Impact of a Newly Developed Direct-Fed Microbial on Performance in Finishing Beef Steers

Laura F. Prados, Nirosh D. Aluthge, Robby G. Bondurant, Samodha C. Fernando, and Galen E. Erickson

Summary

An individual feeding experiment (n = 60) was conducted to evaluate the effects of feeding a direct-fed microbial (DFM) or not on performance of finishing steers fed 0 or 40% modified distillers grains (MDGS) in a 2 × 2 factorial design. Gain and F:G were improved when cattle were fed MDGS compared to the corn diet. No significant differences ($P \geq 0.23$) were observed between cattle fed DFM or not for DMI and ADG. However, numeric advantages were observed for F:G when cattle were fed a DFM, with a 5% improvement in feed efficiency for steers supplemented with DFM.

Introduction

Direct-fed microbial (DFM) have been defined as single or mixed cultures of live organisms, which, when fed to animals, beneficially affect the host. Available DFM have been used to increase animal productivity and to improve health. For beef cattle, some DFM have shown improved feed efficiency and ADG; however, these responses have been variable. Some researchers suggest that feeding DFM to feedlot cattle results in a 2.5 to 5% increase in ADG and approximately 2% improvement in feed efficiency. Several dietary and management factors may have an influence on the effect of DFM's. Gain and efficiency responses to DFM have been variable, with this variation typically being attributed to differences in culture and/or dosage of DFM. A new DFM was isolated from cattle feces that may impact food safety or shedding of *E. coli* O157:H7.

Thus, the objective of this study was to determine the effect of this newly developed DFM in beef steers fed with either a dry-rolled corn-based or MDGS-based diet.

Procedure

Sixty yearling steers (initial BW = 848 lb, SD = 76 lb) were utilized in a completely randomized design experiment at the University of Nebraska–Lincoln at the Agricultural Research and Development Center (ARDC). A 2 × 2 factorial design consisting of two diets (factor 1; Table 1) with or without direct-fed microbial (DFM; factor 2) was used in this study. Yearling steers were previously trained to the Calan gates. Steers were limit-fed a common diet of 50% alfalfa hay and 50% Sweet Bran® (Cargill, Blair, Neb) at 2% of BW for 5 days prior to the start of the trial to minimize gut fill variation and then weighed on three consecutive days (d-1, 0, and 1) and the average was used to establish initial BW. On d 1, steers were implanted with Ralgro® (Merck Animal Health) and reimplanted with Revalor-S (Merck Animal Health).

Steers were housed in open front barns with 30 steers in a common pen (i.e., barn). Steers within each pen received their respective basal diet consisting of dry-rolled corn (CON) or 40% MDGS (40MDGS) treatments (Table 1). Each barn was given either no DFM or was dosed daily with DFM grown in lab. The DFM treatment was dosed based on barn to avoid any possible contamination of bunks within a barn or contamination of the housing environment with the DFM and subsequently inoculate steers not getting DFM. Steers were adapted to finishing diets using limit feeding by starting cattle on finishing diets provided at 2% of BW and increased by 0.5 lb/d (DM basis) until reaching *ad libitum* intake of finishing diets (approximately 20 days).

The DFM bacteria were isolated from cattle fecal matter which were identified on a previous study as low-shedders beef steers (2014 Nebraska Beef Report, pp.101–102) in August 2011. The bacteria were of the genera *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

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

Ingredient[a]	Corn	MDGS
Dry-rolled corn	87	47
Modified distillers grains plus solubles	—	40
Sorghum silage	8	8
Supplement[b]		
Fine ground corn	1.670	2.885
Limestone	1.315	1.600
Urea	1.500	—
Salt	0.300	0.300
Tallow	0.125	0.125
Beef trace minerals	0.050	0.050
Rumensin-90[c]	0.016	0.016
Vitamins A-D-E	0.015	0.015
Tylan-40[c]	0.009	0.009

[a]MDGS = modified distillers grains plus solubles. Cattle with DFM were fed with 1×10^9 cells of each culture per day.
[b]Supplement formulated to be fed at 5% of dietary DM.
[c]Formulated to supply: Rumensin-90 = 375 mg/steer daily; Tylan-40 = 90 mg/steer daily

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 1×10^9 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 1×10^9 cells/ml of each bacterium). Frozen DFM tubes were stored at -80°C until transport in liquid nitrogen to ARDC, where they were kept in the freezer at −4°C. Samples were stored in daily aliquots (30 tubes) and transferred to the refrigerator and allowed to thaw for 24 hours prior to each feeding.

Feeds were sub-sampled and analyzed for DM content weekly. Feed refusals were weighed back, sub-sampled, and analyzed for DM content to determine DMI of each steer. Steers were fed once daily and DFM was top-dressed by emptying tubes into each individual bunk.

