Monitoring Subclinical Ketosis Using Milk Strip Test and Control Chart in Dairy Herds

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Introduction

Subclinical ketosis (SCK), based on a serum beta-hydroxybutyrate (BHB) concentration ≥1400 µmol/L (14.4 mg/dL), is a metabolic disease that has been associated with reduced milk production and increased risk of other metabolic disorders. Duffield *et al* (2001) have reported a median prevalence of SCK of 41% among 25 dairy herds, and a within-herd prevalence ranging between 8 and 80%. A milk strip cow-side test (Keto-Test, Elanco Animal Health, Guelph, Ontario) has been shown to have a sensitivity of 91% and a specificity of 74% to detect SCK in dairy cows when using a cut-off value of 100 µmol/L of BHB (Osborne *et al*, 2002). Statistical Process Control (SPC) and the use of Control Charts are tools that can be used in order to monitor health status in production medicine programs. Our objectives are to provide an overview of the SPC and Control Charts and to present a practical application of this tool using milk Keto-Test to monitor SCK in dairy herds.

Materials and Methods

The SPC uses frequent sampling to check on the process of interest. The basic concept of Control Charts (CC) is to distinguish between inherent random variation and real changes in measured performance like SCK apparent prevalence. The CC has two axes. The horizontal axis is time and the vertical one is the base of a normal distribution of SCK prevalence. A horizontal line is drawn across the chart representing the target prevalence of SCK. Horizontal lines drawn at the target level plus or minus 3 standard deviations (SD) of the prevalence are called the control limits. Additional lines are drawn at plus or minus 1 and 2 SDs. In our herd example, a single milk sample collection from all cows in the herd was taken once between two and 14 days in milk (DIM) and tested for BHB after collection using the Keto-Test strips. Cows were classified as positive for SCK if the milk strip test changed color to the threshold level greater than or equal to 100 µmol/L. Herd monthly prevalence of positive cows was plotted on the chart over time, and if the SCK prevalence was in control, then the plotted proportion was expected to fall within the control limits and lie on either side of the accepted proportion. In our example, a target monthly prevalence was set at 0.30±0.15. Decision rules to decide if the prevalence was "in control" were applied. The situation needed to be investigated if 1) 1 point was outside of the control upper limit (0.75); 2) 2 of 3 consecutive points lay between +2 and +3 SDs (0.60-0.75); 3) 4 of 5 consecutive points lay between +1 and +2 SDs (0.45-0.60); or 4) 8 consecutive points lay on the same side of the mean (over 0.30).

Results and Conclusions

The use of the SPC and CC will be presented with the monitoring of SCK prevalence in a few dairy herds. When the apparent prevalence of SCK is monitored over time using a control chart, the information can be used as an alarm system in order to determine when to make a change. If any of the 4 statistical criteria identifying higher SCK prevalence are met, the cause of the problem needs to be determined and fixed.