

Variable Effectiveness of a Vaccine and Direct-fed Microbial for Controlling *Escherichia coli* O157:H7 in Canadian Feedlot Cattle

Purpose

To compare the Econiche® vaccine and Bovamine® direct-fed microbial (probiotic) for controlling *E. coli* O157:H7 in feces and on hides of cattle.

Methods

Feces from 864 commercial feedlot cattle were screened for *E. coli* O157:H7 prior to allocating animals to one of three experimental groups: Direct-fed Microbial, Vaccine, and Control. The **Direct Fed Microbial (DFM)** animals were fed standard finishing diets containing DFM at a dose of 10^9 colony forming units (CFU)/animal/day. The **Vaccine** group received standard finishing diets and a 2 mL intramuscular injection of vaccine at allocation and 28 days later. **Control** cattle were fed only standard finishing diets for comparison purposes.

Candidate animals for the study were sourced from two different feedlots prior to the start of the study and were sorted by their initial levels of *E. coli* O157:H7 before randomization to experimental groups. Thirty pens were allocated on June 15th, 2011 (Set 1, **S1**) and 18 pens were allocated on June 21st, 2011 (Set 2, **S2**) with each pen containing 18 head. All cattle had rectal fecal samples collected every 28 days until shipment to slaughter (103 to 145 days on trial). In addition, a subset of cattle had hide swabs collected at 28 day intervals during the feeding period, with swabs collected from all cattle at shipment to slaughter.



Vaccine Results

During the *feeding period*, the vaccine achieved a statistically significant reduction ($P < 0.05$) in the percentage of hide swabs and fecal samples positive for *E. coli* O157:H7 from S1 cattle compared to controls. However, in S2 cattle the percentage of positive hide samples compared to controls significantly increased and there was no effect of the vaccine on fecal samples. Also, for the samples taken at *shipment to slaughter* from S1 and S2 cattle, no statistically significant effects of vaccination were seen in fecal or hide samples from either set.

Over the course of the study, the vaccine did achieve a statistically significant reduction in the percentage of samples with enough *E. coli* O157:H7 to count (> 40 CFU/gram of feces) compared to controls, although the average number of *E. coli* O157:H7 in feces was the same for vaccine and control cattle. Vaccination did not prevent cattle from becoming higher-shedders as vaccinated animals shed as much as 13 million *E. coli* O157:H7/gram of feces 1 month following the booster injection.

Direct-Fed Microbial Results

During the *feeding period*, the direct-fed microbial significantly ($P < 0.05$) reduced the percentage of hide swabs positive for *E. coli* O157:H7 from S1 cattle compared to controls. In S2 cattle the percentage of positive fecal samples compared to controls significantly increased. No statistically significant effects of the DFM were seen in fecal samples from S1 cattle or hide samples from S2 cattle compared to controls.

For the samples taken at *shipment to slaughter*, no statistically significant effects of DFM were seen in fecal or hide samples from S1 cattle, although the percentage of fecal and hide samples positive for *E. coli* O157:H7 was higher ($P < 0.05$) in S2 cattle fed DFM compared to controls.

The DFM did not reduce the percentage of samples with enough *E. coli* O157 to count (> 40 CFU/gram of feces) and the average number of *E. coli* O157:H7 in feces from these cattle was the same as for controls.

Neither feeding the DFM nor vaccination resulted in any significant reduction in the number of fecal samples or hide swabs positive for *E. coli* O157:H7 at shipment to slaughter.

Summary of Impacts of a Vaccine and Direct-Fed Microbial on Detection of *E. coli* O157:H7 at Feeding and at Shipment to Slaughter

During the Feeding Period*					At Shipment to Slaughter				
	Fecal Samples		Hide Swabs			Fecal Samples		Hide Swabs	
	S1	S2	S1	S2		S1	S2	S1	S2
Vaccine	✓	■	✓	✗	■	■	■	■	■
Direct-Fed Microbial	■	✗	✓	■	■	✗	■	✗	✗

* samples at several time points

✓ Reduced (better) ✗ Increased (worse) ■ No Effect (same as controls)

Discussion

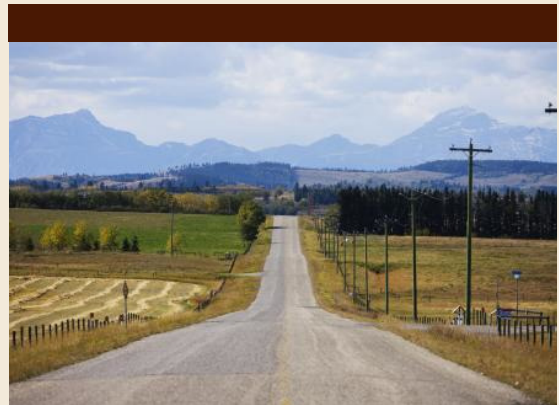
Cattle were sourced from two feedlots before entering the study. The genetics of the *E. coli* O157:H7 shed by animals varied according to the source feedlot and this may help to explain the variable effectiveness of the interventions. When the genetics of the *E. coli* O157:H7 isolates were examined in the laboratory, the subtypes isolated from S1 cattle were relatively similar, while isolates from S2 were genetically diverse. Toxin genes carried by the *E. coli* also differed between the two sets. Isolates from S2 cattle had both stx1 and stx2 toxin genes, while S1 isolates generally had only the stx1 toxin gene. It is the production of toxins that makes people ill after eating food contaminated with *E. coli* O157:H7 and the stx2 gene has been more frequently associated with human illness. Neither the DFM nor vaccine reduced prevalence of *E. coli* O157:H7 in S2 cattle which shed the *E. coli* O157:H7 more likely to cause human disease. Further, neither product resulted in any significant reduction in fecal samples or hide swabs positive for *E. coli* O157:H7 at shipment to slaughter, which is the preharvest time period more relevant to food safety of beef products produced at processing plants. As such, the potential human health benefits from the use of these preharvest interventions in feedlot cattle may be limited.

Conclusion

Neither the vaccine nor DFM consistently reduced *E. coli* O157:H7 in all groups of cattle and neither intervention lowered the average number of *E. coli* O157:H7 in cattle feces. Unexpectedly, some cattle subjected to these pre-harvest interventions showed significantly higher numbers of fecal and hide samples positive for *E. coli* O157:H7 than control cattle.

As the vaccine and DFM demonstrated variable efficacy in the present study, these products will have to be improved before they could be recommended for on-farm control of *E. coli* O157:H7.

Neither the DFM nor vaccine appeared to be effective for reducing prevalence of *E. coli* O157:H7 at shipment to slaughter or at any time for S2 cattle (which shed *E. coli* O157:H7 of the type more frequently linked to human illness). As such, potential human health benefits from use of these preharvest interventions may be limited.



Acknowledgements: The research described in this fact sheet was performed by Dr. Kim Stanford - Alberta Agriculture and Rural Development and Dr. Calvin Booker and Dr. Sherry Hannon - Feedlot Health Management Services Ltd.

Funding for the study was provided by the Alberta Livestock and Meat Agency Ltd., Bioniche Life Science Inc. and Nutrition Physiology Company, LLC.