

HEIFER RAISING—BIRTH TO WEANING

28) IMPORTANCE OF COLOSTRUM FEEDING

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WHAT IS COLOSTRUM?

Colostrum is the thick, creamy, yellow secretion collected from the udder after calving. By definition, only the secretion of the first milking after calving should be referred to as colostrum. Secretions from the second to the eighth milking (fifth day of lactation) are called transitional milk because the composition gradually becomes similar to that of whole milk (Table 1).

In addition to its high nutritive value, colostrum provides antibodies needed to protect newborn calves from many infections that may lead to diarrhea and death. The concentration of antibodies in colostrum averages 6% (6 g/100 g of colostrum), but ranges from 2 to 23%. In contrast, the concentration of antibodies in the milk is only 0.1%.



Figure 1: At birth, a calf has no defense against infectious agents; colostrum feeding increases the chances of survival.

WHAT ARE ANTIBODIES?

Antibodies or immunoglobulins are proteins normally found in the bloodstream. These proteins are vital components of the immune system. They help identify and destroy bacteria and other foreign particles (antigens) that have invaded the body. Antibodies are not present in the bloodstream of newborn calves because they cannot cross the placenta during pregnancy. However, when newborn calves are fed good quality colostrum, antibodies are absorbed through the intestine. Many studies

Table 1: Composition of milk and colostrum

Component	Milking number					
	1	2	3	4	5	11
	Colo- strum	Transitional Milk				Whole milk
Total solid, %	23.9	17.9	14.1	13.9	13.6	12.5
Fat, %	6.7	5.4	3.9	3.7	3.5	3.2
Protein ¹ , %	14.0	8.4	5.1	4.2	4.1	3.2
Antibody, %	6.0	4.2	2.4	0.2	0.1	0.09
Lactose, %	2.7	3.9	4.4	4.6	4.7	4.9
Minerals, %	1.11	0.95	0.87	0.82	0.81	0.74
Vitamin A, ug/dl	295.0	--	113.0	--	74.0	34.0

¹ Includes percentage of antibodies indicated on the next line.

show that without adequate amounts of antibodies in the blood, the mortality of newborn calves increases dramatically in the first few days and weeks of life.

HOW DO ANTIBODIES FIGHT INFECTIONS?

Colostrum contains several types of antibodies. IgG and IgM destroy antigens or micro-organisms that have entered the blood (systemic infections). IgA, a third type of antibody, protects the membranes that line many organs against infection, especially the intestine, and prevents antigens from entering the bloodstream.

HOW IS COLOSTRUM QUALITY EVALUATED?

To assess colostrum quality, both the amount and types of antibodies must be considered.

Amounts of antibodies

Visual observation gives a good indication of colostrum quality (amounts of antibodies). A thick, creamy colostrum is rich in antibodies. In contrast, a thin, watery colostrum is likely to contain a lower antibody concentration. Concentration of antibodies in colostrum is influenced by numerous factors:

- **Inadequate length of the dry period (less than four weeks), premature calving, milking before calving and milk leakage before calving** lower the concentration of antibodies in colostrum;
- **The age of the cow:** On the average, concentration of antibodies is higher in older cows (>8%) than first-calf heifers (5-6%). In addition, older cows produce colostrum with more diverse antibody populations than younger cows because they have had more time to build immunity to the diseases existing in the herd;

- **The breed of dairy cow:** Holsteins have a lower antibody concentration (6%) in their colostrum than other dairy breeds such as Ayrshire, Brown Swiss, Guernsey and Jersey (8 to 9%).

Types of antibodies

Colostrum of good quality is rich in antibodies that provide immunity for a wide variety of diseases specific to an environment. The range of disease organisms and vaccinations to which the cow has been exposed determines the range of antibodies found in the colostrum. Mature cows that were born and raised on a farm have the ideal colostrum to protect calves born on that same farm. In contrast, the immune value of a cow's colostrum purchased shortly before calving is limited. Similarly, a calf purchased and moved within the first 6-8 weeks after birth has a high risk of not resisting infectious disease because it has not received antibodies specific to its new environment.

IMPORTANCE OF PROPER AMOUNT AND TIMING OF COLOSTRUM FEEDING

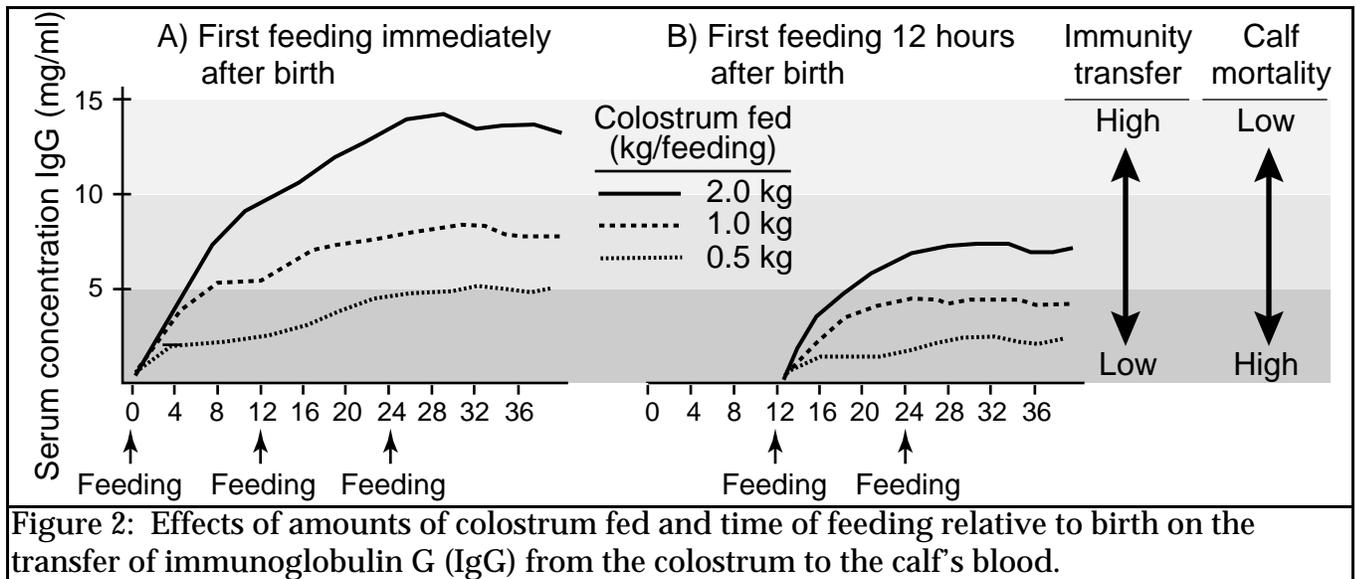
Colostrum has a laxative effect and stimulates the normal function of the digestive tract. More importantly, the amount of colostrum fed and the time of feeding in relation to birth considerably influences calf survival (Table 2, Figure 2).

