



Colostrum Supplements and Replacer

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Topics include:

Reasons for use
Differences between supplements and replacer
Effect of ingredients on performance
Apparent efficiency of absorption

REASONS FOR USE

Failure of passive transfer (FPT) in dairy calves is defined as a blood IgG level of less than 10 mg/ml at 24 to 48 hours after birth. Calves that experience FPT are more likely to become sick or die in the first two months of life than calves with adequate immunity. Many factors can contribute to FPT, but colostrum and the management of colostrum feeding are often involved. Feeding colostrum late or not at all and being forced to feed poor quality colostrum are primary causes of FPT in calves. Unfortunately, not all colostrum is the same. There is a lot of variability between cows, and all colostrum should be tested to ensure its quality. When colostrum is of lower quality, producers have three options: stored colostrum, supplement products, and colostrum replacer.

Storing excess high quality colostrum provides insurance in case the dam is unable to produce an adequate quantity of good quality colostrum due to mastitis, death, or various other causes. Stored colostrum from test-negative cows also is an essential component of eradication strategies for diseases such as Johne's and leukosis. In some herds the supply of disease-free, high quality colostrum is very limited, and supplement and replacer products can provide viable options for ensuring adequate immunity in calves. In other cases, the consistency and convenience of colostrum products is preferred over testing, sorting, and storing maternal colostrum.

SUPPLEMENT OR REPLACER—WHAT'S THE DIFFERENCE?

Colostrum products that contain IgG are regulated by the USDA Center for Veterinary Biologics. Supplement products are unable to raise the blood concentration of IgG above the species standard, which is 10 mg/ml. Any product that is able to raise serum IgG concentration above 10 mg/ml may be called a colostrum replacer.

Typically, colostrum supplements contain less than 100 g of IgG per dose and are composed of bovine colostrum, other milk products, or bovine serum. Colostrum supplements can be used to increase the amount of IgG fed to calves when only low or medium quality colostrum is available. However, supplements cannot replace high quality colostrum. Even when a supplement is added to low quality colostrum, the IgG is

often absorbed poorly, and antibody absorption is reduced compared to high quality maternal colostrum.

A limited number of products designed to replace colostrum are now on the market. These are bovine serum-based products and contain at least 100 g of IgG per liter plus fat, protein, vitamins, and minerals needed by the newborn calf. Colostrum replacer contains more immunoglobulin than supplement products and provides more antibodies than poor or moderate quality colostrum. In research trials, calves fed colostrum replacer have performed as well as calves fed maternal colostrum with no differences in IgG levels, efficiency of IgG absorption, incidence of scours, or growth rates.

EFFECT OF INGREDIENTS ON PRODUCT PERFORMANCE

When comparing products, it is important to consider both the amount of IgG provided and the efficiency of IgG absorption, which is greatly influenced by ingredients and

processing. The three primary sources of IgG in colostrum products are dried colostrum, blood serum or eggs. Egg-based colostrum supplements have mostly been replaced by

dried colostrum and blood serum supplements. Most supplements contain 30 to 45% IgG or protein which, when fed according to the manufacturer's directions, provides 45 to 50 mg/ml of IgG per dose. Ideally, when fed along with poor quality colostrum enough IgG would be absorbed to provide calves with 10 mg/ml of IgG in the blood and successful passive transfer. However, absorption rates differ depending on the ingredient used as the source of IgG. Supplement and replacer products based on bovine serum contain high levels of IgG and have absorption efficiencies similar to maternal colostrum (25 to 35 percent). Products based on colostrum or whey have variable IgG contents and absorption efficiencies ranging from 5 to 30 percent. Egg-based supplements to date are not well-absorbed, but can provide local protection in the intestine against scours causing bacteria.

Arthington et al. (2000) showed absorption efficiency and IgG levels in calves 12 and 24 hours after feeding four different types of colostrum products. One group of calves was fed maternal colostrum (MC), another group was fed First Milk Formula (S-1; supplement based on dried colostrum), another group was fed Colostrx (S-2; supplement based on dried colostrum) and the last was fed LifeLine (BS; supplement based on dried bovine serum). Each was fed twice, within 2 hours of birth and at 12 hours, according to manufacturer's directions. Due to the different IgG content of colostrum products, calves were fed a total (for both feedings) of 200, 90, 50 and 60 g of IgG, respectively, for MC, S-1, S-2 and BS.

