January 2005

Direct-fed Microbial Products for *Escherichia coli* O157:H7 in Market Ready Feedlot Cattle

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Summary

A clinical trial was conducted during the summers of 2002 and 2003 to evaluate the effect of a direct-fed microbial product (DFM) on the prevalence of E. coli O157:H7 in feces of feedlot steers. The DFM consisted of Lactobacillus acidophilus (NPC 747) fed at the rate of $1x10^9$ colony forming units (CFUs) per head per day. Treatments included supplemental DFM or no supplemental DFM. Feedlot steers supplemented with DFM were 35% less likely to shed E. coli O157:H7 in the feces compared with steers that were not supplemented with the DFM. Finishing performance was not affected by adding a DFM into the ration.

Introduction

Bacteria used as direct-fed microbial products (DFM) have been defined as single or mixed cultures of live organisms, which, when fed to animals, beneficially affect the host (Krehbiel et al., 2003). Additionally, preliminary research from Nebraska, as well as other institutions, has shown that feeding a *Lactobacillus*-based DFM will decrease fecal shedding of *E. coli* O157:H7 without detrimental effects on performance (*2004 Nebraska Beef Report*, pp. 67-68, Brashers et al., *2003 J. Food Prot.*, Younts-Dahl et al., *2004 J. Food Prot.*). Because *E. coli* O157:H7 has emerged as an important food borne pathogen, and beef cattle represent an important reservoir for human exposure, there has been an increased interest in using DFMs as a pre-harvest intervention strategy to control the carriage and shedding of *E. coli* O157:H7 in the feces. Folmer et al. (*2004 Nebraska Beef Report*, pp. 67-68) reported that over five test periods the probability for control steers to shed *E. coli* O157:H7 averaged 21.3%; whereas, the probability for steers treated with the DFM (NPC 747; Nutrition Physiology Corp.) to shed *E. coli* O157:H7 was only 13.3%. However, this response, though seemingly meaningful, was not statistically significant ($P = 0.21$). The purpose of this study was to continue evaluating the effects of feeding a DFM by extending the trial another year to increase the power of the study by doubling the total number of observations.

Procedure

Four-hundred-forty-eight medium-framed steer calves were used in a feedlot finishing experiment during the summers (May-September) of 2002 and 2003. In 2002, steers were blocked into three weight groups and stratified by weight within block and assigned randomly into 24 pens (8 steers/pen). Pens within each block were assigned randomly to one of two treatments. Treatments included DFM supplementation (NPC 747; Nutrition Physiology Corp.) and no DFM supplementation. The finishing diet dry matter composition was 55% high moisture corn, 35% wet corn gluten feed, 5% corn silage, 2% alfalfa hay, 2% supplement, and 1% water (used to mix the direct-fed microbial). In 2003, steers were blocked into two groups, stratified by weight and assigned randomly to 24 pens and one of four dietary treatments (*2005 Nebraska Beef Report*, pp. 54-56). The two DFM treatments were assigned randomly within dietary treatments. Again, DFM treatments included DFM supplementation and no DFM supplementation. In both years of the study DFM product was mixed with water and applied to the feed truck mixing box and fed at a rate of $1x10^9$ colony forming units (CFUs)/steer/day. Steers were fed once daily. The control steers were fed with a control feed truck; DFM-treated steers were fed with a separate feed truck to prevent cross contamination. Steers were weighed on two consecutive days at the start of the experiment after a three-day period of limit-feeding to equalize gut fill. In 2002 and 2003, steers were fed for an average of 121 and 127 days, respectively. In 2002, steers were sampled one block per week in three-week experimental periods, resulting in one pre-treatment sampling and five experimental periods. In 2003, steers were sampled in one block per day on two consecutive days every three weeks, resulting in one pre-treatment sampling and six experimental periods. Rectal fecal grab samples were obtained from each steer in each period.

All fecal samples were taken immediately to the UNL *E. coli* lab and analyzed for the presence of *E. coli* O157:H7 using procedures previously described (*2004 Nebraska Beef Report*, pp. 67-68) with modifications.

