

# Prediction models for feed nutrients intake using individual milk mid-infrared spectral data

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## Background

Quantifying cow feed and nutrient intake is essential:

- Fiber intake supports rumen health and digestion,
- Nitrogen intake affects protein synthesis and nitrogen excretion.

Dry matter intake (DMI) and the intake of the different feed nutrients is expensive and laborious to measure on a large number of cows at the individual level.

Milk mid-infrared (MIR) spectroscopy is:

- Routinely used worldwide for the quantification of fat, protein, and lactose,
- Already used to develop equations for milk characteristics (e.g. fatty acids) and animal characteristics (e.g. DMI, methane emissions).

## Objective

The objective of this preliminary study was to predict DMI, intake of neutral detergent fiber (NDF), acid detergent fiber (ADF), and nitrogen (N), and nitrogen use efficiency for milk production (NUE) from individual milk MIR spectra.

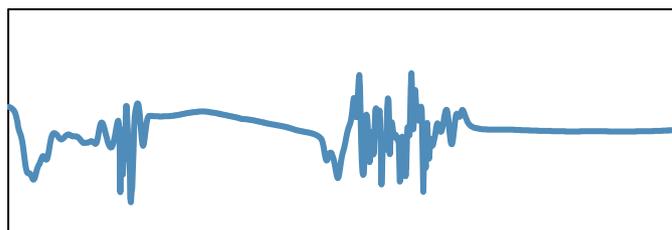


Figure 1. Mid-infrared spectrum of the milk

## Materials and Methods

- Historical data on individual feed intake and diet composition (2015-2024) and individual MIR spectra from routine milk recordings (2020-2024) were available from the Agroscope-Posieux experimental farm.
- DMI and nutrient intake was averaged for 5 to 7 days around the date of milk sampling for each nutrient.
- NUE was quantified as the proportion of N in milk (milk crude protein / 6.38) divided by the total N intake.
- Prediction equations were developed using partial least squares regression on the MIR spectra and milk yield.
- Four-fold cross-validation was used to assess prediction accuracy.

## Results

The summary statistics and prediction results of the traits are in Table 1. Table 1 includes the trait, unit of measurement (unit), number of records used for the model development (n), mean, and standard deviation (SD) for DMI, NDF intake, ADF intake, N intake, and NUE, along with the accuracy metrics resulting from the model development. These metrics include the number of latent variables used by partial least squares regression (LV), the bias, the root mean square error (RMSE), the coefficient of determination ( $R^2$ ), the slope of the true values regressed on the predicted values (slope), and the ratio of performance to interquartile range (RPIQ).

### Summary

- The coefficient of determination ranged from 0.57 for NUE to 0.65 for DMI, NDF intake, and ADF intake.
- The slope for all the traits was always greater than 0.93.
- Even if prediction results were promising, no external validation was undertaken yet; therefore, no information is available on the prediction performance on other farms.

Table 1. Summary statistics and prediction results of the studied traits.

Trait	Unit	n	Mean	SD	LV	Bias	RMSE	R <sup>2</sup>	Slope	RPIQ
DMI	kg/d	1,633	17.9	4.1	20	0.04	2.48	0.65	0.95	2.59
NDF intake	g/d	1,637	6,482.1	1,735.8	20	8.52	1,048.17	0.65	0.96	2.70
ADF intake	g/d	1,637	3,753.9	1,060.0	20	11.39	630.34	0.65	0.95	2.67
N intake	g/d	1,635	402.9	104.0	20	-0.48	64.66	0.63	0.94	2.45
NUE	g/g	1,635	0.44	0.12	20	0.00	0.076	0.57	0.94	2.09