Calves fed maternal colostrum had the highest IgG concentrations at 12 and 24 hours after feeding (Figure 1), and all attained successful passive transfer. This difference can be at least partially explained by the amount of IgG fed; colostrum-fed calves received more than double the IgG of calves on the other treatments. The next highest IgG concentrations were observed in calves fed

the serum-based colostrum supplement (BS); half of these calves attained successful passive immunity. The colostrum supplements based on dried colostrum were poorly absorbed, resulting in failure of passive transfer. The supplement products also had different absorption efficiencies (Figure 2), with the serum-based product being numerically higher than S-2 and significantly higher than S-1. These results underscore the importance of choosing colostrum supplements carefully, not only selecting for the highest IgG concentration but also the best absorption efficiency.

The amount of IgG fed in a single feeding is another important factor affecting IgG absorption efficiency. As a result, when trying to attain greater passive immunity, feeding a better quality product or colostrum with higher concentration of IgG is more beneficial than feeding more of the original product by increasing the amount of powder or volume fed. In other words, don't increase the concentration of IgG by adding more powder, but feed a higher quality product.

Another difference between colostrum supplements is the inclusion of *Escherichia coli* antibody (*E. coli*). This can be misleading, causing producers to believe that if they feed this product, it will protect their calves from *E. coli* as well as provide successful passive transfer. These products are designed to provide antibodies specific for *E. coli*, but unfortunately there are many different species of *E. coli* that are present in different areas of the country and on different farms. The *E. coli* found in a colostrum supplement manufactured in some other state or country will probably not have the ability to protect against the specific *E. coli* found on farms in Pennsylvania.

Finally, read and follow manufacturer's instructions for feeding; some products are mixed with water and fed in an extra feeding, others are added to colostrum, and the number of feedings recommended may vary.

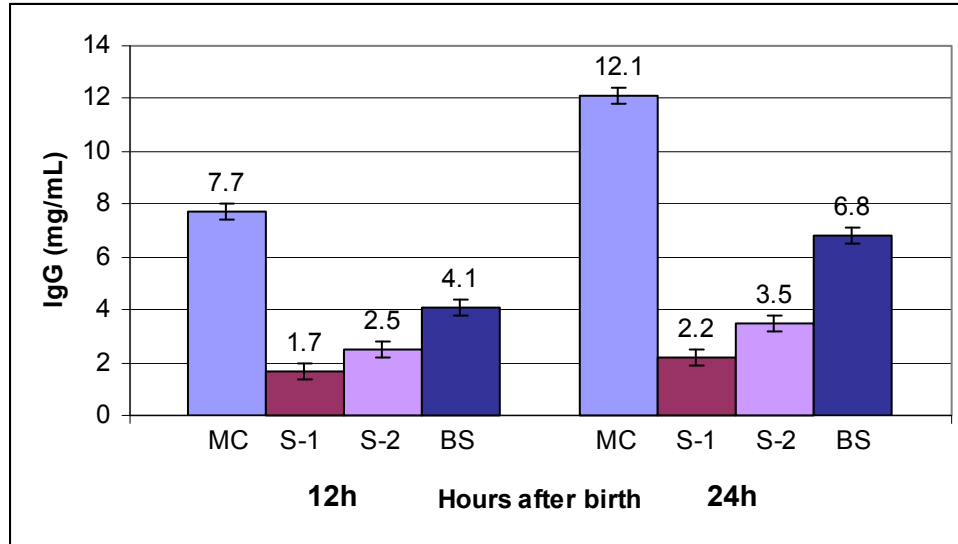


Figure 1. Plasma IgG concentration at 12 h and 24 h of calves fed different colostrum products. MC = maternal colostrum; S-1 = colostrum supplement 1; S-2 = colostrum supplement 2; BS = serum based supplement.

