Relationship between Serum Total Protein and Immunoglobulin G Levels in Calves Fed Maternal Colostrum or Commercial Colostrum Replacement Product

Lauren Geiger and Patrick Pithua
Department of Veterinary Medicine and Surgery, University of Missouri, Columbia, MO 65211

INTRODUCTION

The physiology of the bovine placenta prevents the transfer of immunoglobulins from mother to offspring, so the immature immune system of the calf is completely dependent upon the colostrum it receives to prevent disease. Colostrum intake, therefore, is one of the most important factors in calf management. Failure of passive transfer can predispose calves to disease and even increase neonatal mortality risk. Currently, producers measure serum total protein to ascertain if acceptable passive transfer has occurred. Consensus in literature appears to point to a cut off of greater than or equal to 5.0 or 5.2 g/dl serum total protein as a marker of acceptable passive transfer of immunity; however, few studies have been conducted to determine whether serum total protein is an accurate predictor of serum immunoglobulins in vivo.

OBJECTIVES

The purpose of this study is to compare serum immunoglobulin G and serum total protein to determine their correlation for different sources of colostrum and ascertain if a different threshold should be used when establishing passive transfer status.

MATERIALS & METHODS

For this project, 23 calves were fed either maternal colostrum (8 calves), lacteal-derived colostrum (7 calves), or plasma-derived colostrum (8 calves). Serum samples were taken before colostrum ingestion and subsequently at 36 hours and weekly for up to 8 weeks after colostrum. Each sample was examined for serum total protein levels using a refractometer and immunoglobulin G levels using radial immunodiffusion assay kits. Statistical analysis was completed using resulting data. A simple linear regression model was used to determine serum protein levels required to reach 1000 mg/dl serum immunoglobulin G using each colostrum source.

23 calves
- 8 fed maternal colostrum
- 8 fed plasma-derived colostrum replacer
- 7 fed lacteal-derived colostrum replacer

Serum Samples Taken
- Before colostrum
- At 36 hours after colostrum
- Weekly (up to 8 weeks) after colostrum

Serum Samples Examined
- Serum total protein using refractometer
- Serum IgG using radial immunodiffusion assay kits

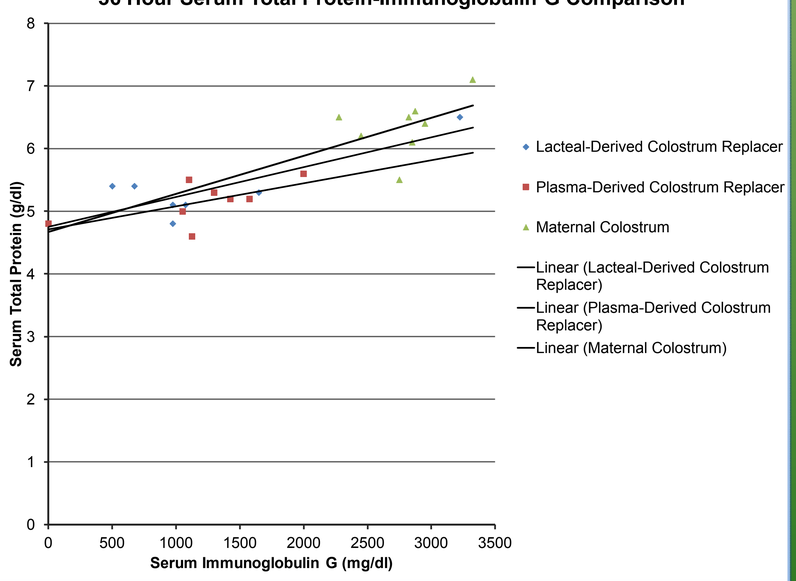
Statistical Analysis
- Simple linear regression model
- Serum TP levels for 1000 mg/dl serum IgG

RESULTS

The mean (± standard deviation) serum total protein levels at 0 hours for plasma-derived colostrum replacer, maternal colostrum, and lacteal-derived colostrum replacer respectively were 4.78±0.46 g/dl, 4.55±0.21 g/dl, and 4.80±0.59 g/dl. At 36 hours, serum total protein levels increased to 5.15±0.34 g/dl, 6.36±0.46 g/dl, and 5.37±0.54 g/dl. The immunoglobulin G levels at 0 hours for plasma-derived colostrum replacer, maternal colostrum, and lacteal-derived colostrum replacer respectively were 9.38±0.51 mg/dl, 21.88±33.91 mg/dl, and 321.43±673.06 mg/dl. At 36 hours, immunoglobulin G levels increased to 1196.88±575.61 mg/dl, 2787.5±317.64 mg/dl, and 1296.43±923.81 mg/dl. To reach the selected threshold of acceptable passive transfer serum immunoglobulin G levels of 1000 mg/dl, it was calculated that serum total protein levels must reach 5.1094 g/dl for plasma-derived colostrum replacer, 5.2703 g/dl for maternal colostrum, and 5.2532 g/dl for lacteal-derived colostrum replacer (derived from graph below).

The aforementioned data is summarized in the table below.

	Plasma-Derived Colostrum Replacer	Maternal Colostrum	Lacteal-Derived Colostrum Replacer
Serum Total Protein (0 hr)	4.775±0.4590	4.55±0.2070	4.8±0.5888
Serum Total Protein (36 hr)	5.15±0.3381	6.3625±0.4596	5.3714±0.5407
IgG (0 hr)	9.375±0.5125	21.875±33.9051	321.4286±673.0572
IgG (36 hr)	1196.875±575.6111	2787.5±317.6364	1296.4286±923.8088



Graph: Regression equation for each colostrum is as follows: Plasma-Derived Colostrum Replacer: y=0.0004x+4.7094; Maternal Colostrum: y=0.0006x+4.6703; Lacteal-Derived Colostrum Replacer: y=0.0005x+4.7532.

CONCLUSIONS

Seeing that the thresholds determined by this study (5.1094 g/dl for plasma-derived colostrum replacer, 5.2703 g/dl for maternal colostrum, and 5.2532 g/dl for lacteal-derived colostrum replacer) are comparable to ranges established by previous research, this study demonstrates there is no need for producers to utilize different cutoffs of serum total protein levels used to determine passive transfer status when using various colostrum replacement products. In agreement with previous research, this study shows the threshold of acceptable passive transfer is approximately 5.0 or 5.2 g/dl with no difference between the type of colostrum replacement product that is fed to calves. There is, however, a different relationship between serum total protein and immunoglobulin G levels resulting from the replacer products. At 36 hours, the measurements of serum total protein and immunoglobulin G in maternal colostrum were significantly different than those of the plasma-derived colostrum replacer (serum total protein P-value=0.000, IgG P-value=0.000) and the lacteal-derived colostrum replacer (serum total protein P-value=0.001, IgG P-value=0.001). There was no difference between the two varieties of colostrum replacer (serum total protein P-value=0.614, IgG P-value=0.951).

One drawback to this study was that there were only 23 calves involved. Divided by 3 treatments, this makes each animal's contribution to the data more substantial and thus a single outlier can pull the average more easily than a larger sample size might have shown.

In conclusion, commercial colostrum replacers can provide viable alternatives to producers looking to avoid using maternal colostrum on the basis of disease prevention, ensured quality/quantity of colostrum, or convenience offered, and producers can continue using their current threshold for acceptable passive transfer, no matter what type of colostrum replacer they invest in.

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Please address correspondence to Dr. Patrick Pithua.
Telephone: 15734894389, E-mail address: pithuap@missouri.edu