2016

# Effects of Direct- Fed Microbial Supplementation in Different Diets on Performance and Carcass Characteristics of Beef Feedlot Heifers

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# Effects of Direct-Fed Microbial Supplementation in Different Diets on Performance and Carcass Characteristics of Beef Feedlot Heifers

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## Summary

*The objective of this study was to evaluate performance and carcass characteristics of heifers fed a newly developed direct-fed microbial (DFM), using 336 heifers in a pen study. The experiment consisted of feeding corn (CON) or 40% modified distillers grains plus solubles (40MDGS) and presence or absence of DFM added as a top-dress. No significant differences were observed for heifer performance and carcass characteristics due to DFM. Feeding MDGS increased ADG, while reducing F:G compared to CON. The DFM developed for this study did not enhance performance as was hypothesized, while feeding MDGS did.*


## Introduction

The FDA defines direct-fed microbial (DFM) as "a source of live (viable) naturally-occurring microorganisms". Several mechanisms are plausible in explaining if DFM will improve performance such as: competitive exclusion of pathogenic organisms (for nutrients or site of activation in the mucosa); synthesis of bacteriocins; prevention of ruminal acidosis (altering ruminal fermentation products, reducing lactic acid) and/or activation of the immune system. For beef cattle, DFMs have been used to improve feed efficiency and daily gain. However, effects on animal performance in beef cattle are still inconsistent and dietary factors may have an influence on whether DFM affect performance. In a previous study, cattle were individually fed and supplemented a DFM developed here at UNL and steers had 4% lower DMI and 5% lower F:G when supplemented DFM, but differences were not significant (*2016 Nebraska Beef Report*, pp. 108–09). Therefore, we conducted a trial to evaluate the effect of DFM in two different diets in a larger study with more cattle to conclusively determine the impact on performance and carcass characteristics in beef feedlot heifers.



## Procedure

Three hundred thirty-six heifers (initial BW = 768 lb, SD = 60 lb) were utilized in a randomized block design experiment at the University of Nebraska–Lincoln, Agricultural Research and Development Center (ARDC). A 2 × 2 factorial design consisting of two basal diets (factor 1; Table 1) with or without DFM (factor 2) was used in this study. All diets contained Rumensin (Elanco Animal Health) to supply 390 mg/heifer daily, MGA (Zoetis Animal Health) to supply 0.5 mg/heifer daily, and Tylan (Elanco Animal Health) to supply 90 mg/heifer daily. Heifers were limit-fed a 50% alfalfa hay and 50% Sweet Bran® (Cargill, Blair, Neb) diet (DM basis) at 2% of BW for five days prior to trial initiation to minimize gut fill variation. Following five days of limit feeding, heifers were weighed two consecutive days (d 0 and 1) and the average was used to establish initial BW. Heifers were blocked into four BW blocks (6 replications in each block) based on d 0 BW, and assigned randomly within strata to a total 24 pens. Pens (14 heifers/ pen) were assigned randomly to one of four treatments with six replications per treatment. On d 1, heifers were implanted with Revalor®-IH (Merck Animal Health) and were reimplanted on

**Table 1. Diet composition fed to finishing heifers to evaluate feeding DFM in diets based on corn only or with 40% modified distillers grains (DM basis)**

| Ingredient | Basal Diets[a] | |
|---|---|---|
| | CON | 40MDGS |
| Dry-rolled corn | 40 | 20 |
| High-moisture corn | 40 | 20 |
| Modified distillers grains plus solubles | 0 | 40 |
| Corn silage | 15 | 15 |
| Supplement[b] | | |
| Fine ground corn | 1.619 | 2.930 |
| Limestone | 1.545 | 1.545 |
| Urea | 1.311 | — |
| Salt | 0.300 | 0.300 |
| Tallow | 0.125 | 0.125 |
| Beef trace minerals | 0.050 | 0.050 |
| Rumensin-90[c] | 0.017 | 0.017 |
| Vitamins A-D-E | 0.015 | 0.015 |
| MGA[c] | 0.010 | 0.010 |
| Tylan-40[c] | 0.009 | 0.009 |

[a]CON=control basal diet; 40MDGS = modified distillers grains included in finishing diets. Cattle with DFM were fed with 1 × $10^9$ cells of each culture per heifer daily as a top-dress.
[b]Supplement formulated to be fed at 5% of dietary DM.
[c]Formulated to supply: Rumensin-90 = 390 mg/heifer daily; MGA = 0.5 mg/heifer daily; Tylan-40 = 90 mg/heifer daily

d 78 with Revalor®-200 (Merck Animal Health). Heifers were acclimated to finishing diets (Table 1) over a 22-day period consisting of four adaptation diets. Alfalfa hay inclusion was gradually decreased from 30 to 0% while inclusion of dry-rolled corn and high-moisture corn was increased from 25 to 40% (DM basis) in corn diet. For the distillers based treatment, alfalfa hay inclusion was gradually decreased from 30 to 0% while inclusion of dry-rolled corn and high-moisture corn were increased from 5 to 20% while MDGS inclusion was constant at 40% (DM basis).

