

Analytical methods evaluated for assessing passive transfer in calves

THERE are two primary questions about passive transfer of colostrum antibodies to calves: (1) What proportion of antibodies transferred as measured? and (2) How is that best measured in calves?

In addition, another question may be: How many days after calves are fed colostrum can blood antibodies be analyzed and still be a relevant indicator of the calf's antibody status?

For the latter question, I typically cite the German study by Kaske et al. (2006) in which total serum protein (Figure) increased rapidly within 24 hours after administration and stayed at that respective level for seven days. At 14 days, total serum protein had decreased by about 10% from the previous week. Thus, it looks like total serum protein should be representative of the amount of colostrum originally administered to calves for up to seven days of age.

To address the first two questions, a recent study was devised and conducted (Sutter et al., 2020) on two farms in northeastern Germany from August to October 2018. The study used a statistically based sample number of 216 clinically healthy calves between 24 hours and seven days of age. Calves with diarrhea, pneumonia or dehydration were not used in the study.

Whole blood was collected via jugular vein without anticoagulant. Samples were analyzed by a digital handheld Brix optical refractometer for immunoglobulin G (IgG) concentration via capillary electrophoresis (CE) and for IgG concentration by radial immunodiffusion (RID) enzyme-linked immunosorbent assay (ELISA) test.

The paper contains considerable details about how samples were processed and analyzed and data collected with statistical analyses.

Based on RID analyses (considered the gold standard), 59 of 216 calves (27%) had serum IgG concentrations of less than 10 mg/mL, and thus, adequate antibody transfer was deemed a failure. A number less than 10 IgG mg/mL is considered comparable to total serum protein of less than 5 mg/mL. However, those numbers are not sacrosanct, as

Bottom Line

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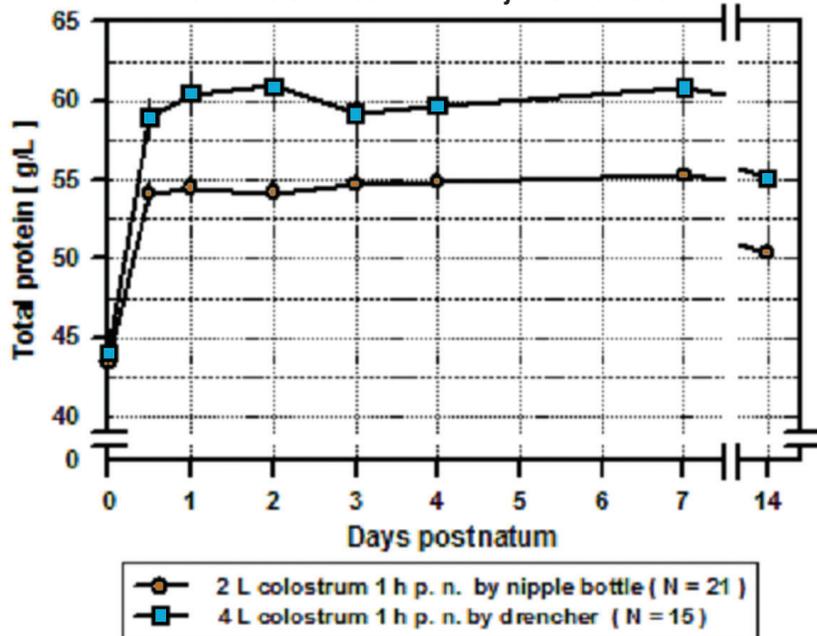
some now prefer that they be at least 15 mg/mL and 5.5 mg/mL, respectively.

In the Dairy Calf & Heifer Assn.'s *Gold Standards* (Second Edition), the targeted immunity level of total serum protein

for calves at two to seven days of age is at least 5.5 mg/mL for 80% of calves and 5.2 mg/mL for 90% of calves. Thus, calves in this database fared very poorly, since only 73% averaged more than 10 mg/mL IgG, which meant that 27% failed to have adequate passive transfer of antibodies from colostrum.

The mean IgG (Table) was quite good at 17.3 mg/mL, but the standard deviation of 9.77 was more than one-half the

Total serum protein over 14 days from calves administered two levels of colostrum and by two methods



Data statistics

Method	Mean ± SD	Minimum	Maximum
Brix refractometer			
Centrifuged serum, %	8.2 ± 0.78	6.6	11.1
Centrifuged plasma, %	9.0 ± 0.81	7.2	11.8
Filtered plasma, %	9.1 ± 0.84	7.3	11.8
Optical refractometer, total protein			
Centrifuged serum, g/dL	5.3 ± 0.64	4.0	7.4
Centrifuged plasma, g/dL	5.9 ± 0.66	4.5	8.0
Filtered plasma, g/dL	5.9 ± 0.68	4.4	8.4
Sandwich ELISA, IgG			
Centrifuged serum, mg/mL	8.6 ± 4.52	0.3	21.5
CE, IgG			
Centrifuged serum, mg/mL	11.0 ± 5.72	1.2	32.9
Radial immunodiffusion-RID, IgG			
Centrifuged serum, mg/mL	17.3 ± 9.77	0.8	47.8

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mean due to a very wide range of 0.8-47.8 mg/mL samples.

The paper contains 10 individual graphs and regression equations. Here are some of the key points:

- Brix refractometer readings are really for total solids. These readings for centrifuged serum, centrifuged plasma and filtered plasma versus RID IgG mg/mL had R-square values of 0.715, 0.645 and 0.604, respectively. This means that 71.5%, 64.5% and 60.4% of variation was accounted for by those regressed relationships of RID to those three blood plasma and filtered value categories.

It would be much better if those relationships were in the 90% range, but that is an indication of how much accuracy is given up by using the Brix refractometer instrument for total protein versus IgG measures. Of course, that instrument is used because it is simple, quick and can be used on the spot on a calf operation. It costs much less than doing IgG in a laboratory. Also, remember that total serum protein is a broader category and really is a proxy for IgG.

- Measured IgG by ELISA and CE regressed versus RID IgG had R-square values of 0.804 and 0.939, respectively. These R-squares are considerably

greater than the range of 0.60-0.71 noted previously for the Brix refractometer. Again, these values are regressing IgG values versus the IgG from the gold standard of RID IgG, while the Brix readings are for total serum protein versus the RID IgG value.

- Total serum protein values regressed versus RID IgG values had R-square values of 0.687, 0.651 and 0.635, respectively, for centrifuged serum, centrifuged plasma and filtered plasma. These values are within the range of Brix refractometer values of 0.604-0.715 noted above.

Not shown are data for the area under the curve used to evaluate failure of passive transfer of antibodies from colostrum into the calves' blood. All categories noted in the Table had area under the curve of 0.90-0.99 with a 95% confidence interval.

That brings us back to the purpose of measuring total serum protein or IgG: How well did feeding colostrum provide minimum serum protein or IgG blood levels to avoid low levels of either and, thus, have failure to transfer adequate levels of antibodies to the calf? This study found all methods to be suitable for that measure.

The Bottom Line

All four methods used in this study (Brix and optical refractometers, ELISA or CE) to assess failure to transfer adequate antibodies from colostrum to a calf's blood provided results that were highly correlated with the gold standard of RID IgG. Thus, any of those methods can be used.

However, on the farm, refractometers are the simplest, quickest and least expensive and can be done on the spot to determine how well the administration of colostrum to a calf has provided antibody protection.

References

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