Many factors contribute to the size, health, and productivity of dairy cattle. One such factor occurs in the first day of a calf’s life. The ability of a calf to absorb antibodies from colostrum occurs only within about 24 hours after birth. These antibodies, biochemically referred to as immunoglobulins, contribute to the calf’s ability to resist infections. After 24 hours, the calf no longer is able to absorb immunoglobulins via the intestine. Therefore, if a calf has not received an adequate amount of quality colostrum, the calf may not be able to resist disease. An animal that has been sick as a calf often has other health problems later in life which in turn may result in a decrease in productivity.

Many mammalian species do not have an effective immune system when born, including the calf. Immunoglobulins ingested as part of colostrum are the calf's sole immunity to infectious diseases until the calf's own immune system develops. Colostrum contains several types of immunoglobulins (Ig), including IgG1, IgG2, IgA, and IgM. Immunoglobulin G1 constitutes about 85 percent of the total immunoglobulins in cow colostrum and is absorbed in the largest amount by the gut of the calf. The uptake of immunoglobulins by the calf's intestine is a process that does not last long. The gut "closes" or ceases uptake of Ig at about 24 hours after birth. There seems to be a progressive decline in the uptake of Ig with 50 percent to 75 percent of the total absorptive capacity occurring within twelve hours after birth. Therefore, consumption of colostrum during the period shortly after birth is vital to the calf's health and survival. In addition, for maximum immunity levels to be reached, it is important that the calf receive an adequate amount of good quality colostrum. However, consumption of an adequate amount of good quality colostrum is influenced by many factors, as is the efficiency of intestinal absorption of immunoglobulins. Some of the major factors which contribute to the absorption of adequate quantities of immunoglobulins in the calf are given below, as well as ways to minimize any negative effects of these factors.

1. **Low immunoglobulin concentration in colostrum.** A low immunoglobulin level in colostrum can result in inadequate uptake of Ig by the calf. Several factors have been found to affect Ig concentrations in colostrum. Age of the dam influences colostral Ig, with first calf heifers having lower concentrations than older cows. This can be accounted for by checking colostrum quality with a colostrometer and by freezing excess colostrum saved from older cows. Prepartum milking will decrease Ig concentrations in the colostrum during the period when the calf is born. Diet also seems to affect Ig concentrations in the colostrum. A diet that consists of more grass or hay and lacks the "extra" nutrients to challenge a cow seems to increase Ig levels in colostrum. Some research has indicated immunizing with a mixed vaccine about 6 weeks prepartum also may increase Ig in colostrum.

2. **Thawing frozen colostrum.** Rapid thawing of colostrum in boiling water or on high microwave settings can destroy proteins resulting in a substantial reduction of colostrum quality. To minimize degradation of frozen colostrum, thaw gradually in warm water or microwave on a low setting.

3. **Inadequate amount of colostrum received.** An inadequate amount of colostrum received by the calf can result in insufficient immunoglobulins available for transport in
the gut before closure occurs. Several factors can contribute to less immunoglobulins available for absorption. Size of calving area influences colostrum intake; freshening cows among the herd can allow the neonate to suckle any cow's teat which can result in the young's first meal being whole milk rather than colostrum. A difficult birth requires recovery time for both the dam and calf. If left alone to recover and then expected to suckle when strong, the optimal absorption time may have past by the actual time that the calf receives colostrum. Other physical factors which can hinder an adequate amount of colostrum the calf receives include: poor udder conformation, weak neonate, anxious/nervous mother, and milk fever. Feeding a sufficient amount of colostrum shortly after birth and periodically thereafter can reduce problems associated with this factor.

4. **Using an esophageal tube.** Tube-feeding a calf negates the purpose of the esophageal groove, allowing colostrum to enter the immature rumen instead of by-passing it. Colostrum which enters the rumen requires a longer time to reach the site of absorption, the intestine. Fullest benefit of absorption time can be achieved by minimizing esophageal tube-feeding, or if tubing must be done, by giving the neonate a larger amount.

5. **Stress.** Glucocorticosteroids released during stress can cause premature closure of the gut. Factors resulting in stress such as heat, environment (temperature, pen size, age of grouped animals) and absence of the dam (transition and lack of nurturing) should be kept to a minimum to ensure maximum absorption.

6. **Genetics.** There may be genetic components to passive transfer in antibody uptake from the blood in the dam and Ig uptake in the calf, although these components have not been specifically identified. Also, onset of active immunity in the calf may be genetically linked.

7. **Season.** Time of year seems to effect absorption of immunoglobulins. Calves born in the fall may have an increase absorption of Ig.

8. **Sex of calf.** It has been shown that heifer calves have a higher absorption rate than males.

After reviewing these factors, several questions may come to mind, such as 1) can some of the variability in colostrum quality be off-set by using colostrum supplements and 2) what is an adequate amount of colostrum. The latter question will require a long-term series of investigations to answer. However, we have conducted a preliminary experiment addressing the first question concerning supplementation of colostrum. Our objective was to determine the effect on IgG1 levels in calves when mixing a dried colostrum powder with pooled colostrum.

**Methods**--Eleven newborn calves from the University of Illinois dairy farm were separated from their dams at birth prior to nursing. Calves were randomly assigned to one of two treatment groups: Treatment 1 (6 calves) received a pooled colostrum and
Treatment 2 (5 calves) received the pooled colostrum mixed with 272 grams of a dried colostrum powder. Pooled colostrum was chosen to represent marginal quality colostrum, as indicated by a colostrometer reading in the yellow zone, and by a marginal IgG1 concentration 28 milligrams/milliliter (mg/ml). Calves were fed their respective treatment (2 liters) within three hours after birth and their second treatment feeding (2 liters) twelve hours later. All feedings after 12 hours were with whole milk. Blood samples were taken from the jugular vein at 0 (immediately prior to the first feeding), 4, 8, 12 (immediately prior to the second feeding), 24, and 48 hours. Blood samples were allowed to clot and serum collected. Sera were analyzed by radial immunodiffusion for IgG1. The levels of IgG1 in the calf’s blood indicates the amount of absorption from colostrum.

**Results and Conclusions** -- The results (Figure 1) suggest that adding the dried colostrum to the pooled colostrum was not of benefit to the calf. Mixing the dried colostrum with the pooled colostrum resulted in a viscous liquid which often was difficult to feed. A lack of positive results from supplementation may have been the result of a decreased availability of immunoglobulins for intestinal absorption from the viscous fluid.

Many colostrum supplements have a total immunoglobulin content of less than 10 to 25 grams per dose (5-12.5 mg/ml). Good quality colostrum has a total immunoglobulin concentration of greater than 60 mg/ml. It is easy to recognize that colostrum supplements are generally lacking vital immunoglobulins that the calf requires to achieve adequate immunity. Some colostrum supplements contain cheese whey, dried whey, or colostral whey, while others contain bovine colostrum. However, those with bovine colostrum immunoglobulins may not be of sufficient levels to achieve substantial absorption. All in all, colostrum supplements should not be a replacement for feeding high quality colostrum. It appears that the real thing can not be beat. Yet, the question remains on how to utilize this natural gift to its fullest potential. The answer to what is an adequate amount of colostrum for a calf remains to be answered.
Figure 1. Effects of feeding supplemental dried colostrums on serum IgG1 in calves