

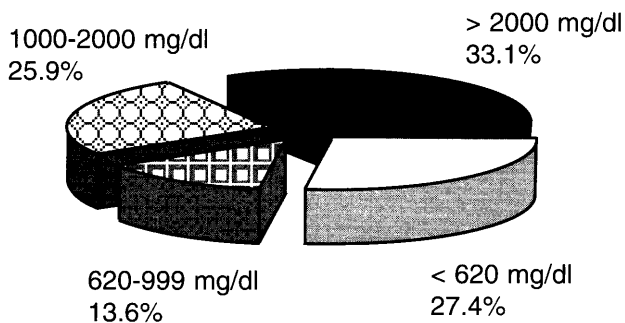
A GUIDE TO COLOSTRUM AND COLOSTRUM MANAGEMENT FOR DAIRY CALVES



Introduction

This guide is published by the Bovine Alliance on Management and Nutrition, which is composed of representatives from AABP (American Association of Bovine Practitioners), ADSA (American Dairy Science Association), AFIA (American Feed Industry Association), and USDA (United States Department of Agriculture). It has been compiled to assist the dairy industry regarding management practices studied in the USDA:APHIS National Dairy Heifer Evaluation Project (NDHEP).

Figure 1. Distribution of IgG in serum of calves (USDA:APHIS:VS, 1992 NDHEP)



A significant portion of calf mortality on U.S. dairy farms could be prevented by proper colostrum feeding and management. The purpose of this guide is to describe the importance of colostrum to the neonatal calf and explain optimal methods of managing colostrum.

The NDHEP conducted by the National Animal Health Monitoring System (USDA:APHIS:VS) included 1,811 farms in 28 states representing 78% of all milking cows in the U.S. Blood samples from 2,177 heifer calves were used to determine antibodies in blood by measuring serum immunoglobulin (Ig) levels. Blood was sampled from heifers between 24 and 48 hours after birth and serum was measured for serum IgG, which represents most of the Ig in blood. Serum IgG in newborn calves is obtained by consumption of colostrum during

the first 24 hours of life. While the level of IgG that provides adequate protection will vary with exposure to infectious organisms, stress, environment, temperature, and other factors, a level of 1,000 mg/dl has been suggested as a minimum level for IgG in the serum of calves by about 24 hours of age.

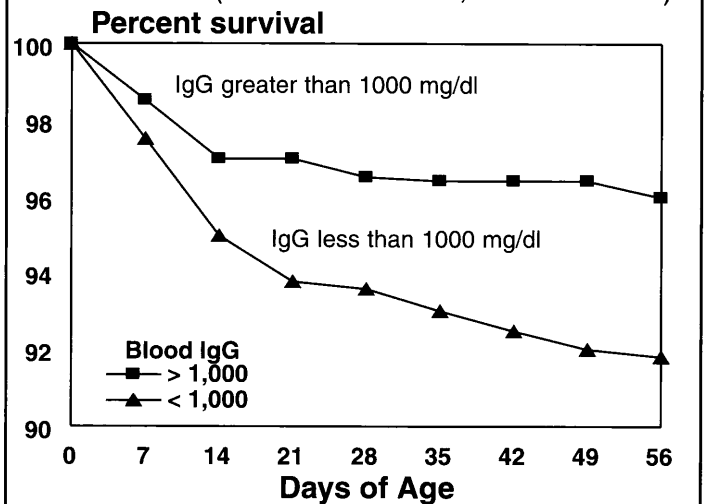
Over 40% of calves in the NDHEP had serum IgG concentrations below 1,000 mg/dl at 24-48 hours after birth (Figure 1). More than 25% of calves were below 620 mg/dl, putting them at much higher risk of disease. Calves with less than 1,000 mg/dl (colostrum deficient) are more likely to get sick and die than calves with serum IgG concentration greater than 1,000 mg/dl (Figure 2).

Of course, many factors contribute to calfhood mortality, but results of this study indicate that over half of the calf death loss in this study could be attributed to failing to absorb enough IgG from colostrum (heifers with serum IgG levels less than 1,000 mg/dl).

What is colostrum?

In the dairy industry, the first milking after calving is considered colostrum. Milk produced on the second and third day after calving is called *transition milk*.

Figure 2. Calf survival by serum IgG concentration (USDA:APHIS:VS, 1992 NDHEP).