After 132 d, cattle were weighed and transported to a commercial abattoir (Greater Omaha Pack, Omaha, Nebraska), where HCW, and after 48 hours, LM area, marbling score, and 12th rib fat thickness were recorded. Yield grade was calculated from following formula: 2.5 + (2.5 × 12th rib fat) − (0.32 × LM area) + (0.2 × 2.5 [assumed KPH]) + (0.0038 × HCW). With the use of a common dressing percentage (62%), final BW, ADG, and F:G were calculated.

Intake, 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. Steer was the experimental unit. Main effects of diets and DFM were tested, as well as the interaction between these factors.

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

Item[a]	Diets		DFM		SEM	P-value		
	Corn	MDGS	+	−		Diet	DFM	Diet * DFM
Performance								
Initial BW, lb	852	844	846	850	12	0.74	0.89	0.93
Final BW[b], lb	1282	1323	1303	1303	13	0.14	0.98	0.75
DMI, lb/d	22.5	22.4	22.0	22.9	0.38	0.92	0.23	0.50
ADG[b], lb	3.26	3.63	3.46	3.42	0.06	< 0.01	0.80	0.71
F:G[b,c]	7.00	6.30	6.49	6.82	—	0.02	0.29	0.44
Carcass characteristics								
HCW, lb	795	820	808	808	8.4	0.14	0.98	0.75
LM area, in[b]	12.9	13.0	13.1	12.9	0.15	0.72	0.43	0.09
Marbling[d]	447	448	433	462	8.9	0.96	0.10	0.13
12th rib fat, in	0.51	0.60	0.54	0.56	0.02	0.02	0.62	0.80
USDA Yield grade	3.29	3.59	3.38	3.50	0.07	0.04	0.40	0.23

[a]Diets = main effects of diets (corn or modified distillers grains with solubles) in steers; DFM = main effects of direct-fed microbial supplementation in steers; Diets * DFM = interaction between diets and direct-fed microbial supplementation.
[b]Calculated from carcass weight, adjusted to 62% common dressing percentage.
[c]Analyzed as G:F, reported as F:G.
[d]Marbling score: 400 = Small°; 500 = modest°; etc.

Results

There were no significant interactions ($P \geq 0.23$) between the diets and DFM for DMI, ADG, fat, and USDA yield grade in this study (Table 2). However, LM area ($P = 0.09$) and marbling score ($P = 0.13$) tended to have an interaction between diet and DFM supplementation. Main effects of basal diet and DFM are presented (Table 2) and discussed.

For the main effect of basal diet, DMI was not affected ($P = 0.92$; Table 2) by whether steers were fed 40MDGS or CON. In contrast, some variables (ADG, F:G, fat, and USDA yield grade) were affected by basal diet, which were generally improved when cattle were fed with 40% MDGS compared to corn. Gain was 11.4% greater ($P < 0.01$) for steers fed 40MDGS compared to CON. Feed efficiency was improved by 10% for cattle fed 40MDGS, which agrees with previous trials. Steers fed 40MDGS had greater ($P \leq 0.04$) fat and USDA yield grade compared to steers fed the corn control diet. Research has shown that the MDGS has a greater feeding value when compared to corn, and improves ADG and F:G, which supports results from this study.

For the main effect of supplementing the DFM, no significant differences ($P \geq 0.23$) were observed for performance. However, numeric advantages were observed for DMI and F:G when cattle were fed with DFM supplementation. Steers supplemented with DFM had 4% numerically lower DMI ($P = 0.23$) compared to non-supplemented steers, but similar ADG ($P = 0.80$). While not significant statistically ($P = 0.29$), there was a 5% numerical improvement in F:G with steers supplemented with DFM having lower F:G compared to steers not receiving the DFM. Carcass characteristics were not affected ($P > 0.40$) by feeding DFM or not, except for marbling ($P = 0.10$). Steers not fed DFM had a greater marbling score than steers fed DFM. The impact on marbling is difficult to explain and likely unimportant given the relatively small number of steers on test.

Results from this study suggest DFM supplementation may improve performance of cattle, but with limited experimental units, the 5% numerical improvement in F:G was not significant. More research is needed evaluating performance. As a follow up to this experiment, 336 finishing heifers were fed the same DFM in a pen performance study, and no improvement was observed in ADG or F:G (*2016 Nebraska Beef Report*, pp. 110–11). As expected, steers fed 40% MDGS had greater ADG and lower F:G than steers fed a corn control.

Laura F. Prados, visiting researcher (CAPES scholarship)

Nirosh D. Aluthge, graduate student

Robby G. Bondurant, research technician

Samodha C. Fernando, professor

Galen E. Erickson, professor. University of Nebraska–Lincoln; Department of Animal Science, Lincoln, Neb.