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Intervention Strategies for Reduction of *E. coli* O157:H7 in Feedlot Steers

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Beef producers may be able to reduce shedding of *E. coli* O157:H7 in feedlot cattle with intervention strategies.

Summary

Two experiments were conducted to evaluate the effects of three intervention strategies on the prevalence of E. coli O157:H7 in feedlot steers. In both experiments, 432 steers were assigned to one of 54 pens. Intervention strategies were two competitive exclusion products, monthly pen cleaning. In Experiment 2 a diet change treatment was imposed prior to slaughter. No differences in performance or carcass yield were observed for the competitive exclusion products or the pen cleaning treatments, compared to the control. However, changing the finishing diet prior to slaughter decreased steer performance. We also observed a non-significant decrease in the prevalence of E. coli O157:H7 with inclusion of the competitive exclusion products.

Introduction

E. coli O157:H7 has been implicated in many outbreaks of food-borne illnesses and deaths. Many of these outbreaks have been traced back to beef products or manure from bovine animals spread on crops consumed by humans. Preliminary Nebraska research has indicated that inclusion of competitive exclusion products (*Lactobacillus acidophilus* organisms that out compete other microorganisms) fed in the diet of beef animals, may reduce the numbers of *E. coli* O157:H7 shed in the feces (Moxley, unpublished data). Also, previous research has indicated increased mud and manure in feedlot pens is associated with a higher prevalence of cattle shedding *E. coli* O157:H7. In addition, removal of starch from the diet by either hay feeding or elimination of starch feedstuffs has been found to increase fecal pH, decrease fecal VFA and decrease acid-resistant *E. coli*, and *E. coli* O157:H7 (*2001 Nebraska Beef Report pp 86-88*). Therefore, an experiment was conducted to evaluate the effect of inclusion of competitive exclusion products, pen cleaning, and diet change intervention strategies on the prevalence and shedding of *E. coli* O157:H7.

Procedure

Experiment 1

Four hundred thirty-two medium framed steer calves (737 lb) were used in two experiments covering a 140-day feedlot finishing period. Experiment 1 steers were blocked into three weight groups and stratified within block and assigned randomly to one of 54 pens (8 steers/pen). Pens were assigned randomly to a 3 x 2 factorial treatment design; either one of two *Lactobacillus acidophilus* competitive exclusion products (NPC 747), or (NPC 750), or a negative control; and monthly pen cleaning or pen cleaning at the end of the experiment. Competitive exclusion products were mixed with water and applied to the feed truck mixing box and fed at a rate of $1x10^9$ colony forming units/steer/day. Steers were fed once daily with the control steers fed first and a load of non-experiment feed was fed between loads of experiment feed to minimize cross contamination of competitive exclusion products. Steer weights were taken for two consecutive days at the start of the experiment after a 3-day period of limit-feeding to equalize gut fill. In Experiment 1, four rectal fecal samples were obtained from each steer over a period of 3 months. Also, weekly water and composite fecal samples were collected from each pen throughout the experiment.

Experiment 2

Experiment 2 was initiated immediately after the end of Experiment 1 using the same pens and animals. Again, a 3 x 2 factorial treatment design was used continuing the competitive exclusion product treatments, and implementing a 14-day diet change versus no diet change treatments at the end of the feeding period. Rectal fecal samples were collected on days 0, 7 and 14 of Experiment 2. Concentrate type and finishing diet formulation was changed from a 33% high moisture corn, 15% dry rolled corn, 40% wet corn gluten feed diet to a 44% corn bran and 44% wet corn gluten feed diet in a two-day change period (Table 1). Alfalfa hay and supplement were included in both diets at rates of 7% and 5% respectively. Steers were slaughtered on day 14 after rectal fecal sampling.

All samples were taken immediately to the UNL *E. coli* lab and analyzed for presence of *E. coli* O157:H7. A pen was considered positive if at least one animal in the pen was positive during the period of the study. Performance

Table 1. *E. coli* O157:H7 intervention experiment finishing diets.

Ingredients (DM %)	Finishing Diet	Experimental Diet
Wet Corn Gluten Feed	40.0	44.0
High Moisture Corn	33.0	—
Dry Rolled Corn	15.0	—
Corn Bran	—	44.0
Alfalfa Hay	7.0	7.0
Supplement[a]	5.0	5.0
Nutrient Composition, % DM		
Crude Protein	14.1	15.9
Calcium	0.82	0.82
Phosphorus	0.51	0.43

[a]Supplement formulated to deliver 30g/ton Rumensin® and 10g/ton Tylan® and meet NRC requirements for trace minerals and vitamins.

