Heritabilities of the mid-infrared spectra of sheep milk throughout the lactation

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not only heritabilities but also genetic correlations …



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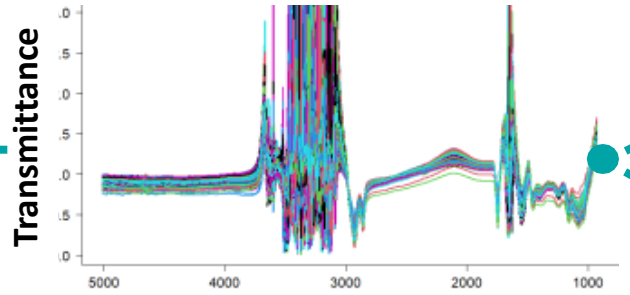
Introduction

Milk's dairy sheep

Mid-infrared (MIR) spectra



Two possible uses

Prediction equations

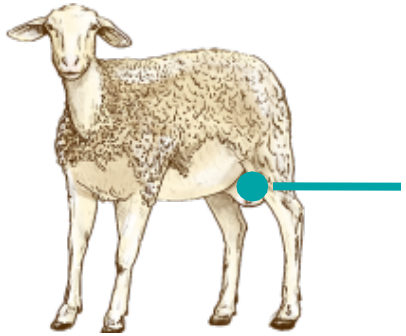
Fat and protein content of milk

+

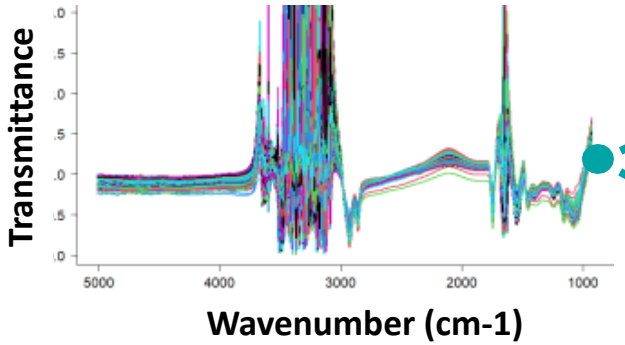
Other predictors of **milk components** or **abilities**

Introduction

Milk's dairy sheep



Mid-infrared (MIR) spectra

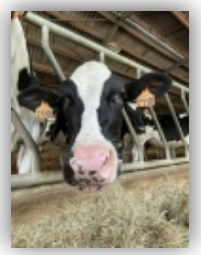


Two possible uses

Prediction equations

Capturing variability

Genetic variability of the infrared spectra …



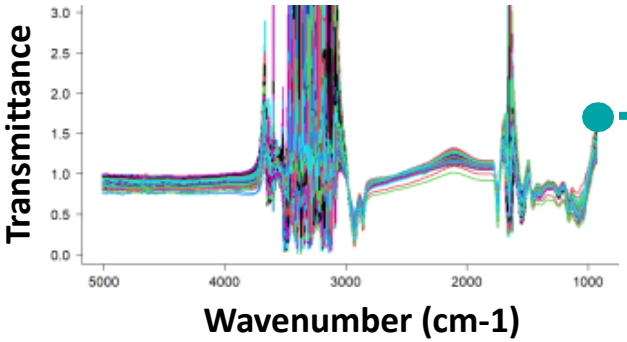
Soyeurt *et al.* (2010), Dagnachew *et al.* (2013), Bittance and Cecchinato (2013), Wang *et al.* (2016), Rincent *et al.* (2018), Zaalberg *et al.* (2019), Du *et al.* (2020), Tiezzi *et al.* (2022); …

?

Objective: Estimating the genetic variability of MIR spectra of milk from dairy sheep throughout the lactation

Material and methods

Acquisition of MIR spectra …



✓ **Spectra recovered**

in dairy sheep since 2019 from the official milk recording

✓ **Standardisation**

spectra comparable over time and between machines (OptiMIR)

Grelet *et al.* (2015)

