Passive Immunity of Neonatal Calves Given Colostrum Containing E. coli O157:H7 SRP Antibodies from an E. coli K99 Challenge

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Introduction

Epitopix LLC has the first license for an E. coli O157 vaccine in the USA that is based on use of siderophore receptors and porin proteins (SRP™) that are highly conserved across a large number of Escherichia coli isolates. Neonatal calf diarrhea is one of the leading causes of morbidity and mortality in calves. The most commonly described causative agents of acute neonatal diarrhea (scours) are Escherichia coli, coronavirus, rotavirus, and Cryptosporidium. E. coli strains of the K99 pilus type have been responsible for an estimated 25-30% of the scour related morbidity in calves during the first 3-4 days after birth, and approximately 30-50% of the scour-related mortality. Since the SRP antigens in the O157 vaccine are highly conserved among E. coli isolates, it is hypothesized that there may be a high degree of cross-protection to non-O157:H7 species of E. coli. The goal of this study is to examine the degree of cross-protection provided by colostrum containing a known amount of E. coli O157:H7 SRP antibodies against an oral challenge of E. coli K99 as evidenced by morbidity and mortality effects in neonatal colostrum deprived calves.

Materials and Methods

Prior to initiation of the study, heifers were vaccinated with E. coli O157 H7 SRP prior to parturition and the colostrum from these heifers was collected. The colostrum was pooled and placed into three quart aliquots (SRP colostrum). Colostrum was also collected from non-vaccinated heifers, pooled and placed in three quart aliquots (control colostrum). For blinding study personnel, the bags of colostrum were then labeled with only A or B, corresponding to dam vaccination. Neonatal, colostrum deprived bull calves (n=11) were procured from a dairy calving facility and transported to a climate controlled research facility. Calves were randomly assigned to one of two treatment groups, A or B. Calves were administered the E. coli challenge orally one hour after colostrum treatment administration. Serum blood samples were taken on calves daily (day 0-7) to measure E. coli O157:H7 SRP specific antibody titers. Calves were observed twice a day (day 0-7) and a hydration (1-3), fecal (1-4), respiratory (1-3), and an attitude score (1-4) was recorded. Data was statistically analyzed in STATA® using linear regression and ordered logistic regression models.

Results

A total of five calves died prior to study termination from causes unrelated to E. coli K99 challenge (three from SRP, two from controls). Colostrum treatment assignment had no significant effect on rectal temperature, attitude, respiratory, or hydration scores of calves (P > 0.05). Day of challenge was significantly predictive of rectal temperature, attitude, respiratory, and hydration scores of calves (P < 0.05). There were no significant day by colostrum treatment interactions for any of the predictors (P > 0.05). SRP colostrum treated calves had significantly improved fecal scores compared to control calves (P = 0.05). Colostrum treatment had no effect on fecal shedding of E. coli K99 by calves (P > 0.05). However, SRP colostrum treated calves had a 0.45 log CFU/mL lower concentration of E. coli K99 in feces (P = 0.05). Control colostrum calves had significantly lower serum E. coli O157:H7 SRP antibodies than SRP colostrum treated calves (P < 0.001).

Significance

This is the first report examining the cross-protection efficacy of colostral E. coli O157:H7 SRP specific antibodies to E. coli K99 challenge. This study demonstrated that there is some degree of cross-protection in terms of decreased fecal concentration of E. coli K99 and improved fecal consistency in challenged dairy calves. The loss of calves from unrelated causes was due to hypoxic and/or hypothermic complications, thus significantly limiting the power of this study. Further research into the cross-protective effects of E. coli O157:H7 SRP specific antibodies against pathogenic E. coli K99 strains is needed.