Colostrum differs from normal milk in many ways. It is markedly higher in solids, fat, protein, vitamins, and Ig, and lower in lactose (Table 1). The amount of solids and protein (especially Ig) declines rapidly after the first day, so that by day 4 the milk reaches normal composition.

Timing of colostrum feeding

If intestinal cells are not saturated by colostral proteins, pathogenic bacteria may reach these sites allowing colonization. If bacteria reach absorptive sites before colostral proteins, the calf will be at a greater risk of blood infection, which is often fatal. **Therefore it is critical that the first milking colostrum be fed as soon as possible after birth.** The risk of calves swallowing feces, bedding, or other contaminated material can be minimized by early colostrum feeding and separation of the calf from the cow.

Item	Milking Number			Milk
	1	2	3	
Specific gravity	1.056	1.040	1.035	1.032
Solids, %	23.9	17.9	14.1	12.9
Protein, %	14.0	8.4	5.1	3.1
Casein, %	4.8	4.3	3.8	2.5
IgG, mg/mi	48.0	25.0	15.0	.6
Fat, %	6.7	5.4	3.9	3.7
Lactose, %	2.7	3.9	4.4	5.0
Vitamin A, ug/L	2950	1900	1130	340
Vitamin D, IU/g fat	.9 to 1.8			.4
Riboflavin, ug/ml	4.8	2.7	1.9	1.5
Choline, mg/ml	.70	.34	.23	.13

From: Foley & Otterby, 1978. J. Dairy Sc. 61.1033.

The importance of colostrum to the calf

Newborn calves (as well as pigs, foals, sheep and goats) are born without antibodies in the blood which are critical to the proper function of the immune system. Colostrum contains large amounts of antibodies and is the primary source of them for the calf. The newborn digestive system can absorb large molecules such as antibodies intact for only a short time after birth (approximately 24 hours). Early feeding of colostrum is essential. During this time, normal digestive enzymes in the abomasum and small intestine do not function or function with limited activity, allowing antibodies to reach the small intestine without being digested. Further, colostrum contains enzyme inhibitors that allow antibodies to escape intestinal digestion and be absorbed intact. Colostrum reduces the risk of diarrhea and pneumonia and is life saving to the calf.

In addition to the important role of colostrum as a source of antibodies, colostrum is also the first feed the calf consumes. Colostrum is a concentrated source of fat (a source of energy), protein (for energy and body growth), vitamins (especially fat soluble vitamins) and minerals. Colostrum also contains hormones and growth factors that may play an important role in calf growth and health.

Colostrum quality

Concentration of Ig in colostrum varies according to the cow's disease history, volume of colostrum produced, season of the year, breed and nutrition during the dry period. Research indicates the average concentration of IgG₁ (a sub-fraction of IgG) in colostrum from Holstein cows was 48 g/L with a range of 20 to >100 g/L. Colostrum from Jersey cows averaged 66 g/L of IgG, with a range of 28 to 115 g/L. The difference between 20 and 100 g/L of IgG in colostrum can mean the difference between colostrum deficiency and adequate colostrum status in the calf. Older cows will often produce better quality colostrum than younger cows. However, if older cows are not exposed to many pathogens, the colostrum produced may not have high levels of antibodies.

The type of antibodies in colostrum depends on the antigens to which the cow was exposed, by disease exposure or vaccination. Moreover, cattle raised on a farm will produce colostrum with antibodies specific for the organisms on that farm which is an added benefit. Milking or leaking of milk from the udder before calving will significantly reduce the concentration of antibodies in colostrum.

In general, colostrum produced in large volumes will have lower Ig concentration than colostrum produced in smaller volumes. Colostrum from cows which produce more than 18 pounds (approximately 2 gallons or 8 quarts) at the first milking is usually lower in Ig concentration (18 lb. rule). This is only a general rule, however, as the relationship between Ig concentration and volume is not constant.

The large variation in Ig content makes accurate colostrum management and feeding difficult. Colostral Ig can be measured in the laboratory with great accuracy; unfortunately, the assays involved are time-consuming and expensive. Measurement of specific grav-

Colostrum Feeding Do's and Don'ts.

