Effects of BeefPro on performance and carcass characteristics of finishing beef cattle

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Introduction

Cattle entering feedlots are rapidly transitioned from forage-based to high-concentrate diets, a process that is often associated with an increased potential for ruminal acidosis. Direct-fed microbials (DFM), which typically include viable cultures of bacteria or fungi (Krehbiel et al., 2003), are frequently fed to feedlot cattle to decrease the likelihood of acidosis. Previous research has shown that DFM can decrease the time that ruminal pH is below 5.6, as well as increase nutrient digestion (Krehbiel et al., 2003), but effects on feedlot performance have been variable. In addition to DFM, digestive enzymes added to cattle diets have sometimes increased nutrient digestion, with subsequent increases in ADG and efficiency of feed utilization (Tricarico et al., 2007). The present study evaluated performance and carcass characteristics of finishing beef cattle fed a microencapsulated DFM (BeefPro;   C&E Agri Products, Baldwin, ND) containing lactate-producing bacteria and digestive enzymes compared with a control diet that did not contain DFM.

Experimental Procedures

Cattle. One hundred twenty-three steers were purchased from auction barns in Missouri and delivered to the Texas Tech University Burnett Center at New Deal, TX. The first load of 44 steers arrived on October 6, 2009, whereas the remaining load of 79 steers arrived on October 8, 2009.

Trucks were unloaded on arrival (average body weight [BW] on arrival = 612 lb), and cattle were housed in Burnett Center soil-surfaced pens and allowed access to a 65% concentrate diet (approximately 6 lb/steer, as-fed basis), sudangrass hay (approximately 2 lb/steer, as-fed basis), and water. Shortly after arrival (48 and 24 h for the first and second load, respectively), steers were taken through the Burnett Center working facilities for initial processing, which included: (1) placement of a numbered tag in the ear; (2) recording of coat color; (3) vaccination with Vista 5 SQ (Intervet/Schering-Plough, Inc., DeSoto, KS) and Vision 7 with SPUR (Intervet/Schering-Plough); (4) treatment down the backline with ivermectin (Aspen Veterinary Resources, Ltd., Liberty, MO); and (5) s.c. injection with Micotil (Elanco Animal Health, Indianapolis, IN). All products were administered according to the dose specified on the product label. After processing, cattle were returned to the same soil-surfaced pens they had been housed in since arrival and offered the 65% concentrate diet.

Following an adaptation period of 30 d to the starter diet and facilities, the steers were weighed, and 96 were selected for use in the experiment. Selected steers were blocked by BW and sorted to 24 concrete, partially slotted-floor pens (4 steers/pen; 9.5 feet x 18.33 feet, with 8 feet of bunk space). Treatments were assigned randomly to pens within blocks (1 pen/treatment within 12

blocks), resulting in a total of 12 pens (48 steers)/treatment. The cattle were weighed individually, implanted with Revalor IS (Intervet/Schering-Plough), and switched to the experimental diets to initiate the experiment. At the time the experiment began, the cattle were stepped up to a 75% concentrate diet and subsequently switched (at 1-wk intervals) to 85 and 90% concentrate diets. On d 70, each steer was reimplanted with Revalor S (Intervet/Schering-Plough).

Experimental Design and Treatment and Pen Assignment. Treatment diets were steam-flaked corn based with a mixture of tub-ground alfalfa hay and cottonseed hulls as the roughage. As noted previously, treatments consisted of: (1) no DFM (Control); or 2) 200 mg/(steer•d) of BeefPro. BeefPro is a DFM containing lactate-producing bacteria (*Lactobacillus acidophilus, Bifidobacterium thermophilum, Enterococcus faecium, and Bacillus subtilis*; 2.5 x 10^9 CFU/g) and several digestive enzymes (amylase, proteases, hemi-cellulases, phytase, cellulose, lipase, pectinase, and glucanase). One Ziplock plastic bag supplied the BeefPro needed for all 12 pens on the treatment. The contents of the Ziploc bag containing the BeefPro treatment were mixed with 1 lb (as-fed basis) of ground corn, after which the ground corn mix was added to the diet in a tractor-pulled mixer (see description below) and allowed to mix for approximately 3 to 4 min before feeding. For the Control treatment, 1 lb of ground corn was added in the same manner as for the BeefPro treatment. Ingredient composition of the step-up diets (75 and 85% concentrate) and of the final 90% concentrate diet is shown in Table 1. The 90% concentrate diet was formulated to contain 13.5% CP. Vitamins, minerals, Rumensin (30 g/ton, DM basis; Elanco Animal Health, Indianapolis, IN),

and Tylan (10 g/ton, DM basis; Elanco Animal Health) were provided in a loose-meal premix.

