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ELIANCE

➤ Predicting methane production and intensity from milk mid-infrared spectra

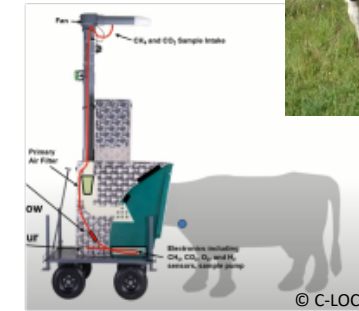
Solène FRESCO, A. Vanlierde, D. Boichard, R. Lefebvre, M. Gaborit, R. Boré,
S. Fritz, N. Gengler & P. Martin

➤ Why predict CH₄ emissions ?

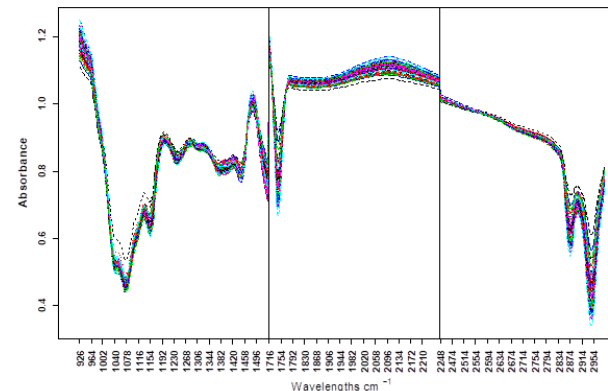


Direct measurement is challenging:

- Measurement tools are low to medium throughput, costly, labor-intensive and require technical skills
- Need for a proxy !

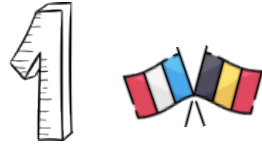


➔ *Prediction from milk MIR spectra*

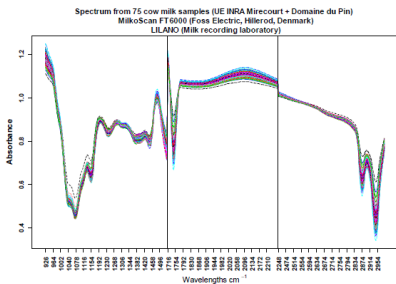


➤ The Methabreed project

led by Eliance and funded by APIS-GENE



Develop methane prediction equations from milk mid infrared spectra

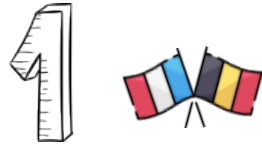


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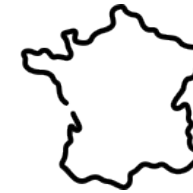
Predicting CH₄ from MIR spectra
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➤ The Methabreed project

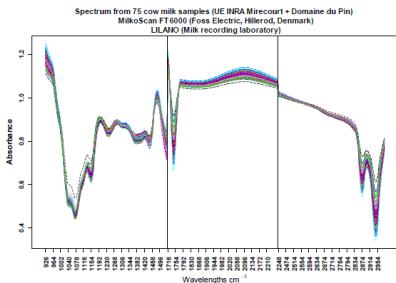
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Apply the equation to the national database

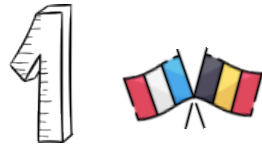


Develop methane prediction equations from milk mid infrared spectra

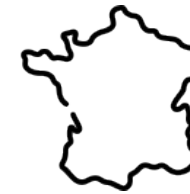


➤ The Methabreed project

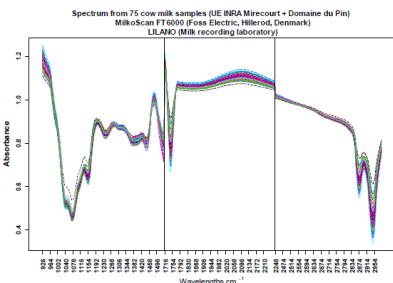
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Apply the equation to the national database