ITEM	DO	DON'T
Dry Cow Mgt	<ul style="list-style-type: none"> • Ensure that dry cows are well fed and gain 100 pounds during the dry period and are protected from heat stress. • Work with your veterinarian to develop a vaccination program which will help protect young calves from disease. 	<ul style="list-style-type: none"> • Have dry cows in same pens as lactating cows.
Calving Area	<ul style="list-style-type: none"> • Calve cows in a clean, dry maternity pen or on a clean pasture. 	<ul style="list-style-type: none"> • Forget to separate close-up cows and lead feed 3 weeks before calving. • Forget to clean pens between cows.
Separating Calves	<ul style="list-style-type: none"> • Separate calves from the dam as soon as possible. 	<ul style="list-style-type: none"> • Leave the calf and dam together for more than an hour.
Colostrum Collection	<ul style="list-style-type: none"> • Clean cow and udder prior to milking. • Milk out cows as soon as possible after birth (Preferably within 1-2 hours after birth). • Collect colostrum in a sanitary manner and test for quality. 	<ul style="list-style-type: none"> • Wait until 6 hours or longer before milking out cow after calving. • Mix colostrum with transition or hospital milk. • Collect colostrum from a dirty udder.
Colostrum Quality	<ul style="list-style-type: none"> • Measure colostrum quality with a colostrometer or quick test method before use. • Use only good quality colostrum. • Use fair and poor quality colostrum only for calves 24 hours and older. 	<ul style="list-style-type: none"> • Use colostrum from cows that are known Johnes, BLV, BVD-PI or Mycoplasma positive. • Use thin, watery colostrum, especially if from a heifer. • Use mastitic colostrum. • Use colostrum that contains blood or otherwise abnormal. • Pasteurize colostrum.
Colostrum Storage	<ul style="list-style-type: none"> • Chill colostrum immediately after collection. • Refrigerate only in 2 quart containers(40° F.) for less than 24 hours. • Colostrum should be frozen if stored for more than 24 hours. • Save good quality colostrum by freezing in double bag, plastic freezer bags and label properly. (Cow #, disease status, date, etc.) 	<ul style="list-style-type: none"> • Pool colostrum. • Store colostrum at room temperature. • Place frozen colostrum in extremely hot water or thaw in a microwave under high power for > 1 min at a time (this destroys the antibodies). • Store colostrum for more than one year.
Colostrum Feeding and Timing	<ul style="list-style-type: none"> • Feed first feeding of colostrum as soon as possible (warm and within 1 hour after birth). • Use fresh colostrum from the dam if good quality. • Do one of the following options. <ul style="list-style-type: none"> A. Feed 3 quarts of high quality colostrum (green range) via nipple bottle as soon after birth as possible (within 1 hour) and repeat 12 hours later. B. Feed 4 quarts of high quality colostrum (green range) by esophageal feeder as soon after birth as possible (within 1 hour). • Use an esophageal feeder if the calf will not consume sufficient colostrum. • Clean and disinfect esophageal feeder between calves. 	<ul style="list-style-type: none"> • Use colostrum from cows that are leaking colostrum from their udder prior to or at calving. • Use colostrum that contains blood or is mastitic. • Wait for the calf to get up on its own and nurse. • Allow the calf to get its colostrum from nursing the cow, or feed less than 2 quarts per feeding. • Use a broken or dirty esophageal feeder. • Use same esophageal feeder on sick calves as that used to feed colostrum.
Calf Management Tasks	<ul style="list-style-type: none"> • Dip navels with 7% tincture of iodine as soon as possible. • Put calf in an isolated, dry, and draft-free environment. • Test calves to determine the effectiveness of your colostrum program. (Serum total protein testing or other tests). 	<ul style="list-style-type: none"> • Use teat dip or other solution other than tincture of iodine to dip navels. • Group calves together or house calves in a wet or drafty environment for 2-3 days after birth.

ity of colostrum using a device called a colostrometer is one method to estimate IgG content of colostrum. The relationship between specific gravity and IgG is dependent on temperature. Colostrum should be at 72°F when tested with a colostrometer. The colostrometer gives a reasonable estimate of colostrum quality - particularly if the colostrum is of poor quality. **Test all colostrum before feeding and use only good quality colostrum.**

Avoid contamination of colostrum at time of collection. Udders and teats should be cleansed just as you would prepare the cow for saleable milk. Colostrum should be fed as soon as possible after birth (within 1 hour) since the colostrum itself is not sterile. Bacteria in the colostrum will begin to grow quickly and can increase tremendously within a few hours of collection.

