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Predicting the risk of ketosis using mid infrared spectrometry

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Ketosis: a metabolic disease of high productive dairy cows

Session 1
Wednesday 10th June

Ketosis = trouble of energy metabolism of dairy cows in high negative energy balance in early lactation

- **2 ketosis types signalled by different biomarkers:**
  - **Hypoglycemic ketosis**
    → high beta-hydroxybutyrate content in blood
  - **Hyperglycemic ketosis**
    → high non esterified fatty acids content in blood
- **High prevalence**
  but few clinical symptoms
- **Consequences on animal welfare and farms competitiveness**
  but difficult to diagnose

Context & objective of the study

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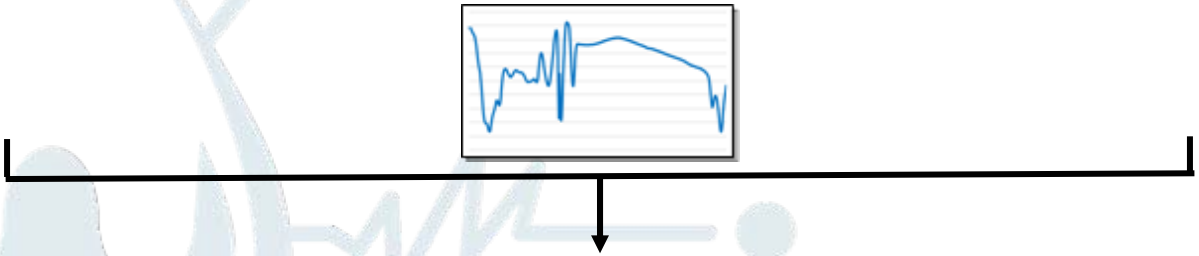
Ketosis modifies milk composition

- Increase in Fat:Protein ratio
- Expression of biomarkers in milk

Mid infrared spectrum reflects milk composition

- Each molecular bond absorbs the light at specific wavelengths

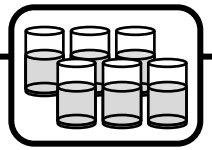


Is MIR spectroscopy a reliable method to predict ketosis risk situations?

Material & Methods

DATA COLLECTION

Milk samples (large variability)



MIR spectra

Reference analysis for the trait

DATA PREPARATION

Standardization

Cf. Grelet *et al*

Classification

DATA PROCESSING

Mathematic models

Sensitivity / Specificity / Accuracy

Data collection in 4 French and German experimental farms

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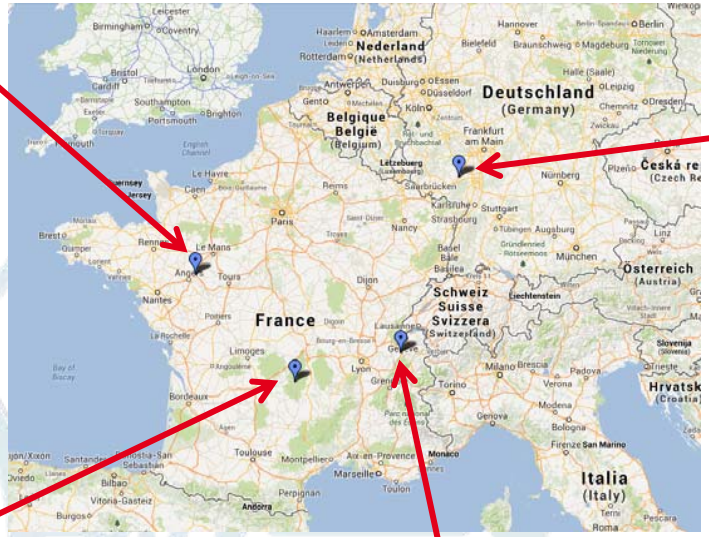
Les Trinottières

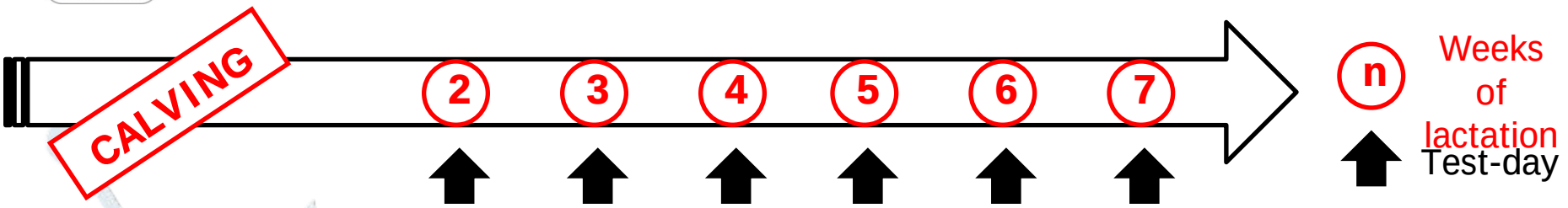


Hofgut Neumühle

Marcenat

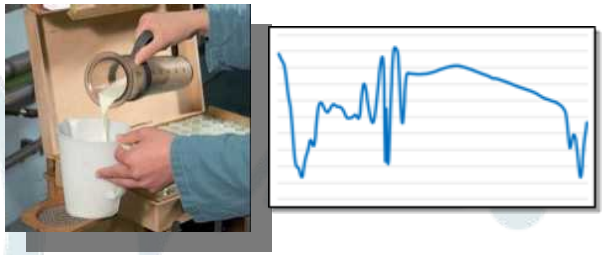
Poisy

1,124 collected phenotypes on 214 cows



Data collected during each test-day:

