Assessing differences in early lactation milk constituent estimates between Holstein cows of varying health outcomes

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Introduction

Cows have an increased risk of disease shortly after parturition due to the energy and macromineral demands that occur secondary to the initiation of lactation. Our objective was to assess the feasibility of identifying a healthy or maladaptive transition using Fourier-transform infrared (FTIR) spectroscopy of milk.

Materials and methods

We collected proportional milk samples once daily on all cows in the early lactation pen of a commercial dairy farm in Cayuga County, N.Y. from June through August 2021. Milk was stored at 4°C until analysis via FTIR. Estimated constituents included % lactose, protein and fat; relative % and yield of de novo, mixed and preformed fatty acids; the individual fatty acids C16:0, C18:0 and C18:1 cis:9; milk urea nitrogen, milk acetone, milk beta-hydroxybutyrate and milk predicted blood non-esterified fatty acids. Cows (n = 1,024) were followed through 14 days in milk (DIM) and classified as healthy (n = 881; no adverse health events) or sick (n = 143; diagnosis of clinical ketosis, metritis and/or displaced abomasum). We used partial least squares regression to model the response variable (healthy vs. sick) separately for each DIM from 3 to 10 as a function of the 16 predictor estimated milk constituents and parity group (primiparous vs. multiparous). All models included 3 components and were cross validated using a 100-repetition bootstrap method. Predicted response probabilities from cross-validated models were used in receiver operating characteristic curves.

Results

Areas under the curve for prediction of health outcome category ranged from 0.80 at 3 DIM to 0.61 at 10 DIM. Sensitivity, specificity, positive predictive value and negative predictive value of identifying a sick cow ranged from 18 to 69%, 77 to 85%, 2 to 44% and 91 to 98%, respectively, with sensitivity and positive predictive value decreasing from 3 to 10 DIM and specificity and negative predictive value increasing from 3 to 10 DIM.

Significance

Although conducted in only one herd, our results suggest that FTIR estimates from a single proportional milk sample collected between 3 and 10 DIM can identify healthy cows with good accuracy. This finding could have beneficial implications for management of cows in early lactation.