



Minnesota Dairy Team

*Educating the dairy industry on
today's and tomorrow's dairy technologies.*

Colostrum

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This presentation will discuss colostrum management to help get calves off to a good, healthy start.

5 C's for a Healthy Start

- Colostrum
- Calories
- Cleanliness
- Comfort
- Consistency

Always remember the 5 C's for success.

Optimum Immunity needed

- Getting optimum immunity in calves has been an issue for decades.
- It is still a challenge today.
- At the Nov., 2008 Calf Discovery Conference in Roanoke, VA. scientists, private consultants, other dairy industry personnel agreed that the issues of immune function and colostrum feeding are still very important and needs to be improved.

Optimum immunity should be the goal immediately after the calf is born.

What is GOOD colostrum?

- From a cow or first calf heifer that is healthy
- Donor is vaccinated
- Cow or first calf heifer has been in pre-fresh group 2-3 wks
- Udder is prepared just like milk was going to the bulk tank
- Cow is milked within 4 hrs of calving
- If colostrum isn't fed right away, it is in the refrigerator
- If colostrum is older than 5 days, it is thrown out

These factors provide good colostrum.

Principles of Colostrum Management

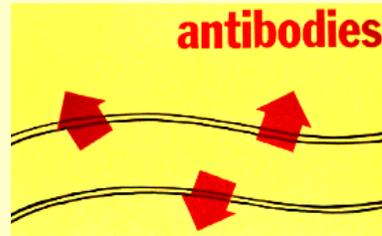
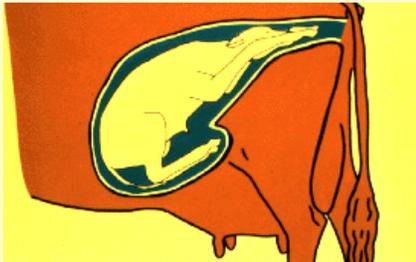
- Quality > 50 g/L IgG
- Quantity 4 qts (10% Bwt)
- Quickness < 6 hrs
- Cleanliness < 100,000 cfu/ml TPC

Godden, U of MN

Guidelines for defining good colostrum management

Calf is born devoid of antibodies

- Dam supplies all of the prenatal protection needed before birth.
- Only during the calf's first 24 hours of life ...



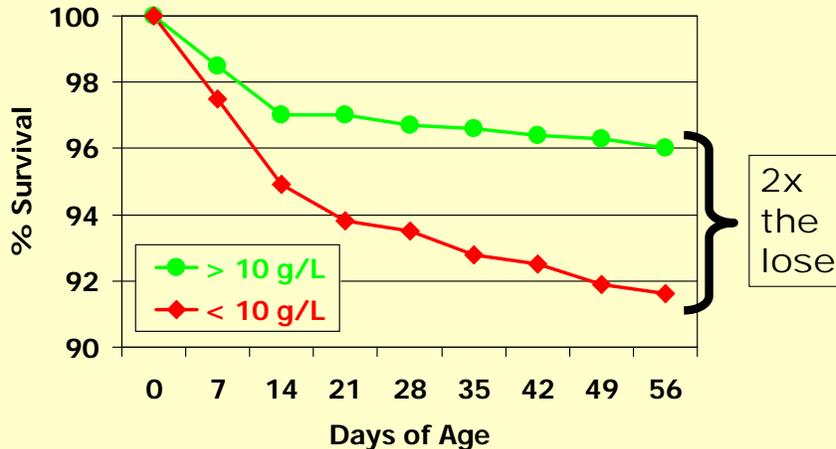
can it absorb whole antibodies through its small intestine wall.

McGuirk, U of WI

Before calves are born, they are in a sterile environment, so disease protection isn't necessary. The dam supplies all of the protection normally needed before birth. The calf is born essentially devoid of antibodies.

During a calf's first twenty-four hours of life it can absorb whole antibodies through its small intestine wall. These antibodies circulate in the animal's bloodstream to help fight off diseases and infections during the first few weeks of life.

Calf survival rates by level of serum IgG in colostrum



Source: USDA NAHMS Report, National Animal Health Monitoring System, 1993

Success in providing adequate immune protection to calves can be monitored by taking blood samples from calves at 24 to 48 hours of age and measuring serum total protein. This measure of total protein in serum is highly correlated to IgG levels. If calves have received enough high quality colostrum, serum total protein will be 5.5 grams per deciliter (g/dl) or greater. When total protein falls between 5.0 and 5.5 g/dl, there is a marginal risk for mortality and morbidity. Total serum protein levels less than 5.0 g/dl put the calf at high risk for health problems.

