Effects of Glutamine Supplementation on Lymphocyte Subpopulations and Proliferation in the Peripheral Blood Supply of the Transition Dairy Cow

J. A. Woodward[1], C.J. Field[1], S.D. Goruk[1], J. Bell, G. K. Murdoch, J.R. Thompson[2], M.A.G. von Keyserlingk[2] and R.J. Christopherson[1]
[1]Department of Agriculture, Food, and Nutritional Science, University of Alberta
[2]Faculty of Agricultural Sciences, The University of British Columbia

Most infectious and metabolic diseases occur in dairy cows 2 weeks following parturition when they tend to be immunosuppressed and in negative energy balance. Glutamine has been shown in a number of species to play a key role in supporting immune cell proliferation and function in stressed animals. In this experiment, we supplemented transition dairy cows with glutamine in an attempt to elevate post-calving circulating glutamine concentrations and to reduce the degree of immunosuppression. Cows received either glutamine [0.25 mmol·kg$^{-0.75}$h^{-1} (n=9) or 0.50mmol·kg$^{-0.75}$h^{-1} (n=10)] or saline (n=9) infusions for 7 days, 8 hours·day^{-1}, commencing on the day of calving. Mean plasma glutamine concentration before calving (day –7) was 61.4 ± 3.0nmol·ml^{-1} in the control treatment, and decreased to 46.9 ± 3.6nmol·ml^{-1} by day 7 after calving. The other two treatment groups followed a similar pattern, though the decrease was attenuated by the glutamine infusion. Plasma glutamine concentrations on day 7, four hours into the infusion were 49.0 ± 2.98nmol·ml^{-1} for the control group, 63.8 ± 4.4nmol·ml^{-1} for the 0.25mmol·kg$^{-0.75}$h^{-1} group, and 76.0 ± 10.4nmol·ml^{-1} for the 0.50mmol·kg$^{-0.75}$h^{-1} group. Lymphocytes from the peripheral blood supply were isolated 7 days prior to and on days 0, 7, 14, and 21 following calving. Using immunofluorescence and flow cytometry the percentage of gated cells belonging to various lymphocyte subpopulations was determined. The ability of lymphocytes to proliferate when incubated with and without mitogens was determined by thymidine uptake. Animals supplemented with glutamine had significantly higher percentages of naive T cells and B cells, as indicated by detection of the CD62L marker. On days 0 and 21 glutamine treated animals had significantly higher percentages of both T cells and B cells than control animals (Fig. 1). Although there were no differences between treatments for the ability of the lymphocytes to respond to mitogens, unstimulated lymphocytes from control animals had significantly higher thymidine uptake than lymphocytes from glutamine supplemented cows. Together, the evidence indicates that control animals have an activated immune system in comparison to glutamine treated animals. Further studies investigating function of immune cells in the gastrointestinal tract, a major infection site, as well as determining plasma concentrations of glutamine in treated and control animals, will be necessary in order to determine possible causes for the difference in activation levels of glutamine supplemented and control cows.

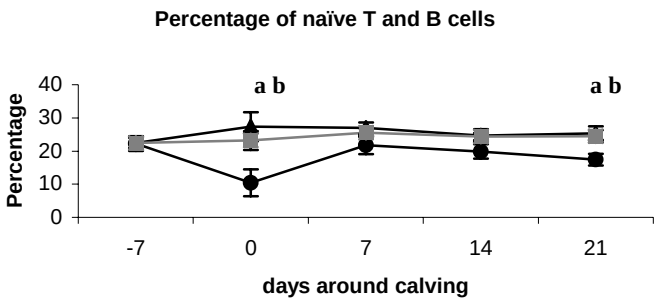

Figure 1: Percentage of gated lymphocytes from whole blood samples positive for CD62L antigen.
a: significant difference between 0.50mmol·kg$^{-0.75}$h^{-1} glutamine infusion (grey squares) and control (black circles);
b: significant difference between 0.25mmol·kg$^{-0.75}$h^{-1} glutamine infusion (black triangles) and control (black circles).