Effect of hyperketonemia on circadian patterns of blood metabolites and milk predicted constituents in dairy cows

C. R. Seely, MS[1]; **K. D. Bach**, DVM, PhD[1]; **D. M. Barbano**, PhD[2]; **J. A. A. McArt**, DVM, PhD[1]
[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

Estimates of milk and blood constituents by Fourier-transform mid-infrared (FTIR) analysis of milk offer a promising tool to monitor energy deficit in dairy cows. We sought to explore: 1) diurnal changes in plasma non-esterified fatty acids (NEFA) and β-hydroxybutyrate (BHB) and FTIR estimates of milk BHB and milk predicted blood NEFA (pbNEFA); 2) correlation between plasma BHB and NEFA; and 3) effect of hyperketonemia (HYK) on circadian patterns of plasma and milk metabolites.

Materials and Methods

Multiparous Holstein cows (n=28), between 3 and 9 DIM, were fitted with jugular catheters and blood samples were collected every 2 h for 5 d. Cows were milked thrice daily (0600, 1400, 2200 h) and milk samples were collected at every milking for the same 5 d. Cows were fed daily at 0900 h and offered ad lib access to a TMR. Plasma NEFA and BHB were quantified by enzymatic analysis, and milk BHB and pbNEFA were estimated by FTIR. Cows were retrospectively grouped as HYK positive (n=13) if plasma BHB was ≥1.2 mmol/L for ≥ 3 study days or HYK negative (non-HYK; n=15) if plasma BHB was ≥1.2 mmol/L for ≤ 2 study days. Explanatory models were used to analyze plasma and milk metabolites over time and differences in metabolites between HYK groups. Models analyzing metabolites over time included the random effect of cow and fixed effect of time; those analyzing differences between groups included the random effect of cow and fixed effects of HYK group, time, and HYK group×time. The correlation between plasma NEFA and BHB was analyzed by calculating the area under the curve for total plasma NEFA and BHB.

Results

Plasma BHB and NEFA, milk BHB, and pbNEFA all changed throughout the day ($P < 0.001$). The amplitude of change in plasma BHB was greater within a day for the HYK cows than the non-HYK cows ($P=0.009$). Plasma NEFA and BHB were positively correlated ($r=0.81$), suggesting that accounting for diurnal variation increased the correlation of plasma metabolites.

Significance

Our results support the use of FTIR estimates of milk constituents as a tool to monitor energy deficit and suggest that time relative to feeding should be considered when analyzing both plasma and milk metabolites.