Supplemental Lysine in Finishing Cattle Diets

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Summary with Implications

The objective of this experiment was to evaluate the effects of increasing lysine supply in finishing beef cattle diets. Crossbreed steers (n=120, BW= 577± 2 lb) were individually fed using a Calan Gate system for 195 days. Animals received a common finishing diet (63% corn, 15% corn silage and 15% distillers grains) with 0, 1, 2, 3, 4, 5, 6, or 7 g per day of supplemental rumen bypass lysine. High levels of lysine (5 or more g per day) in the diet decreased dry matter intake, carcass adjusted average daily gain, and carcass adjusted body weight with no impact on carcass adjusted feed efficiency. Hot carcass weight decreased as supplemental lysine increased in the diet with no impact on other carcass performance parameters. In conclusion, there were no improvements in performance as supplemental lysine increased in finishing beef cattle diets.

Introduction

In Nebraska, corn and corn byproducts are the primary ingredients in most finishing cattle diets. Lysine has been found to be the first limiting amino acid in corn-based beef cattle diets. To meet lysine requirements, crude protein is often increased in beef cattle diets; however, increasing crude protein can lead to decreased efficiency in nitrogen utilization and increased nitrogen excretion in urine. Rumen-protected lysine sources have been used to help meet lysine requirements and may improve performance and ADG of cattle when lysine is limiting growth.

The objective of this experiment was to evaluate if increasing rumen protected lysine supply in finishing beef cattle diets would improve cattle performance.

Procedure

This experiment utilized 120 crossbred beef steers (577 ± 2 lbs) at the Eastern Nebraska Research, Extension, and Education Center (ENREEC) near Mead, NE. Steers were individually fed using the Calan Gate System (American Calan Inc., Northwood, New Hampshire). Steers were fed a base diet of 15.0% modified distillers grains plus solubles, 15.0% corn silage, 39.6% high moisture corn, 23.4% dry rolled corn, 4.0% supplement, and 3.0% Smartamine ML topdress consisting of dry rolled corn and Smartamine ML. Smartamine ML (Adisseo USA, Inc., Alpharetta, Georgia) is a rumen-protected source of lysine that is 80% bioavailable for the animal. This product consists of 55% hydrochloride lysine, 15% methionine, and 30% inert products. The Smartamine ML topdress was fed to provide 0, 1, 2, 3, 4, 5, 6, or 7 grams of post-rumen available lysine daily, which also provided 0. 0.3, 0.7, 1.0, 1.4, 1.7, 2.0, and 2.4 grams per day of methionine. The amount of Smartamine ML provided to each steer was consistent throughout the experiment and the amount of dry rolled corn in the top dress varied based on intake to maintain the top dress at 3% of the diet. The Smartamine ML topdress was mixed weekly in a small batch mixer.

Initial BW was determined by 3 days of individual weighing following a 5-day period of limit feeding a 50% alfalfa, 50% Sweet Bran (Cargill Corn Milling, Blair, NE) diet at 2% BW to equalize gut fill. On days 63 and 64, two consecutive day body weights were taken in the morning prior to feeding. On day 162, a one-day weight was taken.

Cattle were implanted with Revalor XS (Merck Animal Health, Summit, NJ) on day 1 and reimplanted with Revalor-200 (Merck Animal Health) on day 91. Optaflexx (Elanco Animal Health, Greenfield, IN) was fed from days 163 to 195 at a rate of 300 mg/steer daily. Cattle were on feed for 195 days. Animals were slaughtered at a commercial abattoir (Greater Omaha Packing Plant, Omaha, NE). During harvest, hot carcass weight (HCW) was recorded, and carcass adjusted final BW was calculated based on a common 63% dress. Carcass characteristics including marbling, 12th rib fat thickness, yield grade, and *Longissimus* muscle (LM) area were collected after a 48-hour chill.

Data were analyzed using the MIXED procedure of SAS (SAS Institute Inc., Cary, NC) as a completely randomized design with steer (n= 15) as the experimental unit and treatment as the fixed effect. Orthogonal contrasts were used to explore the linear and quadratic responses. Contrasts were also used to compare the control and 1, 2, and 3 g/d treatment groups, which were deemed to be the most biologically and economically relevant treatments.