The bacteria of DFM were isolated from cattle fecal matter (*2014 Nebraska Beef Report*, pp. 101–102) in August of 2011. The bacteria were *Bacteroides* and *Anaerovibrio*. Each bacterium was grown separately in broth media (5 days at 42°C in anaerobic media). At the end of the growth period, the optical densities (OD) of the broth cultures were measured and the cells were harvested by centrifugation (3000 rpm, 15 min at 4°C). Subsequently, the cells were diluted with sterile 20% glycerol/anaerobe basal broth so that each culture had a cell density of $1 \times 10^9$ cells/ml (based on the OD reading of each bottle). After the dilution, the same volume of each culture was mixed in a sterile polypropylene tube and 'snap-frozen' in liquid nitrogen (thus, each tube contained $1 \times 10^9$ cells/ml of each bacterium). Frozen DFM tubes were stored at −80°C until transported in liquid nitrogen to ARDC near Mead, NE, where they were kept in freezer at −4°C.

Feeds were sub-sampled and analyzed for DM content weekly. Cattle were fed once daily and pens that received DFM were top-dressed by emptying DFM tubes into one gallon of water, followed by even distribution on top of feed at feeding. Tubes of DFM were thawed in the refrigerator 24 h prior to feeding.

After 135 d, cattle in the heavy block (4 pens) were harvested and after 149 d, cattle in the light and medium blocks (20 pens) were harvested. Cattle were transported to a commercial abattoir (Greater Omaha Pack, Omaha, Neb), where HCW was obtained on the day of slaughter. Following a 48-h chill, USDA marbling score, 12th rib fat thickness, and LM area were recorded. Hot carcass weight was used to calculate adjusted final BW by dividing HCW by a common dressing percentage (63%) and used to calculate ADG and feed efficiency.

**Table 2. Main effects of diet or feeding a new direct-fed microbial on performance and carcass characteristics**

| Item[a] | Basal Diet | | DFM | | SEM | *P*-value | | |
|---|---|---|---|---|---|---|---|---|
| | Corn | MDGS | − | + | | Diet | DFM | Diet * DFM |
| Performance | | | | | | | | |
| Initial BW, lb | 768 | 769 | 770 | 768 | 15 | 0.32 | 0.10 | 0.86 |
| Final BW,[b] lb | 1230 | 1287 | 1264 | 1252 | 14 | < 0.01 | 0.22 | 0.25 |
| DMI, lb/d | 24.1 | 25.1 | 24.6 | 24.6 | 0.26 | < 0.01 | 0.98 | 0.27 |
| ADG,[b] lb | 3.21 | 3.60 | 3.44 | 3.37 | 0.05 | < 0.01 | 0.25 | 0.25 |
| F:G[b,c] | 7.49 | 6.96 | 7.13 | 7.32 | — | < 0.01 | 0.08 | 0.34 |
| Carcass characteristics | | | | | | | | |
| HCW, lb | 775 | 811 | 797 | 789 | 8 | < 0.01 | 0.22 | 0.25 |
| LM area, in[b] | 12.6 | 12.5 | 12.6 | 12.5 | 0.12 | 0.64 | 0.72 | 0.68 |
| 12th rib fat, in | 0.60 | 0.67 | 0.64 | 0.63 | 0.013 | < 0.01 | 0.68 | 0.08 |
| Marbling[d] | 555 | 571 | 560 | 565 | 4 | 0.06 | 0.53 | 0.71 |

[a]Diets = main effect of diets (Corn or MDGS) in cattle; DFM = main effect of direct-fed microbial inclusion in cattle diet; Diets*DFM = interaction between diets and direct-fed microbial inclusion.
[b]Calculated from carcass weight, adjusted to 63% common dressing percentage.
[c]Analyzed as G:F, reported as F:G.
[d]Marbling score: 400 = Small°; 500 = Modest°; etc

Performance and carcass characteristics were analyzed as a 2 × 2 factorial using the MIXED procedure of SAS (SAS Institute, Inc., Cary, N.C.) using $P \leq 0.05$ as the significance level for type I error. Pen was the experimental unit and BW block was included as a random effect. Main effects of diets and DFM were tested, as well as the interaction between these factors.

## Results

There were no significant interactions ($P \geq 0.25$; Table 2) between diets and DFM for performance and HCW, LM area, and marbling, but fat depth tended to be significant ($P = 0.08$; Table 2). Given the lack of interactions, main effects of diets and DFM are presented (Table 2).

There were no significant differences in performance ($P \geq 0.08$) and carcass characteristics ($P \geq 0.22$) due to feeding DFM. Dry matter intake during the trial was similar ($P = 0.98$; Table 2) between heifers fed DFM or not. It was expected that DFM would improve F:G; however, no improvements ($P = 0.08$) were observed due to feeding this specific DFM. Actually, F:G tended ($P = 0.08$; Table 2) to be 2.6% poorer for cattle fed DFM compared to none.

For the main effect of basal diet, feeding 40MDGS increased ($P < 0.01$) DMI compared to CON. Feeding 40% MDGS increased ($P < 0.01$) ADG by 12% and decreased F:G by 7% ($P < 0.01$) compared to heifers fed corn. Hot carcass weight was 4% greater ($P < 0.01$) compared to the corn control diet. *Longissimus* muscle area was similar ($P = 0.64$) among diets, while 12th rib fat thickness was greater ($P < 0.01$) for cattle fed MDGS. Heifers fed MDGS were 11% fatter than cattle fed the corn control diet. There was a tendency ($P = 0.06$) for marbling score of heifers fed 40MDGS to be greater compared to CON.

In conclusion, the DFM developed for this study did not enhance performance, while feeding modified distillers grains compared to corn did improve performance similar to previous research.

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