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Colostrum Supplements and Replacer

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TOPICS

Reasons for use
Differences between supplements and replacer
Apparent efficiency of absorption

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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. All calves should receive colostrum within 2 to 4 hours of birth. Research suggests that calves should be fed at least 100 g of IgG, and feeding 150 to 200 g is recommended to ensure plenty of IgG is available to the calf. Feeding colostrum late or not at all and feeding 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 available colostrum is low in quality, producers have several options using stored colostrum and products formulated to supplement or replace colostrum.

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 for calves. Any product that is able to raise serum IgG concentration above 10 mg/mL may be called a colostrum replacer.

Colostrum supplements available today are made from dried bovine colostrum or serum and contain 40 to 60 g of IgG per dose (9 to 13% globulin protein). The fat content of these products ranges from 0.5 to 15%. 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. Research has shown that when a supplement is added to low quality colostrum, the IgG is often absorbed poorly and calves often experience FPT (see table below). Poor antibody absorption when adding a supplement to colostrum may be due to the large amount of protein entering the intestine in a short period of time. Competition between IgG molecules and other proteins for absorption sites has been suggested as one reason this occurs. Colostrum replacers developed because supplements were not particularly effective. Supplement products are less expensive than replacer products, but they are less convenient and do not provide a break in the disease transmission cycle because some colostrum must still be fed. One strategy to reduce the overall cost of using these products is to feed a replacer for the first feeding and a supplement for the second feeding.

Numerous products designed to replace colostrum are now on the market. These products are made from bovine colostrum or serum and contain 100 to 150 g of IgG per dose. These products also provide fat, protein, vitamins, and minerals needed by the newborn calf, although the amount varies between products. For example, fat content ranges from 6 to 25%. Colostrum replacer contains more immunoglobulin than supplement products and provides more antibodies than poor or moderate quality colostrum. In an experiment where calves received the same amount of IgG from either colostrum or a serum-based colostrum replacer (Jones et al., 2004), no differences between the calves were observed in IgG levels, efficiency of IgG absorption, incidence of scours, or growth rate during the first month of life. In other trials the amount of IgG transferred to the calves' blood has been lower in calves fed replacer products than calves fed maternal colostrum; however, the amount of IgG provided by colostrum and replacer products is often different. A University of Minnesota study (Pithua et al., 2010) followed 497 calves from birth through 54 months of age and found no differences in the risk of death or culling, milk production, or reproductive performance of cows that were fed either maternal colostrum or serum-based colostrum replacer at birth. Another part of this project evaluated the risk

of calves becoming infected with *Mycobacterium avium* subsp *paratuberculosis* (Pithua et al., 2009) and found calves fed colostrum replacer at birth were less likely to be infected than those fed colostrum. All calves were born into herds known to have Johne's disease present, so these results suggest that colostrum replacer can be effective in breaking the transmission from cow to calf. Multiple trials have reported acceptable levels of serum IgG and total protein in calves fed various replacer products (see table below). However, it is important to select products that are proven to be effective, because not all products that have been tested in public research have provided adequate immunity. Generally speaking, the quality and effectiveness of colostrum replacer products have improved in recent years.

The table below summarizes the results of 26 research trials published in peer-reviewed journals with nearly 90 different treatments investigating colostrum supplement and replacer products. The table provides a summary of treatment means, which reduces the variability that may have been observed within an individual experiment (or that might occur between individual calves on a farm), but provides a good overview of the performance we can expect on average. Because some of these studies were conducted during the development of replacer products, they provided less than 100 g/dose of IgG. If preliminary studies are removed from the summary to provide a better estimate of products currently on the market, replacer products provided an average of 157 g of IgG, with an absorption efficiency of 31%, and serum IgG of 12 mg/mL. Supplement products (fed in addition to colostrum) provided 136 g of IgG with 19% absorption efficiency and resulted in serum IgG of 9 mg/mL.

Be sure to read and follow the manufacturer's instructions for feeding; some products are mixed with warm water and fed in an extra feeding, others are added to colostrum, and the number of feedings recommended may vary. Some products packaged in bulk also offer the option of selecting the IgG dose by adding different amounts of powder.

Summary of treatment means from 26 published studies investigating colostrum products

	Number of Means	Average	Maximum	Minimum
IgG Intake, g				
Maternal Colostrum	19	203	447	53
Colostrum-based Replacer	21	126	210	18
Serum-based Replacer	30	129	260	53
Colostrum-based Supplement	8	157	297	85
Serum-based Supplement	4	96	100	90
Serum IgG, mg/mL				
Maternal Colostrum	25	16	27	3
Colostrum-based Replacer	21	11	20	2
Serum-based Replacer	30	9	16	5
Colostrum-based Supplement	8	10	20	5
Serum-based Supplement	6	9	11	7
Apparent Efficiency of Absorption, %				
Maternal Colostrum	16	23	36	10
Colostrum-based Replacer	14	33	51	12
Serum-based Replacer	22	25	38	15
Colostrum-based Supplement	7	12	26	6
Serum-based Supplement	4	32	38	25

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 timing of first feeding, colostrum quality and amount being fed, or colostrum products being used. Knowing whether the calf has successful passive transfer is most important, however knowing apparent efficiency of absorption can help in trouble shooting.

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 maximum absorption efficiencies of around 35% for maternal colostrum. Time of the first colostrum feeding is the most critical factor affecting absorption efficiency, and calf care personnel need to do everything they can to feed colostrum or colostrum products as soon as possible after birth. As mentioned previously, the amount of protein in the calf's intestine can also influence the absorption of IgG. Providing two smaller feedings of colostrum may be beneficial.

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. 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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