Feeding, Weighing, Routine Management, and Sampling. Estimates of the approximate quantity of unconsumed feed remaining in the feed bunk were recorded for each pen from 0700 to 0730 h daily. Adjustments to the feed delivery for each pen were made to ensure ad libitum access to feed, with the target for feed bunk management being to leave from 0 to 1 lb of feed in the bunk each day. Diets were mixed in a 45-cubic foot-capacity paddle mixer (Marion Mixers, Inc., Marion, IA) and transferred by a conveyor to a tractor-pulled mixer/delivery unit (Roto-Mix 84-8, Dodge City, KS; scale readability of ± 1 lb), which was used to deliver feed to each pen. Diet samples were taken from the feed bunks weekly to determine the DM content (dried in a forced-air oven at 100°C for approximately 24 h). Weights for DM determination were taken on an Ohaus (Pine Brook, NJ) electronic balance (readability of ± 0.1 grams). Feed bunks were cleaned on d 35, 70, 105, 140, and before shipment to slaughter. The DM content of feed weighed back from the bunks was determined as described for weekly diet samples. The DM intake (DMI) by each pen during various periods of the study was calculated by subtracting the quantity of dry feed refusal at the end of each period from the total dietary DM delivered to each pen during that period. The number of animals housed per pen was multiplied by number of days in the period to determine animal days, which were divided into the corrected total DM delivered to the pen to obtain average DMI/steer. Weekly diet samples were composited across the overall study period for each treatment and ground to pass a 2-mm screen in a Wiley mill. Ground samples

were subsequently analyzed by SDK Laboratories (Hutchinson, KS).

Individual BW measurements (initial BW and final BW before shipment to slaughter) were obtained using a hydraulic squeeze chute (Silencer Squeeze Chute; Moly Mfg. Inc., Lorraine, KS; set on 4 Avery Weigh-Tronix [Fairmount, MN] load cells; readability ± 1 lb). Cattle in the heaviest 7 blocks were weighed individually on d 151 and shipped to the Cargill Meat Solutions facility in Plainview, TX, whereas on d 172, cattle in the remaining 5 blocks were weighed individually and shipped to the same facility for collection of carcass data. Personnel of the Texas Tech University Meat Laboratory collected carcass data, including yield grade, quality grade, marbling score, percentage of kidney, pelvic, and heart fat (**KPH**), longissimus muscle (**LM**) area, fat thickness at the 12th rib, and liver abscess score.

Statistical Analyses. Performance and carcass data (pen basis) were analyzed using the Mixed procedure of SAS (SAS Inst., Inc., Cary, NC) for a randomized complete block design. The effects of treatment and block were included in the model, with block as a random effect. Carcass quality grade (proportion of cattle in the pen grading USDA Choice or greater) and liver data (proportion of cattle in the pen with condemned livers) were analyzed as binomial proportions using the Glimmix procedure of SAS. The same model was used as for performance data. Three steers were removed from the study for reasons unrelated to treatment. Because of the removal of these 3 animals, a significant ($P = 0.04$) difference between treatments was detected for initial BW. Therefore, initial BW was evaluated as a covariate for the statistical analysis of performance and several carcass variables as described by Littell et al. (1996).

Results and Discussion

Data for chemical composition (Table 2) of the diets was averaged over the Control and BeefPro treatments because the only difference between the treatment diets was the addition of BeefPro, which should not have affected chemical composition. Chemical composition values generally agreed with expected values based on diet formulation.

