Colostral Management: Enhancing Dairy Calf Health
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For our Colorado Dairy News readership, focusing a Standard Operating Procedures (SOP) protocol on colostral management seemed like a good place to start. We believe most dairy producers have become increasingly aware of the importance of replacement heifer health. Not only can disease episodes become a major financial problem, but these animals represent the future producing herd. Calves that require treatment for disease tend to be less productive in the long run, and production efficiency is negatively impacted if heifers fail to grow and begin milk production by 2 years of age.

At birth, the baby calf is highly susceptible to disease and has been provided with very meager nutritional reserves. The dam's colostrum specifically provides elements that enhance the calf's disease defenses and fulfills many nutritional needs. Therefore, colostrum can be viewed as the single most important nutritional factor for the newborn calf and management practices that enhance the appropriate supplementation of colostrum to newborn calves are critical for increasing calf survival.

Immunoglobulins (also known as antibodies or gamma globulins) are proteins that the body manufactures to attach to invading organisms and neutralize them. Specific immuno-globulin (Ig) will therefore be manufactured against specific organisms. The process of passive transfer of Ig involves the secretion of Ig by the dam into the colostrum, the consumption of the colostrum by the newborn calf, and subsequently the absorption of the Ig through the intestinal wall and into the calf's circulation. The absorbed immuno-globulins protect the calf against systemic invasion by microorganisms, thus are a critically important aspect of the calf's immune defense system.

It is important to realize that passive immunoglobulin transfer is not a simple "yes" or "no" equation. Acquisition of Ig does not guarantee the calf a disease-free future. To protect the calf against disease, the immunoglobulin has to be present at the right place where the organism is invading, must be present in sufficient quantity to neutralize the agent, and must be of the appropriate immunoglobulin type to attach to the specific invading or-ganism. Whether a calf remains healthy or develops disease will depend on the balance between disease exposure versus disease defenses.

Because circulating Ig is effective in preventing microorganism invasion, passive Ig transfer is primarily responsible for preventing invasive bacterial infections. Absorbed immuno-globulin is not nearly as effective at preventing localized enteritis (neonatal calf scours). Agents such as rotavirus, coronavirus, and Cryptosporidia only affect the superficial lining of the gut wall and it appears that circulating Ig has limited efficacy in preventing this type of infection. Numerous studies suggest, however, that the severity of diarrhea in enteric disease of neonatal calves and the ability of affected calves to survive is positively influenced by increased circulating Ig. Although passively acquired Ig cannot prevent all calf diseases, virtually all studies of neonatal calf performance show a

positive benefit of high circulating immunoglobulin concentration on neonatal calf health and survival.

Factors Involved in Passive Transfer

The two most important factors in passive Ig transfer are the total immunoglobulin mass that is ingested and the time after birth when the colostrum is received. The immuno-globulin mass is a combination of Ig concentration in the colostrum and the amount of colostrum fed. The product of these two factors is the total immunoglobulin available for absorption by the calf's intestine.

The volume of colostrum produced by a cow is generally not a limiting factor in dairy operations. The volume of colostrum consumed, however, determines the amount available for ab-sorption and this is determined by the amount the calf suckles or is fed. Some producers let the calf suckle the dam and it might be expected that this would be an efficient method. This method of feeding can be associated with a significant rate of failure of passive transfer. Factors that contribute to this failure include poor mother-ing ability by the dam, dam sickness at parturition, poor udder conformation and/or teat structure, and poor calf viability or sucking ability. All of these factors can lead to inadequate voluntary consumption by the calf. It is noteworthy that dairy calves have less vigor and poorer suckling drive than beef calves where this method of colostral consumption is the norm.

Colostral immunoglobulin concentration can vary tremendously between cows. Older cows generally produce higher quality colostrum than heifers but there is also wide variation between individuals, even in multiparous cows. The immunoglobulin con-centration of colostrum can be estimated by measuring its specific gravity and a commercially device is available for this purpose. This colostrometer can be valuable in helping select the cows from which colostrum is fed to the newborn calf. Variations in first milking immuno-globulin concentration can easily range from 20 to 80 mg/ml, or a four-fold difference.

Recommendations for the minimum immunoglobulin mass that a newborn calf should receive are about 100 gm of immunoglobulin. A more appropriate aim would be to provide between 200 to 300 grams; thus, 4 liters of colostrum at 50 mg/ml would provide 200 gm im-munoglobulin to the newborn calf, well in excess of the suggested minimum.

The time at which colostrum is fed to the newborn calf is also very important. The earlier the calf receives an appropriate amount of immunoglobulin, the better the absorption will be. The recommen-dation must be that colostrum is fed as soon as possible after birth and preferably within the first two hours of life. Delaying the first colostral feeding beyond six hours of life has been shown to decrease the efficiency of im-munoglobulin absorption and increase the calf's susceptibility to disease.

The method of feeding colostrum to calves has also been investigated. These studies suggest that suckled colostrum provides better passive transfer to the calf. In many cases, however, this is impractical and it is frequently better to ensure colostral inges-tion than

to wait until the calf consumes the colostrum by nipple feeder. Feeding colostrum via nipple feeder is a good practice but it may require inordinate amounts of time for calves with weak suckle reflex. Administration of colostrum by an esophageal feeder will introduce the colostrum into the rumen rather than the abomasum. When sufficient volume is provided, however, the majority will pass rapidly into the abomasum and allow adequate absorption, even though the efficiency of ab-sorption may be slightly impaired.

