Accuracy of milk ketone bodies from flow-injection analysis for the diagnosis of hyperketonemia in dairy cows

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Abstract

The objectives of this study were (1) to determine the correlations between blood β-hydroxybutyrate (BHBA) and milk components [BHBA, acetone, fat, protein, and fat:protein (F:P) ratio], and (2) to establish optimal thresholds for milk components to predict hyperketonemia in dairy cows. Data on 163 cows from 37 herds were used in this cross-sectional study. Herds were visited once during the study period, and cows between 2 and 90 d in milk were blood sampled within 4 h of milk sampling for the Dairy Herd Improvement test. Blood BHBA concentrations were measured using a cow-side electronic meter, Precision Xtra, which was considered the gold standard test in this study. Milk BHBA and acetone concentrations were measured in Dairy Herd Improvement milk samples by flow-injection analysis; whereas, milk fat and protein were tested using Fourier transform infrared spectroscopy. Hyperketonemia was defined by a blood BHBA concentration ≥1.4 mmol/L. The prevalence of hyperketonemia (based on blood BHBA values) in this study population was 21.0%. Pearson correlation coefficients between blood BHBA and milk BHBA, acetone, fat, protein, and F:P ratio were 0.89, 0.73, 0.21, 0.04, and 0.17, respectively. Receiver operating characteristic curves were generated and thresholds for each individual milk component were determined based on the maximal sum of sensitivity and specificity. Optimal threshold values for hyperketonemia were milk BHBA ≥0.20 mmol/L, acetone ≥0.08 mmol/L, fat ≥4.2%, and F:P ratio ≥1.3. Based on these thresholds, milk BHBA and acetone had greater sensitivity (84 and 87%, respectively) and greater specificity (96 and 95%, respectively) than the other milk components (fat, protein, and F:P). Series and parallel testing slightly improved the accuracy of milk BHBA and acetone values to predict hyperketonemia. A multivariable model that accounted for milk BHBA and milk acetone values simultaneously had the highest accuracy of all tested models for predicting hyperketonemia. These results support that milk BHBA and milk acetone values from flow-injection analysis are accurate diagnostic tools for hyperketonemia in dairy cows and could potentially be used for herd-level hyperketonemia surveillance programs.

Key words: