Prediction of energy status of dairy cows using MIR milk spectra

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Abstract

A key task within the GplusE project is to undertake a genetic evaluation using ten thousand cows to improve health traits of dairy cows, with energy status (ES) being a trait of major interest. To achieve this, cost effective and large scale phenotyping methods are required. This study was designed to evaluate the possibility of using MIR spectra of milk to predict ES of cows.

Data was collected from 241 cows, from calving until 50 days in milk (DIM) in six research herds of the GplusE consortium distributed in Belgium, Denmark, Germany, Ireland, Italy and UK. Daily milk MIR spectra were collected twice weekly during this period. All the MIR instruments used in the experiment were standardized into a common format, following the European Milk Recording method. ES was 'quantified' by 3 different approaches: 1) measuring daily energy balance (EB), residual feed intake (RFI) and dry matter intake (DMI), 2) measuring at 14 and 35 DIM blood metabolites/hormones (Glucose, BHB, NEFA and IGF-1) and 3) performing K-means clustering based on these 4 blood components in order to discriminate 2 groups with healthy vs imbalanced cows. Regression models between each of these variables and milk MIR spectra have been developed using PLS and classification model with PLS-DA method.

The R^2 of cross-validation obtained when predicting EB, RFI, DMI, Glucose, BHB, NEFA and IGF-1 were respectively 0.43, 0.46, 0.47, 0.33, 0.68, 0.39 and 0.37. Despite the relatively low R^2, the use of thresholds to classify predictions could allow to fairly discriminate the healthy vs imbalanced cows. When grouping the blood metabolites by clustering, the discriminant model was able to differentiate healthy vs imbalanced cows with sensitivity and specificity of 85% and 71%, respectively.

These preliminary results demonstrate that milk MIR spectra have reasonable potential to provide information on ES related variables. This could allow large scale predictions for both genetic studies and farm management.

Keywords: MIR, energy status, blood metabolites, clusters