Management of Colostral Feeding

Knowing that immunoglobulin absorption is critical to optimal calf health and knowing the factors that are most influential in passive Ig transfer provides some simple guidelines for colostral feeding.

The calves at highest risk of contracting neonatal disease are those from first calf heifers. In general, heifers will have the highest rates of dystocia and this in turn will reduce the viability of their offspring. Dystocia has far reaching effects on the well being of a calf but included among its effects are a reduced suckle reflex and increased time to first standing. Under unmanaged or natural suckling conditions, this reduced viability contri-butes to a very high rate of failure of passive transfer in affected calves. In addition, the dam has poorer colostrum on average than her older herdmates, compounding the effects of delayed time to suckling and reduced volume of colostral consumption.

Monitoring the success of passive Ig transfer to newborn calves is a very important aspect of the colostral management program. Measuring calves' blood protein con-centration can be easily and economically accomplished and should be routinely performed on a percentage of calves less than seven days old. Adjustments in the colostral program should be considered on the basis of these measurements. Equally important is a system to monitor calf health or disease problems. Colostral transfer is very important but by no means the only factor influencing calf disease. A monitoring system that provides information on both colostral transfer and disease occurrence is invaluable in helping direct management changes to improve calf health. The herd veterinarian should be involved in diagnosis of specific disease problems. Some diseases, such as calf septicemia, can be very responsive to changes in colostral management. Others, such as calf scours, are less responsive to colostrum, and their control requires close attention to other management features.

Nonimmunoglobulin Components of Colostrum

Factors besides immunoglobulin are also secreted into the colostrum. These include immune-acting cells and a variety of nonim-munoglobulin proteins. The more standard nutritional elements are also present in far greater abundance in colostrum than in normal cows' milk. The total solids in colostrum are approximately double those found in milk. Fat percentage is approximately 50% increased, while protein content is more than quadrupled. The bulk of the increased protein is of course immuno-globulin but casein content is also double that found in milk. Lactose is the only major constituent of colostrum that is lower (approximately 50%) than the level in normal milk. Thus, while the newborn calf's body reserves are not extravagant, the feeding of colostrum provides the calf with an abundance of protein and energy.

Associated with the high levels of fat in colostrum, the fat soluble vitamins A, D and E are also present at four to eight times normal milk levels. Vitamin B12 is available at an 8-fold higher concentration. The macrominerals (calcium, phosphorus and magnesium) are at double to quadruple normal milk levels, while the micronutrients (e.g. copper, iron, zinc, cobalt) are present at 5 to 20 times normal milk levels. Aside from its value as a source of immune enhancement, colostrum provides the calf with critically impor-tant nutrients.

Summary

In the evaluation of dairy calf nutrition, one of the most important areas is the provi-sion of colostrum to the newborn calf. Colostrum provides not only high quality and high density nutrition in the conventional sense of energy, protein, vitamins, and minerals, but is also the single most important factor in the enhancement of neonatal calf immune defenses. A variety of factors are involved in the establishment of good passive immunoglobulin transfer to calves and most of these factors can be positively influenced by a good colostral management scheme. Despite increased knowledge about the importance of colostral management in dairy calf health, recent surveys show inadequate passive transfer in 40 to 65% of dairy calves with a resultant negative impact on dairy calf health and survival. The institution of good colostral management practices can have a substantial impact on overall calf performance.

Standard Operating Procedures: Guidelines for Colostral Management

MANAGEMENT OF COLOSTRAL SUPPLY
Selection of Donors

Biosecurity Concerns: Identify diseases of importance to the operation

Identify disease problems that can be influenced by colostral management

For problems that can transfer via colostrum (e.g. Johne's disease, BLV) colostral donors should be preselected based on negative status by testing.

Do not pool colostrum from infected animals.

Feed colostrum only from the calf's dam or a preselected donor.

Clean teats and udder before milking colostrum from the dam.

Quality concerns: Healthy dams with prolonged residence at the farm

No precalving milking or milk loss

Only first milking colostrum should be given during the first 14 hours of life

For diseases that can be prevented, or decreased by colostrum (e.g. E. coli K99, Clostridial disease) donors should be vaccinated appropriately.

Monitor colostral quality with a colostrometer and exclude lower quality colostrum from the first feedings.

For calves whose dam produces inadequate colostrum, use colostrum from a preselected donor

Maintain a frozen bank of high quality colostrum for use as needed.

Frozen colostrum should be stored from individual donors, identified as described above

MANAGEMENT OF COLOSTRAL FEEDING
Remove the calf from the maternity area as soon as possible.

Do not allow calf to suckle from the dam or other maternity pen cows

Feed a minimum of 5% of body weight (typically two quarts) at each colostral feeding

Feed first within two hours of birth and again within 12 hours of birth.

Several methods of feeding are acceptable.

After the first two feedings, continue to feed colostrum from later milking and of lower quality for its nutritional value.

MONITORING THE PROGRAM
On a routine, periodic basis (monthly), monitor calf health:

Incidence of specific diseases

Age of disease onset

Response to treatment

Death rate

Growth rate

On a routine periodic basis (monthly), monitor blood of calves less than seven days old with no signs of illness or dehydration for Ig content. At a minimum, calves should have greater than 1,000 mg/dl IgG or greater than 5.5 gm/dl total protein. More optimally, IgG should exceed 2,000 mg/dl and total protein concentration should exceed 6.0 gm/dl.