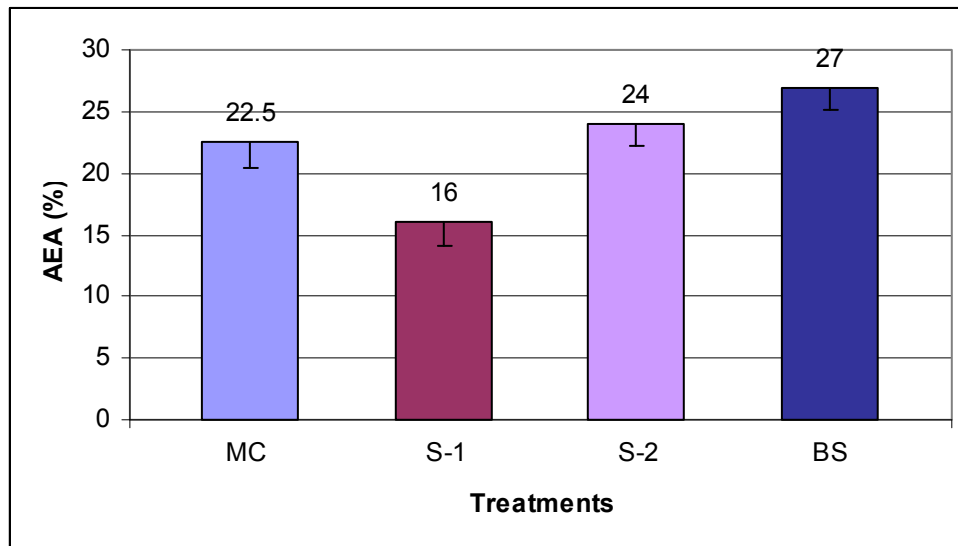


Figure 2. Apparent efficiency of absorption of IgG by 24 h of age. MC = maternal colostrum; S-1 = colostrum supplement 1; S-2 = colostrum supplement 2; BS = serum based supplement.

APPARENT EFFICIENCY OF ABSORPTION (% AEA)

The absorption efficiency of calves can be calculated on-farm to determine whether the different factors involved in colostrum feeding are working efficiently. These factors can include management, colostrum quality being fed and/or colostrum supplements being used. Knowing whether the calf has successful passive transfer is most important, however knowing apparent efficiency of absorption can help determine whether the colostrum supplement being used is worth the money.

To calculate apparent efficiency of absorption, the IgG concentration in the blood needs to be known (this is also used to determine passive transfer). Once this has been established, the blood IgG concentration (in g/L, which is the same as mg/ml) is multiplied by the plasma volume in liters (which can be estimated at 9.1% of bodyweight in kilograms for a Holstein calf). This result, the total grams of IgG in the blood, is then divided by the total amount of IgG fed, which can be estimated using a colostrometer for colostrum or found on the label of colostrum supplement or replacer products. The result is then multiplied by

100 to express absorption efficiency as a percentage.

As an example, a 45 kg calf will have a plasma volume of 4.1 L (45 kg × 0.091). Let's assume the blood IgG concentration tested at 24 hours of age was 8 mg/ml (or g/L) and the calf was fed a total of 100 g of IgG (assuming 2 L of colostrum containing 35 g/L IgG was fed, and due to its poor quality, a supplement was used to provide another 30 g of IgG). Absorption efficiency would be:

$$[(8 \text{ g/L IgG} \times 4.1 \text{ L}) / 100 \text{ g IgG}] \times 100 = 32.8\% \text{ AEA}$$

This absorption efficiency is very good when we consider that research data suggests absorption efficiencies of around 35% for maternal colostrum. Only a small fraction of the colostrum IgG fed is actually absorbed into the calf's bloodstream. Time of the first colostrum feeding is the most critical factor affecting absorption efficiency, and producers need to do everything they can to feed colostrum or colostrum products as soon as possible after birth.

SUMMARY

High quality maternal colostrum is still the "gold standard" for feeding newborn calves. However, colostrum supplement and replacer products can be valuable tools to increase calf immunity when colostrum supplies are limited or disease eradication is desired. Colostrum supplements can be used to increase the amount of IgG fed to calves when no source of quality colostrum is available, but supplements cannot

replace high quality colostrum. They do not contain sufficient quantities of antibodies to raise the blood IgG level in calves beyond what average quality colostrum will do. On the other hand, colostrum replacer contains greater levels of IgG and other nutrients and provides an effective, convenient method of providing passive immunity to calves when maternal colostrum is not available.

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