

Association between rumination behavior, hyperketonemia and milk production in early lactation

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Introduction

Increased blood beta-hydroxybutyrate (BHB), also known as hyperketonemia (HYK), is a common metabolic disorder in dairy cows, that occurs during first and second week postpartum, defined by elevated blood concentration of BHB (≥ 1.2 mmol/L). HYK is associated with impaired health, decreased performance, and decreased milk production. Nonetheless, elevated BHB concentrations in early lactation are not detrimental to all cows. Past studies from our group found that cows with HYK that had high milk production had similar performance (pregnancy rates and herd removal risk) to non-hyperketonemic cows that also had high milk production. Moreover, there are reports showing that rumination time in the first week postpartum and milk production are positively correlated, with animals that have a high rumination time producing more milk. For these reasons, our objective was to evaluate whether rumination behavior modified the association between blood BHB concentration during the first week postpartum and milk yield during the first 3 herd tests.

Materials and methods

In this observational trial, blood BHB was measured in dairy cows ($n = 955$) from 2 commercial farms in Minnesota once between 2 and 8 DIM. Rumination time (RT), used to quantify rumination behavior, was recorded daily using an automated monitoring system (Smartbow, Zoetis Inc.). Cows with blood BHB > 1.2 mmol/L were deemed HYK positive (HYK+), otherwise HYK negative (HYK-). The sum of rumination time was calculated and used in minutes per day then it was used to calculate the individual slope of RT during the first week post calving. Cows were then divided in tertiles blocked by farm and blocked by lactation group, based on their slopes for RT. Information on monthly herd test milk yield (kg/d) were collected from farm software. The association between HYK and milk yield in the first 3 herd tests across RT groups was analyzed using a multivariable mixed linear regression model with the fixed effects of HYK group, RT group, lactation group, herd, total daily activity slope and treatment for ketosis (either before or after we diagnosed) and interactions between HYK group, RT group and Herd test. Cow was included in the models as a random effect, and Tukey adjustment method was used.

Results

The HYK+ cows in the High RT group had the highest adjusted average on milk production at 106.4 lb/d (95% CI: 98.3, 114.5), during the first 3 months when compared with all the other groups. Cows with the highest RT and HYK+ produced 5.25 lb/d more than cows in the same RT group but HYK- in the first test. Comparing cows in the highest RT and HYK+ to cows in the Medium RT and HYK+ during the second test, the former produced 17.6 lb/d. In the second herd test, High RT and HYK- produced 12.2 lb/d compared to the Medium RT and HYK+. Cows that produce the least in the first and second herd test were HYK+ cows in the medium RT group at 72.7 lb/d (95% CI: 64.8, 80.6) and 83.7 lb/d (95% CI: 75.7, 91.7), respectively. In the third herd test, HYK+ cows, regardless of the RT group, had the highest milk production: Low-RT HYK+ (105.3 lb/d; 95% CI: 96.2, 114.4), Medium-RT HYK+ (107.3 lb/d; 95% CI: 99.0, 115.6) and High RT HYK+ (103.7 lb/d; 95% CI: 92.9, 114.4), despite the highest absolute average, it was not finding any statistically significant comparisons. The 3-way interaction between HYK, RT group, and the 3-herd test was significant ($P = 0.02$).

Significance

Results suggest that HYK+ cows in the high RT group produced more milk in the first 2 herd tests. Cows in the lowest and Medium RT group and that was affected by HYK showed to be more affected by the decrease on milk-yield. Among HYK+ cows, those with the highest RT produced more milk overall. The effect of rumination behavior was not observed in the third herd test.