The “clinical threshold dose” (the level of exposure that results in disease) is considerable lower for colostrum-deprived calves than for colostrum-fed calves. The number of organisms needed to cause disease is much lower in calves that have not acquired immunity from colostrum antibodies.

Beyond the clinical threshold dose, the greater the pathogen exposure is, the more severe the illness. Calves with colostrum-acquired immunity can be exposed to larger pathogen doses yet suffer less severe illnesses than colostrum-deprived calves.

This figure shows that colostrum affects both morbidity (illness) and mortality (death). Results of a national survey of heifer management practices showed mortality rates for calves with low antibody levels (less than 10 grams per liter) were more than twice that of calves with higher levels.

Factors affecting [IgG]

- **First milk volume**
 - > 18 lb < quality
- **Immune status**
 - Exposure/vaccination
- **Length of dry period**
 - 3 to 4 wk minimum
- **Dry cow nutrition**
 - Deficient protein and energy reduce quality
- **Age of cow**
 - 2 yr olds = poorest
- **Leaking**
 - Removal & dilution
- **Breed**
 - Jerseys = highest
 - ~66 [28-115 g/L]
 - Holstein = lowest
 - ~48.2 [20-100 g/L]
- **Season**
 - Weather stress
 - Forage quality

Here's a summary of some major factors affecting the IgG concentration in colostrum: First milking volume—cows that produce a large quantity of colostrum (greater than 18 pounds, or about 2 gallons) often produce lower concentrations of immunoglobulins, likely due to dilution. Immune status of the dam—as it relates to her pathogen exposure and vaccination level. Length of the dry period—a 3 to 4 week dry period is needed to allow antibodies from the blood to be concentrated in colostrum. Dry cow nutrition—cows fed too little protein or energy tend to produce lower quality colostrum than cows fed adequately. Age of the cow, especially as it relates to increased exposure to pathogens—2- year-old cows often have the poorest colostrum quality. Leaking milk prepartum or milking before calving—both reduce antibody levels; by colostrum removal or by dilution. Breed—Jerseys tend to have the highest levels of antibodies averaging 66 grams per liter of IgG with a range of 28 to 115 grams per liter, Holsteins the lowest typically averaging 48.2 gram per liter of IgG with a range of 20 to 100 grams per liter of colostrum, and other breeds fall in the middle. Season of the year—may be related to added stress and forage quality. Temperature extremes are problematic. In the north, late winter is often associated with poor quality. In the south, summer's heat and hot temperatures have been associated with lower quality colostrum.

Typical composition of colostrum and transitional milk

Item	Milking number			Milk
	1	2	3	
Solids (%)	23.9	17.9	14.1	12.9
Protein (%)	14.0	8.4	5.1	3.1
IgG (mg/ml)	48	25	15	0.6
Fat (%)	6.7	5.4	3.9	4.0
Lactose (%)	2.7	3.9	4.4	5.0
Minerals (%)	1.1	1.0	0.8	0.7
Vitamin A (ug/dl)	295	190	113	34

Source: *Journal of Dairy Science* (1987) 61:1033-1060.

McGuirk, U of WI

True colostrum contains twice as much dry matter; three times as many minerals; and five times as much protein as whole milk. It is also higher in energy and vitamins. The high content of vitamins A, D, and E and fat in colostrum are especially important because the newborn calf has low reserves of these nutrients. In addition, the relatively low lactose content of true colostrum reduces the incidence of diarrhea.

Calf management before arrival at SROC at 2-4 days of age:

- Getting calves off to a good start = feeding colostrum
- Prior to pick-up all calves will have received at least 3 feedings of high quality colostrum, navel dipped twice, ear tagged and administered an agreed health program protocol. Unthrifty calves will be not sent to the Calf Raiser (SROC)

Calves that arrive at SROC are picked up twice per week at 2-4 days of age. All calves are fed colostrum at least 3 times before leaving the farm for SROC, as well as having their navel dipped twice, ear tagged and are administered a health program protocol agreed upon between the farm and SROC.

Average initial body weight and serum protein profiles for 2,420 SROC calves, 2003-2006a

Serum protein profiles and % calves

BW,	Av SP	< 4	4.1 to 4.5	4.6 to 5.0	5.1 to 5.5	> 5.6
lb	-----g/dl-----					

All 2420 calves

87.0	5.3	2.5%	13.8%	27.2%	21.1%	35.8%
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2005-2006 (1,153 calves)

87.0	5.5	1.0%	6.9%	26.8%	22.3%	43.0%
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2006 only (787 calves)

87.0	5.5	0.2%	7.6%	23.8%	23.3%	45.1%
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^aserum protein < 5 g/dl (100 ml) calves have higher health risk; between 5 and 5.5 g/dl calves have marginal health risk; goal of > 5.5 g/dl

These are the results of testing for serum protein levels and their weights on 2,420 calves on the day they arrive at SROC between 2003-2006.

