

Antibody Absorption

A newborn calf's resistance to disease is partly a consequence of the timing of colostrum intake: Sooner is always better than later.

In the most general terms we know that calves can absorb antibodies (and any other large molecules and/or whole cells) through their gut wall. This provides protection from disease. The efficiency of antibody absorption is higher the closer the feeding of colostrum is to the birth of the calf.

How are antibodies transferred?

To move antibodies from maternal colostrum into the calf's circulatory system a special category of cells, called enterocytes, have to:

- absorb these macromolecules,
- transport them across the cell
- deposit them into the lymphatic system.

This absorption process is called pinocytosis. (Bush, L.J. 1980) One-third of the gut's absorptive ability is lost within 6 hours. For practical purposes on farm, we may assume that virtually all absorption ends at 24 hours after birth. This is the basis of the best management practice of feeding colostrum to newborn calves as soon as practical after birth.

It is thought that this decrease in absorption is due to both the replacement of enterocytes by more mature intestinal cells (gut maturation) and the exhaustion of pinocytotic capability. (Weaver, 2000) In other words, the calf runs out of functional enterocytes.

How quickly do antibodies start providing protection against infections?

The transfer process that takes place within enterocytes is relatively slow. And, once the IgG molecules are released into the lymphatics they still must move from the abdomen to the heart to gain access to the entire circulatory system.

Therefore, IgG concentrations in blood do not start to increase until roughly 4 hours after colostrum feeding. Then IgG levels rise rapidly over the next 12 hours before reaching a plateau where the rate of increase is quite slow. Due to ongoing transport of IgG across the enterocytes, small insignificant increases in IgG levels may continue for about 32 hours after the first colostrum feeding (Weaver, 2000, Heinrichs, A. J.,2009).

Sam Leadley, Calf & Heifer Management Specialist

sleadley@yahoo.com www.atticacows.com

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Another factor favoring the early feeding of colostrum is that the gastrointestinal environment at birth favors the survival of intact protein molecules. This environment changes rapidly, virtually by the hour. By 24 hours a high proportion of protein molecules like antibodies are being digested and are no longer available for absorption.

As long as a calf does not get anything by mouth the decline in pinocytosis may be delayed as long as 36 hours. However, given on-farm circumstances virtually every calf ingests some macromolecular material from her environment (unfortunately, this often is adult cow manure) within minutes of birth, thus starting the gut closure process.

References: Weaver, D.M. and Others "Passive transfer of colostral immunoglobulins in calves." J. Vet. Intern. Med. 14: 569-577 (2000). Bush, L.C. and T.E. Staley "Absorption of colostral immunoglobulins in newborn calves." Journal of Dairy Science 63:672-680 (1980). Heinrichs, A. J. and J.A. Elizando-Salazar "Reducing failure of passive immunoglobulin transfer in dairy calves." Revue de Medecino Veterinaire 160:436-440 (2000).