

Passive Transfer of Immunity:

How to test for immunity levels

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Why is passive transfer of immunity important?

Calves are born with a functioning immune system but few immune resources. Think of this like a gun without ammunition. Feeding plenty of clean, antibody-rich colostrum as soon as possible after birth gives a calf a chance to absorb antibodies and maternal immune cells directly into her blood. These provide temporary immunity until the calf develops her own white blood cells and antibodies.

In a recent analysis from a client's preweaned calf enterprise I found that while 75 percent of the calves that died had low immunity [blood serum total protein levels (BSTP) of 4.5 or below], only 5 percent of the dead calves had high immunity levels [BSTP levels above 5.5]!

How can I test for the rate of passive transfer of immunity?

Clinical refractometers have scales for blood serum and urine. A BRIX refractometer will have one scale for the sugar content of an aqueous solution. By using blood serum from a calf on a refractometer we can estimate her blood antibody level. How does this work? A refractometer allows light to go through the sample of blood serum. The optics bend the light rays depending on the concentration of protein in the serum. The greater the protein concentration, the more light is bent. Thus, a high protein sample will have a smaller dark area at the top of the viewing area than a low protein one.

Sampling at the proper time and age for reliability.

- Blood from a fully hydrated calf is a more reliable estimate of total protein than from a partially dehydrated calf. Do not waste your time drawing blood on a scouring calf. Also, delay blood collection on calves that did not drink their most recent feeding. By timing your blood collection about 60 to 90 minutes after a feeding you will get optimum hydration.

- Hydration levels vary quite a lot during 24 hours for calves. If you must collect blood longer than 90 minutes after a feeding, try to do the collection at the same interval after feeding every time. That way, even if your BSTP levels are artificially high (due to partial dehydration), they will be consistently biased the same amount all the time. BSTP values collected from calves after an 8-hour feeding interval may be inflated as much as 0.3 to 0.5 g/dl.
- Wait to draw blood until a full 24 hours after the calf's first colostrum feeding. Blood IgG levels are about 80 percent of maximum at 18 hours. These values peak around 24 hours after the first colostrum feeding. For more details click [HERE](#)
- Draw blood before the calf is more than a week old. Sooner is better than later. Our estimates of immunity are better between 1 and 3 days rather than later. Past 7 days the only values I use are the really low ones below 4.5 g/dl. Values that low predict passive transfer failure reliably even at 7 days.

Collecting the blood sample.

- The jugular vein in the neck is the largest, most accessible source of blood. A tail draw is acceptable – blood is blood.
- After restraining the calf, press your thumb or finger in the groove at the base of the neck. This stops the flow of blood in the vein and creates pressure. By sliding your finger down the neck several times you can pump more blood into the vein. That makes it stand out better.
- Use a redtop vacuum tube with a double-ended blood needle to draw the blood. Alternatively, if you prefer, use a 12 cc syringe with a #18 or #20 one-inch needle and transfer the blood to a vacuum tube. I always use a new needle on every calf.

Handling the blood sample carefully.

- Avoid breaking the red blood cells in the sample. We do not want the protein from the red blood cells contaminating the serum. Once collected, protect the vacuum tubes from undue rough handling. When collecting more than one sample I often put them into a milk replacer cup. Alternatively, I go in the trash, find a plastic bottle (soft drink or IV fluids) and cut it off. A paper towel or bedding stuffed into this container will keep the tubes from knocking around.
- Avoid extreme temperatures. Do not freeze samples. Do not store them on the dashboard of the pickup in hot summer sun. Refrigeration is not required if normal room temperature conditions are available.

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Separating serum from red blood cells.

- Ten minutes in a standard laboratory centrifuge is a common procedure. Just set the timer and walk away.
- Excessively short centrifuge time can result in unreliable results. Never judge the centrifuge time on the visual appearance of the samples. Even one minute in the centrifuge results in samples that may “look okay” but the separation is far from complete.
- If a centrifuge is not available, let the samples sit at room temperature (i.e., 60-75°) undisturbed for about 24 hours. The serum separation is nearly as complete as a 10-minute centrifuge sample – a comparison of readings using serum separated by using a centrifuge and simple gravity showed 95% agreement (Wallace, M. M. and Others, “A comparison of serum harvesting methods and types of refractometers for determining total solids to estimate failure of passive transfer in calves.” Canadian Veterinary Journal, 47:573-575, 2006).

Using the refractometer.