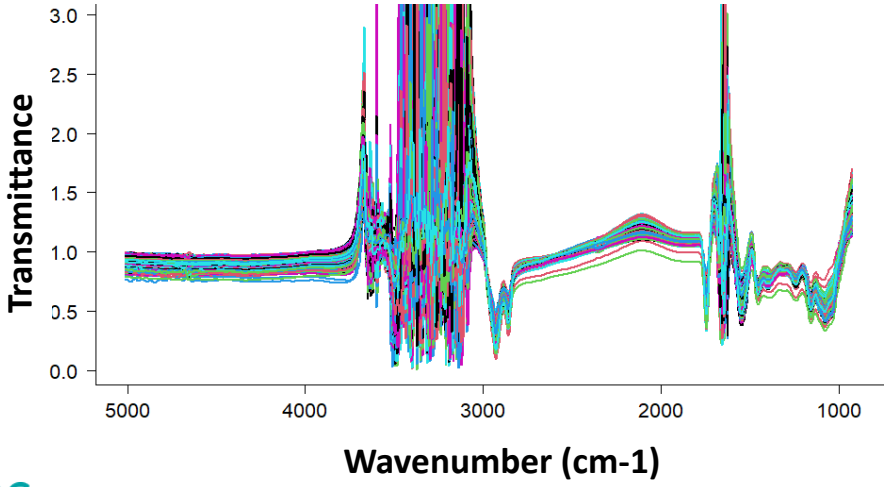
✓ **Variable selection**

1060 wavenumbers or 446 wavenumbers

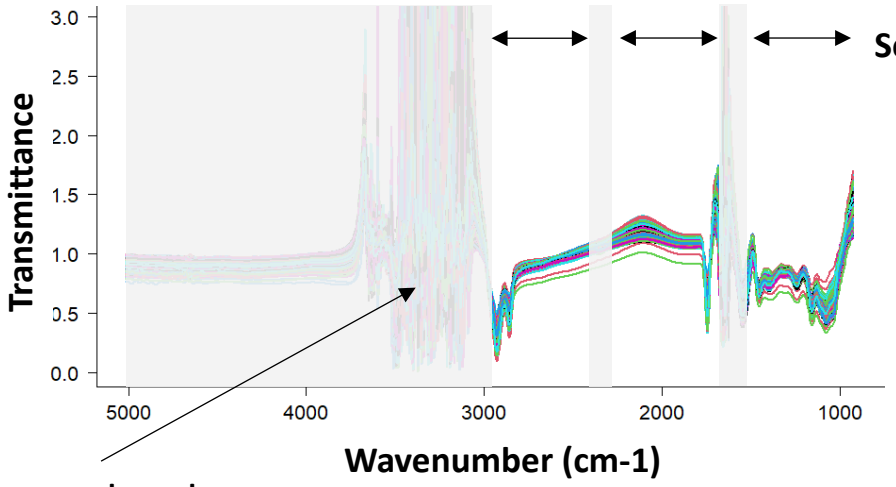
Foss (1998), Ferrand *et al.* (2011)

Wavenumber selection of the MIR spectra …

1060 wavenumbers



446 wavenumbers



water molecules

Material and methods

Study population …

Smarter **European Project data :**

- **8** French Lacaune commercial farms
- **Multiple** stages (2 years, 6 lactation months)
- **36,873** MIR spectra
- **4,712** phenotyped females
- **1,794** genotyped females (38,523 SNP)
- **19,157** individuals in pedigree

Lacaune

Material and methods

Study population …

Statistical approaches …

European Project data :

- **8** French Lacaune commercial farms
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Heritabilities :

$$y = X\beta + Zu + \mathrm{W}p + \epsilon \quad [1]$$

β : flock*year*lactation month + parity

➡ **Merging all data & at each lactation stage**

Genetic correlations :

$$\begin{bmatrix} y_1 \\ y_2 \end{bmatrix} = \begin{bmatrix} X_1 & 0 \\ 0 & X_2 \end{bmatrix} \begin{bmatrix} b_1 \\ b_2 \end{bmatrix} + \begin{bmatrix} Z_1 & 0 \\ 0 & Z_2 \end{bmatrix} \begin{bmatrix} a_1 \\ a_2 \end{bmatrix} + \begin{bmatrix} W_1 & 0 \\ 0 & W_2 \end{bmatrix} \begin{bmatrix} p_1 \\ p_2 \end{bmatrix} + \begin{bmatrix} e_1 \\ e_2 \end{bmatrix} \quad [2]$$