Body Weight and Performance Data. As noted previously, initial BW differed between the 2 treatments ($P = 0.04$, Table 3), and data for which initial BW was a significant covariate in the analysis are noted in the tables. The 2 treatments did not differ for shrunk final BW ($P = 0.19$); however, steers fed BeefPro tended ($P = 0.10$) to have greater carcass-adjusted (hot carcass weight divided by the average dressing percent) final BW than those fed the Control diet. Likewise, cattle fed BeefPro tended ($P < 0.07$) to have a greater live-basis ADG for the overall feeding period, and carcass-adjusted ADG was greater ($P = 0.037$) for cattle fed BeefPro. Moreover, cattle fed BeefPro had a greater DMI than Control steers ($P = 0.04$). As would be expected from greater DMI coupled with greater ADG, there were no differences in gain:feed (G:F) ratio ($P > 0.55$) between the 2 treatments on live or carcass-adjusted basis.

The results of the present experiment agree with information presented in the review of Krehbiel et al. (2003), who reported that steers fed bacterial DFM had increased ADG and DMI compared with steers fed a control diet. Similarly, Brown and Nagaraja (2009) reported a 2% increase

in ADG by finishing steers fed DFM. To our knowledge, BeefPro has not been tested before in feedlot cattle; therefore, comparisons with other experiments are not possible.

Carcass Characteristics. Hot carcass weight tended to be greater for cattle fed BeefPro than for Control ($P = 0.10$, Table 4). Dressing percent ($P = 0.41$), 12th rib fat thickness ($P = 0.39$), LM area ($P = 0.68$), percentage of KPH ($P = 0.20$), yield grade ($P = 0.24$), marbling score ($P = 0.32$), proportion of cattle grading USDA Choice ($P = 0.22$), and proportion of cattle with condemned livers ($P = 0.37$) did not differ between treatments.

Conclusions

Feeding BeefPro (200 mg/steer daily) during the feedlot finishing period resulted in an increased DMI, which was reflected in a greater ADG (5.7% relative to the Control treatment on a carcass-adjusted basis) and a tendency for increased hot carcass weight. Gain:feed ratio was not altered by BeefPro. Besides hot carcass weight, carcass measurements of steers fed BeefPro did not differ from those of cattle fed the Control diet. Thus, present data suggest that BeefPro, when fed daily at a dose of 200 mg/steer can have positive effects on DMI and ADG by finishing beef cattle.

Literature Cited

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Acknowledgements

Table 1. Ingredient composition (%, DM basis) of the 2 step-up diets and the 90% concentrate finishing diet

	Dietary concentrate, %		
Ingredient	75	85	90
Steam-flaked corn	57.25	67.68	72.57
Cottonseed hulls	15.08	7.55	5.05
Alfalfa hay, ground	10.06	7.55	5.10
Cottonseed meal	7.22	6.10	5.83
Urea	0.75	0.86	0.92
Fat (yellow grease)	2.51	3.02	3.05
Molasses, cane	4.02	4.03	4.19
Limestone	1.10	1.21	1.27
Supplement[1]	2.00	2.00	2.02

[1]Supplement contained (DM basis): 66.383% cottonseed meal; 0.500% Endox (Kemin Industries, Des Moines, IA); 0.648% dicalcium phosphate; 10% potassium chloride; 4.167% ammonium sulfate; 15.000% salt; 0.002% cobalt carbonate; 0.196% copper sulfate; 0.083% iron sulfate; 0.003% ethylenediamine dihydroiodide; 0.333% manganese oxide; 0.125% selenium premix (0.2% Se); 0.986% zinc sulfate; 0.010% vitamin A (1,000,000 IU/g; DSM Nutritional Products, Inc., Parsippany, NJ); 0.157% vitamin E (500 IU/g; DSM Nutritional Products, Inc.); 0.844% Rumensin (176.4 mg/kg; Elanco Animal Health, Indianapolis, IN); and 0.563% Tylan (88.2 mg/kg; Elanco Animal Health). Concentrations in parenthesis are expressed on a 90% DM basis.

