

A first approach to predict nitrogen efficiency of individual dairy cows through milk MIR spectra

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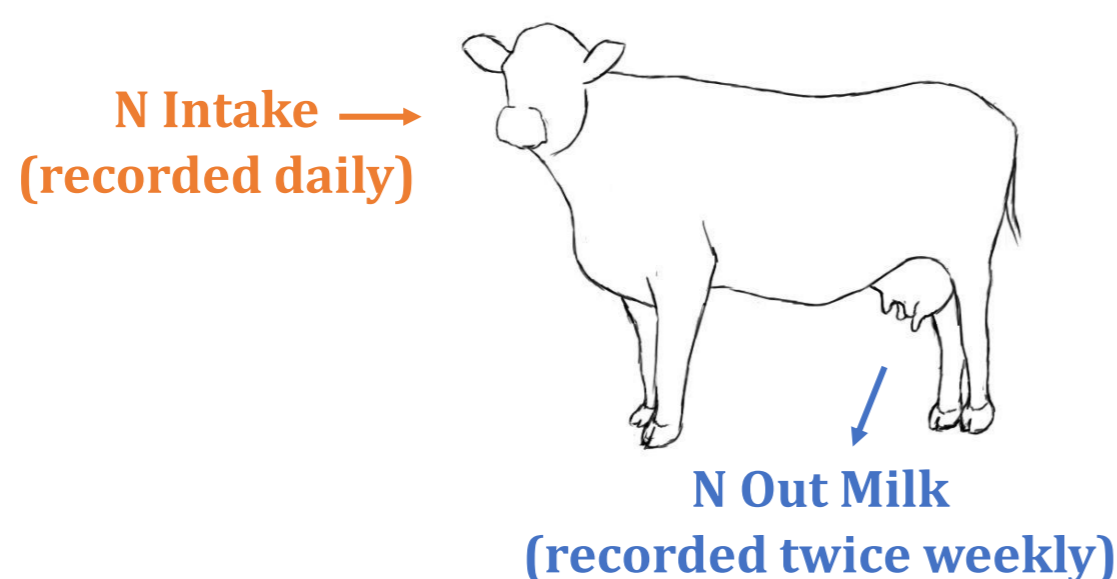
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Objective




- Use MIR spectra of milk to predict individual N efficiency
 - Prediction of phenotype at large scale for management and genomic studies
 - Reduction of feeding costs and environmental impact

Methods

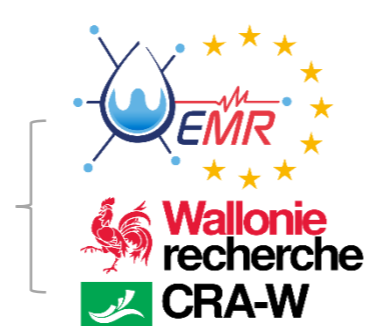
$$\text{N Use Efficiency (\%)} = \frac{\text{N Out Milk}}{\text{N Intake}} * 100$$



Common sampling protocol in 3 experimental farms
136 Holstein cows in early lactation (calving to DIM 50)

	# Cows	MY	Diet 1	Diet 2	Diet 3
 (UK)	62	31.6	Standard (50% Cc)	High Cc (70% Cc)	Low Cc (30% Cc)
 (DK)	35	35.5	Standard	High Sugar	High Starch
 (IE)	39	30.5	Standard		

MIR spectra collected twice weekly
Spectra standardized into a common format



Merging of spectra with N efficiency data of the same day

Modelling by PLS (Partial Least Square - Linear method)
or SVM (Support Vector Machine - Nonlinear Method)

Conclusions

- Fair estimation of N efficiency when similar diets are included in the model
- Preliminary study, results to be validated
- Model only valid for beginning of lactation and Holstein
- Robustness of models to be improved by adding complementary data