LDHVet. Nantes (FRA):
Blood BHB & NEFA



Milk Recording Organizations:
Milk fat and protein contents + **Spectra**

Experimental farm:
- **Weight**
- **BCS**
- **Diet**

BHB : beta hydroxybutyrate - NEFA : non esterified fatty acids

Classifying the reference ketosis status of the cows

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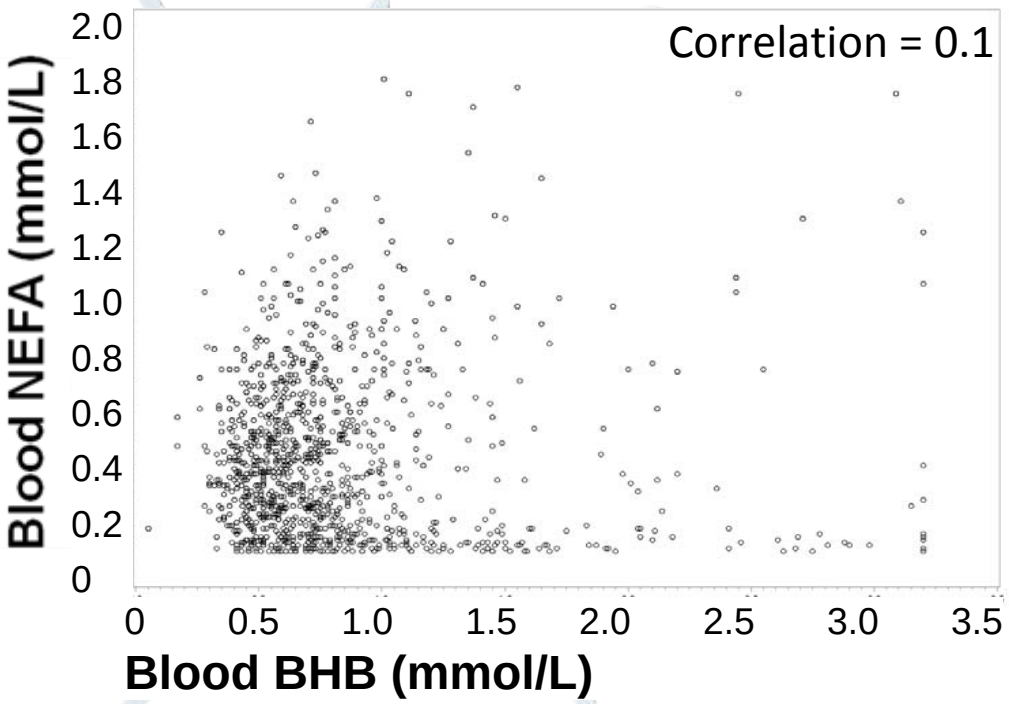
No correlation between biomarkers

Combination of biomarkers into a classification



Classification	Distribution
Low Risk of Ketosis	71 %
High risk of Ketosis	29 %

Risk of type I Ketosis	18.7 %
Risk of type II Ketosis	5.1 %
Suspected ketosis	5.2 %

BHB : beta hydroxybutyrate - NEFA : non esterified fatty acids

Prediction of the level of ketosis risk

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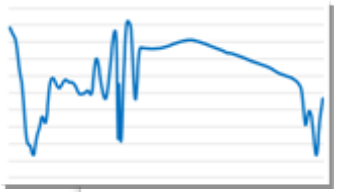

Reference ketosis status
High risk / Low risk

Logistic PLS regression

Results on external validation dataset

Sensitivity = 81 %
Specificity = 69 %
PPV = 48 % / NPV = 91 %

		Prediction	
		Negative	Positive
Observation	Low risk	188	83
	High risk	18	78

VPP: Positive Predictive Value - NPV: Negative Predictive Value

Prediction of the type of ketosis high risk

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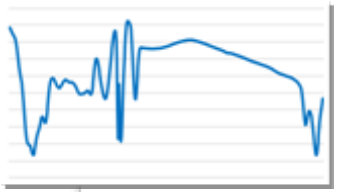

Reference ketosis status
Risk due to BHB / Risk due to NEFA / Ketosis

canonical powered PLS regression & DA

Results on external validation dataset:

Accuracy = 85 %

		Prediction		
		Risk due to BHB	Risk due to NEFA	Ketosis
Observation	Risk due to BHB	65	4	2
	Risk due to NEFA	4	15	2
	Ketosis	1	1	2

BHB : beta hydroxybutyrate - NEFA : non esterified fatty acids

Conclusion

MIR spectrum gives the possibility of giving an alarm on the level of risk and the type of risk

➔ **Information on animals**

To treat (« ketosis »)

To monitor (« high risk »)

➔**Information on practices to change (energy density in early lactation and/or managing the dry period…)**

Prospects for improvement:

➔**Increase in the volume of records**

➔**Better balance of the calibration dataset**

OptiMIR

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

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Thank you for your attention !