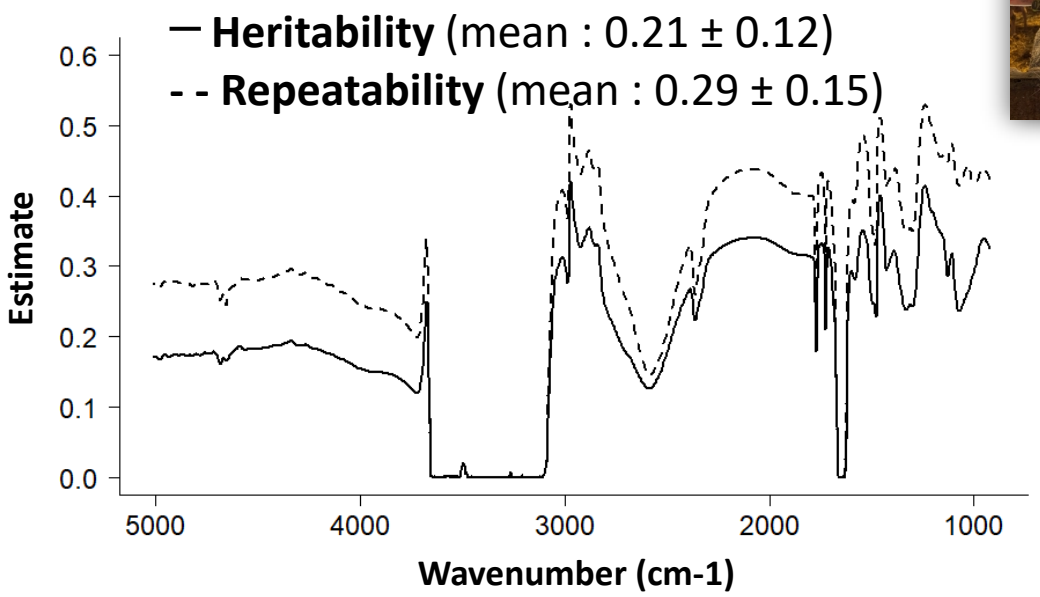
β : flock*year + parity

➡ **Between 2 groups of lactation stage**

- **Models:** Single-trait [1] or bivariate [2] animal repeatability model **at each wavenumber** of the MIR spectra
- **Relationship matrices:** Genomic + Pedigree
- **Method:** AI-REML
- **Software:** airemlf90

Results

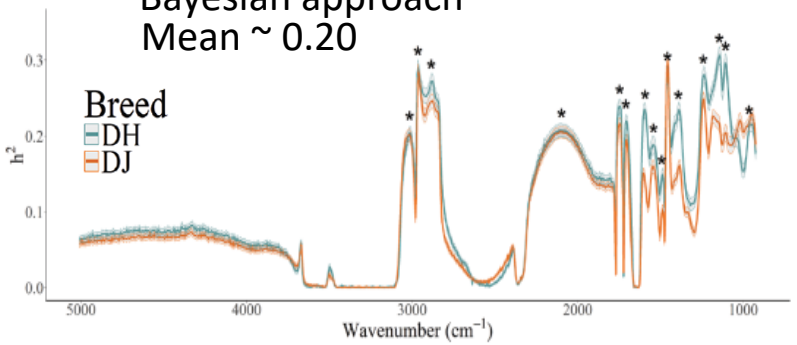
Capturing genetic variability at each wavenumber of the MIR spectra …

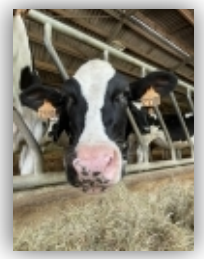


n = 1060

Zaalberg *et al.* (2018): [Dairy cattle]

Bayesian approach
Mean ~ 0.20





Dagnachew *et al.* (2013): [Dairy goat]

AI-REML animal model
h^2 from 0.02 to 0.41

- **Heritability profile along the MIR spectra for ewes is close to the ones for dairy cattle or goats**

