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# EFFECTS OF *LACTOBACILLUS ACIDOPHILUS* AND *PROPIONIBACTERIUM FREUDENREICHII* ON GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF FINISHING BEEF CATTLE

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## Summary

There have been contradicting reports of the efficacy of direct-fed microbials in finishing cattle diets. Some researchers have observed improvements in daily gain and feed efficiency when direct-fed microbials are included in finishing diets, whereas others have reported no differences in dry matter intake or ruminal and blood pH. Many of these studies have been conducted on a relatively small scale and used few animals per pen compared with that of typical commercial feedlot operations. In our study, yearling crossbred beef steers and heifers (n=3,539; 796 lb body weight) were used in an experiment conducted at a commercial feedlot operation to characterize growth performance and carcass characteristics associated with the supplementation of direct-fed microbials (*Lactobacillus acidophilus* and *Propionibacterium freudenreichii*) in finishing cattle diets. Including direct-fed microbials in the diet throughout a 122-day finishing period had no measurable impact on growth performance or carcass characteristics of finishing cattle.

## Introduction

Direct-fed microbials used in ruminant feed supplements include live microbial cells (yeasts, molds, and bacteria) and(or) their metabolites to alter the rumen and lower-gut microflora. The concept of inoculating ruminants with beneficial microorganisms is not a new practice. Increased interest in direct-fed microbials has stemmed from the concern about the widespread use of antibiotics in the cattle feeding industry, reports of improvements in finishing cattle performance, and the potential to inhibit food-borne pathogens such as *Escherichia coli* O157:H7. Previous research with cattle has demonstrated the ability to improve daily gain and efficiency by supplementation with strains of *Lactobacillus acidophilus* and *Propionibacterium freudenreichii*. More recent reports show no differences in dry matter intake or ruminal and blood pH when cattle are fed combinations of lactate-producing and lactate-utilizing microorganisms. Many of these studies were conducted in small pens with relatively few animals. The objective of this study was to assess the impact of supplementing direct-fed microbials on performance of cattle fed in a commercial feedlot facility.

## Experimental Procedures

Yearling crossbred beef steers and heifers (n=3,539; 796 lb BW) were transported to a commercial feedlot in central Kansas. Upon

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arrival, a standard processing regimen was applied to each animal that consisted of animal identification, vaccination against common viral diseases, and treatment for internal and external parasites. Heifers identified as pregnant were administered 5 cc of prostaglandin and 5 cc of vitamin E and immediately returned to their home pen. Steers less than 850 lb and heifers less than 750 lb were implanted with an estrogenic implant (Compudose®) at processing and reimplanted after approximately 50 to 70 days with a combination trenbolone acetate/estradiol implant (Component TES® for steers or Component TEH® for heifers). Steers exceeding 850 lb and heifers exceeding 750 lb initial body weight received a single implant (Component TES for steers or Component TEH for heifers) at the time of processing. Cattle within each load were split into two groups on the basis of order of processing, such that even-numbered cattle were placed into one group and odd-numbered cattle were placed into another. Groups were placed into 20 feedlot pens (average of 177 animals per pen) and treatments were assigned randomly within paired pens for the ten replications.

Throughout the experiment, cattle identified as sick were treated in accordance with standard operating procedures of the feedlot, with the exception that cattle were returned to their home pen immediately after therapeutic treatment. Cattle identified as bullers were removed from the experiment permanently, and feed consumption for the pen was adjusted by prorating intake based on the number of head days.

Cattle were adapted to their final finishing ration during a period of two to three weeks after arrival and were fed for an average of 122 days. Direct-fed microbials were incorporated into a steam-flaked corn finishing diet (Table 1) by using a microingredient application system installed at the feedlot by the manufacturer. The experimental diets provided doses of $1 \times 10^9$ CFU *Propionibacterium freudenreichii* strain NP 24, $1 \times 10^6$ CFU *Lactobacillus acidophilus* strain NP 45, and $1 \times 10^9$ CFU *Lactobacillus acidophilus* strain NP 51 per animal daily. The direct-fed microbials were added to the diet after the addition of corn, supplement, and roughage, but before the addition of wheat middlings. A separate truck was used for mixing and delivery of each experimental diet to prevent the possibility for cross-contamination of the control diet with the direct-fed microbial supplement.

Total body weight for each pen of cattle was determined at the start of the experiment and immediately before being transported to a commercial abattoir. Pens of cattle were harvested when they achieved an estimated 12th rib fat thickness of 0.4 inches. All pens within a given replicate were shipped and slaughtered on the same day. Data obtained for each pen of cattle included daily gain, feed intake, feed efficiency, carcass weight, dressing percentage, USDA yield and quality grades, incidence of dark cutting beef, and incidence of liver abscesses. Carcass adjusted final weights were calculated by using a common dress yield of 64%, and weight gain and feed efficiency were calculated from the adjusted final weight.

## Results and Discussion

Growth performance and carcass characteristics are reported in Table 2. Initial body weights were similar between treatments. Direct-fed microbial supplementation had no significant effects on dry matter intake (21.35 vs 21.33 lb/day; $P=0.92$), daily gain (3.38 vs 3.33 lb; $P=0.41$), or feed efficiency (6.33 vs 6.43; $P=0.27$) of cattle fed control or supplemented diets, respectively. Final adjusted weights and carcass characteristics also were similar ($P>0.10$) between the two treatments.

