Effects of Butyrate in Finishing Cattle Diets

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Summary with Implications

Butyrate is produced in the rumen as an end product from fermentation and is an important energy source for epithelial tissue. In a corn based finishing cattle diet ruminally protected butyrate (Ultramix-C) was supplemented at 0.3% of diet dry matter while a ruminally unprotected butyrate product (MiruTyton) was fed at 1% of the diet, with both compared to a common control diet (0% butyrate). There were no differences in dry matter intake among treatments. There were also no differences in final body weight, daily gain, feed efficiency, and hot carcass weight. There was a significant difference in ribeye area with cattle consuming the butyrate diets having greater ribeye area (15.8 in^2) than control cattle (14.4 in^2). While interim weights suggest feeding butyrate early in the feeding period may hold some benefit for young or newly weaned calves, there is no clear benefit throughout the feeding period.

Introduction

Butyrate is a short-chain fatty acid that is produced by microbial fermentation in the large intestine as well as the rumen of ruminant animals. It has been shown to enhance gut development, reduce inflammation, improve growth performance and help control enteric pathogens in the rumen when fed to young growing calves. Butyrate can also improve rumen epithelium development which can improve animal performance, especially early on in life. Butyrate is commonly added to milk replacers and colostrum in early weaned calf diets to increase rumen papillae development. However, feeding butyrate to finishing steers is not common as butyrate is already produced in the rumen of these mature animals. The benefits of butyrate are primarily observed in the lower GI tract. In ruminant animals, protecting these butyrate products from absorption or metabolism in the rumen may be necessary. Therefore, 2 butyrate products were used, a ruminally protected butyrate product at 0.3% of diet DM (Ultramix-C, Nutriad-Adisseo, Alpharetta, GA) and an unprotected butyrate product at 1% of diet DM (MiruTyton, White Dog Labs, Inc., New Castle, DE). The objective was to determine if butyrate is beneficial in finishing cattle diets.

Table 1. Dietary treatment compositions for finishing steers fed rumen protected or unprotected butyrate

Ingredient, % of DM	Control	Ultramix C[1]	MiruTyton[2]
Grass Hay	7	7	7
Modified Distillers Grains plus Solubles	20	20	20
Dry rolled corn	34.5	34.2	33.5
High moisture corn	34.5	34.5	34.5
Unprotected butyrate	0	0	1.0
Protected butyrate	0	0.3	0
Supplement[1]	4	4	4

[1] Ultramix C is a rumen protected butyrate source (Nutriad-Adisseo, Alpharetta, GA)
[2] MiruTyton is a rumen unprotected butyrate source (White Dog Labs, Inc., New Castle, DE)
[3] Supplement contained 1.37% fine ground corn, 1.64% limestone, 0.10% tallow, 0.50% urea, 0.30% salt, 0.05% trace mineral, 0.015% Vitamin ADE, rumensin (30 g/ton), and tylan (8.9 g/ton).

Procedure

A 141-d finishing study was conducted at the University of Nebraska Research and Extension Center near Mead, NE using 30 crossbred yearling steers (initial body weight (BW) = 877 lb.). Prior to this trial, cattle were backgrounded on corn residue through the winter months, until start of the trial in May. Steers were limit fed a diet consisting of 50% alfalfa hay and 50% Sweet Bran (Cargill corn milling, Blair, NE) for five days prior to trial initiation at 2% of BW to reduce gut fill variation. Steers were then weighed 3 consecutive days to establish average initial BW. Steers were stratified by BW and assigned randomly to one of 3 treatments (control, protected butyrate at 0.3% of diet DM, and unprotected butyrate at 1% of diet DM). Treatment diets are presented in Table 1. The diets consisted of a 50:50 blend of dry rolled corn and high moisture corn with 7% grass hay and 20% modified distillers grains plus soluble. Rumensin and Tylan (Elanco Animal Health, Greenfield, IN) were included in all diets. The butyrate products were added to the feed truck as an ingredient at the time of feeding and replaced dry rolled corn in the diet. All steers were individually fed using the Calan gate system.

Steers were implanted on d-1 with Revalor-IS and re-implanted on d-57 with Revalor-200 (Merck Animal Health, Summit, NJ). Interim individual cattle body weights were taken on days 30, 56 and 57 of the trial. Cattle were fed ad libitum once daily. Feed refusals were collected weekly, weighed, and dried in 60° C forced air oven for 48 hours to calculate accurate DMI for individual steers.

