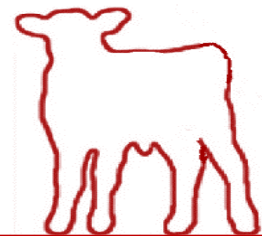




Extension

UNIVERSITY OF WISCONSIN-MADISON



## Feeding the Newborn Calf

Feeding high-quality colostrum to the calf as soon as possible after birth is the most important thing you can do for calf health. It is especially important for dairy and beef x dairy calves destined to leave the farm at a young age to receive colostrum. Calves are born with an immature immune system which means they have little defense or immunity against disease. Unlike key nutrients, the placenta does not allow the transfer of the dam's immune cells to the unborn calf<sup>1</sup>. However, the dam transfers them to colostrum, which she begins to make five weeks prior to calving<sup>2</sup>. The timely ingestion of adequate amounts of high-quality colostrum allow the calf to acquire passive immunity from the dam. Passive immunity helps the calf to fight disease during the first four months of life as their immature immune system is developing<sup>3</sup>.

### Factors affecting passive transfer

Passive transfer occurs when immunoglobulin (IgG), immune cells (white blood cells) and hormones are absorbed through the lining of the calf's gut from the mother's colostrum<sup>4</sup>. After a calf is born, oral stimulation starts the passive transfer clock. To maximize passive transfer, the calf should be fed colostrum within the first four hours of life. After six hours there is a progressive decline in the efficiency of absorption<sup>5</sup>. The passive transfer process ends 24 hours after birth<sup>3</sup>.

It is important that newborn calves are born in clean, dry environments so they do not ingest manure or other materials from the calving process and as they learn to stand. Remember, whatever is ingested first starts the passive transfer clock. It is not desirable to have fecal bacteria absorbed first. The passive transfer process allows any large molecule to pass from the gut into the blood stream of the calf. Bacteria may also bind IgG in the gut preventing transfer into the bloodstream<sup>6, 7</sup>.

It is also important to minimize bacterial contamination in colostrum. Contaminated colostrum is one of the earliest potential exposures to infectious agents, such as *Salmonella*, *Mycoplasma*, fecal coliforms, and the

organism that causes Johne's disease<sup>8, 9, 10</sup>. These infectious agents are known to cause diarrhea and septicemia.

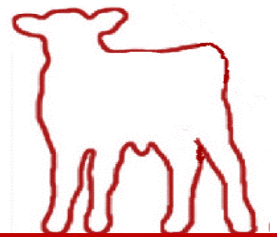
### Factors affecting colostrum quality

It is recommended that fresh colostrum contain less than 100,000 colony forming units per milliliter (cfu/mL) total bacteria count and fewer than 10,000 cfu/mL total coliform count<sup>11</sup>. There are three main sources of bacterial contamination of colostrum: infection or fecal contamination on the udder; contamination during collection, storage, or while feeding from dirty equipment; and bacterial proliferation in stored colostrum<sup>2</sup>. Collect colostrum from udders that have been prepared just like milk was going into the bulk tank for human consumption; use clean, sanitized equipment. Feed immediately, refrigerate, or freeze it in small batches.

Colostrum quality varies dramatically among cows. Several factors including dam vaccination<sup>12</sup>, length of the dry period<sup>13</sup>, and the time of colostrum collection can be managed by producers.<sup>2</sup> Colostrum should be collected within three hours of giving birth to minimize dilution of IgG by milk production<sup>14</sup>. It is not recommended to feed colostrum that is of low quality, or bloody, or from cows with mastitis, or positive with Johne's disease<sup>15</sup>.

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A tool to help reduce colostrum bacterial counts is pasteurization. In this process, colostrum is heated to 140°F for 60 minutes. Pasteurization is recommended even though the process destroys 80 - 90 percent of the colostrum's white blood cells. Heating at this low temperature for an hour maintains immunoglobulin activity and colostrum fluid characteristics, while reducing important pathogens including *E.coli*, *Salmonella*, *Mycoplasma*, and the Johne's disease pathogen<sup>16, 17</sup>.

### Measuring colostrum quality

Good quality colostrum should have an IgG concentration above 50 grams/Liter (g/L)<sup>11</sup>. Although colostrum's IgG measurement does not indicate the white blood cells and hormones that are also included, it is an excellent indicator of colostrum quality. Moderate quality colostrum has an IgG concentration between 20 and 50 g/L and poor quality colostrum has an IgG concentration less than 20 g/L. Producers should measure the quality of the colostrum prior to feeding by measuring it on-farm using either a Colostrometer™, a Brix refractometer, or a cow-side immunoassay kit.

The Colostrometer™ is a low-cost method of differentiating high from low quality colostrum. It measures specific gravity and uses a color-coded scale to indicate quality. Unfortunately, colostrum components other than IgG can affect specific gravity, which can give inaccurate readings. Colostrum measured in the green area of the Colostrometer™ is ranked as okay to feed.

To use the Colostrometer™, the colostrum must first be at room temperature (72°F). At lower temperatures, the Colostrometer™ overestimates the IgG concentration; IgG is underestimated at higher temperatures<sup>18</sup>. To read the measurement, float the Colostrometer™ in the cylinder filled with room temperature colostrum, wait for

approximately one minute, and determine green (good), yellow (okay), or red (bad) measurement.

The Brix Refractometer is designed to measure the amount of soluble solids in a sample, meaning it measures all the solids dissolved in the water, beginning with sugar, salts, protein, acids, etc. It is not dependent on the temperature of the colostrum. A Brix value of 22% corresponds to 50 g/L of IgG<sup>18,19</sup>. Therefore, a colostrum sample with a value of 22% or greater on a Brix refractometer represents a good quality sample.