Results

Capturing genetic variability of MIR spectra at each stage of lactation …

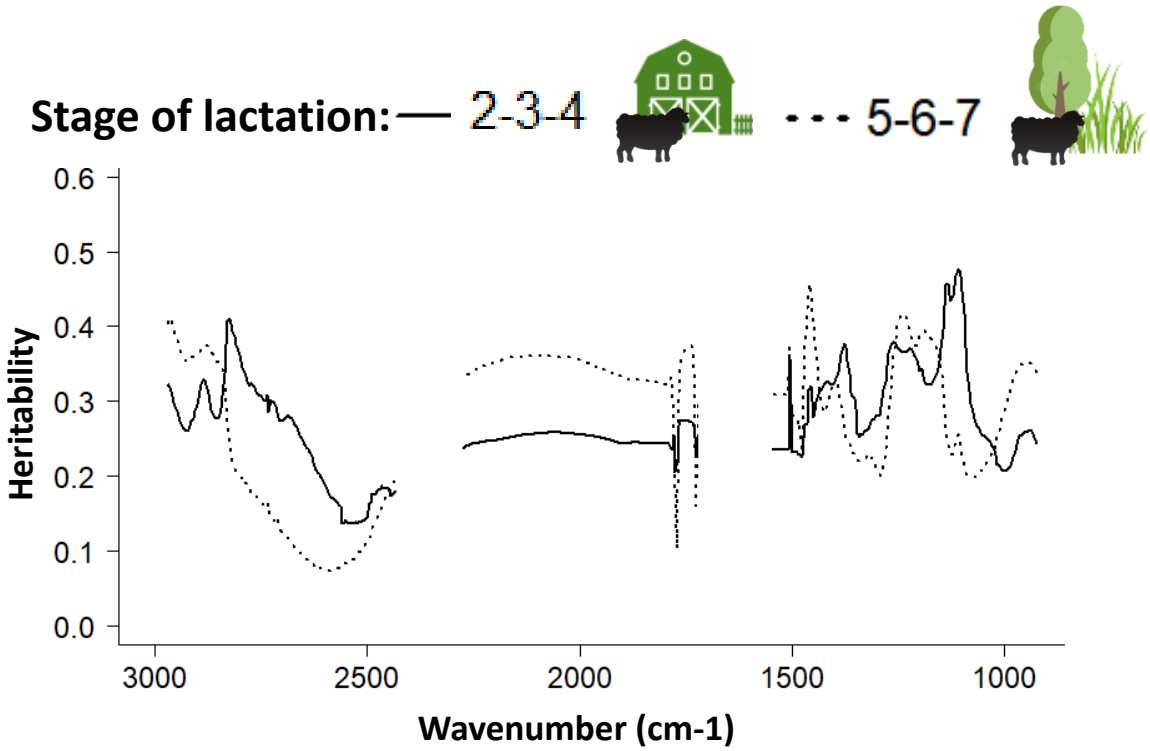
Stage of lactation: — 2-3-4 - - - 5-6-7

indoor

outdoor

Results

Capturing genetic variability of MIR spectra at each stage of lactation …



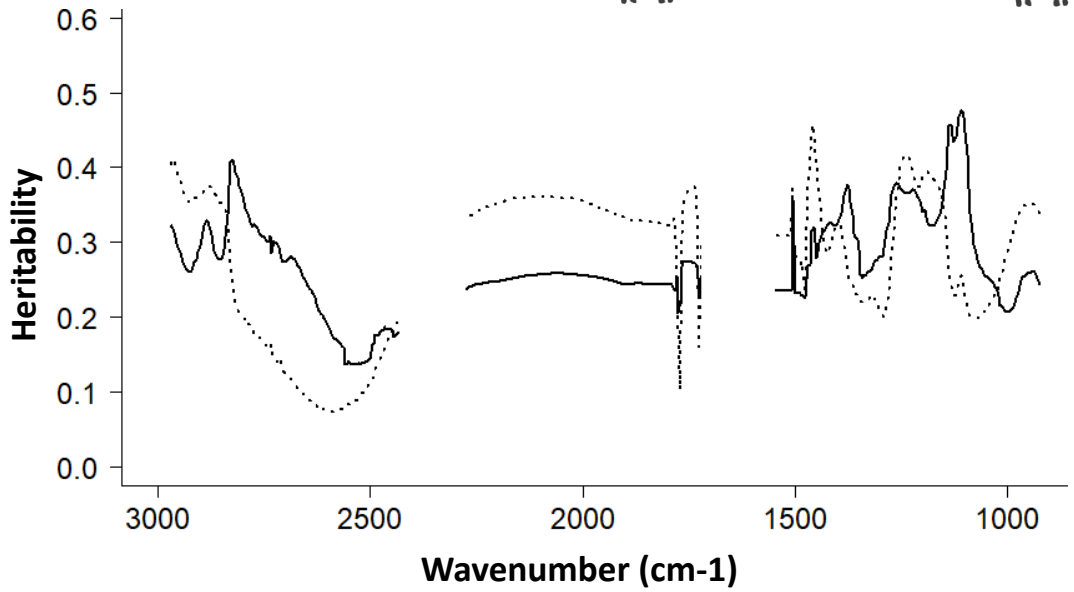
n = 446

- **Heritability profile along the MIR spectra of ewes are different between early and late lactation stages**

