Effects of Cultures of *Lactobacillus acidophilus* (LA) and *Propionibacterium freudenreichii* (PF; Bovamine) on Feedlot Performance and Carcass Merit by Steers Fed a High-Concentrate Diet

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Story in Brief

Nutritionists and feedlot managers are looking for management and nutritional strategies to improve performance of finishing cattle. The utilization of direct-fed microbials (DFM) as an alternative to feeding antibiotics to improve feedlot performance and decrease cost of gain has gained interest in the feedlot industry. However, because the results obtained when DFM are included in finishing diets have not been consistent, further research is needed for validation of this technology for the feedlot industry. To test the effects of *Lactobacillus acidophillus* (LA) and *Propionibacterium freudenreichii* (PF) in finishing diets, an experiment was conducted at the Willard Sparks Beef Cattle Research Center at Oklahoma State University.

Key Words: Direct-Fed Microbials, Feedlot, Performance, Carcass.

Introduction

Direct-fed microbials (DFM) are receiving increased attention from the feedlot industry. Increased interest in DFM has resulted from increasing concerns about antibiotic use in production agriculture, and the need for producers to implement preventive measures against pathogen outbreaks in the food supply. Recent research has shown that bacterial DFM reduce fecal shedding of *Escherichia coli* O157:H7 from infected calves. Therefore, a possible application for DFM might be to reduce shedding of this pathogen from cattle. In addition, bacterial DFM have been shown to increase daily gain and feed efficiency in feedlot cattle. In several experiments, supplementing feedlot steers with lactate-utilizing and/or lactate-producing bacteria has been shown to improve feed efficiency and daily gain (approximately 2.5%) with little change in DM intake (Krehbiel et al., 2003). Few attempts have been made to determine the mechanisms responsible for the beneficial effects of DFM, but the potential for a decrease in subacute acidosis has been suggested. Responses to bacterial DFM have included a reduction in area below subacute ruminal pH, increases in ruminal propionate concentrations, increased protozoal numbers, and changes in viable bacterial counts. Effects on some blood variables (lower CO^2 and lactic acid dehydrogenase) also suggest a reduced risk of metabolic acidosis. Overall, data indicate that DFM have the potential to improve production efficiency by feedlot cattle, alter ruminal fermentation processes and products, and decrease fecal shedding of harmful pathogens in inoculated animals. However, as results have been inconsistent, more research is needed to evaluate the efficacy of DFM use. The objective of this experiment is to evaluate the effects of *Lactobacillus acidophilus* (LA) and *Propionibacterium freudenreichii* (PF) on feedlot performance and carcass merit by finishing beef steers fed a high-grain diet.

Materials and Methods

Cattle. Four hundred twenty Brangus steers (557 ± 57 lb) were delivered to the Willard Sparks Beef Research Center on November 21, 2003. On arrival, steers were individually weighed and a uniquely numbered ear tag was placed in the left ear of each calf. On November 22, steers were individually weighed, vaccinated with IBR-PI3-BVD-BRSV (Titanium 5, Intervet, Millsboro, DE), treated for control of external and internal parasites (Ivomec-Plus injectable, Merial, Duluth, GA), and implanted with Component E-S (VetLife, Overland Park, KS). Of the initial 420 steers, 360 were assigned to treatments. Steers were divided by initial BW into six weight blocks. Within block, steers were randomly assigned to four pens (12 pens/treatment; 15 steers/pen). Steers were reimplanted with Revalor-S (Hoechst Roussel Vet, Clinton, NJ) on d 81 (Feb. 10, 2004).

