

tively), but IM and SC were not different ( $P=0.29$ ). Similarly, plasma alpha-tocopherol:cholesterol mass ratio was higher ( $P < 0.01$ ) in IM and SC than in controls ( $4.03, 4.26$  and  $2.75 \times 10^{-3}$ , respectively), but there was no significant difference among the treated groups ( $P=0.5$ ). Plasma  $\alpha$ -tocopherol:cholesterol mass ratio peaked on day two after injection for both IM and SC, and was not different among these groups. IM-treated cows maintained higher ( $P < 0.05$ ) plasma  $\alpha$ -tocopherol:cholesterol mass ratio than the control animals for seven days, while SC animals were higher for 14 days after the injection. Treated animals sustained higher plasma  $\alpha$ -tocopherol from 10 days before calving to one day after calving with no difference between the

treatment groups. There were no significant treatment effects on neutrophil  $\alpha$ -tocopherol concentrations, but these were numerically higher in IM and SC cows than in controls ( $0.20, 0.14$  and  $0.1 \mu\text{g}/10^6$  neutrophils, respectively), and followed a similar pattern to the changes in plasma concentrations.

### Significance

These results suggest that, if used, vitamin E should be injected within one week of expected challenge, and that SC administration is as effective at raising circulating vitamin E concentrations as IM injection.

## Preliminary Results from a Field Study to Investigate the Relationship between Colostrum Quality and Management and Serum Immunoglobulin Concentrations in Dairy Calves

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### Introduction

Results of two large national studies indicate that the national preweaning mortality rate in dairy heifers has improved very little over the past ten years (10.8% in National Animal Health Monitoring Systems (NAHMS), 1993, 8.7% in NAHMS, 2002). Failure to reduce mortality in preweaned dairy heifers is partially attributable to poor colostrum management practices. In 1993 (NAHMS), 41% of 2177 calves sampled between 24 and 48 hrs of age suffered from failure of passive transfer (FPT), or low serum immunoglobulin G (IgG) concentrations. Numerous studies have demonstrated that failure of passive transfer (FPT; calf serum IgG concentration  $< 10 \text{ mg/ml}$ ) is associated with a significant increase in risk for morbidity and mortality in the period between birth and weaning (Fowler, 1999; Wells *et al.*, 1996). Conventional factors considered to be important in an effective colostrum management program

have included quantity of colostrum fed, quality of colostrum fed (IgG concentration) and quickness (or age at first feeding). Offering a second feeding of colostrum is also frequently recommended. Recently, calf management experts have also begun to evaluate colostrum cleanliness (total bacteria count or total coliform count) as another potentially important factor. Limited studies have suggested that bacteria counts in colostrum not only serve as a pathogen source, but may also reduce efficiency of IgG absorption in the gut. The objective of the current study was to evaluate the relationship between serum IgG concentrations in dairy calves and the aforementioned colostrum management factors (colostrum quantity, quality, quickness, cleanliness).

### Materials and Methods

A field study was performed between July and September 2003 in 12 commercial Holstein dairy herds in

Minnesota and western Wisconsin. Records kept for newborn Holstein calves included age at first feeding (hours), volume of colostrum fed at first feeding and whether or not a second feeding of colostrum was offered. Farm staff also collected and froze a sample of colostrum immediately prior to feeding each calf. A study technician visited the farm once per week to collect frozen colostrum samples and to collect a venous blood sample from all calves between 24 hours and 8 days of age. Calf serum and colostrum samples were tested for total IgG concentration (mg/ml) using a turbidometric immunoassay (TIA; College of Veterinary Medicine, University of Minnesota). Colostrum samples were also submitted for culture for total coliform counts (CFU/ml) and total plate counts (TPC, CFU/ml; Udder Health Laboratory, University of Minnesota).

Descriptive statistics were produced, and then univariate regression analysis was performed (Proc Mixed, SAS Version 8.2) to investigate the relationship between the dependent variable of interest (serum IgG concentration) and each of the following explanatory variables of interest: age at first feeding (hours), volume at first feeding (qts), second feeding offered (Yes/No), colostrum IgG concentration (mg/ml), colostrum total bacteria count log (CFU/ml) and colostrum coliform count log (CFU/ml). All regression models controlled for farm as a random effect. Covariates that were significant at  $P < 0.20$  in the univariate analysis were carried forward into a multivariate model, and a backwards stepwise approach used to eliminate covariates until all remaining covariates were significant at  $P < 0.05$ . The possible presence of interaction terms was explored between all remaining significant covariates.

## Results

At the time of this preliminary analysis, complete laboratory data were available for approximately 171 calves enrolled into the study. Mean serum IgG concen-

tration for study calves was 14.8 mg/ml (SD = 7.2; 2.2-38.6). Mean IgG concentration for the colostrum fed was 76.5 mg/ml (SD 30.2; 8.8-185.7). Mean age at first feeding was 1.4 hours (SD = 1.0; 0.25 – 9.0). All but one farm fed four quarts of colostrum at the first feeding (the remaining farm fed two quarts). Mean total plate count for the colostrum samples collected was 2.1 billion CFU/ml (median =  $420 \times 10^8$  CFU/ml). The mean total coliform count for the colostrum samples collected was 185 million CFU/ml (median = 7 million CFU/ml). Univariate analysis showed that there was a significant relationship between serum IgG concentration and both colostrum IgG concentration (mg/ml) (estimate = 0.14 (0.02) mg/ml;  $P < 0.0001$ ) and age at first feeding (hours) (estimate = -0.96 (0.46) mg/ml;  $P = 0.036$ ). Multivariate analysis, including these two covariates, showed there was a significant positive relationship between serum IgG concentration and colostrum IgG concentration (mg/ml) (estimate = 0.15 (0.02) mg/ml;  $P < 0.0001$ ) and there tended to be a negative relationship with age at first feeding (hours) (estimate = -0.82 (0.53) mg/ml;  $P = 0.13$ ). None of the other covariates investigated were associated with serum total protein concentration in the calf.

## Significance

While preliminary in nature, the results of this study confirm that colostrum quality and age at first feeding are significant factors in improving passive transfer of immunity in dairy calves. Volume at first feeding could not be adequately assessed in this study because all but one participating herd fed four quarts of colostrum at first feeding. Preliminary data suggested that bacteria counts in colostrum were not associated with serum IgG concentrations in the calf. Results of analysis of the final data set will be presented.