To use a portable Brix refractometer (Image 1), place a few drops of colostrum on the prism and cover the sample. The refractometer is then held up to a light source. The Brix value is read at the line between the light and dark areas that appear on the scale. The prism and sample cover must be thoroughly cleaned after each use. To use an electronic Brix refractometer (Image 2) place the manufacturer specified amount into the designated spot on the refractometer. The electronic Brix Refractometer will display the colostrum value. The manufacturer should provide instructions on checking and adjusting the calibration. Distilled water should have a reading of zero if the instrument is calibrated correctly<sup>18</sup>.



Image 1: Portable Brix refractometer. Photo courtesy of Matthew Lippert, Division of Extension.



*Image 2: Electronic Brix Refractometer. Photo courtesy of Matthew Lippert, Division of Extension.*

Colostrum quality may also be measured using an immunoassay test such as the Colostrum Bovine IgG Quick Test Kit™. This is a cow-side immunoassay kit that differentiates high- from low-quality colostrum<sup>20</sup>. The test yields only a positive or negative result, but does not provide an estimate of the actual IgG concentration. Each sample takes about 20 minutes to complete.

#### How much does the calf need?

To achieve passive transfer, a 90-pound calf should be fed a minimum of 100 g of IgG in the first feeding of colostrum. However, because producers frequently do not know the concentration of IgG in the colostrum being fed, it is currently recommended calves be fed 10% to 12% of their body weight in colostrum at first feeding<sup>2</sup>. This means the calf should be fed three to four quarts of colostrum at birth and an additional two quarts by 12 hours after birth. Research has shown calves fed four quarts of colostrum at birth and two quarts 12 hours later have higher blood serum IgG levels at 24 hours of life<sup>21</sup>. The calf should be hand-fed a known volume of colostrum using either a nipple bottle or an esophageal feeder to guarantee enough colostrum is consumed<sup>11</sup>.

Feeding high quality maternal colostrum is the best, and should be the first option. If the colostrum from the dam is not of adequate quality, then either feed acceptable colostrum collected or stored from another animal, or add a colostrum supplement. A colostrum supplement is designed to be fed with the maternal colostrum because it does not provide the desired 50 g/L IgG when fed alone<sup>2</sup>.

Colostrum replacer may be fed when good quality colostrum is not available. A good quality colostrum replacer contains at least 50 g/L IgG extracted from cow's milk and provides fat, protein, vitamins, and minerals like colostrum would<sup>22</sup>. Serum-based colostrum replacers are also available that contain IgG harvested from bovine blood but they do not contain intact white blood cells or hormones. It is important to keep in mind that colostrum replacers are designed to be fed in place of colostrum, while colostrum supplements are to be fed in addition to maternal colostrum. Although colostrum replacers are designed to replace colostrum there have been mixed results, with many products failing to routinely provide the necessary 10 milligram/milliliter (mg/mL) IgG in blood serum of calves<sup>22, 23, 25, 26</sup>.

If you have extra good quality colostrum (> 50g/L) it can be saved for use when you do not have good quality colostrum readily available. To store colostrum, immediately divide it into portions less than two quarts in size to enhance cooling and reduce bacterial growth. Immediately refrigerate these portions if they will be used within five days. Adding potassium ascorbate as a preservative enhances refrigerator shelf life<sup>27</sup>. Colostrum can also be frozen for future needs. Frozen colostrum can last up to one year when frozen in a chest or deep freezer. Freezing in a refrigerator freezer is not advised due to the freeze/thaw cycles. Slowly thaw frozen colostrum in a warm water bath prior



to feeding, do not microwave or rapidly thaw. Rapidly thawing, can destroy some of the IgG content. Freezing kills all white blood cells found in colostrum<sup>2</sup>. Therefore, always feed some fresh or refrigerated colostrum along with the colostrum that was frozen.

### Measure calves for passive transfer failure

It is important to routinely check your pre-weaned calves including your beef x dairy calves for failure of passive transfer. Calves that experience failure of passive transfer are more likely to become sick or die in the first two months of life as compared to calves with adequate immunity<sup>27</sup>. Failure of passive transfer occurs when the calf does not absorb an adequate amount of antibodies from the colostrum. In the United States mortality rates in pre-weaned dairy heifers are estimated to range from 8% to 11%<sup>28</sup>. This can happen for many reasons including not feeding high quality colostrum (IgG > 50 g/L), not feeding an adequate amount of colostrum, and not feeding colostrum in a timely fashion.

### Summary

Feeding sufficient amounts of high-quality colostrum to calves at a young age is the single most important management factor in determining health and survival of the neonatal calf<sup>29</sup>. It is vitally important for those calves (market dairy bulls and heifers, and beef x dairy calves) leaving the farm. These market calves will encounter increased pathogen levels during transport, at the market, and when grouped in their next feeding facility. Share your farm's passive transfer protocol and TP history with the next buyer of your calves. Doing so will build buyer trust in your market calves.

The major factor affecting the absorption of IgG molecules is how quickly after birth the calf was fed colostrum. A calf is considered to have failure of passive transfer if its blood serum IgG levels are less than 10 mg/mL. Sampling of blood serum IgG levels should occur between 24 and 48 hours of life<sup>3</sup>.

An indirect measurement of serum IgG is performed by measuring serum total protein (TP) in calves that are 24 hours to seven days old. Producers should work with their veterinarian to develop a plan for measuring TP. This plan should include drawing blood from 12 clinically normal calves and testing the serum with a refractometer. Interpret the results at the group level. The goal is for 80% of those calves tested to have a TP greater or equal to 5.5 grams/deciliter (g/dL). Researchers are finding that higher TP levels (>6 g/dL) are better<sup>19</sup>. However, TP > 7.5 g/dL in calves less than one week of age indicates an inflammatory immune response; >8 g/dL indicates dehydration.

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