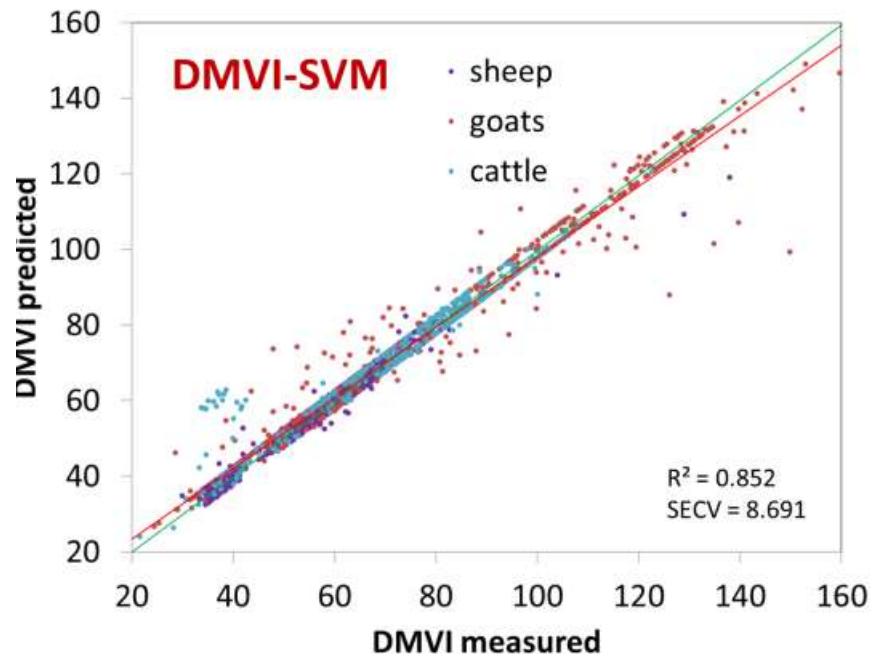
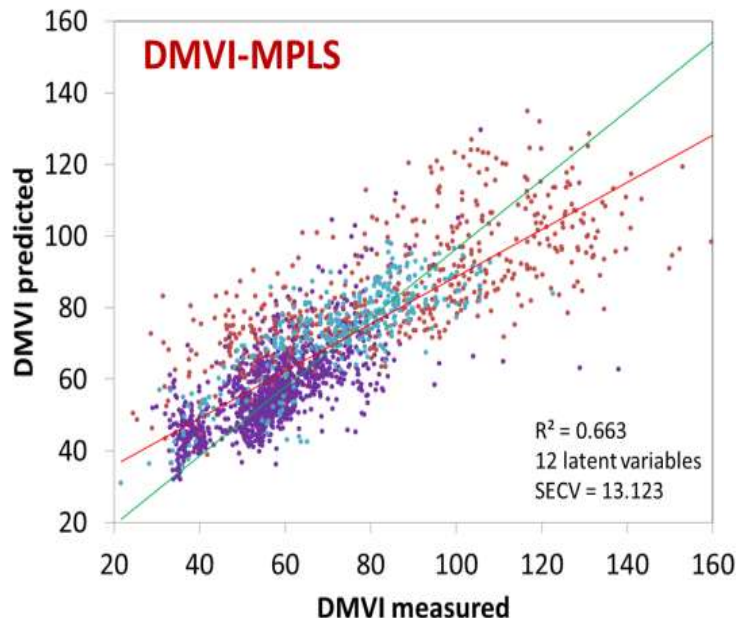
**Real progress in development of chemometrics models**