Treatments included: 1) control (no DFM), or 2) *Lactobacillus acidophilus* and *Propionibacterium freudenreichii* (Bovamine; Nutrition Physiology Corp., Amarillo, TX) fed from d 1 through finish. The finishing diet contained 60.0% dry rolled corn and 20.0% dry rolled wheat, and was formulated to meet or exceed NRC (1996) nutrient requirements (Table 1). Monensin (33 mg/kg of diet) and tylosin (11 mg/kg of diet) were fed. Steers were gradually adapted to their final treatment diet over a 23-d period. The DFM was stored in a freezer in individual packets. Each day, contents of one packet/treatment was reconstituted with 18,000 mL of tap water in an individual container that was labeled with color markings that corresponded with each color-coded treatment. The 18,000 mL of water was equally divided among 12 containers (1,500 mL/container) corresponding to the 12 pens/treatment. Contents of the appropriate container were poured directly onto the feed after feed was delivered to the bunk in pens of cattle assigned to that treatment. Pens of steers on the control treatment received an equal volume of water with no DFM. The DFM or water was mixed with the feed in the bunk. Feed refused was weighed on d 27, 81, 144, shipping and as needed (e.g., following inclement weather). In addition, diet samples were collected, and DM content of diets and dietary ingredients determined weekly. Diet and ingredient samples were composited by weigh-day periods, allowed to air dry, and ground in a Wiley mill to pass a 1-mm screen. Diet samples will be analyzed for ash, N, starch (AOAC, 1990), NDF and ADF (Goering and Van Soest, 1970).

Interim unshrunk BW was determined by weighing pens and individual animals on d 28, 81 (reimplant), 144 (pens only) and immediately prior to shipping for harvest. For calculating ADG, weights taken on d 28, 81, 144, and at shipping were shrunk 4%.

Steers were harvested at Tyson Fresh Meats, Inc., Emporia, KS. The three heaviest weight blocks were harvested after 208 d on feed and the three lightest weight blocks after 227 d. Trained personnel from the Kansas State University Carcass Data Collection Service obtained all carcass measurements. Measurements included hot carcass weight, liver abscess score (data collected by Elanco personnel), longissimus muscle area and marbling score of the split lean surface at the 12th/13th rib interface, percentage of kidney, pelvic, and heart (KPH) fat, fat thickness at the ¾ measure opposite the split lean surface between the 12th and 13th rib, USDA yield grade, and USDA quality grade. Liver abscess scores were recorded on a scale of 0 to 6, with 0 = no abscesses, 1 = A-, 2 = A, 3 = A+, 4 = telangiectasis, 5 = distoma (fluke damage), and 6 = fecal contamination that occurred at slaughter. Carcass price was calculated using actual grid and pricing data provided by Tyson Fresh Meats, Inc.

Statistical Analyses

Data for BW, dry matter intake (DMI), average daily gain (AFG), feed efficiency, hot carcass weight (HCW), carcass-adjusted variables (calculated using carcass-adjusted final weight, which was calculated as HCW/average dressing percent for each harvest date), and normally distributed carcass characteristics were analyzed as a randomized complete block design using the Proc Mixed procedure of SAS Release 8.02 (SAS Institute Inc., Cary, NC). Non-parametric USDA quality grade data was transformed using Friedman's test by listing the percentage of Choice and Select for each pen within a block and then analyzed as normally distributed data as above. Pen was the experimental unit. The model statement included treatment, and the random statement included block.

Results

Performance. Effects of *L. acidophilus* and *P. freudenreichii* on feedlot cattle performance are shown in Table 1. Body weight did not differ (P=0.20 to 0.49) among treatments on d 27, 81, 144 or at finish. Carcass adjusted final BW was similar to final BW, and did not differ (P=0.28) among treatments. Results suggest no effect of DFM on 27-day adaptation performance by feedlot steers. However, a numerical increase (P=0.21; 5.9%) in ADG was observed from d 28 through 81 for steers consuming *L. acidophilus and P. freudenreichii*. Interim and overall ADG did not differ (P=0.18 to 0.97) among treatments. Overall (d 1 through finish) ADG and carcass adjusted ADG were similar among treatments.

Table 1. Effects of *Lactobacillus acidophilus* and *Propionibacterium freudenreichii* (Bovamine) on feedlot cattle performance

