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Abstract Submission Form

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Preferred presentation Oral

Preferred session Session 2: SC Milk Analysis – New tools to extend the horizon of milk mid-infrared spectrometry

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Title of your paper Daily standardization of milk mid-infrared spectra in a comprehensive regression model framework considering animal related data

Insert ABSTRACT text

Milk mid-infrared (MIR) spectrometry has been utilized worldwide and for decades to analyze the components of milk. In a routine use, the method demonstrates a very high precision and repeatability, particularly for the main milk components, which is supported by repeated analyses of standard milk samples with known reference values whereof a slope-intercept (S/I) correction is derived. However, this does not apply to routinely collected spectral data, whereby deviations and drift can be observed both between different machines and within a machine over time. The aim of this study was to demonstrate a new approach for standardization of milk MIR spectral data using a framework of regression models considering results of laboratory analyses and information on the animal, such as days in milk (DIM) or parity, to estimate daily and machine-wise standardization coefficients for the individual wavelengths. The data used in this study was provided by the Landeskontrollverband Niedersachsen (LKV Niedersachsen, Leer, Germany) and included spectral data from five spectrometers (Foss, Hillerød,

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Denmark) as well as the corresponding data from the milk performance testing (MPT), which were routinely collected in the first half of 2022. In addition to the total of 2.3 M spectra from the MPT, 61.0 K spectra of control samples were available. In the daily laboratory routine, these samples of the weekly changing North German standard milk are analysed three times in a row every 200 regular samples (reference analysis by LUFA Nord-West, Oldenburg, Germany). Beyond this, triple analyses of the same 5.3 K MPTs milk samples on three of the five spectrometers were carried out, which were collected as part of the project "Metabolic monitoring from milk performance test data" initiated by the LKV Weser Ems and vit covering the first half of 2022. In a first step, the MPT spectra were used to quantify and eliminate day-specific machine effects in a complex framework of regression models, considering information on the animal as well as data obtained from the lab analyses to finally estimate machine-, day- and wavelength-wise standardization coefficients. With the aim of demonstrating the effect of standardisation, the data set with triple analyses was used in a second step to build prediction models for both raw Foss MIR spectra and the vit standardised spectra using the S/I-corrected fat values obtained from the laboratory. Based on this, two separate analyses were performed: first, the data set with the triply analysed MPTs was used for a principal component analysis, a wavenumber-wise inter-machine comparison of the spectra as well as for a comparison of the predictability of fat in each case of raw and standardised spectra. Second, the data set with the analyses of standard milk samples was used, whereby the S/I-corrected Foss estimates from the laboratory were compared with estimates from the developed models based on both raw and vit standardised spectra for fat across all five machines over time.
It can be shown that the vit standardisation procedure leads to a harmonisation of the spectra between machines as well as over time and thus corrects both general and temporary machine effects. Furthermore, the fat modelling ability is optimized, with the RMSEcv decreasing from 0.036% with raw spectra to 0.020% fat with standardized spectra during calibration. Regarding the independent standard milk analyses, the RMSEP was also reduced from 0.046% to 0.021% and thus closely approximates the RMSEP of 0.014% fat of the S/I corrected laboratory values. This study showed that there is not only a high need for standardisation across machines, but also over time. Therefore, the vit standardisation as a statistical procedure featuring a daily standardisation seems to be a promising approach.

Enter keywords

Standardization, milk mid-infrared spectrometry, regression model framework

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