OptiMIR: Use of MIR spectra to predict multiple cow status as advisory tools for dairy farms

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Abstract

Considering the current increasing of herd size, there is a need for precise and rapid information on individual cow state. Fourier transform mid-infrared spectrometry (FT-MIR) technology is already used worldwide for milk analysis; it allows rapid and cost effective determination of milk composition. The objective of OptiMIR project was to optimize the use of FT-MIR spectra in order to produce indications on cow status thereby providing advisory tools to dairy farmers. Hence phenotypes of interest were collected in several countries and linked to FT-MIR spectra. Since the OptiMIR network comprised 65 FT-MIR instruments in 6 countries, standardization of FT-MIR data was necessary, allowing the collation of spectral databases and the use by all milk recording organizations of the models developed. Using chemometric tools (like Partial Least Squares regression), predictive models were developed to provide indicators on fine milk composition, on milk biomarkers of physiological imbalance, and directly on status of the cows. Equations predicting fine milk composition such as fatty acids and minerals were consolidated through the OptiMIR network, providing indirectly information on technological properties of milk and cow status. As biomarker of early physiological imbalance, an equation predicting citrate in milk was developed with good accuracy ($R^2cv=0.86$); and as milk biomarkers of ketosis, beta-hydroxybutyrate and acetone were calibrated with fair results ($R^2cv=0.63$ and 0.67 respectively). Direct classification of spectra regarding low vs high risk of ketosis was also performed (84.5% sensitivity and 84.2% specificity). Direct regressions were realized for various negative energy balance criteria (r from 0.43 to 0.57) and enteric methane ($R^2cv=0.7$). All equations are available to be used by milk recording organizations on field and converted into advisory tools for the dairy sector.

Keywords: FT-MIR, milk, cow status, network, standardization