Brix Refractometers for Assessment of Colostrum Quality

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Introduction

Colostrum is the initial secretion from the mammary gland after parturition, and is an important source of immunity and nutrition for the neonate. Arguably, the most important factor influencing future calf health and performance is adequate intake of high quality colostrum, as soon as possible after birth[1]. The failure of passive transfer (FPT) of immunoglobulins (Ig) results in an increased morbidity and mortality of calves, as a result of an increased susceptibility to pathogens and subsequent disease[2]. Many methods have been used to assess the Ig concentration of colostrum. The colostrometer, which measures the specific gravity of colostrum, is the most commonly used on-farm method to assess colostrum quality. Yet, the colostrometer is a fragile instrument, and is not accurate on refrigerated or warm colostrum[3]. The Brix refractometer has been used to assess the colostrum of mares, resulting in a high correlation (R=0.85) between the Brix score and radial immunodiffusion assay (RID) laboratory quantification of Ig[4]. It is clear that improved, validated methods to evaluate bovine colostrum are needed. The objective of this study was to determine the diagnostic test characteristics of both an optical and digital Brix refractometer for assessment of colostrum quality in dairy cattle.

Materials and Methods

An evaluation of the optical (Animal Reproduction Systems; CA, USA) and digital (Atago Co. Ltd; WA, USA) Brix refractometer instruments was performed using colostrum from 288 Holstein dairy cows, from the University of Guelph Elora Dairy Research Centre, the University of Minnesota Transition Management Facility (TMF; Emerald Dairy II, Emerald, WI) and a commercial herd in eastern Ontario. Two samples of colostrum were collected from the first milking for analysis; one used as a fresh sample and one frozen for future analysis. The fresh sample was measured using both optical and digital Brix refractometers shortly after collection. The second sample was frozen at -20 ºC, and then thawed to room temperature for analysis using the both Brix instruments. After measurement, the fresh sample was frozen, and subsequently transported for laboratory quantification of Ig concentration using the RID procedure (Saskatoon Colostrum Company, Saskatoon, Saskatchewan). Optical and digital Brix refractometer scores were plotted against each other for both fresh and frozen colostrum samples. Descriptive statistics were used to compare the refractometer scores for fresh and frozen colostrum samples, as well as comparing both Brix refractometers to the RID. Spearman rank coefficients of correlation were calculated to determine the level of relationship between the instruments. Epidemiological diagnostic test characteristics (sensitivity, specificity and predictive values) were calculated to compare the optical and digital Brix refractometers to the RID gold standard.

Results and Discussion

In total, 273 colostrum samples were assessed for Ig concentrations by the laboratory RID assay. The RID Ig concentrations displayed a normal distribution and ranged from 22.4 g/L to 196.9

g/L. The mean and median of the RID Ig concentrations were 94.4 g/L and 91.8 g/L, respectively. Only 7.7% of samples were below the standard cut off point of 50 g/L for Ig concentration. The Brix scores ranged from 13.5% to 32.0%, and 13.6% to 37.0% for the optical (Figure 1a) and digital Brix refractometers, respectively. The fresh and frozen samples measured using the digital Brix instrument had a mean and median Brix value of 26.3% and 26.4%, and 26.3% and 26.5%, respectively. The correlation coefficient for the optical and digital Brix instruments and the RID (for fresh and frozen colostrum samples) ranged from 0.50 to 0.53 (Figure 1b). Brix scores for fresh and frozen colostrum samples measured by the optical Brix were strongly correlated (R^2= 0.97). Brix scores for fresh and frozen colostrum samples measured by the digital Brix were also highly correlated (R^2= 0.95). When comparing Brix values for fresh, as well as frozen, colostrum samples between the optical and digital Brix refractometer instruments, both were found to have a strong correlation (R^2= 0.96 and R^2= 0.95, respectively). For assessment of the Brix instruments, three different cut-off levels were used for the Brix scores: 18%, 20% and 22%. For the optical Brix measuring fresh samples, the highest values for sensitivity and specificity were found to be at the 22% cut-off level at 90.5% and 85.0%, respectively. A cut-off level of 22% for the digital Brix to measure fresh colostrum samples resulted in a sensitivity and specificity of 92.5% and 80.0%, respectively. There was no evidence of a difference between fresh and frozen samples when using the optical or digital Brix refractometers.

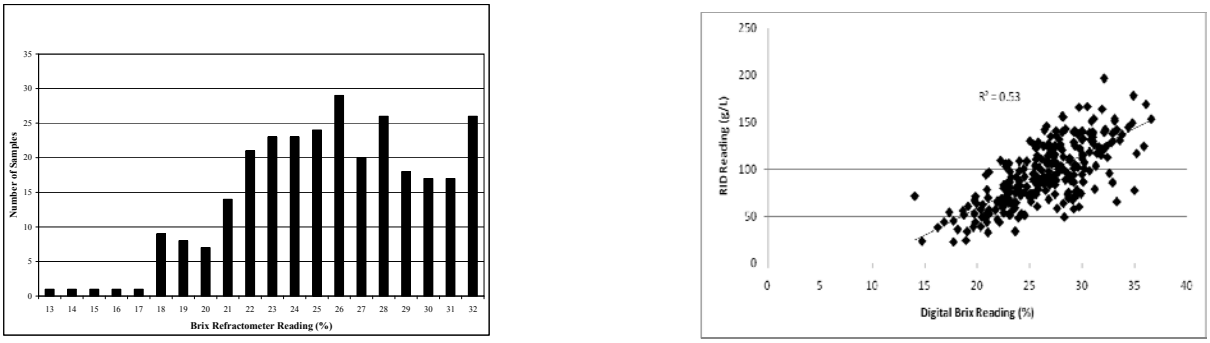

Figure 1. A distribution plot of a) optical Brix refractometer readings (%) for 287 fresh colostrum samples, and b) a scatter plot of RID versus digital Brix refractometer readings for frozen samples (N=273)

References

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