Steers were fed for 141 days prior to harvest. Cattle from all treatments were individually weighed on 3 consecutive days at

Table 2. Effects of rumen protected and unprotected butyrate on cattle performance and carcass characteristics

	Control	Ultramix C[1]	MiruTyton[2]	SEM	*P*- Value
Initial BW, lb	878	879	868	23.1	0.94
Live Performance					
Final BW, lb	1422	1415	1411	32.0	0.97
Dry Matter Intake, lb/d	24.4	24.8	24.7	0.69	0.89
Daily Gain, lb	3.86	3.65	3.70	0.12	0.44
Feed:Gain	6.29[a]	6.80[b]	6.67[b]	—	0.10
Carcass Adjusted Performance					
Final BW[3], lb	1420	1453	1431	30.5	0.74
Daily Gain, lb	3.85	3.90	3.83	0.12	0.90
Feed:Gain	6.29	6.33	6.41	—	0.84
Dressing Percentage, %	62.9[a]	64.7[b]	64.0[b]	0.50	0.04
Hot Carcass Weight, lb	895	916	902	19.2	0.74
Ribeye Area, in^2	14.4[a]	15.8[b]	15.8[b]	0.35	0.01
12th Rib Fat, in	0.63	0.66	0.64	0.04	0.89
Marbling	478	501	509	19.1	0.50

[1] Ultramix C is a rumen protected butyrate source (Nutriad-Adisseo, Alpharetta, GA)

[2] MiruTyton is a rumen unprotected butyrate source (White Dog Labs, Inc., New Castle, DE)

[3] Harvest was done at a commercial abattoir for the Control treatment and across 12 days at the UNL Meat Science Lab for the Ultramix-C and MiruTyton treatments which may have influenced carcass adjusted performance.

Table 3. Interim cattle performance

	Control	Ultramix C[1]	MiruTyton[2]	SEM	*P*- Value
Initial BW, lb	878	879	868	23.1	0.94
Day 30 performance					
Body weight, lb	1006	1020	1004	24.1	0.88
Daily gain, lb	4.44	4.87	4.69	0.15	0.12
Dry Matter Intake, lb/d	24.2	25.2	24.7	0.51	0.39
Feed:Gain	5.41	5.16	5.24	—	0.59
Day 57 performance					
Body weight, lb	1137	1128	1122	26.8	0.92
Daily gain, lb	4.64	4.46	4.53	0.17	0.75
Dry Matter Intake, lb/d	25.5	25.9	25.5	0.72	0.91
Feed:Gain	5.46	5.81	5.62	—	0.51

[1] Ultramix C is a rumen protected butyrate source (Nutriad-Adisseo, Alpharetta, GA)

[2] MiruTyton is a rumen unprotected butyrate source (White Dog Labs, Inc., New Castle, DE)

the conclusion of the feeding period. Cattle from the control treatment were loaded on trucks in the afternoon of d-141 after feeding 50% of the previous day's intake. These cattle were then harvested at a commercial abattoir the following morning. The two butyrate products were not FDA approved to be fed to cattle; therefore, cattle on those treatments were composted. The cattle fed the butyrate products were harvested across 12 days (starting on d-142) at the University of Nebraska Meat Science Lab (5 animals per day and 4 harvest dates). For all treatments, on the day of harvest kill order, liver abscess scores and HCW were recorded and carcass- adjusted BW was calculated from a common 63% dressing percentage. Carcass characteristics included marbling score, longissimus muscle area and yield grade, were recorded after a 48-hour chill.

Data were analyzed using the GLIMMIX procedure of SAS as a randomized design. Steer was the experimental unit and treatment was a fixed effect. Treatment means were compared when the F-statistic for treatment was significant. Significance was declared at $P \leq 0.05$ and tendencies at $P \leq 0.10$.

Results

Performance results are presented in Table 2. There were no significant differences observed for DMI (dry matter intake), ADG (average daily gain), and final BW among the treatments ($P \geq 0.44$). Live feed:gain tended ($P = 0.10$) to be improved for the control (6.29) compared to the butyrate supplemented diets (6.73); however, there were no differences in carcass adjusted feed:gain ($P = 0.84$). Hot carcass weight was not different among treatments ($P = 0.74$). The different harvest procedures used for the butyrate treatments compared to the control did result in differences in dressing percentages ($P = 0.04$), 62.9% for CON and 64.4% for the butyrate treatments. This was likely due to harvest method (cattle fed the butyrate products could not be harvested at a commercial abattoir) and not related to treatment. Marbling and 12th rib fat were not different between treatments ($P \geq 0.50$). Ribeye area was larger for both butyrate treatments (15.8 in^2) compared to the control (14.4 in^2; $P = 0.01$).

Interim performance suggests there may be benefits of butyrate supplementation early in the feeding period (Table 3). After the first 30 days on feed there were no differences in DMI ($P = 0.39$) and a tendency for an improvement in ADG ($P = 0.12$), with a 7.5% increase for butyrate supplemented treatments. Similar to final performance, there were no differences observed on day 57 ($P \geq 0.51$). Day 30 performance is based on a 1-day body weight measurement while body weights were measured on 2 consecutive days for the day 57 performance. Yearling cattle that had undergone a backgrounding period were used for this study. Different results may be observed for newly weaned calves, especially during the step up period going from a forage based to concentrate based finishing diet when rumen and gut health are critical.

Conclusion

Supplementation of butyrate had limited effects on yearling cattle performance in a finishing diet. Both ruminally protected and unprotected butyrate increased ribeye area. Feeding butyrate to finishing cattle at different inclusion levels or at targeted times during the feeding period may result in different results. Butyrate may be more beneficial in young cattle diets, with evidence of improved performance due to rumen and gut development for bottle-fed and newly weaned calves.

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