# How IR databases can be used for DST?

**Building global merged databases that encompass a maximum of variability (production area, species...)**

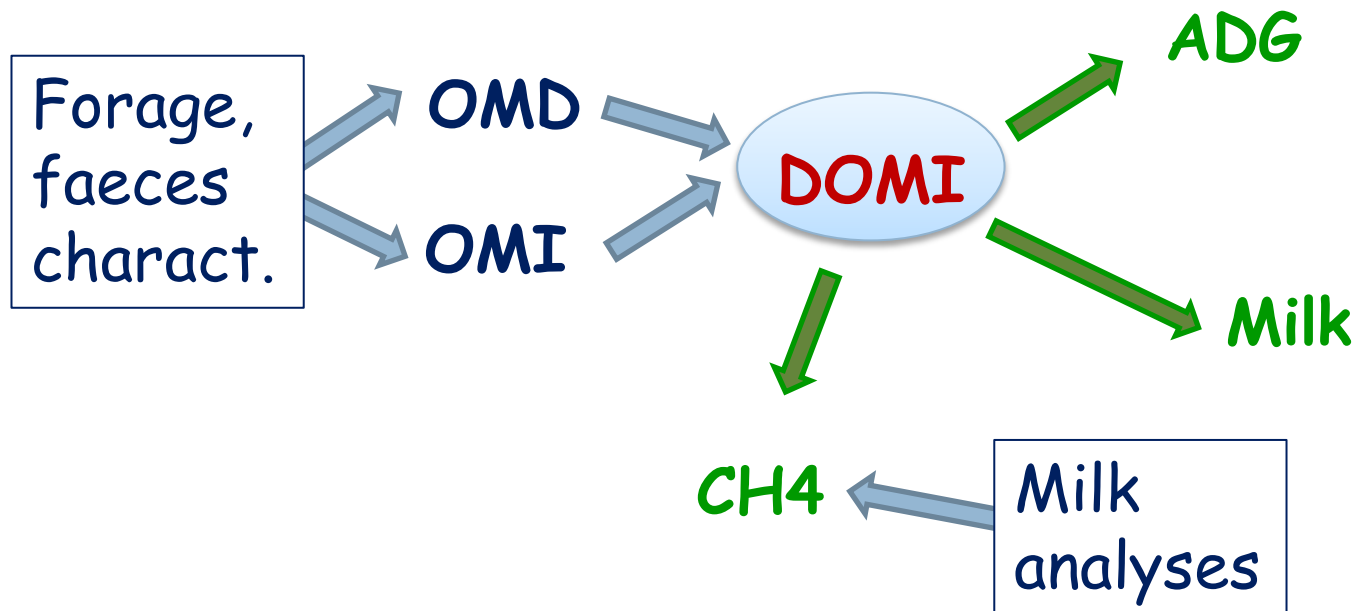
**Use appropriate chemometrics models for estimating the parameter of interest**

**Example :** Faecal NIR database (temperate + tropical forages, goats + sheep + cattle faeces) with 2 models (**MPLS vs. SVM**).



# 3 Examples of potential of IR databases

To predict digestible organic matter intake (DOMI) and estimate animal performances (ADG, milk), livestock environmental impact (CH<sub>4</sub> emission) in temperate or tropical contexts