- The optic surface should always be clean and dry.
- Handling the vacuum tube gently to retain the full separation of serum and red blood cells, carefully remove the stopper and draw up to 0.5 ml of serum in a clean syringe. Extend the needle tip only into the serum; avoid approaching the blood cell mass at the bottom of the tube.
- With the lid in the raised position, squeeze enough serum onto the optic surface to cover about one-half of it. Lower the lid. This should result in at least one-half of the optic surface showing liquid between it and the lid.
- For a clinical refractometer read the value using the 10-0 scale. The line that separates the dark section from the light indicates the BSTP value. Most samples will fall between 4.0 and 6.0. For a Brix refractometer most of the values will fall between 6 and 10.
- Regularly calibrate the refractometer. Using distilled water add enough water to the clean optic surface so that the water covers at least one-half of the surface with the lid down. Reading on the urine scale (on right side) look to see if the value is 0.0. For a Brix refractometer distilled water should give a zero reading. If

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the reading is not zero, check the instructions with the refractometer for the procedure to recalibrate. Usually this involves turning a screw. Recheck and adjust until you get a 0.0 reading.

What do the values mean for a clinical refractometer?

- Higher than 6. This may mean that the calf absorbed an unusually large volume of antibodies and is well protected against most infections. Or, it may mean the calf was partially dehydrated when the blood sample was taken. It is good to check on these calves just in case it is a matter of undetected scours.
- Between 5.5 and 6. These calves are well protected against infections unless they have experienced a heavy pathogen exposure. That exposure could take place in the calving area, from contaminated colostrum, unsanitary housing or bacteria in their milk or milk replacer coming from pails, whisk, holding tank, or improper refrigeration.
- Between 5.0 and 5.4. These calves are moderately protected against infections when they have experienced only an average pathogen exposure.
- Between 4.5 and 4.9. These calves have minimal protection against infections. They are vulnerable to having been in the calving area too long. Usually, unclean colostrum will make them sick; sometimes even kill them during the first week of life.
- Below 4.5. Very high risk calves. In most calf enterprises, the bulk of the preweaned calves that die come from this group. Some will die during the first 10 days due to enterotoxemia (go off feed, fluid in gut, then go down, die within 8 to 16 hours, swollen abdomen). Others will have persistent scours between 10 and 21 days. Many will have to be treated with antibiotics for respiratory illness. Some respiratory cases will go chronic. Growth rates are poor.

What do the values mean for a Brix refractometer?

- The value of 8.3 has been established as equal to 5.0 on the clinical refractometer.

What BSTP goals should a farm have?

- On the average, I recommend that 90 percent of the BSTP values are above 5.0 and 80 percent of the values be above 5.5.

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- On the average, higher is always better. Nevertheless, given genetic variation in the ability of calves to absorb antibodies, we are never going to eliminate low values one hundred percent of the time. Cost has to be included in the equation since our time to manage colostrum collection, handling, and feeding is neither free nor unlimited.
- The best goal is to improve. Determine the current situation. Set a goal to have an achievable percentage improvement for the coming month, quarter or year. For example, the current percentages are 10 percent above 5.5 and 40 percent above 5.0. For the next quarter, the goal could be 20 percent above 5.5 and 60 percent above 5.0 – that sounds like a “can do” situation.

What do BSTP values mean for newborn management?

- The first step in evaluating a colostrum management program is to assess the effectiveness of passive transfer. I recommend checking 10 to 12 calves at least twice a year. That will give us hard facts. Pat everyone on the back and serve pizza if the values are high. Keep up the good work. If the values are low, serve pizza and talk over how to jump-start the colostrum management program.
- However, what if we have young calves with high BSTP values that are still getting sick? That means we need to look at our overall pathogen control management. Do we have clean, dry bedding in the calving areas? Are the calves removed from the dams early enough to prevent calves from getting manure meals as they search for something to eat? Is there any unnecessary exposure to adult animals, especially adult manure?

What about ventilation in and around the calving areas? Is there seasonal variation in how we manage calving (for example, overstocking calving areas, frequency of bedding, promptness in removing calves from calving area)? In sum, do the newborn calves have any unusually high exposure to pathogens?

- Do we have a supportive therapy protocol for extremely low BSTP (less than 4.5) calves? If we have many low BSTP calves we may need a stopgap protocol for them. Working with the farm’s veterinarian, it is possible to make some educated guesses about the pathogens involved in deaths and severe illnesses. It may involve necropsies and some laboratory work. Then, it is just a matter of patient, persistent work to find the right antibiotics, right dose, and right duration that effectively reduce death and sickness rates. Careful record keeping is an essential part of this process, as well.

Related Resources:

At www.calfnotes.com find Calf Note #39: Using a Refractometer and Calf Note #62: Calf Age, Total Protein and FPT in Calves. Also at this same site, click on Calving Ease for the May 1999 issue entitled, “Blood Serum Total Protein.”