Colostrum Feeding Recommendations

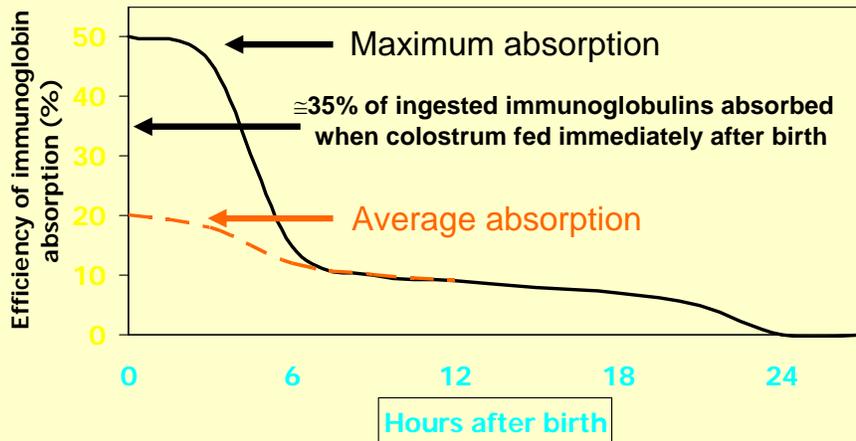
- ALWAYS test quality (>50 g/L)
- For calves over 100 pounds
 - 4 quarts at birth, 2 quarts at 12 hours
- For calves between 50 and 100 pounds (Jersey breed)
 - 3 quarts at birth, 2 quarts at 12 hours
- For calves under 50 pounds
 - 2 quarts at birth, 2 quarts at 12 hours

Good colostrum has more than 50 grams per liter of immunoglobulins. Feeding recommendations are based on weight of the calf.

The initial key to success is passive immunity transfer from colostrum feeding

- Recent Arizona work with Brown Swiss calves given ½ gallon or 1 gallon of colostrum within 1 hour after birth.
- Lower vet cost; 22% increase in pre-pubertal growth under the same conditions.
- Calves fed 1 gallon colostrum within 1 hour after birth had 5% more milk by end of 2nd lactation & 16% increase in survival.

Feed Colostrum within 1 hour after birth



Feed colostrum within one hour after birth. At best, only 25 to 30 percent of the antibodies a calf consumes ever reach the bloodstream. Within six hours, the average ability of the gut walls to absorb immunoglobulins decreases by one third. By 24 hours, the walls absorb less than 10 percent of what could originally be absorbed.

Approximately 35 percent of ingested immunoglobulins can be absorbed when calves are fed colostrum immediately after birth, but this declines to less than 5 percent absorption of immunoglobulins when calves are fed 20 hours after birth. The rate at which gut closure occurs varies from calf to calf, with some calves unable to absorb immunoglobulins 10 hours after birth (See Figure).

Disease on the Calf Operation

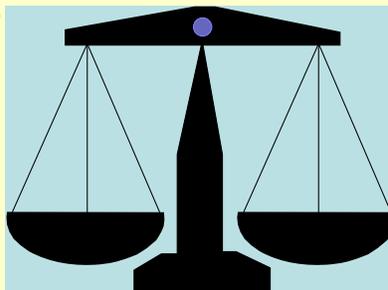
IMMUNITY

(Calf's ability to
fight off disease)

vs.

PATHOGEN LOAD

(Number of
disease-causing
bacteria and
viruses presented
to the calf)

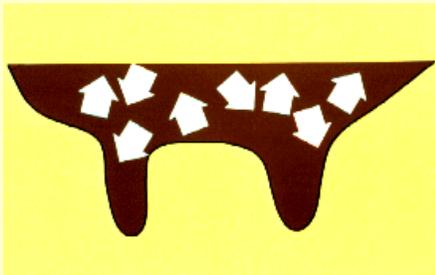


Dr. Steve Hayes

There is an on-going battle in managing disease on the calf operation. On one side of the scale is immunity, or the ability of the calf to fight off disease. On the other side is the pathogen load, or the number of disease-causing bacteria and viruses presented to the calf. The lower the pathogen load on the right, the higher goes the ability to fight off disease on the left side.

Avoid contamination

- Antibodies circulate in the bloodstream and eventually end up in the colostrum.



