Distribution Characteristics and Sampling Strategy Considerations for Plasma Non-Esterified Fatty Acid (NEFA) Testing in Late-Gestation Dairy Cows

Thomas H. Herdt[1,2] *DVM MS dip. ACVN ACVIM*
Paul C. Bartlett[1] *DVM PhD*
Department of Large Animal Clinical Sciences[1] *and Animal Health Diagnostic Laboratory*[2]
Michigan State University
East Lansing, MI 48824

Prepartum negative energy balance, as estimated by plasma NEFA concentration, is a demonstrated, positive risk factor for postpartum disease in dairy cows.[1,2] Thus, determination of plasma NEFA concentration is potentially valuable for nutritional monitoring and disease risk assessment in late-gestation cows. In a given herd, however, there is considerable within- and among-cow variation in plasma NEFA. This makes herd-level interpretation of plasma NEFA profiles challenging. The objective was to examine statistical distributions of plasma NEFA concentrations in herds selected for diagnostic testing, with the aim of developing better sampling strategies for NEFA evaluation. Cows in the last three weeks of gestation were studied in fifty-three herds of Holsteins. Data were analyzed in reference to both discrete and continuous probability distributions.

For analysis of NEFA values as discrete variables, each cow was classified into positive or negative energy balance, based on plasma NEFA concentration. The distribution among herds of proportions of cows in negative energy balance differed significantly from binomial ($p<.01$), exhibiting a "contagious" probability dispersion. This is evidence that herd-level management factors influence the probability of negative energy balance in late gestation cows on dairy farms. Based on these data, groups of cows in the last three weeks of gestation can be classified based on the probability of negative energy balance. Probabilities of negative energy balance greater than 30 to 40% can be determined with 80% confidence using the following sample sizes (group size, sample size) 6,5; 9,7; 12,8; 15,10; 18,11.

For use of blood NEFA values as continuous variables, data distribution is critical. Within herd, NEFA concentration values were skewed to the left in a non-normal distribution. In addition, variance was non-homogeneous. Logarithmic transformation of the data resulted in a normal distribution. Variance was still significantly heterogeneous after log-transformation, but less severely so than in the non-transformed data. This indicates that comparisons among herds by parametric statistics should be based on log-transformed NEFA values. Analysis of variance using log-transformed NEFA values indicated 45% of total variability ($p<.001$) to be attributable to herd effects, likely related to nutrition and nutritional management.

For clinical evaluation of a herd NEFA concentrations as continuous variables, we suggest using 95% confidence intervals (CI), and comparing them to similar confidence intervals from late-gestation cows in known positive energy balance. Normal distribution is required for accurate calculation of 95% CI; thus, log-transformed NEFA values must be used. When analyzed in this manner, the 95% C.I. of twenty-five of fifty-three herds (47%) submitted for diagnostic NEFA testing were above the CI of twenty cows in known positive energy balance. The reference population was 5 to 11, and the clinical population 2 to 21 days prepartum at sampling.

The minimum number of cows to test for comparison of herd CIs to reference CIs cannot be stated across all herds. This is because the CI is influenced by herd variability, as well as by the number of animals sampled. From a practical standpoint, it appears that seven to ten animals in the last three weeks of gestation should be sampled. If this number of animals is tested, and the CI is greater than 1.5 log NEFA units (natural logarithm), sampling additional animals should be considered.

References

1. Cameron, R.E.B., Dyk, P.B., Herdt, T.H., Kaneene, J.B., Miller, R., Bucholtz, H.F., Liesman, J.S., VandeHaar, M.J., Emery, R.S.: Dry cow diet, management, and energy balance as risk factors for displaced abomasum in high producing dairy herds. *J. Dairy Sci.*, 81:132-139, 1998. 2. Kaneene, J.B., Miller, R.A., Herdt, T.H., Gardiner, J.C.: The association of serum nonesterified fatty acids and cholesterol, management and feeding practices with peripartum disease in dairy cows. *Prevent. Vet. Med.*, 31: 51-58, 1997.