Association of mid-infrared predicted milk and blood constituents with early lactation disease and herd removal in Holstein cows

K.D. Bach,[1] MS, VMD; **D.M. Barbano**,[2] PhD; **J.A.A. McArt**,[1] DVM, PhD
[1] Department of Population Medicine and Diagnostic Sciences, College of Veterinary Medicine, Cornell University, Ithaca, NY 14853
[2] Department of Food Science, College of Agriculture and Life Sciences, Cornell University, Ithaca, NY 14853

Introduction

Partial least square regression estimates of milk and blood constituents using Fourier transform mid-infrared (FTIR) analysis have shown promise as a tool for monitoring early lactation excessive energy deficit in dairy herds. However, the association of these various predicted constituents and subsequent disease events and production outcomes have yet to be established. Our objectives were to determine the association of early lactation predicted milk β-hydroxybutyrate (BHB) concentrations, predicted blood nonesterified fatty acid (NEFA) concentrations, and predicted de novo fatty acid percentages relative to total fatty acid concentrations with the risks of hyperketonemia (HYK), displaced abomasum (DA), and metritis (MET) diagnosis and removal from the herd (CULL).

Materials and Methods

We enrolled 507 multiparous Holstein cows from 2 dairy farms in New York State between July and November 2016. Proportional, composite milk samples were collected twice weekly from 3 to 18 DIM for a total of 4 test days and analyzed using mid-FTIR spectrometry (Delta Instruments, Model FTA, Drachten, NL) for milk BHB and fatty acid composition as well as fat, protein, lactose, and predicted blood NEFA. Blood samples were collected for determination of HYK (blood BHB ≥1.2 mmol/L) using a Nova Vet meter (Nova Biomedical, Billerica, MA) on the same day as milk sample collection, and farm-diagnosed occurrence of disease or removal from the herd during the first 30 DIM was collected from herd management software (DairyComp 305, Valley Agriculture Software, Tulare, CA).

The incidence of HYK was 13.8% between 3 and 18 DIM, and there were 1 DA, 31 MET, and 15 CULL cases during the first 30 DIM. As there was only 1 case of DA, no further analysis of this outcome was performed. Outcomes of interest for each test day were thus HYK, MET, and CULL. For individual test day analyses, data were time ordered with only data from milk samples obtained on or before disease diagnosis included. Univariable analyses were conducted using PROC TTEST in SAS 9.4 (SAS Institute Inc., Cary, NC).

Results

No associations between MET and non-MET cows were noted for milk BHB, predicted blood NEFA or predicted de novo fatty acid relative percentages at any test day. For all test days, cows diagnosed with HYK had higher predicted milk BHB (all results in mmol/L; test day 1: HYK 0.16, non-HYK 0.08; test day 2: HYK 0.21, non-HYK 0.12; test day 3: HYK 0.20, non-HYK 0.12; test day 4: HYK 0.20, non-HYK 0.11; all $p<0.0001$), higher predicted blood NEFA (all results in mmol/L; test day 1: HYK 0.98, non-HYK 0.48; test day 2: HYK 0.91, non-HYK 0.46; test day 3: HYK 0.77, non-HYK 0.41; test day 4: HYK 0.65, non-HYK 0.35; all $p\leq0.002$), and lower predicted de novo fatty acid relative percentages (all results in relative %; test day 1: HYK 19.6, non-HYK 23.5; test day 2: HYK 17.9, non-HYK 22.7; test day 3: HYK 18.5, non-HYK 23.0; test day 4: HYK 19.9, non-HYK 23.4; all $p<0.0001$). Additionally, CULL animals had lower predicted de novo fatty acid relative percentages at all test days (all results in relative %; test day 1: CULL 18.6, non-CULL 23.5; test day 2: CULL 20.2, non-CULL 22.5; test day 3: CULL 19.7, non-CULL 22.8; test day 4: CULL 17.3, non-CULL 23.3; all $p\leq0.08$).

Significance

Further multivariable analysis of these milk and blood constituents with potential covariates herd, parity, body condition score, and calving-related measures is currently being performed and will provide clarification of these associations and the accompanying risks. However, from initial univariable analyses, mid-FTIR predicted milk BHB, blood NEFA, and de novo fatty acid relative percentages from milk all appear to be promising indicators of subsequent disease outcomes in early lactation.