- Be sure to properly.....



..... and (or) nursing to avoid feeding the calf bacteria.

McGuirk, U of WI

Colostrum quality is typically expressed in terms of IgG, but contaminants also influence quality. Obviously, fewer contaminants mean higher quality. Common contaminants include blood, mastitis, and bacteria. Even good colostrum can be damaged if a cow's udder and teats are not well cleaned, sanitized, and dried before the initial milking or nursing. Do not feed excessively bloody or mastitic colostrum. Regularly maintain and clean milking equipment, especially waste milk cans and their lids. These containers should be cleaned and sanitized just like other milking equipment to minimize bacterial contamination of colostrum.

These antibodies circulate in the cow's bloodstream and eventually end up in the colostrum. Be sure to properly clean, sanitize, and dry a cow's udder and teats before the initial milking or nursing. If you don't, you'll end up feeding the calf any dirt and bacteria that may be on the dam's teats

**Reduce bacterial contamination in colostrum
because.....**

- Pathogenic bacteria cause disease (E. coli scours, Johne's disease, etc.)
- Bacteria can block IgG absorption across the intestine

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Bacteria in colostrum can cause diseases and block IgG absorption.

3 Major Sources of Bacterial Contamination of Colostrum

- Infected gland or fecal contamination
- Contaminated collection, storage or feeding equipment
- Bacterial proliferation in stored colostrum (happens when not stored properly)

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Bacterial contamination of colostrum can come from many sources but the three major ones are listed here.

Approaches to reduce pathogen exposure through colostrum

- Avoid pathogens from infected glands, fecal contamination:
 - Identify infected cows (Johne's)
 - Don't let calf suckle dam
 - Udder prep
 - Don't pool raw colostrum
- Reduce other sources of contamination:
 - Sanitation of milking, storage and feeding equipment
- Prevent bacterial proliferation in stored colostrum
- Feed (<1-2 hrs), refrigerate (<48 hrs) or freeze ASAP
 - Use of preservatives?
- Additional tools:
 - Colostrum replacers (feed 150-200g IgG, efficacy tested)
 - Pasteurize colostrum

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Some key management practices to help prevent bacterial contamination of colostrum.

Bottle vs Tube

Does Volume Fed Matter?

- **Study** – 4 treatment groups. Newborn calf removed from dam < 1 hr old
- **Conclusions:**
 - Producers should feed large volumes of colostrum or colostrum replacer (these calves had highest serum IgG levels)
 - For calves fed a small volume, feeding with a bottle resulted in improved efficiency of absorption and higher serum IgG levels.
 - For calves fed a large volume, method of feeding did not affect efficiency of absorption or IgG levels.

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Biosecurity **(Disease Prevention)**



- Cleanliness
- BVD-PI testing
- Control Access

Three keys to help prevent disease from spreading: 1) always be mindful of keeping pens, feeding equipment, the feed and environment as clean as possible, 2) test for BVD-PI, and 3) control access to all animal housing areas and lots so people, trucks, machinery and equipment cannot spread disease from farm to farm, lot to lot or barn to barn.

Storage and Handling

- Prevent bacterial growth in storage
 - Fed as soon as possible (within 1 h) or cooled to less than 40°F
 - **DO NOT** leave at room temperature
 - ½ h at RT = 2X bacteria
 - Includes thawed colostrum
 - **Pour off and refrigerate**
- Use surplus when fresh not available:
 - Refrigeration (33 to 35°F) good for only 24 hours
 - Freeze (-5°F) continuously for at least 1 year



Storage and handling influence colostrum quality. Colostrum must be fed as soon as possible (within one hour) after collection or cooled to less than 40°F to prevent bacterial growth during storage. Do not let colostrum sit at room temperature; even half an hour at room temperatures during the summer may allow bacterial populations to double. The same problem with bacterial growth can occur after frozen colostrum is thawed. Pouring off the liquid portion periodically as colostrum thaws (and putting it in the refrigerator) will help limit bacterial growth.

Storing high quality colostrum is a good management practice. Surplus colostrum can then be used when good quality, fresh colostrum is not available for a newborn calf. Refrigeration (at 33 to 35°F) can preserve colostrum quality for less than 24 hours before bacterial growth reaches unacceptable levels. For long-term colostrum storage, freezing is the best alternative. Colostrum may be frozen (at -5°F) for up to a year without significant decomposition of antibodies. One report indicated that colostrum was stored for up to 15 years without serious deterioration. 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. Repeated freeze-thaw cycles markedly shorten colostrum storage life.

