



Trouble Shooting Colostrum Management with the Colostrum Calculator Excel Spreadsheet

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Topics include:

Apparent efficiency of absorption
Using AEA for comparisons
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Determining how much colostrum to feed

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If you have recently dealt with a calf health crisis or continually have to pay an extra fee to your grower for calves with low blood proteins, you have probably already looked at how you harvest, store, and feed colostrum. Colostrum is the cornerstone of calf health, and we've developed a tool to help you conduct a detailed evaluation of this critical feed and some of the factors affecting calf health.

The tool is an Excel spreadsheet that automates the calculations of apparent efficiency of absorption (AEA), blood IgG levels, and the amount of colostrum needed by calves. It is designed to allow you to experiment with and investigate factors related to IgG absorption.

APPARENT EFFICIENCY OF ABSORPTION

The first part of the spreadsheet calculates apparent efficiency of absorption or AEA for IgG. This value indicates how much of the IgG fed actually makes it into the calf's bloodstream. Take note, this value rarely exceeds 35%, even when we do absolutely everything right. The AEA can be used in several ways.

If AEA is low (remember, we are comparing it to a maximum of about 35%) it points at a couple of potential problems. Colostrum feeding may have been delayed. The ability to absorb IgG declines quickly after birth; by 6 hours, most calves can absorb only about half of what they could absorb within the first hour.

Colostrum may be loaded with bacteria that are interfering with absorption. Some research suggests that bacteria in colostrum can reduce IgG absorption; however, at least one study found no effect on IgG of feeding high levels of bacteria in colostrum.

Another possible reason for low AEA is feeding large amounts of IgG at one time,

such as colostrum that contains very high levels of IgG, adding colostrum supplement to good quality colostrum, or offering a single feeding of 4 quarts or more. When a lot of IgG is made available to the intestinal cells at one time, it is possible to overwhelm their ability to absorb IgG. Therefore, the efficiency of absorption may be reduced. This can sometimes result in calves with low blood IgG values. If calves are otherwise healthy, have a clean, dry environment, and are raised on the home farm, this scenario is often not detrimental. However, if low AEA results in low blood protein levels and you are sending calves to a custom grower, you may have a problem. Entrance criteria for calves going to a custom facility are often necessary and will set the best growers apart from the rest. If your colostrum feeding protocols cause calves to fail entrance tests and generate an additional fee, you might want to consider changing colostrum protocols.

USING AEA FOR COMPARISONS

Another use of AEA is to compare management practices or colostrum sources. If one of the issues above is suspected, you can take steps to correct the problem, then measure AEA again to see if the changes helped. Colostrum

supplements and replacers can also be compared on their AEA. When choosing one of these products, you want to maximize the amount of IgG absorbed by calves and get the most "bang for your buck;" AEA can help you make the decision.

Ingredients used as the source of IgG cause the AEA of supplement and replacer products to vary. Those based on bovine serum contain high levels of IgG and have AEA similar to maternal colostrum (25 to 35%). Products based on colostrum or whey have variable IgG contents and absorption efficiencies ranging from 5 to 30%. Egg-based supplements to date are not well-absorbed, but may provide local protection in the intestine against scour-causing bacteria. In effect, their potential benefits are different from colostrum.

The following pieces of information are needed to calculate AEA using the Colostrum Calculator spreadsheet: total amount of colostrum fed, colostrum IgG content, calf body weight, and calf blood IgG (plasma is preferred, but serum values can be substituted). From this information the spreadsheet will calculate the grams of IgG fed, the grams of IgG in the calf's blood, and the resulting AEA percentage.

Some example calculations from this section of the spreadsheet are provided in Table 1. Notice that lower quality colostrum fed to calves 2 and 3 resulted in greater AEA, but both of these calves experienced failure of passive transfer (blood IgG less

than 10 g/L). It is important to consider AEA a piece of the puzzle, not to evaluate it alone, because the end goal is not to increase AEA, but to increase blood IgG. Calves 2 and 3 were likely fed soon after birth; the strategy for improving passive transfer in these calves would be to get more IgG into them by feeding higher quality colostrum or more colostrum.

Calf 1 had an AEA less than 20%, but achieved adequate passive transfer. Colostrum management is likely not limiting her health. Compare this to Calf 4, where excellent colostrum was fed, and passive transfer was successful, but the AEA was very low. We would expect this calf to have a blood IgG in the mid-20s if AEA was normal (approaching 25%). If colostrum quality slips to 80 g/L, this same calf would have a blood IgG of about 9.5 g/L. Let quality slide a little further to 50 g/L, which is still good quality colostrum, and we're looking at blood IgG of only 6 g/L. This is an example of AEA interfering with passive transfer, and we would want to investigate the cause of this low efficiency, starting with some of the factors described above.

Table 1. Apparent Efficiency of Absorption (AEA) Calculator from the Colostrum Calculator spreadsheet.

