

Calf 101 – An Introduction to Calf Nutrition and Management

Transcript Unit 01, Section 3

40. Welcome back to Unit 1, Colostrum Feeding and Management. This is Section 3 on feeding colostrum. In this section, we'll cover IgG, absorption, timing, feeding amounts and methods, and feeding after day one. Let's begin.
41. We'll start with the importance of immunoglobulins in newborn calves. All newborn ungulates—cattle, horses, swine, sheep, and goats—are born without immunoglobulins in their bloodstream. This differs from species like humans, cats, and dogs, where antibodies cross the placenta before birth. In calves, that transfer does not occur, so they must consume colostrum to obtain immunity and protect against environmental pathogens.
42. The intestine of the newborn has a unique, temporary ability to absorb immunoglobulins and other large proteins without digestion. After this period, the animal can no longer absorb intact macromolecules—this is called closure. The timing varies by species and conditions such as birth stress and feeding time, but generally occurs around 24 hours in calves and up to about 72 hours in piglets.
43. The graph shows a hypothetical model of IgG absorption. Early in life, absorption efficiency is high—around 50%—and declines over time to near zero by about 24 hours. This process, called apparent efficiency of absorption, or AEA, reflects the calf's ability to absorb IgG. The exact shape of the curve varies and is not fully defined, but the overall decline is consistent.
44. Most researchers describe the AEA curve as a decay—often exponential or polynomial. However, data are limited, and much of the variation among calves remains unexplained.
45. Some studies suggest a rapid decline after an initial slower phase, similar to a logistic curve. For example, one study reported a gradual decline to about 12 hours, followed by a sharp drop. The key point is that although closure occurs around 24 hours, the exact pattern of decline remains something of a “black box.”
46. Why isn't AEA ever 100%? Because we measure IgG in the bloodstream, but some absorbed IgG moves into extravascular pools—fluids outside circulation. These pools are larger than blood volume. The ratio of extravascular to vascular volume is about 1.3 to 1. So, if 100 grams of IgG are absorbed, about 56 grams move into extravascular space and about 44 remain in circulation. In addition, some IgG is lost to digestion. Together, these factors prevent AEA from reaching 100%.
47. It's important to remember that serum IgG is just a snapshot. IgG absorption and redistribution are dynamic, so a single sample at 24 hours does not tell the whole story. Many factors influence both absorption and movement into extravascular pools that are not captured in that measurement.
48. Now let's look at how IgG is absorbed. Colostrum contains fat, lactose, immunoglobulins, and other proteins. In the intestine, cells absorb these components through a process called pinocytosis. First, the cell membrane forms a vacuole that engulfs material from the intestinal lumen. This vacuole contains a mix of components—fat, lactose, IgG, other proteins, and even bacteria. The vacuole then moves across the cell. Early in life, there are few digestive vacuoles, so less breakdown occurs. As the calf ages, more digestive activity develops. In the final step, most proteins and bacteria are digested, but IgG is protected within the vacuole.

The contents are then released into the lymph and ultimately the bloodstream. This process is nonspecific—many substances are taken up, not just IgG.

49. Here is a YouTube video that describes this process in a slightly different way. **{Video}**
50. A critical practical question is when to feed colostrum. Timing strongly affects disease risk and survival. In one study, calves fed colostrum before exposure to *E. coli* had no illness or mortality. Calves exposed to *E. coli* before feeding had morbidity and mortality rates approaching 75%, even though they received the same colostrum afterward. The conclusion is clear: colostrum must be fed before pathogen exposure. What enters the intestine first matters greatly for calf health.
51. Let's consider how much colostrum to feed. In this example, a calf receives 2 liters at 2 hours and 2 liters at 12 hours, with colostrum containing 50 grams of IgG per liter. Using AEA estimates, absorption is about 45% for the first feeding and 10% for the second. Using plasma volume—about 9% of body weight—we can estimate serum IgG concentration. For a 45 kg calf, this results in about 13.6 g/L at 24 hours, above the traditional target of 10 g/L.
52. In another example, feeding 4 liters at 2 hours results in serum IgG above 22 g/L, providing greater protection.
53. If the same 4 liters are fed later—at 8 hours—serum IgG drops to about 10 g/L, roughly half of what early feeding would achieve.
54. If colostrum quality is poor—25 g/L instead of 50 g/L—serum IgG falls to about 6.8 g/L, well below the target. **{Breakout}**
55. In 2020, experts updated recommendations based on calf health data. While 10 g/L is adequate for reducing mortality, higher levels are needed to reduce morbidity. The new herd-level targets recommend: 40% of calves above 25 g/L, 30% between 18–24.9 g/L, 20% between 10–17.9 g/L, and fewer than 10% below 10 g/L. This requires regular sampling and good record keeping.
56. To reach higher IgG levels, we can feed more IgG or improve AEA. Since AEA is difficult to control, most recommendations focus on feeding more colostrum—often 4 liters at first feeding, with a second feeding at 8–12 hours. However, large volumes may cause digestive issues, especially in small calves, and improper use of feeders can cause injury. So simply feeding more is not always the best solution.
57. A new tool at CalfNotes.com allows users to model serum IgG based on feeding strategies. It uses a Monte Carlo simulation to predict outcomes under different conditions. The tool is free and available at tools.calfnotes.com.
58. Let's pause for discussion. These new recommendations shift focus from individual calves to herd-level outcomes. This requires better data collection and management. Are producers in your area collecting enough good data—and using it effectively—to evaluate their colostrum programs? **{Discussion}**
59. After gut closure, IgG can no longer be absorbed into the bloodstream, but it still plays an important role in the intestine. IgG can bind pathogens and help train the immune system. Because IgG resists digestion, feeding colostrum or transition milk after closure can still provide local intestinal immunity.

60. In one study, calves fed transition milk after gut closure showed reduced health problems—particularly nasal, eye, and ear infections—by about 50%. There was no significant effect on fecal scores or coughing.
61. In another study, calves fed colostrum mixed with milk for the first 14 days showed improved health, including reduced fever, depression, and pneumonia, along with improved growth and feed efficiency. This demonstrates that colostrum components remain beneficial beyond the first day.
62. Let's reflect. Feeding high-quality colostrum early is essential for achieving strong circulating IgG. Continued feeding provides additional benefits. Monitoring serum IgG helps evaluate program success. Are producers using tools like Brix refractometers effectively, and are they acting on the data they collect?
63. To summarize: feed high-quality colostrum as soon as possible after birth. Aim for herd-level targets where at least 40% of calves exceed 25 g/L IgG. Achieving this requires active management of the colostrum program.