Effect of SRP Vaccine Against E. coli O157 in Naturally Infected Feedlot Cattle

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Introduction

Escherichia coli O157 is a foodborne pathogen commonly isolated from beef cattle feces and can enter the food chain at harvest. In the past 10 years, E. coli O157 has been estimated to cost the beef industry $2.67 billion in recalls, research and loss of consumer confidence (NCBA, 2006). A relatively new vaccine technology developed by Epitopix (Wilmar, MN) targets pathogenic bacteria based on their inherent requirement for iron. Vaccines developed with this technology target siderophore receptor and porin proteins (SRP) of specific bacteria and disrupt their iron transport system, which ultimately causes death of the organism. Preliminary studies in experimentally infected cattle have shown that SRP vaccines reduce fecal shedding of E. coli O157 (Stevens and Thomson, 2005; Thornton et al., 2006). Therefore, the objective of the current experiment was to test the efficacy of the E. coli O157 SRP vaccine in feedlot cattle naturally infected with E. coli O157.

Materials and Methods

Six-hundred feedlot heifers were screened for the presence of E. coli O157 in the feces. Cattle testing positive for E. coli O157 were re-sampled to confirm shedding. Sixty cattle were selected from the original population for use in this study. Fifty of these 60 animals were fecal positive for E. coli O157 on two occasions and the remaining 10 animals were fecal positive on one occasion. Cattle were stratified based on results of screening samples and randomly allotted to 1 of 3 treatment groups: 2 ml saline injection (CON), vaccinated on day 0 and 21 with 2 cc with SRP E. coli vaccine (VAC2), or vaccinated on d 0 and 21 with 3 cc with SRP E. coli O157 vaccine (VAC3). Cattle were housed in 1 of 3 barns containing 20 individual feeding pens. Animals were allocated to pens in treatment blocks within barn to eliminate sharing of waterers across treatments and reduce animal to animal contact across treatments. Waterers were cleaned 3 times weekly to reduce the potential of these as a transmission vector. Cattle were fed a standard feedlot receiving diet once daily. Fecal samples and rectoanal mucosal swab (RAMS) samples were collected 2 or 3 times a week for 8 weeks to monitor shedding of E. coli O157. Detection of E. coli O157 was by selective enrichment, immunomagnetic separation, and plating on selective agar. Biochemical and antigenic tests were also used for further confirmation. To identify high-shedding animals, pre-enriched samples were streaked onto selective agar in triplicate and if 2 or 3 of these plates had confirmed E. coli O157 colonies present, the animal of sample origin was considered a super-shedder.

Results

Overall, average E. coli O157 prevalence across all sampling days in the feedlot heifers was 5.8% as detected by RAMS and/or fecal culture. Prevalence was analyzed as repeated measures on animals over weeks. Overall prevalence of E. coli O157 in CON, VAC2, and VAC3 treatments was 33.7%, 29.1%, and 17.7% and was statistically different ($P < 0.01$) between CON and VAC3. Treatment also reduced the number of days that animals were found positive for E. coli O157, with a significant difference in pair-wise comparison of CON vs VAC3 treatments ($P = 0.02$). Modeling efforts by Matthews et al. (2006) revealed that 80% of natural transmission of E. coli O157 in a cattle population is attributed to 20% of infections in which animals are shedding the organism at abnormally high levels. Reducing the number of animals shedding at high levels would be an important outcome of pre-harvest intervention strategies. In the current experiment, pair-wise comparison of CON and VAC3 treatments revealed that the vaccine tended to reduce ($P = 0.08$) the proportion of animals identified as high-shedders.

Significance

The E. coli O157 SRP vaccine reduced prevalence and the number of days that cattle shed E. coli O157 and there is evidence that the vaccine may decrease the number of cattle shedding high levels of the organism.