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# A first approach to predict nitrogen efficiency of dairy cows through milk FT-MIR spectra

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Improving nitrogen efficiency has become a key factor in dairy production for both environmental and economic reasons. Cost effective and large-scale phenotyping methods are required to improve this trait through genetic selection or feeding and management of cows. The aim of this study was to evaluate the possibility of using Mid Infrared (MIR) spectra of milk to predict nitrogen efficiency of dairy cows during early lactation.

Data were collected from 133 Holstein cows, from calving until 50 days in milk, in 3 research herds (Denmark, Ireland and UK). In two of the herds, diets were designed to challenge cows metabolically, while a standard diet was offered in the third herd. Nitrogen intakes (kg/day) and nitrogen excreted in milk (kg/day) were measured daily. Nitrogen use efficiency was calculated as the ratio of nitrogen in milk/nitrogen ingested. MIR milk spectra were recorded twice weekly and were standardized into a common format to avoid bias between apparatus or periods. Regression models between nitrogen efficiency and MIR milk spectra were developed on 1145 observations using Partial Least Squares (PLS) or Support Vector Machine (SVM) regression methods. Evaluation of the data was done through an external-record-validation, an external-cow-validation and an external-diet-validation.

The model was better in terms of $R^2$ of cross-validation and error when using SVM method compared to PLS method. Inclusion of milk yield and lactation number as predictors, in combination with the spectra, also improved the calibration. In cross- validation, the best model was obtained by using spectra, milk yield and lactation number as predictors, and SVM modeling with $R^2cv$ of 0.74 and a relative error of 14%. When performing the external-cow-validation the relative error remained at 14% and during the external-diet-validation the relative error ranged from 12 to 34%.

While the model needs to be validated and improved for use in routine conditions, especially to cover the entire lactation, these

preliminary results showed that it was possible to obtain information on nitrogen efficiency through milk MIR spectra. This could potentially allow large-scale predictions for both genetic studies and farm management.