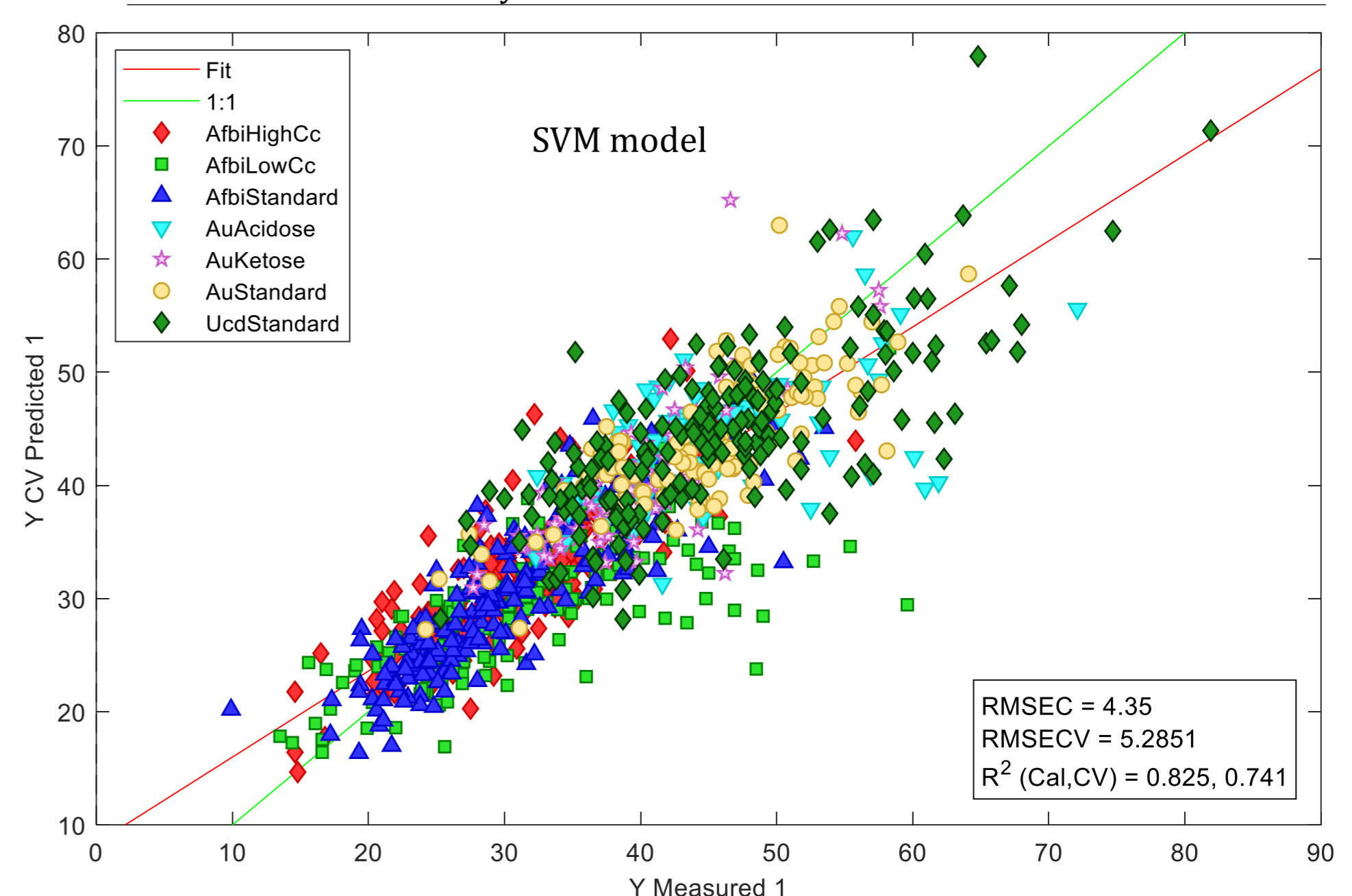
Results

1034 data from 136 cows (≈ 7.6 samplings per cow from calving to DIM 50)

Cross-validation: 10% of data randomly removed

- Estimation of N efficiency with fair accuracy
- Best model obtained with SVM
- But records from a same cow can be in calibration and validation sets

Method	X predictors	R ² cv	Error (RMSEcv)	Relative error (RMSEcv/mean)
PLS	MIR	0.59	6.6	18%
PLS	MIR+Parity	0.62	6.4	17%
PLS	MIR+Parity+MY	0.72	5.5	15%
SVM	MIR+Parity+MY	0.74	5.3	14%



External-cow-validation: 25% of the cows randomly removed

- Confirm potential of the method
- But cows with similar diets are in calibration and in validation sets

Method	X predictors	R ² cv	Error (RMSEcv)	Relative error (RMSEcv/mean)
SVM	MIR+Parity+MY	0.68	5.0	14%

External-diet-validation: diets removed one by one.

- Fair to inaccurate predictions depending of the diets
- Best models were obtained with SVM

Diet	Method	X predictors	Error (RMSEcv)	Relative error (RMSEcv/mean)
Afbi HighCc	SVM	MIR+Parity+MY	6.67	18%
Afbi LowCc	SVM	MIR+Parity+MY	8.13	22%
Afbi Standard	SVM	MIR+Parity+MY	4.38	12%
Au High Starch	SVM	MIR+Parity+MY	6.95	19%
Au High Sugar	SVM	MIR+Parity+MY	7.51	20%
Au Standard	SVM	MIR+Parity+MY	5.96	16%
Ucd Standard	SVM	MIR+Parity+MY	12.58	34%
Average			7.45	20%