Develop methane prediction equations from milk mid infrared spectra



Develop genetic and genomic analyses using the predictions as phenotypes



Develop a genomic evaluation



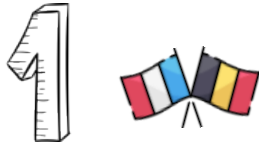
Propose new breeding goals



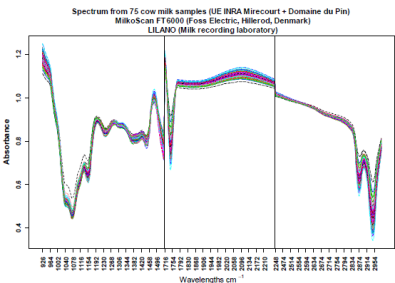
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➤ The Methabreed project

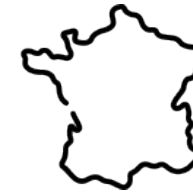
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Develop methane prediction equations from milk mid infrared spectra



Apply the equation to the national database



Develop genetic and genomic analyses using the predictions as phenotypes



Develop a genomic evaluation








Propose new breeding goals

➤ Aims of the study

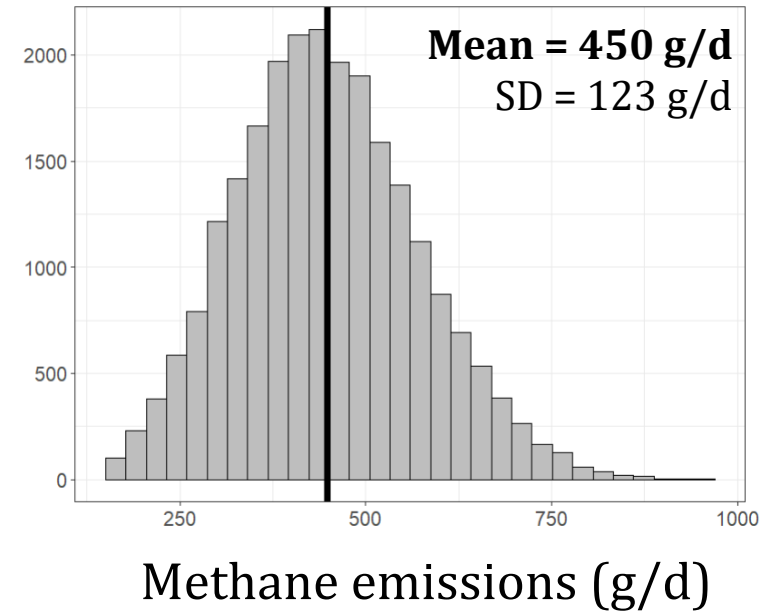
- A Predict methane emissions in g/d (**MeP**) and in g/kg of FPCM (**MeI**)
- B Compare equations calibrated on 1-week and 2-week CH₄ averages



➤ Calibration and validation data

-  5 farms & 9 experiments
-  235 cows
-  3 breeds
-  26 000 CH₄ GreenFeed measurements
-  1 800 MIR spectra

➤ Collected between 5 and 305 DIM
Standardized and DIM-corrected

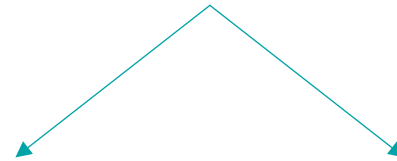


➤ Validation data:
100 spectra from 45 new cows

➤ Calibration of the equations

Method : PLS regression

MeP (g/d) and MeI (g/kg FPCM)



**1 spectrum per week
CH4 averages over 1 week**

**1 spectrum every 2nd week
CH4 averages over 2 weeks**

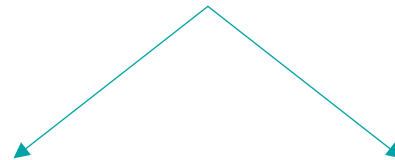
➤ Calibration of the equations

Method : PLS regression

International recommendation
Minimum 20 measurements
for accurate average
(Manafiazar et al., 2016)



