



“Characterization of Fc $\gamma$  (gamma) receptor II (CD32) on B lymphocytes and its role in modulation of antibody responses in neonates”

## IMPROVING IMMUNE RESPONSE IN NEWBORN CALVES

**PROJECT NO.:** 0007-110

**RESEARCH INSTITUTION:** University of Guelph

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**Background:** Newborn calves are susceptible to many microorganisms that can cause respiratory and gut diseases. Antibodies from the cow’s colostrum help provide protection from these diseases during the first few weeks of life. This is known as passive immunity because it comes from the cow rather than the calf’s own immune response. Vaccination may not be very effective during the first few weeks because antibodies from the colostrum may bind the vaccine antigens. Vaccination will not work very well until the passive immune protection from the maternal antibodies declines, and the calf begins to develop its own active immunity. Between the time when the passive (maternal) immunity declines and the calf’s (active) immunity develops the calf may be particularly susceptible to disease. As a result, industry would benefit from vaccines that could produce early, active immunity in calves before the maternal antibodies drop below a protective level. This would provide continuous immune protection to calfhood diseases.

B lymphocytes (B cells) play a large role in active immune response by detecting and responding to foreign organisms. Antigens (substance that causes the production of antibodies) attach to membrane IgM receptors,

signaling the activation of B cells. Receptors CD21 and complement component C3d further enhance the immune response of B cells, while CD32 (the maternal antibody receptor) inhibits response.

**Objectives:** To determine the extent to which immune response in young calves is age dependent and if immune response can be modified, identify agents which enhance antibody response in young calves, and determine whether those agents can be used to develop vaccines that will work in young calves that still have maternal antibodies from colostrum.

**What they did:** The researchers examined B cells in calves up to 6 months of age. Through a new genetic test, two more variants of the CD32 receptor were discovered that had never been reported in cattle. Initial experiments focused on the complement component C3d as a natural vaccine adjuvant to boost immune response.

**What they learned:** At birth, the number of B cells in the bloodstream was less than 20% of that in adults. B cell numbers increased to adult levels by 6-7 weeks of age, which is the time calves normally respond to conventional vaccines. Although 90% of B cells in blood expressed both CD21 (enhancing) and CD32 (inhibitory) receptors at birth, the expression of both receptors was lower in young calves. In addition, the different forms of the CD32

receptor may inhibit active immune response differently.

Varying formulations of C3d alongside a model antigen were developed as vaccines and given to 7 month and 2 week old calves to test for any negative reactions. No toxic effects were observed. Dr. Douglas Hodgins at the Ontario Veterinary College then investigated C3d's inclusion into vaccines and its potential to boost active immune response. A summary of that project, Challenges to developing an effective vaccine for newborn calves, can be found on the BCRC website at <http://www.beefresearch.ca/factsheet.cfm/challenges-to-developing-an-effective-vaccine-for-newborn-calves-39>.

**What it means:** This research provided a great deal of knowledge about the complex interactions between various cell types that function together to create an immune response. The cellular changes underlying the transition from passive (maternal) and active (calf's own) immunity had not been well characterized in cattle, and this research helped to clarify some of those changes. Although this research did not produce a vaccine for newborn calves, it did provide a great deal of insight into the inner workings of the immune system which will help future research develop vaccines that are more effective at a younger age.



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