Evaluation of the MISCO Palm Abbe PA-203X digital refractometer for estimation of serum total protein and serum IgG in neonatal calves

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Introduction

Failure to absorb sufficient colostral immunoglobulins (Ig), termed failure of passive transfer (FPT), may predispose neonatal calves to the development of disease and impaired future performance. The gold standard measurement for FPT is laboratory analysis of serum IgG using RID or ELISA. However, this is too expensive to be part of routine on-farm monitoring programs. As such, historically many producers have indirectly estimated FPT rates through the measurement of serum total protein (STP) using optical refractometers. However, a digital refractometer was recently introduced which offers the option of testing using multiple scales including Brix (%), STP (g/dL), serum IgG (g/L) and colostrum IgG (g/L) (MISCO Palm AbbePA-203X. MISCO. Cleveland, OH). The objective of this study was to describe the test characteristics of the MISCO Palm Abbe PA-203X digital refractometer for the measurement of STP and serum IgG. If successful, then either of these scales could be a useful tool for monitoring colostrum management on dairy farms.

Materials and Methods

The study was conducted in summer of 2013 on a commercial Holstein dairy farm in western Wisconsin. Venous blood samples were collected from 223 Holstein calves ranging between 12 and 48 hours of age in an effort to capture a range of biological values. Blood was allowed to clot overnight, centrifuged, and the serum separated. Serum TP was measured in duplicate using the STP scale on the MISCO Palm Abbe PA-203X digital refractometer and an optical hand-held refractometer (reference test) (Reichert Inc. Depew, NY). Serum IgG was measured in duplicate using the serum IgG scale on the MISCO Palm Abbe PA-203X digital refractometer. Serum samples were then frozen and submitted for laboratory analysis of IgG using an RID assay (gold standard test). Instruments were calibrated before each use. Descriptive statistics, scatter plots and ANOVA were used to describe the relationship between the MISCO STP and IgG results and the gold standard tests. Using a STP cutpoint of 5.2 g/dL and a serum IgG cutpoint of 10 g/L, the test characteristics (sensitivity, specificity, accuracy) of the MISCO STP and serum IgG results were described as compared to the gold standard tests.

Results

Serum Total Protein. The mean ±SD STP results as measured by an optical refractometer and the MISCO digital refractometer were 5.77 g/dL ±0.75 and 5.73 g/dL ±0.76, respectively. There was a high correlation in STP results between the two refractometers (r = 0.97). The true and apparent prevalence of FPT based on STP, according to the optical and digital refractometers were 19.3% and 20.6%, respectively. Using the optical refractometer as the reference test, the sensitivity, specificity, and overall accuracy of the MISCO digital refractometer to classify a calf as having FPT with the STP scale was 0.86 (95% CI, 0.76 to 0.96), 0.95 (95% CI, 0.92 to 0.98) and 0.93 (95% CI, 0.90 to 0.97), respectively. There was high overall agreement between these two test methods (Kappa, 0.79; 95% CI, 0.74 to 0.84).

Serum IgG. The mean ±SD serum IgG results as measured by RID and the MISCO digital refractometer were 21.7 g/L ±8.1 and 9.0 g/L ±4.3, respectively. The true and apparent prevalence of FPT based on serum IgG, according to RID analysis and the digital refractometer were 2.7% and 64.6%, respectively. Using RID as the gold standard test, the sensitivity, specificity, and overall accuracy of the MISCO digital refractometer to classify a calf as having FPT with the serum IgG scale was 1.0 (95% CI, 1.0 to 1.0), 0.36 (95% CI, 0.30 to 0.43) and 0.38 (95% CI, 0.32 to 0.45), respectively. There was very poor agreement between these two test methods (Kappa, 0.03; 95% CI, 0.008 to 0.052).

Significance

The MISCO Palm Abbe digital refractometer yielded very similar STP results as compared to an optical refractometer, so either instrument could be used in the field. However, producers should not use the MISCO serum IgG scale as it grossly under predicts serum IgG and grossly over predict FPT rates in dairy calves.