Table 2. *E. coli* O157:H7 results for competitive exclusion products.

Item	NPC 747	NPC 750	Control	P-Value[a]
Experiment 1				
Positive Pens[b]	3/18	1/18	4/18	.3
Period Prevalence[c]	16.7	5.6	22.2	.3
Odds[d]	0.20	0.06	0.28	
Experiment 2				
Positive Pens[b]	3/18	3/18	8/18	.1
Period Prevalence[c]	16.7	16.7	44.4	.1
Odds[d]	0.20	0.20	0.80	

[a]Model = -2 log likelihood X^2
[b]Indicates number of positive pens out of eighteen possible.
[c]Indicates the prevalence over the experimental period.
[d]Odds = number of pens positive for *E. coli* O157:H7 divided by the number of negative pens.

Table 3. *E. coli* O157:H7 entire feeding period finishing and carcass performance.

Item	NPC 747	NPC 750	Control	No Diet[a]	Diet[b]	Diet P[c]	Diet * Product[d]
Daily Gain, lb	3.83	3.85	3.84	3.95	3.73	<0.01	0.04
Feed/Gain	6.61	6.49	6.56	6.40	6.73	<0.01	0.21
14-day DMI, lb/day[e]	27.0	26.4	27.0	28.2	25.4	<0.01	0.31
HCW[f], lb	802	802	803	812	793	<0.01	0.03
Marbling[g]	503	513	507	513	502	=0.07	0.20

[a]No Diet = main effect of no diet change.
[b]Diet = main effect of diet change.
[c]Diet P = P-value for main effect of diet change in Experiment 2.
[d]Diet by Product interaction.
[e]14-day DMI = dry matter intake for the diet change period.
[f]HCW = Hot carcass weight.
[g]Mabling = Marbling score = 400 = $Slight^0$, 450 = $Slight^{50}$, 500 = $Small^0$, etc.

data were statistically analyzed with the mixed procedures of SAS. *E. coli* O157:H7 data were analyzed on a pen basis using the Proc Logistic procedure of SAS.

Results

E. coli

In Experiment 1 there were no significant (P = 0.3) effects of pen cleaning or competitive exclusion product feeding on the prevalence of *E. coli* O157:H7 (Table 2). However, *E. coli* O157:H7 was detected in 3 of 18 (16.7%) pens treated with NPC 747, 1 of 18 (5.6%) pens treated with NPC 750, and 4 of 18 (22.2%) of the control pens.

In Experiment 2 there were no significant effects of diet change on the prevalence of *E. coli* O157:H7. On marketing day we observed fewer (P = 0.1) pens fed the competitive exclusion products shedding *E. coli* O157:H7 (Table 2). The organism was detected in 3 of 18 (16.7%) pens treated with NPC 747, 3 of 18 (16.7%) pens treated with NPC 750, and 8 of 18 (44.4%) of the control pens. The odds ratio for each competitive exclusion product compared to the control was 0.25 (P = 0.1). Therefore, we observed that the odds for detecting *E. coli* O157:H7 in control pens at marketing time was four times greater than in the treated pens (P = 0.1).

Finishing Performance

Finishing performance is summarized in Table 3. There were no effects of competitive exclusion product or pen cleaning on any aspect of steer finishing performance or carcass merit. However, changing the concentrate in our finishing diet from 33% high moisture corn, 15% dry rolled corn, 40% wet corn gluten feed diet to 44% corn bran, and 44% wet corn gluten feed had large negative effects on steer performance. The 14-day diet change at the end of the feeding period significantly (P < 0.01) decreased average daily gain by 5.6% from 3.95 to 3.73 lb/day, decreased hot carcass weight by 2.3% from 812 to 793 lb, decreased feed conversion by 5.1% from 6.4 to 6.7 lb of feed /lb of gain, and decreased diet change period dry matter intake by 10% from 28.2 to 25.4 lb./day. Also, the diet change tended (P =0.07) to decrease marbling score from 513 to 502.

Addition of a competitive exclusion product tended to decrease the prevalence of E. coli O157:H7 in cattle feces. Even though no significant effects were noted, we did observe a lower *E. coli* O157:H7 recovery from pens treated with the competitive exclusion products and especially from NPC 750. Also, the magnitude of response we observed was large enough to be important and thus deserve further investigation. Manipulation of finishing diets and pen cleaning had no effect on prevalence of *E. coli* O157:H7. Finally, changing the finishing diet had a large negative effect on steer performance.

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