Calf	INPUT				OUTPUT
	Colostrum		Calf body wt	Blood IgG	AEA
	Total qt fed	IgG, g/L	lb	g/L	%
1	4	50	90	10.0	19.4
2	6	20	100	7.3	26.2
3	4	30	90	9.3	30.1
4	4	100	90	12.0	11.7

FACTORS AFFECTING IgG ABSORPTION

The next section of the spreadsheet allows you to experiment with the factors that affect IgG absorption. This can be used to evaluate your current protocols or to investigate options for changing those protocols. The result of this sheet is an expected level of IgG in the calf's blood.

This value can be compared to actual blood IgG to provide an evaluation of how well what *should* be happening matches what *is* happening. This may help you to identify weak links where protocols are not being followed.

The spreadsheet allows information to be entered separately for the first and second feedings. If you want to evaluate your calves using the AEA calculated above, enter the values for total colostrum fed under either feeding and leave the other section blank. The use of a single feeding versus two feedings can be compared in this section, but you will most likely not have known AEA values for each feeding. If you want to evaluate the option of one or two feedings, be sure to enter a lower AEA estimate for the second feeding. Calves will be older at this time, and AEA will not be as high.

Other changes in feeding practices can be simulated with this section as well. You can change the volume fed, the IgG content of colostrum, and calf body weight and see the impact each of these has on final blood IgG values.

Examples of these calculations are shown in Table 2. In these examples, Calves 1 and 2 were fed the same amount of colostrum containing 50 g/L of IgG, but Calf 1 received two feedings and Calf 2 was fed only once. In this case, the larger

volume of colostrum reduced AEA a bit, and Calf 2 had an IgG value of 10.3 compared to 12.9 g/L for Calf 1. Both calves achieved adequate passive transfer. In the case of the third calf, we tried to compensate for low quality colostrum by feeding 2 extra quarts, but the final IgG in plasma was only 7.7 g/L. Calf 4 experienced just the opposite; her colostrum was good quality, and feeding 3 quarts of it increased her IgG level to 26 g/L.

The AEA values in this table are estimates, but it is important to notice that values for the second feeding are lower than the first due to the passage of time. Over the first 24 to 48 hours of life the cells of the small intestine undergo physiological changes that cause AEA to decrease.

In addition, the spreadsheet does not suggest correlations between values. If you increase the amount of IgG fed, you should reduce the AEA a bit, as this normally occurs. If you have calculated values from your farm, they will provide more information than estimates, but using some reasonable estimates, you can evaluate various feeding options.

Table 2. Examples from the Factors Affecting IgG Absorption section of the Colostrum Calculator spreadsheet.

Calf	INPUT						OUTPUT	
	FIRST FEEDING			SECOND FEEDING			Plasma or Serum Total IgG	
	Colostrum	AEA		Colostrum	AEA	Calf BW		
	qt fed	g/L IgG	%	qt fed	g/L IgG	%	lb	g/L
1	2	50	30	2	50	20	90	12.9
2	4	50	20	0	0	0	90	10.3
3	3	20	30	3	20	20	90	7.7
4	3	80	25	3	80	17	90	26.0

DETERMINING HOW MUCH COLOSTRUM TO FEED

The final section of the spreadsheet enables you to set a goal for blood IgG in your calves and then work backward to calculate how much colostrum you need to feed to meet that goal. You simply enter the IgG content of colostrum, the AEA, and calf body weight, and the spreadsheet

calculates how much colostrum is needed to meet your goal.

For some examples from this section, see Table 3. Notice what a difference the IgG content of colostrum makes in the amount required to meet the goal. In both the first and second examples, we set a

goal of 10 g/L for blood IgG, and had an AEA of 25% and calf weights of 90 pounds. This means we needed to provide a total of 147 grams of IgG. If colostrum contains 20 g/L, 8 quarts are required to meet the goal. But, if we feed better colostrum with 50 g/L of IgG, we only need to feed 3.25 quarts to meet the goal. If our standard practice is to feed a total of 6 quarts of colostrum, low IgG

in the colostrum will cause calves to have low blood IgG levels. In the third example, we have raised the goal to 12 g/L. This increases the IgG needed to 176 g and requires 3.75 quarts of colostrum containing 50 g/L of IgG. Finally, if calves weigh more (110 pounds), the requirement increases to 4.75 quarts, which will provide 216 g of IgG.

Table 3. Amount of IgG and volume of colostrum needed to meet a blood IgG goal, adapted from Colostrum Calculator spreadsheet.

INPUT				OUTPUT	
Blood Goal IgG, g/L	Colostrum IgG, g/L	AEA %	Calf BW lb	Colostrum to Feed ¹ qt	IgG to Provide g
10	20	25	90	8	147
10	50	25	90	3.25	147
12	50	25	90	3.75	176
12	50	25	110	4.75	216

¹Colostrum amounts rounded up to the nearest 0.25 qt.

Following the golden rules of colostrum feeding, Quality – high IgG and low bacteria; Quantity – a total of 4 to 6 quarts; and Timing – first feeding within 1 hour of birth and another by 8 hours will go a long

way toward improving calf health on your farm. When problems arise or you want a check-up, the Colostrum Calculator spreadsheet tool can help you find limiting factors and plan solutions.

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