Health benefits of Il-10 egg yolk antibodies administered to milk-fed dairy calves

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Introduction

Cryptosporidium parvum infection in calves causes villous atrophy, resulting in reduced surface area and absorptive capacity of the small intestine. Prevention and treatment of *C. parvum* infections are hindered by a lack of approved, efficacious products and inadequate colostral immunity. An integral component of infection is the dampening of the cell-mediated response by inducing anti-inflammatory cytokines. In calves, ileal intraepithelial lymphocytes express interleukin-10 (Il-10) when infected with *C. parvum*. Interleukin-10 decreases production of interferon-gamma, which is a vital Th1-associated cytokine. Studies have shown that Il-10 knockout mice are resistant to *C. parvum* infection. Oral administration of chicken egg yolk antibodies as a means of controlling enteric disease in calves is of interest to the dairy industry. Egg yolk Il-10 antibodies have been shown to survive gastrointestinal transit, are accessible in the intestinal lumen, and remain locally active, without persistence of systemic residues. Therefore, the objective of this trial was to investigate the effect of feeding Il-10 antibodies on calf health and performance after natural *C. parvum* infection in pre-weaned Holstein dairy calves.

Materials and Methods

A double-blinded, randomized, controlled clinical trial was conducted at a dairy calf ranch in Southern Wisconsin. Holstein dairy calves (n=134) were enrolled at 1-3 d of age during a 2-week period. The calves were randomly assigned on arrival to the farm into a treatment group (TX, n=62; fed 0.96 g egg yolk powder with IL-10 antibody once daily for 11 d) and a control group (CN, n=72; fed 0.96 g of egg yolk powder without IL-10 antibody once daily for 11 d). The Anti-bovine Il-10 peptide IgY antibodies were derived from egg yolks of laying hens inoculated and boosted with a bovine Il-10 peptide conjugated to bovine gamma globulin. All treatments were mixed individually into whole milk. Health scores consisted of attitude, appetite, temperature, oculonasal discharge, cough, ear position, navel and joint assessment. All calves were scored daily for 14 d and once on d 56. Fecal pH and *C. parvum* testing (real-time PCR) were performed on d 5 and 14. Growth, health score, and antibiotic use were documented at the conclusion of the trial on d 56. Specific outcomes of interest included health score, cycle threshold of detection of *C. parvum*, average daily gain, percent respiratory disease and fecal pH. Wilcoxon signed rank tests were used to compare TX and CN groups, as data was not normally distributed. Alpha was $P<0.05$ for all comparisons.

Results

Median days of diarrhea were different between the two groups during the first four days of the study (TX=0.5 vs CN=0.4; $P=0.02$). Although not significant, there was a trend of decreased fecal shedding of *C. parvum* in the treatment group at d 14 (TX=36.2 vs CN=35.1; $P=0.08$). Fecal pH was increased in the TX group on day 14 (TX= 6.7 vs CN=6.3; $P=0.004$). Average daily gain was higher in the CN group (TX=1.65 lbs/day vs. CN=1.72 lbs/day; $P=0.03$). On d 56, 8% of TX calves had respiratory disease compared to 21% of CN calves ($P=0.04$). In addition, 11.1% of TX calves were given antibiotics by farm personnel compared to 25.8% of CN calves ($P=0.03$).

Significance

We suggest that increased fecal pH in the TX group may be an indication of improved gastrointestinal health, as malabsorption is associated with acidic fecal pH. The results from this study suggest that Il-10 egg yolk antibodies can improve gastrointestinal health and, unexpectedly, respiratory health. Future studies will evaluate these impacts on a larger scale by evaluating dose response and the impact of the duration of treatment. Using the common mucosal immune hypothesis, we surmise that enhanced mucosal immunity and host defenses in the gastrointestinal tract may have improved the respiratory health in treated calves.