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Blood Serum Total Protein

What is it?

You may remember from a biology class that blood is made up of red and white blood cells, platelet and plasma. The plasma is the liquid part of blood making up about 55-65% of the total volume of blood. By itself it's straw colored. While plasma is mostly water it does contain many, many other substances. One class of these substances is protein.

Why are we interested in proteins?

There are many different kinds of proteins in the blood plasma or serum. We are interested in one group of the large protein molecules called "globulins."

Immunoglobulins, especially ones we may recognize by the symbol, "IgG," are important for the survival of newborn calves.

IgG is transferred from the bovine dam to calf in the colostrum. One measure of how successful this transfer has been is the presence of IgG in a calf's blood. Unfortunately, direct measurement of IgG by radial immunodiffusion (an accurate method) requires laboratory equipment and is expensive.

Research has been done to discover the relationship between IgG concentration in blood serum and total protein in blood serum (Tyler and others; White). They found that as total protein concentration goes up so does that of IgG. Because we can inexpensively measure serum total protein we can inexpensively estimate the IgG level in the calf's blood. While this way of estimating IgG levels is not

perfect, it can be a workable tool for monitoring newborn management on-farm.

How do we sample it?

Sometime between day two and day seven of the calf's life a blood sample is drawn. We use red top blood collection tubes for collection. If we use the small three-ml tubes two ml of blood is enough. For the larger tubes, about five ml of blood is plenty. Usually, the blood is drawn from the jugular vein in the neck. Some people use a vacuum tube with a double-ended needle because the calves wiggle around so much. Once collected we want to process the sample so that the blood serum ends up on top and the blood solids on the bottom. If a centrifuge is available its use will give consistent and accurate results in only a few minutes. In the absence of a centrifuge gravity will give nearly similar results if the sample is allowed to sit undisturbed for about twenty-four hours (Fowler).

Caution: Calves that are dehydrated even a small amount will not test accurately. That is, their readings will be higher than actual levels. We try to sample blood within one to two hours after the second of two consecutive full fluid feedings. Feeding at 7:00 a.m. and sampling at 3:00 p.m. is likely to result in biased findings.

How do we measure blood serum total protein?

We wanted a procedure for measuring total protein that would require the least in investment. We chose refractometry. We purchased a refractometer in 1998 for around \$300. All of the vet clinics have one in their labs, also. To do the test, a drop of

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serum is placed on the optical surface of the refractometer. A lid is lowered over the sample. The person looks through an eyepiece and reads the value from a scale etched on the lens. The round

optical field is split with dark above and light below at the point on the scale corresponding with the grams of total protein per 100 ml of blood. With practice this determination is quick and accurate enough for on-farm evaluation of passive transfer of antibodies (IgG) from dam to calf via colostrum.

What kind of values should we expect and what do they mean?

Although the refractometer's scale goes from zero to ten, most of our readings should fall between five and six. Five should be the lower limit for acceptable passive transfer. It is equal to about 890 mg/100 ml of IgG in the blood; actually quite low unless the calf had very low exposure to pathogens. Six should mean that the calf had very good passive transfer and is protected against all but very heavy pathogen exposure. Six g/100 ml of total protein is equal to about 1790 mg/100 ml of IgG.

Total protein values alone are only part of the picture; we must always keep in mind that sickness is a balance between immunity and pathogen exposure.

In other words, a calf with a serum protein at 6 g/100 ml will still be susceptible to disease under the poorest of conditions.

Implications for newborn management.

First, assessing the effectiveness of passive transfer of IgG from dams to daughters is one step in evaluating the effectiveness of our colostrum management program. If we check five calves once a month or quarter or year, we have hard facts. If the values are high we can pat ourselves on the back. Low values tell us to start looking for a weak link in the passive transfer chain.

Second, if we have calves with high values that are still getting sick, especially during the first three weeks of life, maybe we need to look into our pathogen management program. How well are we doing in keeping newborns free from adult cow

feces? How consistent are we in keeping clean, dry bedding where dams calve? Where are the newborns housed? How about unnecessary

exposure to adult animals? Ventilation in and around the calving areas? In other words, what unusually high exposure to pathogens may exist for newborns?

Third, what are we going to do if we have a significant number of calves with low total protein values? Until we can fix that problem with changes in our colostrum management program we need to keep some high-risk calves alive. Developing a routine practice for these calves isn't easy and we always need to involve our vet in this process. It is possible to work out a treatment program based on necropsies and lab results that can be applied for several weeks or longer until the farm's colostrum management program can be made more effective.

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