The mechanisms for reported improvements in animal performance in response to direct-fed microbials are not fully understood, but several hypotheses have been proposed.

The presence of some lactate-producing bacteria, *Lactobacillus and Enterococcus*, may create environments in which ruminal microflora can adapt to lactic acid, reducing the risk of subclinical acidosis. Recently though, other studies have shown no differences in intake or ruminal and blood pH when direct-fed microbials have been fed. The data from our large-scale experiment suggest that *Lactobacillus acidophilus* and *Propionibacterium freudenreichii* fed at the amounts included in this experiment do not influence growth performance or carcass characteristics of feedlot cattle. These results are in contrast to other published experiments which have shown significantly greater final body weights and tendencies for improvements in gain when these direct-fed microbials are administered to finishing cattle. In addition, previous studies reported improvements in hot carcass weight, but observed no differences in other carcass characteristics. Another report suggested a 6.9% increase in gain when a cracked-corn and rolled-wheat diet was supplemented with similar microbial treatments. Direct comparison of the results obtained in all of these studies is complicated by variations in feed ingredients, pen size, and inoculation amounts and strains of direct-fed microbials.

The results of this experiment indicate that growth performance and carcass characteristics of yearling crossbred beef steers and heifers fed in a commercial feedlot environment are not influenced by daily supplementation with $1 \times 10^9$ CFU *Propionibacterium freudenreichii* strain NP 24, $1 \times 10^6$ CFU *Lactobacillus acidophilus* strain NP 45, and $1 \times 10^9$ CFU *Lactobacillus acidophilus* strain NP 51.

**Table 1. Composition of Experimental Diets (% of Dry Matter)**

| Item | Control | Direct-fed Microbials |
|---|---|---|
| Steam-flaked corn | 65.8 | 65.8 |
| Wet distillers grain | 15.4 | 15.4 |
| Mixed silage | 7.0 | 7.0 |
| Wheat middlings | 4.0 | 4.0 |
| Tallow | 2.5 | 2.5 |
| Liquid supplement[a] | 5.3 | 5.3 |
| Direct-fed microbials[b] | - | + |
| Nutrient, calculated | | |
| Crude protein | 14.0 | 14.0 |
| Calcium | 0.74 | 0.74 |
| Phosphorus | 0.37 | 0.37 |
| Sodium chloride | 0.3 | 0.3 |

[a]Formulated to provide 320 mg Rumensin, 90 mg Tylan, 40,000 IU vitamin A, 4,000 IU vitamin D, 100 IU vitamin E per animal daily.
[b]Formulated to provide $1 \times 10^9$ CFU *Propionibacterium freudenreichii* strain NP 24, $1 \times 10^6$ CFU *Lactobacillus acidophilus* strain NP 45, and $1 \times 10^9$ CFU *Lactobacillus acidophilus* strain NP 51 per animal daily.

**Table 2. Finishing Performance and Carcass Characteristics of Cattle Fed Direct-Fed Microbials**

| | Treatment | | | |
|---|---|---|---|---|
| Item | Control | Direct-fed Microbials | SEM | P-value |
| No. of head | 1769 | 1770 | - | - |
| No. of pens | 10 | 10 | - | - |
| Days on feed | 122 | 122 | - | - |
| Initial weight, lb | 795 | 797 | 2.8 | 0.69 |
| Final weight, lb[a] | 1207 | 1202 | 6.3 | 0.61 |
| Dry matter intake, lb/day | 21.35 | 21.33 | 0.16 | 0.92 |
| Weight gain, lb/day[a] | 3.38 | 3.33 | 0.04 | 0.41 |
| Feed:gain | 6.33 | 6.43 | 0.06 | 0.27 |
| Hot carcass weight, lb | 772 | 769 | 4.0 | 0.60 |
| Dressing percentage, % | 64.55 | 64.35 | 0.11 | 0.24 |
| USDA Yield grade 1, % | 12.7 | 12.2 | 1.1 | 0.72 |
| USDA Yield grade 2, % | 41.8 | 41.3 | 1.3 | 0.79 |
| USDA Yield grade 3, % | 40.0 | 40.8 | 1.5 | 0.69 |
| USDA Yield grade 4, % | 4.7 | 5.1 | 0.61 | 0.69 |
| USDA Yield grade 5, % | 0.3 | 0.3 | 0.11 | 0.92 |
| USDA Prime, % | 0.9 | 1.3 | 0.22 | 0.19 |
| USDA Choice, % | 45.2 | 41.9 | 1.6 | 0.17 |
| USDA Select, % | 45.7 | 50.5 | 1.9 | 0.10 |
| USDA Standard, % | 5.0 | 3.7 | 0.84 | 0.29 |
| Dark cutters, % | 2.4 | 1.4 | 0.69 | 0.32 |
| Liver abscess, % | 7.1 | 6.9 | 0.55 | 0.86 |

[a]Carcass adjusted final weight calculated by dividing hot carcass weight by a common dress yield of 64%.