Table 2. Chemical composition of the 90% concentrate finishing diet

Item[2]	DM basis value
DM, %	81.6
CP, %	13.6
Ether extract, %	6.0
ADF, %	8.5
Ca, %	0.74
P, %	0.31
K, %	0.93
S, %	0.23
NEm, Mcal/kg[3]	2.14
NEg, Mcal/kg[3]	1.46

[1]Values are the mean of composite samples obtained during each week of the experiment and are averaged over samples collected for the 2 treatments. The BeefPro treatment was mixed in approximately 1 lb (as-fed basis) of ground corn (1 lb of corn only for Control), which was then mixed with the complete diet at the time of feeding, followed by mixing for approximately 3 to 4 min before delivery to the pens.

[2]CP = crude protein; ADF = acid detergent fiber.

[3]Calcuated from NRC (1996) tabular NE values based on the ingredient composition shown in Table 1.

Table 3. Effects of BeefPro on body weight (BW), average daily gain (ADG), dry matter intake (DMI), and gain:feed ratio (G:F) of finishing beef steers

Item	Treatment[1] Control	Treatment[1] BeefPro	SE[2]	P-value[3]
Initial BW, lb	710	706	1.3	0.039
Final live BW, lb[5,6]	1,275	1,298	11.1	0.188
Carcass-adjusted final BW, lb[5,6]	1,272	1,301	11.4	0.103
ADG, lb[6]				
Live basis	3.54	3.72	0.059	0.065
Carcass-adjusted[5]	3.53	3.73	0.062	0.037
DMI, lb/(steer•d)[6]	19.9	20.9	0.28	0.040
G:F				
Live basis	0.178	0.178	0.0019	0.985
Carcass-adjusted[5]	0.177	0.179	0.0026	0.553

[1]The BeefPro treatment was mixed in approximately 1 lb (as-fed basis) of ground corn (1 lb of corn only for Control), which was then mixed with the complete diet at the time of feeding. BeefPro was fed to supply 200 mg/(steer•d).

[2]Standard error of the treatment means, n = 12 pens/treatment.

[3]Observed significance level for the difference between treatments.

[4]Blocks 1 through 5 were fed for 172 d, and blocks 6 through 12 were fed for 151 d.

[5]A 4% shrink was applied to final live BW. Carcass-adjusted BW was calculated from hot carcass weight divided by the average dressing percent (62.17%) across treatments and adjusted by a 4% shrink. Carcass-adjusted ADG was calculated from carcass-adjusted final BW, initial BW, and days on feed, with carcass-adjusted G:F calculated as carcass-adjusted ADG divided by average DMI for d 0 to end.

[6]Initial BW was used as covariate ($P < 0.01$) in the statistical analysis.

Table 4. Effects of BeefPro on carcass characteristics of finishing beef steers

Item	Treatment[1]		SE[2]	P-value[3]
	Control	BeefPro		
Hot carcass weight, lb[4]	823.7	842.3	7.37	0.104
Dressing percent	62.0	62.4	0.30	0.409
12th rib fat, in	0.45	0.49	0.026	0.390
Longissimus muscle area, in^2	14.1	13.9	0.26	0.676
Kidney, pelvic, and heart fat, %[4]	3.2	3.0	0.10	0.199
Yield grade	3.21	3.43	0.127	0.239
Marbling score[5]	457.4	479.7	15.03	0.317
Choice, %[6]	66.7 ± 7.03	78.7 ± 5.97	-	0.223
Condemned livers, %[7]	17.4 ± 5.71	10.6 ± 4.56	-	0.372

[1]The BeefPro treatment was mixed in approximately 1 lb (as-fed basis) of ground corn (1 lb of corn only for Control), which was then mixed with the complete diet at the time of feeding. BeefPro was fed to supply 200 mg/(steer•d).

[2]Standard error of the treatment means, n = 12 pens/treatment.

[3]Observed significance level for the difference between treatments.

[4]Initial BW was used as covariate ($P < 0.01$) in the statistical analysis.

[5]300 = Slight^{00}; 400 = Small^{00}; 500 = Modest^{00}.

[6]Percentage of carcasses grading USDA Choice or greater.

[7]Includes A-, A, and A+ livers, plus livers with fluke damage or telangiectasis.