Item	Control	Bovamine	SEM	Probability value
Pens	12	12		
Steers	180	178		
BW, lb				
Initial	568	566	18.8	.49
d 27	681	678	19.0	.46
d 81	861	869	20.7	.42
d 144	1082	1090	22.7	.21
Finish	1292	1302	17.0	.20
Carcass adj final BW[a]	1294	1305	19.0	.28
Daily gain, lb				
d 1 - 27	4.15	4.16	.13	.97

d 28 - 81	3.40	3.60	.10	.21
d 1 - 81	3.65	3.78	.10	.36
d 82 - 144	3.50	3.51	.08	.97
d 1 - 144	3.59	3.66	.05	.21
d 144 - finish	2.83	2.87	.05	.49
d 1 - finish	3.33	3.39	.05	.18
Carcass adj ADG[a]	3.33	3.41	.06	.22
Dry matter intake, lb				
d 1 - 27	16.0	15.9	.56	.79
d 28 - 81	20.1	20.0	.67	.64
d 1 - 81	18.7	18.6	.62	.65
d 82 - 144	21.2	21.3	.58	.74
d 1 - 144	19.9	19.8	.59	.73
d 144 - finish	22.4	22.4	.64	.99
d 1 - finish	20.7	20.7	.57	.83
Feed:Gain				
d 1 - 27	3.94	3.84	.18	.70
d 28 - 81	5.99	5.58	.23	.14
d 1 - 81	5.20	4.93	.20	.28
d 82 - 144	6.09	6.09	.14	.98
d 1 - 144	5.55	5.41	.13	.12
d 144 - finish	7.93	7.82	.14	.40
d 1 - finish	6.24	6.10	.11	.14
Carcass adj F:G[a]	6.22	6.07	.10	.17

[a]Adjusted final BW was calculated as hot carcass weight/average dress per weight block. Adjusted daily gain was calculated as (adjusted final BW − initial BW)/days on feed. Adjusted feed:gain was the ratio of daily DMI and adjusted daily gain.

Across the finishing period dry matter intake averaged 20.7 lb/d and was not affected by Bovamine (P=0.83). Similarly, feed:gain did not differ among treatments. There were numerical trends for feed:gain to be improved from d 28 to 81 (P=0.14; 7.3%), d 1 to 144 (P=0.12; 2.6%), and d 1 to finish (P=0.14; 2.3%) for steers fed Bovamine. In addition, carcass adjusted feed:gain was numerically improved 2.5% (P=0.17) for steers fed L. acidophilus and P. freudenreichii.

Carcass Characteristics. Effects of *L. acidophilus* and *P. freudenreichii* on carcass characteristics are shown in Table 2. There were no effects (P=0.29 to 0.98) of Bovamine on carcass characteristics, liver score, or carcass price.

Table 2. Effects of *Lactobacillus acidophilus* and *Propionibacterium freudenreichii* (Bovamine) on carcass characteristics of feedlot cattle

Item	Control	Bovamine	SEM	Probability value
Pens	12	12		
Carcasses	178	180		
HCW, lb	838	845	12.2	.29
USDA Yield Grade	2.93	2.93	.07	.98
Yield Grade Distribution, %				
1	1.12	3.89	--	.12
2	24.72	23.89	--	.84
3	52.46	47.54	--	.29
4	19.10	22.78	--	.39
5	.56	.56	--	1.00
USDA Prime and Choice, %	62.0	61.1	5.90	.85
Quality Grade Distribution, %				
Prime	4.49	2.78	--	.77
Choice	56.74	58.33	--	.75
Select	32.58	36.11	--	.47
No roll	5.62	2.78	--	.19
Certified Angus Beef, %	16.9	15.6	4.34	.73
Carcass price, $/cwt	139.50	138.69	1.04	.58
Live price, $/cwt	89.92	90.00	.80	.93

Summary

Results in this experiment were similar to Elam et al. (2003), who reported that feeding combinations of *L. acidophilus* and *P. freudenreichii* did not affect feedlot performance and carcass characteristics. Krehbiel et al. (2003) recently summarized several experiments in which various combinations of *L. acidophilus* and *P. freudenreichii* were fed to feedlot cattle. Results suggested that cattle fed DFM had an approximately 2.5% advantage in ADG and a 2% improvement in feed:gain over control cattle, resulting in increased HCW. If animal performance is not reduced by the inclusion of *L. acidophilus* and *P. freudenreichii* the possible benefits for using this product as a feed additive are the proven efficacy of DFM as a Pre-Harvest intervention for reducing *E. coli* 0157:H7 prevalence in carcasses which decrease the possibility of food-borne illness (Loneragan and Brashears, 2005).

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