Milk And Plasma β-Hydroxybutyrate Concentrations in Holstein Transition Cows Supplemented with a Monensin Controlled-Release Capsule

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Introduction

Ketosis is a common calving-related disorder affecting dairy cows during the transition period. Subclinical ketosis is characterized by serum β-hydroxybutyrate (BHB) levels > 1000 to 1400 µmol/L. The highest incidence of subclinical ketosis occurs within the first two to three weeks of lactation. The Ketolac® test (Nagoya, Japan) is designed for detection of BHB in milk. Therefore, it is a practical tool for diagnosing subclinical ketosis in early postpartum dairy cows. If prevention is not considered during the transition period, cows will be at higher risk of developing ketosis. Monensin is an ionophore that affects rumen fermentation, resulting in increased propionic acid production with a concurrent decrease in the molar proportion of acetate and butyrate. As a result, monensin has been used to prevent ketosis and calving-related disorders in dairy cattle.

It is hypothesized that dairy cows supplemented with monensin and fed diets containing citrus pulp would experience a decreased incidence of subclinical ketosis. Therefore, the objectives of this study were to determine the effect of a monensin controlled-release capsule applied at dry-off on the proportion of cows with concentrations of milk BHB > 200 µmol/L, and to associate these findings with the concentration of serum BHB at 14 d postpartum in Holstein dairy cows fed diets containing citrus pulp.

Materials and Methods

The study was conducted on a commercial Florida dairy farm with 3000 milking cows, and milk rolling herd average of 23,540 lb(10,700 kg). Lactating cows were housed in a dry-lot system and fed the same total mixed ration three times a day, except postpartum transition cows which received a diet higher in forage NDF. Cows were dried off between 50 to 70 days before expected parturition (BEP) and maintained in a dry lot until 21 days BEP. Close-up dry cows (21 days BEP) were housed in a dry lot with adequate feed bunk space and shade. Twice a day they received a diet containing citrus pulp with a dry matter (DM) content of 54.5%, crude protein (CP) of 17.7%, NEl of 1.69 Mcal/kg DM, acid detergent fiber (ADF) 25.1%, neutral detergent fiber (NDF) 36.2% and a DCAD of -51.7 mEq/kg DM using the equation DCAD (mEq)= (Na + K) – (Cl + S).

During July to August 2001, 300 cows were randomly assigned at dry-off to either a treated or a control group. The treated group (n=150) received orally a capsule of monensin (335 mg/day of monesin for 95 days, CRC Rumensin®, Elanco Animal Health, Guelph, ON, Canada). Control cows (no capsule, n=150) were left untreated and matched by parity. The number of animals per treatment was calculated expecting a reduction in the proportion of cows with concentrations of BHB in milk > 200 µmol/L at 14 days postpartum from 25% to 18% (95% confidence, 80% of power). At 14 days postpartum a composite milk sample was obtained from each experimental cow during the morning milking (7 a.m. to 3 p.m.). In a random sub-sample of 50 cows per group, a blood sample for BHB determination was taken from the coccygeal vein.

Milk samples were tested for BHB using a semiquantitative colorimetric milk ketone body test strip (Ketolac®). A color scale defines 0, 50, 100, 200, 500 and 1000 µmol/L of BHB. Two-hundred µmol/L of BHB is considered a positive reaction (subclinical ketosis). Serum BHB was based on an enzymatic-colorimetric method (Sigma beta- BHA kit # 310 – A, St. Louis, MO).

Serum BHB concentration was analyzed by ANOVA, mixed model. Proportion of cows positive to the milk BHB test was analyzed by logistic regression. Sensitivity, specificity, positive and negative predictive value for milk ketone tests were calculated. A ROC (receiver-operating characteristic) analysis for BHB in serum and ketone levels in milk was conducted. Agreement evaluation (kappa estimator) between BHB in plasma and in milk was also performed. Statistical analysis was conducted using SAS 7.0 and Winepiscope®.

Results

Based on three concentrations of BHB in serum (> 0.8 mmol/L; > 1.0 mmol/L, and > 1.2 mmol/L) three ROC analyses were conducted. The highest area under the curve was at the value of 1.2 mmol/L; however, the highest agreement between milk and serum determinations (kappa estimator = 0.37) occurred at the value of 1.0 mmol/L. Therefore, the value of 1.0 mmol/L was used as the gold standard to classify an animal as positive or negative for subclinical ketosis. The value of milk BHB of 200 µmol/L gave the best combination of sensitivity and specificity to classify an animal as positive or negative (Se=71.4; Sp=83.5). This is in accordance with the recommendations of the commercial test strip used in the present study.

Twenty cows were culled between assignment and 14 d postpartum. Therefore, only 280 cows were tested for BHB in milk. Overall, the incidence of subclinical ketosis based on the milk test was 20.35% (57/280). Based on milk BHB test, 26.6% of control cows (n=139) and 14.5% of treated cows (n=141) were positive for subclinical ketosis. The adjusted effect of treatment was that cows receiving monensin were 0.68 times less likely to give a result of 200µmol/L (OR 95% CI =0.53-0.80) than control cows.

Concentrations of BHB in serum did not differ between groups (0.65 ± 0.07 mmol/L and 0.70 ± 0.07 mmol/L for controls and treated, respectively; P > 0.05). However cows with serum BHB concentration < 1.0 mmol/L were 0.063 times (CI 95% 0.013-0.302) as likely as controls to have a positive result for milk BHB ≥ 200 µmol/L.

Significance

If monensin is approved for use in lactating dairy cattle in the United States, a slow- release capsule in cows fed typical Florida diets will be useful to decrease the incidence of subclinical ketosis in the early postpartum period. In general, there is a valuable association between milk and serum BHB determinations. Consequently, Ketolac® test has the sensitivity to identify cows with subclinical ketosis. Therefore, it is a practical tool for use in a routine monitoring program to detect subclinical ketosis in early postpartum dairy cows.

Evaluation of Three Cow-side Tests for Detection of Subclinical Ketosis in Fresh Cows

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Introduction

Subclinical ketosis in dairy cattle can lead to economic losses through decreased milk production, decreased reproductive performance, increased risk of displaced abomasum and increased risk of clinical ketosis. For early detection of the disease, there is a need for rapid and accurate diagnostic tests.

The objective of the study was to evaluate the performance of three cow-side diagnostic tests for the detection of subclinical ketosis in fresh dairy cows, compared to the gold standard serum ß-hydroxybutyrate (BHBA). The cow-side tests were: (1) a commonly used test strip detecting acetoacetate in urine (Ketostix, Bayer Corporation, Elkhart, Indiana, USA), (2) a commonly used powder test used on milk, also detecting acetoacetate (KetoCheck, Great States Animal Health, St. Joseph, Missouri, USA), and (3) a milk test strip detecting BHBA (KetoTest, Sanwa Kagaku Kenkyusho Co. Ltd., Nagoya, Japan, distributed by Elanco Animal Health/Provel, Guelph, Ontario, Canada).

Materials and Methods

The study was performed in a transition management facility housing dry and just-fresh cows for two large dairies in Wisconsin (total of 2500 milking cows). Serum, milk and urine samples were collected from fresh cows of all parities between two and 15 days in milk. Sensitivity and specificity of the cowside tests were cal-