Results

Capturing genetic variability of MIR spectra at each stage of lactation …

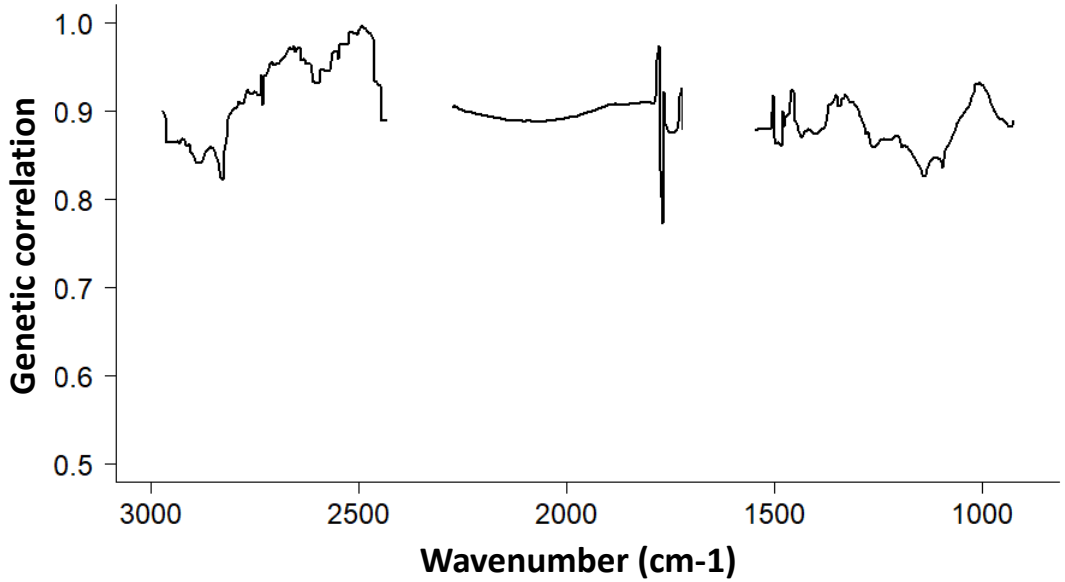
Stage of lactation: — 2-3-4  - - - 5-6-7 



n = 446

- **Heritability profile along the MIR spectra of ewes are different between early and late lactation stages**

Stage of lactation 2-3-4 **X** **Stage of lactation** 5-6-7



n = 446

- **High genetic correlations between 2 management systems**

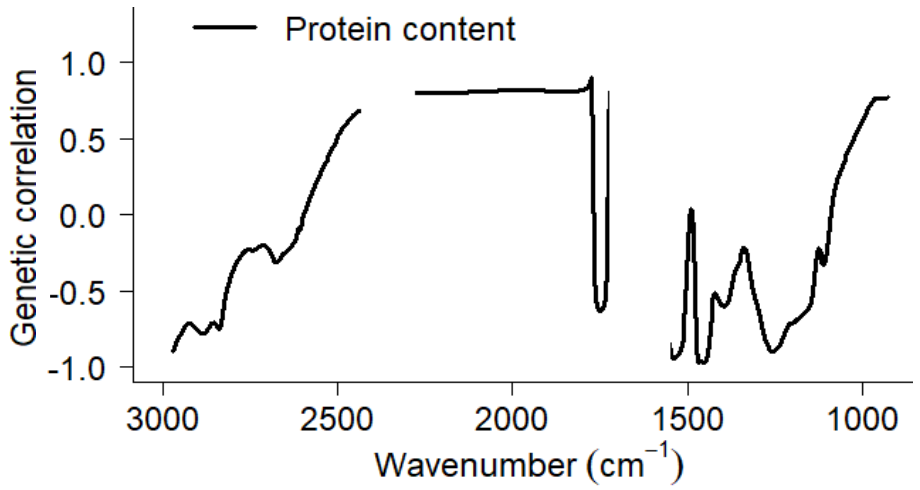
Take home messages

About genetic determinism of the milk MIR spectra …

- MIR spectra from ovine milk are **heritable** (moderate to high)
- Difference of **heritability pattern** between early and late lactation
- Strong **genetic correlations** between early and late lactation

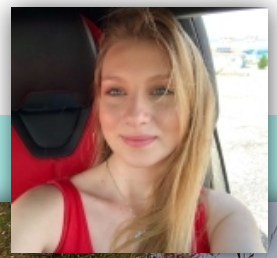
Perspectives …

- Genetic correlations with **dairy traits**
  - milk yield, fat & protein content, SCS
- Genetic correlations with **non-milk related traits**
  - feed efficiency, body fat reserves…
- Potential use of MIR spectra for **genetic evaluation**



n = 446

Thank you!



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