



Test for success - measuring immune transfer in calves after colostrum feeding gives us insight into herd health opportunities

Calves are a unique species in how they rely on colostrum ingestion to provide immune protection for the first months of life. Are refractometers an accurate way to quickly and easily measure immune transfer in individual calves?

Adequate colostrum ingestion is the single most important determinant of health, survival, performance and therein profitability in calf's life. Passive Transfer is commonly used to describe the phenomenon by which a calf acquires its immunity from the dam via colostrum.

My calves received colostrum. How can I now verify that my calves have enough immunity?

Many producers often question if there are visual ways to determine if a calf fails passive transfer; however, it usually requires pulling a blood sample, centrifuging the sample to collect serum and either directly or indirectly measuring the level of IgG.

The indirect way to measure IgG in the serum is by utilizing an optical or digital refractometer which measures serum total protein (STP). This method is considered a calf side test because the blood can be collected on a particular day, centrifuged, and the serum can be placed on the refractometer with the result being known right then.

Because serum total protein is readily analyzed and available on the farm, many producers have relied on this test to

determine the level of passive transfer in calves. While this has been practiced for many years and it is regarded as a useful tool, the results have frequently been misinterpreted due to limitations of the test.

It is important to understand how a refractometer works and the composition of the serum tested before heavily placing emphasis on data from STP. Believe it or not, refractometers were originally designed for use in the wine, beer and maple syrup industries to measure the amount of sucrose or sugar in water. The refractometer itself, whether it is optical or digital, relies on a light source and prism.

Brix refractometers have been validated for use on farm to indirectly measure IgG content in both colostrum and serum.

In calves specifically fed maternal colostrum, use of serum total protein has proven to be highly correlated to levels of IgG in the calf and also used to identify failure of passive transfer (FTP).

However, the serum total protein test is not meant to determine passive transfer status of individual calves.

The serum total protein testing is not meant to answer questions regarding passive transfer status on individual calves. Rather, the correct way to utilize this test is on a population level and to answer one question: Is my colostrum management program likely working or not working? Godden et al., 2008 best describes this and indicates that results need to be interpreted on a group or herd basis and will accurately reflect the relative proportion of calves with FPT.

How do I accurately perform the test and what do the results mean?

To perform it properly, the serum samples should be collected from at least 12 clinically normal calves (without scours or respiratory disease) between 24 hours and 7 days of age. Godden et al., 2008 also mentions two cutoff methods for determining the proportion of calves with FPT where one goal is for 80% or more of calves tested to meet or exceed 5.5 g/dL or another in that 90% or more of calves be above a cut-off of 5.0 g/dL.

It is recommended then when a disproportionate number of calves have FPT, that an investigation be performed to determine problems with the colostrum management program.

Furthermore, this could involve utilizing the gold standard method for determining true IgG concentration in the serum where radial immunodiffusion (RID) testing be performed.

Can I use a refractometer to test my calves after feeding colostrum replacer products?

If a colostrum replacer is fed, serum total protein testing should not be utilized to determine passive transfer status even on a population level. A recent study conducted by Lopez et al., (2021) looked at the accuracy of the use of serum total proteins for maternal colostrum fed calves and calves fed a colostrum-based colostrum replacer. Serum IgG was inaccurate or poorly correlated with serum IgG when considering calves fed a colostrum-based colostrum replacer

Therefore, because results are widely variable and inaccurate, it is not recommended to utilize serum total proteins when monitoring or determining passive level status in calves fed colostrum replacer. It is recommended instead to perform radial immunodiffusion testing.

Which other factors can affect serum total protein levels and alter the results from testing with a refractometer?

It is also important to consider the composition of serum and some of the limitations of what is being tested in the serum. When it comes to trying to understand passive transfer status based on serum total protein, we must remember the following assumptions:

1. Colostrum solids are about 50% proteins (up to half of which is IgG1).
2. All colostrum proteins are nonselectively absorbed into the bloodstream (not only IgG).
3. Calves that suckle large amounts of colostrum can be identified by measuring serum total protein levels and calves with high total proteins have high IgG1 levels. While this is somewhat correct, it is also important to remember that serum total proteins are taken after colostrum ingestion.

Serum total protein therefore will also be affected by the following:

1. Presuckle levels of serum proteins
2. Amount of protein absorbed (as described in terms of 1). The more colostrum absorbed, the more protein absorbed

3. The higher the level of IgG in colostrum, the higher the serum proteins.
4. Timing of blood collection.

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As to the presuckle levels of serum proteins, some colostrum fed calves have lower total proteins than colostrum deprived calves (Tennant et al AJVR 1969 30: 345) likely due to differences in albumin concentrations which can vary from 1.9-3.4 g/100 ml in day old calves (Schultz et al 1971, 35:93). This is to a large degree why calves serum total protein can read high even before colostrum ingestion.

The figure below outlines the many other proteins in serum. As with measuring the total solids content of colostrum, measuring the total proteins in calf serum assumes that if the serum protein is high that the serum IgG is high and visa versa. However, since the IgG is only one component (and not the major component), changes in the other fractions also affect the total serum protein level. In other words, if for example a calf is born with an initially higher albumin level, the serum total protein may read higher and IgG may not be indicative of the higher protein level.

In summary, it is important to measure immune status of our calves, however the most practical and accurate means of doing this is at the herd level. Rather than getting fixated on one individual calf's result, lets ask ourselves, do I have healthy calves? By looking at immune transfer at the herd level, it can give us insight into the colostrum program and health status of our calves.

Serum Total Protein Tests

DO'S

- ✓ Evaluate a herd status of at least 12 calves
- ✓ Understand category levels
- ✓ Draw samples between 12-36 hours
- ✓ Use it to get a general evaluation of your maternal colostrum program

DON'TS

- × Evaluate individual calves
- × Draw samples after 48 hours or on sick calves
- × Use STP to pay calf premiums
- × Use it to test colostrum replacer program success

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