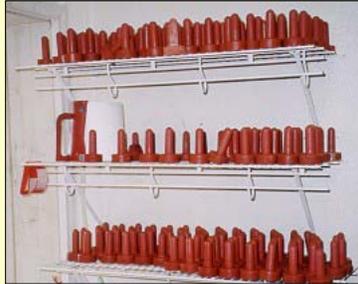
Clean ...and.... Disinfect

- Warm Water Rinse
- Clean with a soap
- Rinse
- Disinfectant or Acid Rinse



Rinse, clean, rinse, disinfect

Keep it Dry



Store pails upside down and do not stack them so they dry inside appropriately.

Keep colostrum on hand



Many dairy farmers make a standard practice of feeding a package of frozen colostrum to all calves born to first-calf heifers....



Colostomy supplements can be added to marginal colostrum, but they **DO NOT** contain sufficient antibodies

It is ideal to keep enough frozen colostrum on hand to feed several calves. A package of frozen colostrum should be used when colostrum is of questionable quality or when it is not available.

Colostrum supplements are another option when high quality colostrum is not available. These products can be added to marginal colostrum when no other source of colostrum is available. Supplements cannot replace high quality colostrum. They do not contain sufficient quantities of antibodies to raise the blood level in calves beyond what average quality colostrum will do.

Frozen Colostrum

- 1-2 quart bottles or 1 gallon plastic bags
- Thaw in warm (not hot, < 120°F) water



- Leukocytes are killed by frozen storage

- If microwave:
 - Use short periods on low power and pour off liquid portion.
 - Extreme heat destroys antibodies



It's a good management practice to periodically freeze surplus high-quality colostrum. You can use frozen colostrum in an emergency when colostrum from a new mother is of questionable quality or when it's not available.

Freezing colostrum in 1- or 2-quart bottles or 1-gallon plastic bags (zipper-closure) is an excellent method of storage. When needed, these containers can be placed in warm (not hot, less than 120°F) water and allowed to thaw. Alternately, colostrum can be thawed in a microwave oven with little damage to the antibodies. It is important to microwave colostrum for short periods on low power and pour off liquid periodically to minimize heating. It is also important to avoid "hot spots" inside frozen colostrum. Use of a turntable can help to minimize antibody damage.

Recent research has indicated that white blood cells (leukocytes) present in colostrum also contribute to the health of calves. Leukocytes in colostrum reduce the effects of bacterial disease in young calves. Leukocytes are killed by frozen storage and are found only in fresh colostrum. Although additional research is needed, it appears that using fresh colostrum from the dam may be the best way to get these disease-fighting cells into calves.

Colostrum Replacement Products

Supplement or Replacer?

- Colostrum replacer contains more immunoglobulin than supplement products.
- Colostrum replacer provides more antibodies than poor or moderate quality colostrum.
- 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

Kehoe, Jones, Heinrichs, Penn St.

There are colostrum supplements and colostrum replacers on the market. Which is better?

Colostrum Replacement Products

- **Do not** use a colostrum “supplement”
- **Use** a colostrum “replacement” product
- They are not all the same
- Must provide:
 - Min of 100 gm IgG/dose (plasma- or lacteal-derived Ig) for absorption in new born calf immediately after birth
 - Nutrients (fat, vitamins, minerals, etc)
 - Cost: \$25 to \$30
 - Convenient, consistent supply of IgG if sufficient clean, high quality maternal colostrum is not available.

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Colostrum supplement and colostrum replacement products are not the same.

Colostrum Replacement Products

Colostrum Replacers --

- Feed separately if also feeding colostrum
- Feed 150-200g IgG in colostrum replacers for success
- Colostrum replacers can be a useful tool to reduce the risk of Johne's transmission.
- Raw colostrum is an important source for transmission of Johne's.
- However, clean teats still goes a long way to reducing bacteria.

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If feeding a colostrum replacement product, do not mix it with colostrum, feed it separately. It is always important to have clean teats when collecting colostrum to reduce bacterial contamination.

Colostrum Replacement Products

Colostrum Supplements --

- Can be used to increase IgG fed to calves, but they cannot replace high quality colostrum.
- Do not contain sufficient quantities of antibodies to raise the blood IgG level beyond what average quality colostrum will do.

Colostrum Replacers –

- Contain greater levels of IgG and other nutrients
- An effective, convenient method of providing passive immunity to calves when maternal colostrum is not available.

Kehoe, Jones, Heinrichs, Penn St.

Remember, there is a difference between colostrum supplements and replacers. Supplements cannot replace high quality colostrum and do not contain sufficient quantities of antibodies to improve average quality colostrum.