Colostrum may transmit several important diseases, including Johne's disease. For this reason, colostrum from cows that are known carriers or suspected of being carriers for specific diseases should never be fed to newborn calves. **In addition, colostrum should not be pooled among cows - colostrum from an infected cow, once pooled, may infect many calves.**

Although pasteurization of colostrum reduces bacterial concentration, it is important to remember that pasteurization only decreases the number of bacteria in colostrum – it does not sterilize it. The time and temperature standards typically used for pasteurizing milk do not apply to colostrum and are not practical for an on-farm pasteurizer. **Finally, batch pasteurization usually destroys most of the antibodies in colostrum, and therefore, is not recommended.**

Colostrum storage

Storage can influence colostrum quality. Refrigerating colostrum (40° F) in 2 quart containers can be done for less than 24 hours. Bacteria growth can occur if refrigerators are not operating properly or large volumes of colostrum are stored. **Don't leave colostrum at room temperature.** One method is to pre-chill nipple bottles in ice water and then place them in the refrigerator or freezer.

For long-term colostrum storage (more than 24 hours) freezing is recommended. Colostrum may be frozen without significant loss of antibodies. Frost-free freezers are not optimal for long-term colostrum storage, as they go through freeze-thaw cycles that can allow the colostrum to thaw and shorten colostrum storage life. Freezing colostrum in double plastic freezer bags is an excellent method of storing colostrum. Frozen colostrum can be thawed in warm (not hot) water or in a microwave for 1 minute cycles on low power. Pour off the thawed liquid periodically to minimize "hot spots" inside the frozen colostrum.

Feeding colostrum

A number of options exist for feeding colostrum to young calves. These include feeding colostrum with a bottle or pail, tubing with an esophageal feeder or allowing calves to suckle their dam. Up to 40% of calves do not obtain enough antibodies when left to suckle, so allowing the calf to suckle the dam is not recommended.

Esophageal feeders are used to deliver large amounts (4 quarts) at one feeding or when calves will not consume colostrum voluntarily. Esophageal feeders should be cleaned and disinfected between calves. An esophageal feeder should have a smooth ball (preferably stainless steel) at the end of the tube.

Colostrum supplements may be useful when colostrum is unavailable or of poor quality. Colostrum supplements are not necessary when good quality colostrum is used.

Regardless of the method of feeding, the amount of colostrum the newborn calf needs to absorb enough antibodies depends on several factors, including the size of the calf (blood volume), concentration of Ig in colostrum, and efficiency of Ig absorption. Although many factors affect the efficiency of Ig absorption, the major factors are the number of hours after birth at which the calf is first fed and volume of Ig consumed. The ability of the calf to absorb IgG declines rapidly as the calf gets older. When calves are offered colostrum after 6 hours of age, the volume of colostrum offered at each feeding should be increased because the amount absorbed is decreased.

Colostrum feeding guidelines

Do either A or B listed below.

A. Feed 3 quarts of high quality colostrum (green range) by nipple bottle as soon after birth as possible (within 1 hour) and repeat 12 hours later.

B. Feed 4 quarts of high quality colostrum (green range) by esophageal feeder as soon after birth as possible (within 1 hour).

Even if good quality colostrum is fed, delays in colostrum feeding may result in sickness and death. Waiting to feed colostrum – even a few hours – will dramatically increase the risk of calves developing a serious disease. **Calves need to be fed colostrum as soon as possible – preferably within the first hour after birth.** The most common source of bacterial and viral infections for newborn calves is usually the dam, followed by the calving environment. Calves born into dirty environments will be at a much higher risk of infection than calves born in a clean calving facility.

Excess colostrum from cows which have tested negative for Johne's can be fed to the calf for the first three days of life. The immunoglobulins from colostrum will "coat the gut" for the first few days of life, thereby further protecting the calf from pathogens.

If transition milk and hospital milk are fed, they should be properly pasteurized and a strict quality control program for pasteurization implemented.

Test calves to measure the effectiveness of your colostrum program. Measuring serum total protein or IgG by one of the quick tests will help you assess the effectiveness of your colostrum program.

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