

# Phenotyping new traits by mid infrared spectrometry: a way to improve milk quality and dairy cows' management

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## Abstract

Since the late 2000s, mid infrared (MIR) spectra acquired from milk recording analysis have been used to phenotype new traits through prediction equations. These equations have been developed from milk samples analysed both by MIR spectrometry and a reference method. When routinely applied on milk recording MIR spectra, they provide high-throughput phenotypes for traits that usually require long and costly analysis. The Livestock Institute, with other French partners, contributed to national and European research and development programs focused on this methodology.

Within PhenoFinlait and Favacal programs, 26 fatty acids (FA), four caseins and calcium content were estimated with a good reliability ( $R^2 > 0.80$  and  $S_{y,x} < 10\%$ ). This large scale milk characterization with MIR spectroscopy paves the way for population variability studies and milk composition modification through management and genetics to meet end-users needs. Indeed, milk nutritional properties are influenced by FA and protein composition. Calcium is also an important health benefit of milk. Knowledge of milk composition is a prerequisite for milk technological properties and dairy products organoleptic qualities improvement. In this sense, current FROM'MIR program aims to use MIR spectra to predict cheese making properties of milk.

Furthermore, milk appears as a biomarker source of physiological status and feeding management of the cows. In EC-funded OptiMIR project, MIR spectra were used to predict animal traits such as pregnancy status, energy balance and methane emissions with different accuracy levels. A model to discriminate high and low risk of ketosis was also developed by using MIR spectra with 84.5% sensitivity and 84.2% specificity. At the same time, the national AcID project allowed progress to be made in the characterization of ruminal acidosis from MIR-estimated milk FA. The feasibility of estimating nitrogen waste of cows by using MIR-estimated milk urea has been studied in the national UREA project.

Several models have also been developed specifically for sheep and goats. Many similar projects are currently on-going in different European countries targeting udder health or milk quality. On this basis, many applications for animal breeding and dairy herd improvement offer future prospects to improve milk quality and optimize milk production from farms to milk processing industries. Other projects are expected in the future to characterize novel traits such as feed efficiency.

*Keywords: MIR spectrometry, milk recording, cows*

