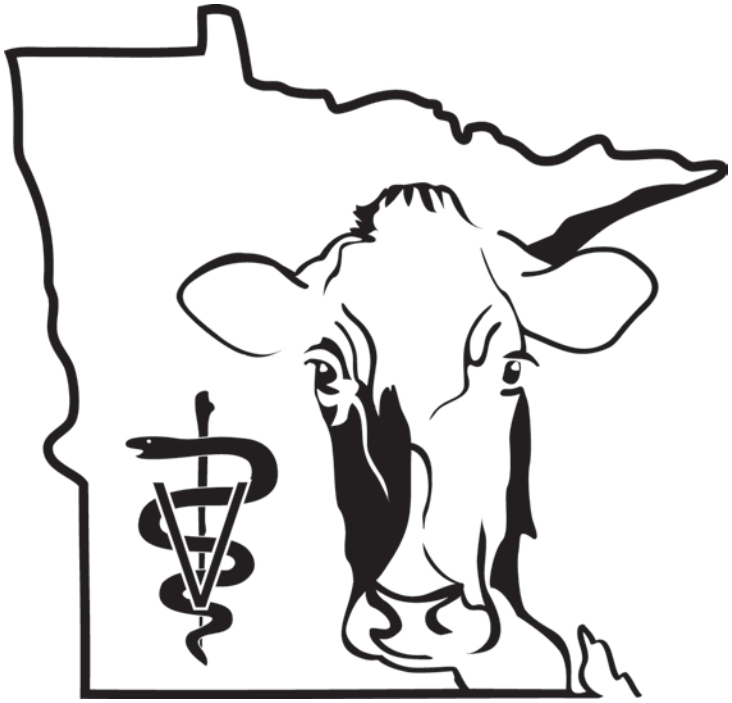
THIS ARTICLE IS SPONSORED BY THE
MINNESOTA DAIRY HEALTH CONFERENCE.

UNIVERSITY OF MINNESOTA

College of Veterinary Medicine

VETERINARY CONTINUING EDUCATION



ST. PAUL, MINNESOTA
UNITED STATES OF MINNESOTA

Validation of a rapid cow-side test for the measurement of blood beta-hydroxybutyrate in fresh cows

K. Konkol, *B.S.* [1], **S. Godden**, *D.V.M, D.V.Sc.* [1], **P. Rapnicki**, *D.V.M., M.B.A.* [1], **M. Overton**, *D.V.M., M.P.V.M.* [2], **E. Rollin** *D.V.M.* [2]

[1] *Department of Veterinary Population Medicine, University of Minnesota*

[2] *Department of Population Health, University of Georgia*

Introduction

Ketosis is an important metabolic disease in transition cows, associated with decreased milk production, impaired reproductive performance and abomasal displacements. Cows with blood beta hydroxybutyrate (BHBA) concentrations greater than 14.4 mg/dL are considered to be ketotic (Duffield et. al, 2009). Producers or veterinarians may measure blood BHBA levels in individual sick cows (diagnostic purposes) or may periodically test representative groups of fresh cows to estimate the herd prevalence of ketosis (monitoring purposes). However there are disadvantages to currently available tests. Though considered the gold standard, submitting serum samples to a veterinary diagnostic laboratory for BHBA analysis is inconvenient, expensive, and the delay in reporting does not lend itself as an individual animal diagnostic test. Conversely, and though they are inexpensive, rapid, and easy to use, available cow-side urine and milk ketone tests have been reported to have lower sensitivity and specificity (Carrier et. al, 2004) and rely on visual interpretation of color change. Ideally the industry would have an accurate, rapid, convenient and inexpensive cow-side test to measure blood BHBA levels in cows. The objective of this study was to evaluate the accuracy of an electronic hand held BHBA meter, designed to measure blood BHBA in human diabetics, for cow-side use in dairy herds.

Materials and Methods

The study was conducted in the summer of 2008 in two large dairy herds in western Wisconsin. A blood sample was collected from the coccygeal vein of fresh cows once between 4 to 10 days in milk. A hand-held meter (Precision Xtra BHBA test, Abbott Laboratories), was used to determine whole blood BHBA levels at cow side. Serum samples were separated then frozen and submitted to an accredited veterinary diagnostic lab for determination of serum BHBA concentration (Michigan State University, Lansing, MI). Results were available for 191 fresh cows (Mean 6.4 DIM, Range 4-10). A laboratory BHBA level of 14.4 mg/dL (1.4 mmol/L) was used as a cutoff for determining ketosis. Test sensitivity, specificity, overall accuracy, positive and negative predictive values and a ROC analysis were determined for the Precision Xtra ketone meter at thresholds ranging from 0.6 mmol/L (6.2 mg/dL) to 1.8 mmol/L (18.5 mg/dL) in increments of 0.1 mmol/L.

Results

The overall true prevalence of ketosis in cows tested was 14.1%. Results recorded from the Precision Xtra ketone test were highly correlated with laboratory results ($R2 = .98$, $P < .0001$). When using thresholds of 1.2 mmol/L (12.4 mg/dL) and 1.4 mmol/L (14.4 mg/dL), test sensitivity was 96.3% and 85.2% and test specificity was 98.2% and 99.4%,

respectively. The positive and negative predictive values at these two cut points were 99.4% and 89.7% (12.4 mg/dL) and 97.6% and 95.8% (14.4 mg/dL), respectively. Apparent prevalence for thresholds of 1.2 mmol/L (12.4 mg/dL) and 1.4 mmol/L (14.1 mg/dL) were 15.2% and 12.6%, respectively, compared to the true prevalence of 14.1%. Overall accuracy was highest when using a threshold of 1.3 mmol/L (13.4 mg/dL), at 98.4%, with a sensitivity, specificity, positive predictive value, negative predictive value and apparent prevalence of 96.3%, 98.8%, 99.4%, 92.9% and 14.7% respectively.

Significance

Blood BHBA levels measured by the Precision Xtra hand held meter were highly correlated to accredited laboratory results, and had excellent overall specificity and sensitivity. This is an accurate and rapid cow side test that could be used either as an individual cow diagnostic test or for group level monitoring programs.

References

Duffield T., K. Lissemore, B. McBride, K. Leslie. Impact of hyperketonemia in early lactation dairy cows on health and production. *J Dairy Science* 2009; 92: 571-580.

Carrier J., S. Stewart, S. Godden, J. Fetrow, P. Rapnicki. Evaluation of Use of Three Cowside Tests for Detection of Subclinical Ketosis in Early Postpartum Cows. *J Dairy Science* 2004; 87:3725-3735.