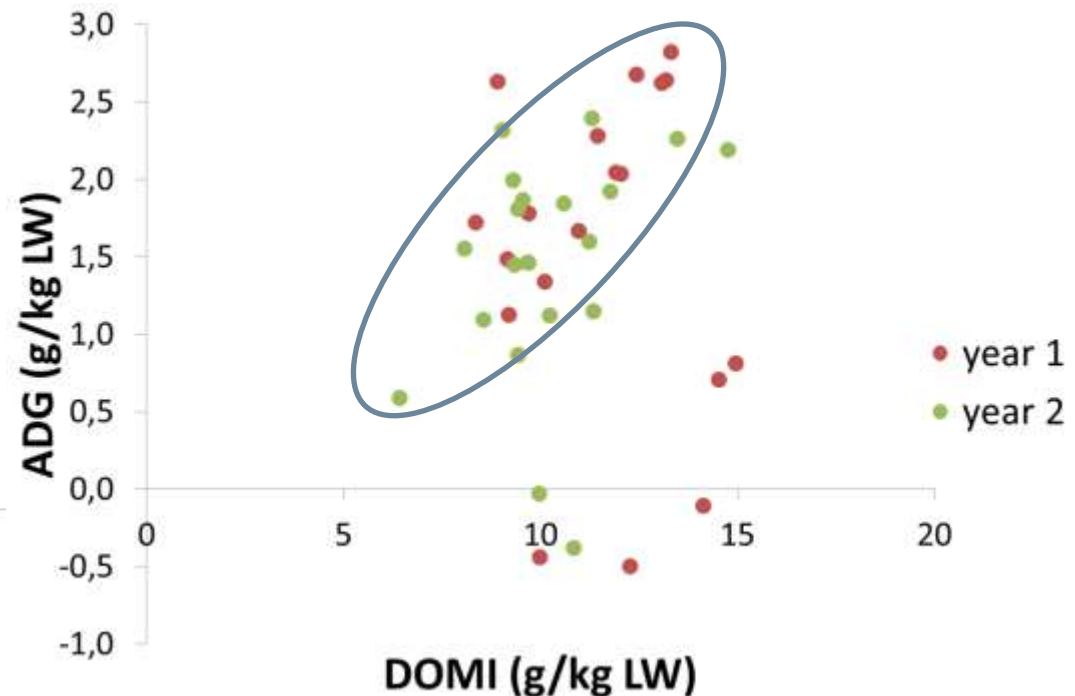
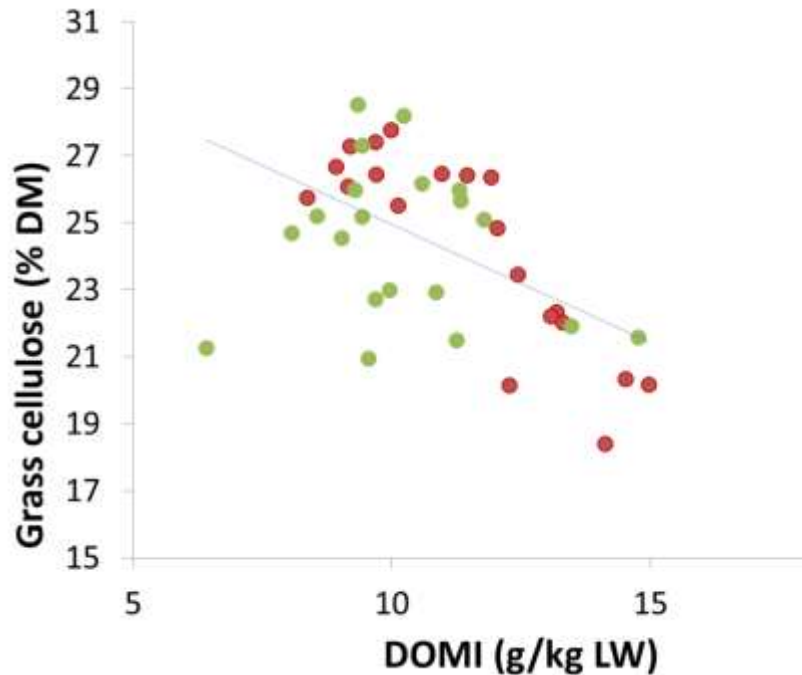


# Diet characteristics and animal performances at grazing

V. Decruyenaere, unpublished data

## DOMI and diet characteristics as indicator of grazing ADG

- Mixed grazing trials (sheep and heifers), temperate pasture
  - *White clover – Rye grass* based pasture
- FNIRS database → estimation of *in situ* diet characteristics
- Forage NIRS database → estimation of grass quality



