

# An Observational Study of Blood Glucose, Non-Esterified Fatty Acid, and Beta-Hydroxybutyrate Concentrations in a Commercial Dairy Herd with a High Incidence of Ketosis

D.F. Calderon, DVM; N.B. Cook, MRCVS; G.R. Oetzel, DVM, MS  
School of Veterinary Medicine, University of Wisconsin-Madison 53706

## Introduction

Ketosis, defined as blood beta-hydroxybutyrate (BHBA) concentrations greater than 1,400  $\mu\text{mol/l}$ , is an important problem in dairy herds. Ketosis in early lactation has been associated with decreased milk yield, increased risk for displaced abomasum, and impaired reproductive performance. The objective of this study was to investigate relationships between concentrations of blood BHBA, glucose, and non-esterified fatty acids (NEFA) in transition dairy cows in a commercial dairy herd with a high incidence of ketosis.

## Materials and Methods

Fifty-seven Holstein cows in a commercial dairy were intensively monitored from about two weeks prior to expected calving until about three weeks after calving. The farm was visited three times weekly with the goal of sampling each cow two or three times before and after calving, at approximately one-week intervals. Samples for glucose analysis (collected into tubes containing sodium fluoride and potassium oxalate) were obtained both before and after calving; samples for NEFA analysis (collected into tubes containing EDTA) were obtained only before calving; and samples for BHBA (collected into tubes without additive) were obtained only after calving. Only the last sample collected prior to two days before calving was submitted for NEFA analysis. Actual days before calving for the NEFA sample ranged from two to 10 days. Glucose and BHBA test results were divided into sampling periods as follows: GLUC-1 (2 to 10 days before calving, 57 samples); GLUC-2 (11 to 19 days before calving, 43 samples); BHBA1 and GLUC1 (3 to 6 days after calving, 54 samples); BHBA2 and GLUC2 (7 to 13 days after calving, 55 samples); and BHBA3 and GLUC3 (14 to 19 days after calving, 36 samples).

## Results

Eight of 57 cows (14%) had high NEFA concentration ( $< 0.40$  mEq/l) prior to calving. One cow was

removed from the herd before the first sampling period after calving. Ketosis was found in 16 of 56 cows (29% incidence). Eighteen of 149 serum samples collected for BHBA analysis had elevated BHBA concentrations (12% population prevalence). None of the eight cows with high pre-fresh NEFA developed ketosis. Cows entering their second or greater lactation had a higher incidence of ketosis than cows entering their first lactation (32% vs. 20%). Average days in milk at first diagnosis of ketosis was 10 days. The prevalence of ketosis was higher in the BHBA2 sampling period (22%) compared to the BHBA1 and BHBA3 periods (7% combined prevalence). Mean plasma glucose concentration for cows with both GLUC-2 and GLUC-1 samples was lower at the GLUC-1 sample (59 vs. 65 mg/dl,  $P < 0.05$ ). Glucose concentrations were not different in the sampling periods just before and just after calving (GLUC-1 vs. GLUC1). However, glucose was lower at the GLUC2 sample compared to the GLUC1 sample (54 vs. 60 mg/dl,  $P < 0.05$ ). The incidence of low glucose concentrations was higher in the GLUC2 sampling period (45%) compared to GLUC1 and GLUC3 sampling periods combined (19%). Higher blood BHBA after calving was associated with lower blood glucose ( $R^2 = .22$ ,  $P < 0.01$ ). Mean glucose concentrations were lower for samples with BHBA  $> 1,400$   $\mu\text{mol/l}$  compared to samples with BHBA  $< 1,400$   $\mu\text{mol/l}$  (41 vs. 59 mg/dl,  $P < 0.01$ ). Cows with high BHBA were also more likely to have low blood glucose ( $< 50$  mg/dl, the lower normal limit established by the commercial laboratory) than cows who did not have high BHBA (94% vs. 20%).

## Significance

High pre-fresh NEFA for cows in this herd was not associated with higher risk of post-fresh ketosis. Yet the overall incidence of ketosis was high (29%) and occurred very early in lactation (average of 10 days-in-milk). This suggests that management factors other than pre-fresh nutritional management can contribute to the development of ketosis very early in lactation. Ketosis was consistently associated with low blood glucose.