Potential of mid-infrared spectrum of milk to detect changes in the physiological status of dairy cows

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Fertility and health problems are causing large economic losses to the dairy industry. Early identification of pregnant cows and early detection of mastitis are key elements to improve reproductive, health, and animal welfare and reduce costs for the farmer. The mid-infrared (MIR) spectrum obtained from milk recording routines measure the absorbance over a large number of wavelengths. Two studies, based on spectral data and extra phenotypes (pregnancy diagnosis and mastitis) from Luxembourg and Wallonia (Belgium) milk recordings, were conducted to investigate the potential use of the entire spectrum in the identification of animal status. In the first study, a total of 9,717 spectral records coupled with pregnancy status coming from milk recording in Luxembourg were used. A subset of MIR spectrum from non-pregnant cows was retained and a multivariate mixed model was applied to obtain predicted MIR spectral values for all test-days, prediction errors (residuals) representing the factors not present in the model (reproductive status, unaccounted factors, and error). A quadratic discriminant function was then constructed on the residual spectra to predict the pregnancy status. Leave one out cross-validation showed promising results with an error rate of cross-validation equal to 3.1% for non-pregnant cow and an error rate of cross-validation equal to 7.4% for pregnant cow. In the second study, a total of 4,126 test-days from cows with at least one mastitis detected during its lactation and coming from the Walloon milk recording were used. Significant differences (p-value < 0.05) were observed between milk MIR spectra considered related to mastitis (in an interval of 10-days around this test-day) and the other spectra for 23.8% of the analyzed MIR spectral data points. Results from both studies showed that MIR milk spectrum could be very useful to detect changes in the physiological status of dairy cows and could be potentially used in routine management decision tools.

KEYWORDS
milk MIR spectrum
pregnancy diagnosis
mastitis