# Estimation of methane emission by grazing cattle.

A. Boval<sup>1</sup> and V Blanfort<sup>2</sup>, unpublished data

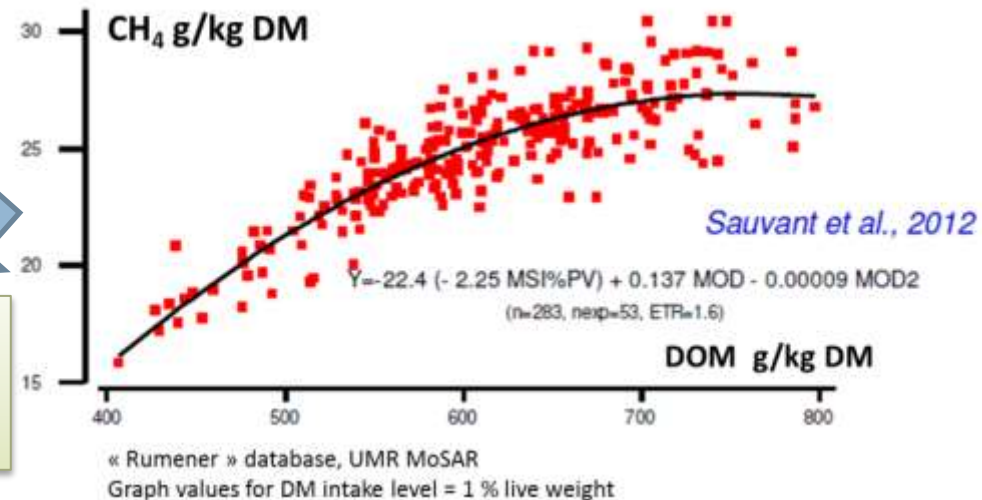
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## Mobilisation of FNIRS to estimate CH<sub>4</sub> emission at grazing

- FNIRS database → estimation of *in situ* diet characteristics (OMD and OMI)
- Digestible organic matter intake (DOMI, g/kg LW) estimation
  - Young *Bos indicus* cattle (400 kg LW)
  - *Brachiaria* based pasture

DOMI ranged from 10 – 14 g/kg LW  
CH<sub>4</sub> emission ranged from 40 – 58 kg/year



**FNIRS = convenient approach to estimate intake and CH<sub>4</sub> emission in grazing cattle in farm conditions**

# Improvement of a method to predict individual enteric methane emission of cows **from milk MIR spectra.**

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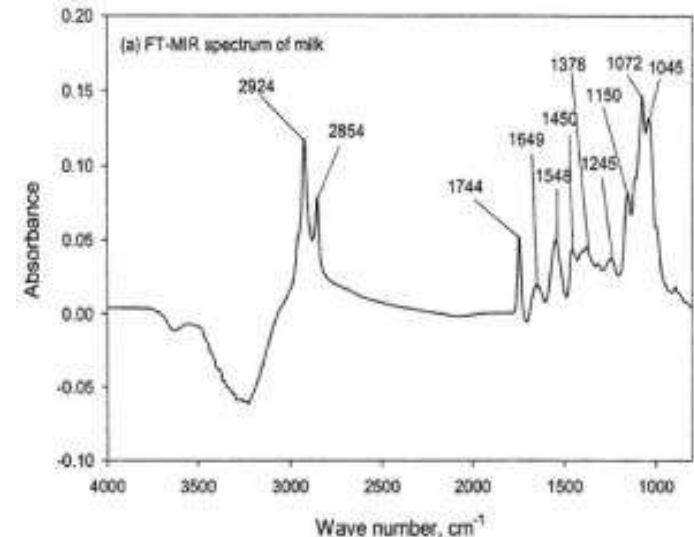
## Milk MIR analyses to estimate CH<sub>4</sub> emission

- Relation between MIR spectra of milk and **enteric** CH<sub>4</sub> emission
  - Reference method for CH<sub>4</sub> (SF<sub>6</sub>)
  - Maximal variation of enteric CH<sub>4</sub> emission in exp. conditions (diet, cows...)
  - Larger scale studies – more accurate relation milk vs enteric CH<sub>4</sub>mission



# Building a global database...

- Integrating a maximum of variability linked to
  - Cows
  - Diets, herd managements
  - Regions
  - ...



- Example of mixed database : Ireland and Belgium MIR milk spectra

Parameter	N	R <sup>2</sup> c	R <sup>2</sup> cv	SECV
g CH <sub>4</sub> /day	452	0.76	0.70	62

## For which use?

Valorisation of MIR spectra (from dairy control) for genetic selection (cows with lower enteric emission), for diet management (feedback in farms directly).

## To conclude...

- **Through these examples, potential of IR database for the development of effective DST appears promising, both in tropical and temperate area.**
- **Development of large merged databases associated to appropriate chemometrics models is a key point to generate predictive regressions**
  - from general calibrations using large heterogeneous data sets
  - from local calibrations, using a specific appropriate set of data