Pen was considered the experimental unit, and ADG, DMI, F:G and the proportion of culture-positive animals per pen during the period were the outcomes of

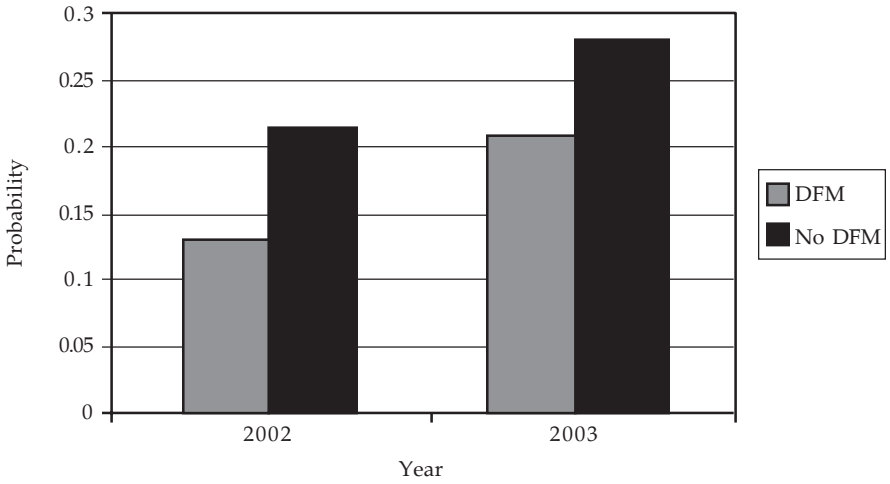

Figure 1. Probability of *E. coli* O157:H7 shedding, by direct-fed microbial treatment and year.

Table 1. Feedlot performance by direct-fed microbial treatment.

Item	No DFM	DFM	SEM[a]	DFM	DFM*Year
Steers	224	224	—	—	—
Pens	24	24	—	—	—
Performance					
ADG, lb	3.76	3.81	0.09	0.43	0.88
DMI, lb/day	25.12	24.93	0.46	0.38	0.92
ADG:DMI,	0.150	0.153	0.002	0.13	0.82

[a]Standard error of the mean.

interest. For proportion of culture positive animals per pen, the odds for a DFM-supplemented pen of cattle was compared with pens of cattle that were not supplemented with the DFM, accounting for repeated measures, year, and block. Odds ratios (OR) were converted to relative risk (RR) using marginal probabilities for prevalence and DFM treatment. Treatment efficacy was calculated as (1-RR). Feedlot performance was evaluated statistically using the MIXED procedure of SAS accounting for year and block. Average daily gain (ADG), dry matter intake (DMI), and ADG:DMI is reported by DFM treatment.

Results

E. coli Results

The probability of recovering *E. coli* O157:H7 from the feces of steers, by treatment and year is summarized in Figure 1. In 2002, the probability of recovering *E. coli* O157:H7 from the feces of steers supplemented with DFM was 13%. The probability of recovering *E. coli* O157:H7 from feces of steers not supplemented with DFM was 21%. In 2003, the probability of recovering *E. coli* O157:H7 from feces of steers supplemented with DFM was 21%. The prevalence of *E. coli* O157:H7 in the feces of steers not supplemented with the DFM product was 28%. The probability of recovering *E. coli* O157:H7 from the feces differed ($P < 0.05$) between 2002 and 2003, however there was no interaction ($P > 0.10$) between DFM treatment and year. The DFM treated steers were 35% less likely ($P = 0.002$) to shed *E. coli* O157:H7 in the feces than steers in untreated pens over the course of the feeding periods of the two years. These results confirm the benefits of using this DFM product as a pre-harvest food safety intervention tool.

Finishing Performance

There was no interaction between DFM treatment and year for any of the finishing performance outcomes; therefore, only effects of DFM treatment on performance are presented (Table 1). Supplementation of the DFM product had no effect ($P > 0.10$) on ADG, DMI, or ADG:DMI. We observed a 2% improvement in ADG:DMI ($P = 0.13$) when cattle were supplemented with the DFM product. Although not significant, a 2% improvement in ADG:DMI might be expected, and meaningful, when supplementing a DFM product in the ration. The true effect of DFM on cattle performance is unclear. In a review of six research trials (n=1,249 cattle), Krehbiel et al., (2003, *Journal of Animal Science*) reported that feeding combinations of lactic acid- and propionic acid-producing bacteria in diets of growing/finishing cattle might improve growth rate by 2.6%. However, in a large scale commercial finishing study (n=3,539 steers and heifers), Greenquist et al. (K-state Cattlemen's Day 2004) reported supplementation of *Lactobacillus acidophilus* and *Propionibacterium freudenreichii* had no measurable impact on growth performance. In our clinical trial only the *Lactobacillus acidophilus* was fed.

In conclusion, supplementing feedlot cattle with $1x10^9$ CFUs/steer/day of *Lactobacillus acidophilus* significantly reduced fecal shedding of *E. coli* O157:H7. Additionally, we observed a non-significant improvement (2%) in ADG:DMI. These data suggest feeding a *Lactobacillus acidophilus* product is an effective pre-harvest intervention control for reducing *E. coli* O157:H7 and further research should be conducted to determine the product's effects on growth performance.

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