MeP (g/d) and MeI (g/kg FPCM)



1 spectrum per week
CH4 averages over 1 week
(min 14 measurements)
→ 1035 spectra

1 spectrum every 2nd week
CH4 averages over 2 weeks
(min 20 measurements)
→ 680 spectra



4 equations developed

➤ Calibration / validation statistics

Statistics	CH4 unit	Equation calibrated using 1-week CH4 averages		Equation calibrated using 2-week CH4 averages	
		CV	V	CV	V
R ²	MeP				
	MeI				
%RMSE / observations mean	MeP				
	MeI				

Average observed MeP = 387 g/d
 Average observed MeI = 14 g/kg FPCM



➤ Calibration / validation statistics

Statistics	CH4 unit	Equation calibrated using 1-week CH4 averages		Equation calibrated using 2-week CH4 averages	
		CV	V	CV	V
R ²	MeP	0.41	0.25	0.38	0.28
	MeI	0.55	0.43	0.47	0.42
%RMSE / observations mean	MeP	13.9	17.9	13.8	16.4
	MeI	17.8	18.0	19.2	16.6



Better prediction of MeI than MeP
Smaller prediction error for the 2-week averages equation



➤ Comparison of validation statistics

Statistics	CH4 unit	Equation calibrated using 1-week CH4 averages	Equation calibrated using 2-week CH4 averages	Comparison with literature
R ²	MeP	0.25	0.28	0.46 ; 0.68 ; 0.17
	MeI	0.43	0.42	0.83 ; 0.27
%RMSE / observations mean	MeP	17.9	16.4	17.8 ; 18.3 ; 20.0
	MeI	18.0	16.6	22.0 ; 19.0

➤ Validation statistics of indirect MeP prediction

Statistics	CH4 unit	Equation calibrated using 1-week CH4 averages	Equation calibrated using 2-week CH4 averages
R ²	MeP	0.25	0.28
	MeI	0.43	0.42
	MeI * FPCM	0.45	0.39
%RMSE / observations mean	MeP	17.9	16.4
	MeI	18.0	16.6
	MeI * FPCM	18.8	16.3



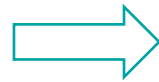
Indirect prediction of MeP better than direct prediction



➤ Predict MeP and MeI



Poor direct prediction of MeP



MeP depends on factors not described in MIR spectrum



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Predicting CH₄ from MIR spectra
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➤ Predict MeP and MeI



Poor direct prediction of MeP

➡ MeP depends on factors not described in MIR spectrum

Satisfying direct prediction of MeI

➡ Interesting but ratio trait less efficient in breeding goal



➤ Predict MeP and MeI



Poor direct prediction of MeP

➡ MeP depends on factors not described in MIR spectrum

Satisfying direct prediction of MeI

➡ Interesting but ratio trait less efficient in breeding goal

Satisfying indirect prediction of MeP

➡ Maintain MeI precision level by multiplying it by a true value (FPCM)

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➤ Compare 1-week and 2-week equations



Prediction error smaller for 2-week CH₄ averages equation



Initial value is more accurate



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➤ Take home messages

We can predict CH₄ from milk MIR spectra

A

Prediction of $\text{MeI} \times \text{FPCM} > \text{Prediction MeP}$

B

Calibration on **2-week CH₄ averages more accurate** than calibration on 1-week CH₄ averages



➤ Take home messages

We can predict CH₄ from milk MIR spectra

A

Prediction of $\text{MeI} \times \text{FPCM} > \text{Prediction MeP}$

B

Calibration on **2-week CH₄ averages more accurate** than calibration on 1-week CH₄ averages



➔ To improve prediction, increase calibration population size



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EAAP
European Federation
of Animal Science



Thank you for your attention !



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