Immediately after birth, the absorption of antibodies averages 20%, but it can vary from 6 to 45%. There is a rapid decline in the efficiency of absorption of antibodies within hours after birth. Digestion of

Table 2: Relationship between mortality and the amount of colostrum fed to newborn Holstein calves within the first 12 hours of birth

Amount fed (kg)	Mortality (%) ¹
2 to 4	15.3
5 to 8	9.9
8 to 10	6.5

¹ Average mortality from 1 week to 6 months of age



antibodies increases and intestinal cells quickly become impermeable to antibodies. At about 24 hours after birth, calves lose the ability to absorb intact antibodies (gut closure). Calves not receiving colostrum within 12 hours of birth rarely absorb enough antibodies to provide adequate immunity. Fifty percent of the calves whose first feeding is delayed until 24 hours after birth are unable to absorb antibodies, they are not protected, and many of them die.

The concentration of immunoglobulin G (IgG) needed in the blood to protect the calf from infectious diseases is 10 mg/ml of serum.. Holstein calves only absorb enough IgG when they are fed two liters of colostrum once shortly after birth and two liters a second time 12 hours after birth (Figure 1a). When less than two liters of colostrum is fed or when the first feeding is delayed (Figure 1b), the amount of IgG in the blood is insufficient to prevent disease (less than 10 mg/ml).

Most of the antibodies found in the blood come from the first meal. Proportionally, less IgG is absorbed from the 12-hour meal and very few antibodies are absorbed from a meal given at 24 hours after birth. In addition, Figure 2B indicates that a delay in feeding colostrum compromises the amount of antibodies absorbed regardless of the amount fed.

COLOSTRUM AND DISEASE TRANSFER

In a few cases, colostrum is a vehicle for disease transfer between a cow and its calf. For example, the bovine leukosis virus is found in the colostrum of infected cows. Thus the calf of a leukosis-positive cow should be removed from the calving area immediately after birth and fed colostrum from a cow free of the disease. Thus there is an advantage to keeping a reserve of frozen colostrum. This is also true for cows diagnosed with Johnes' disease (paratuberculosis).

Table 3: Amounts of good quality colostrum required per feeding as a function of the calf's breed and body weight at birth

Breed: ¹	Small		Medium		Large	
Body weight, kg	25	30	35	40	45	50
Colostrum, ² kg	1.25	1.50	1.75	2.00	2.25	2.50

¹ Small breed = Jersey; Medium breed = Ayrshire and Guernsey; Large breed = Holstein and Brown Swiss

² Amount of colostrum fed at each meal (4 to 5% of body weight)

METHOD OF FEEDING

The amount of colostrum ingested by a calf is easily controlled when fed using a bottle or a pail equipped with a nipple. The equipment must be cleaned thoroughly after each use to minimize bacterial growth and the risk of transferring pathogens.

Feeding colostrum by inserting the head of the calf in an open pail is not recommended because this method may lead to digestive disorders. For the same reasons, colostrum should be fed at body temperature (39°C). Cold colostrum should be warmed in a water bath before feeding. Between feedings, excess colostrum should be kept in a clean, covered container and placed in a cold room.

An esophageal tube may be used to force feed a weak calf unable to nurse. Although this technique may save the life of a calf, injuries or death may result from inserting an esophageal tube improperly. The technique should be first demonstrated by a veterinarian and all equipment must be properly sanitized between use.

FREEZING AND THAWING COLOSTRUM

For long-term storage, colostrum can be preserved by freezing without any loss of its immune value (destruction of antibodies). This practice is a convenient way to ensure that good quality colostrum

is always available. Colostrum from mature cows that were born and raised on the farm should be frozen in packages of 1.5 to 2 kg, the amount needed for a single feeding.

Freezing and thawing do not destroy the antibodies. Frozen colostrum can be thawed, warmed and fed to a newborn calf when there is concern about the effectiveness of its dam's colostrum to transfer immunity. This would be the case when the colostrum:

- Is thin and watery;
- Contains blood;
- Comes from a mastitis-infected quarter;
- Comes from a recently purchased cow or first-calf heifer;
- Comes from a cow that was milked before calving or had significant colostrum leakage.

A warm water bath (45-50°C) should be used to thaw frozen colostrum and warm it up to body temperature before feeding. The impermeable bag of frozen colostrum can simply be placed in a large receptacle filled with lukewarm water. The temperature of warming colostrum should be carefully monitored to avoid the destruction of antibodies and the risk of burning the calf.