Table 1. Diet composition for steers fed varying amounts of rumen-protected lysine

Ingredient	% DM
High moisture corn	39.60
Dry rolled corn	23.40
Modified Distillers Grains plus Solubles	15.00
Corn Silage	15.00
Supplement[1]	4.00
Smartamine ML topdress[2]	3.00
Smartamine ML	0–7 g/d available lysine

[1] Supplement provided 1.66% limestone, 0.30% salt, 0.10% tallow, 0.05% trace mineral premix, 0.015% Vitamin ADE, 0.50% Urea (to meet RDP requirement), Tylan (Elanco Animal Health) targeted at 8.8 g/ton of DM, Rumensin (Elanco Animal Health) targeted at 30 g/ton of DM, and Optaflexx (Elanco Animal Health) for the last 28 d targeted at 300 mg/day, with a fine ground corn carrier.

[2]Smartamine ML topdress included dry rolled corn and Smartamine ML with dry rolled corn replacing Smartamine ML as amount of lysine decreased in the diet. Smartamine ML amount was consistent throughout the trial with dry rolled corn amount varying based on intake.

Table 2. Effect of rumen-protected lysine on cattle performance

	Treatment									*P*-Values[1]				
	0	1	2	3	4	5	6	7	SEM	Linear	Quadratic	0 vs 1 g/d	0 vs 2 g/d	0 vs 3 g/d
Steers, n	15	14	15	15	14	15	15	15						
Overall Performance[2]														
Initial BW, lb	577	574	577	578	580	577	578	577	6.19	0.73	0.80	0.80	0.97	0.89
Final BW, lb	1298	1304	1282	1271	1292	1272	1244	1269	22.26	0.07	0.87	0.84	0.59	0.38
DMI, lb/d	20.7	19.9	19.6	19.2	20.2	19.3	19.3	19.3	0.49	0.04	0.44	0.26	0.12	0.03
ADG, lb	3.70	3.74	3.62	3.56	3.65	3.56	3.41	3.55	0.11	0.04	0.81	0.78	0.57	0.33
Feed: Gain[3]	5.56	5.32	5.43	5.41	5.56	5.38	5.62	5.43	—	0.72	0.67	0.23	0.50	0.43
Day 64 Performance[4]														
DMI, lb/d	17.3	16.6	17.0	16.6	16.8	16.5	17.1	16.5	0.46	0.48	0.62	0.26	0.68	0.25
ADG, lb	3.49	3.47	3.48	3.24	3.35	3.28	3.25	3.22	0.14	0.05	0.81	0.92	0.95	0.20
Feed: Gain[3]	4.97	4.78	4.87	5.10	5.05	5.02	5.23	5.12	—	0.08	0.94	0.40	0.68	0.55
Optaflexx Period Performance[5]														
DMI, lb/d	21.5	20.2	19.0	19.9	20.5	19.7	18.5	18.9	0.70	0.01	0.74	0.21	0.01	0.10
ADG, lb	3.21	3.11	2.86	3.51	3.11	3.12	2.73	3.26	0.38	0.81	0.99	0.86	0.51	0.56
Feed: Gain[3]	6.58	6.45	6.80	5.65	6.62	6.29	6.85	5.88	—	0.69	0.99	0.90	0.86	0.34

[1]Orthogonal contrasts were used to explore the linear and quadratic responses, and contrasts were also used to compare the control and 1, 2, and 3 g/d treatment groups.

[2]Indicates performance from day 1 to day 195 (conclusion of experiment) using carcass adjusted final body weight and 63% dress.

[3]Analyzed as Gain: Feed, the reciprocal of Feed: Gain

[4] Indicates performance from day 1 to day 64 of experiment

[5] Indicates performance from day 163 to day 195 (conclusion of experiment) while Optaflexx was being fed

Table 3. Effect of rumen-protected lysine on carcass characteristics

	Treatment									*P*-Values[1]				
	0	1	2	3	4	5	6	7	SEM	Linear	Quadratic	0 vs 1 g/d	0 vs 2 g/d	0 vs 3 g/d
Steers	15	14	15	15	14	15	15	15						
HCW, lb	818	822	808	801	814	801	784	800	14.0	0.07	0.87	0.84	0.59	0.38
LM Area, in^2	14.2	14.2	14.2	13.9	14.4	14.5	14.3	14.2	0.34	0.62	0.99	0.91	0.89	0.50
12th Rib Fat^2, in	0.41	0.42	0.45	0.42	0.44	0.37	0.42	0.36	0.03	0.20	0.18	0.81	0.33	0.76
Marbling Score[3]	456	463	470	421	471	450	480	432	20.3	0.73	0.80	0.80	0.60	0.22
Yield Grade	3.01	3.04	3.09	3.05	3.10	2.92	3.03	2.89	0.09	0.20	0.20	0.81	0.50	0.73

[1]Orthogonal contrasts were used to explore the linear and quadratic responses, and contrasts were also used to compare the control and 1, 2, and 3 g/d treatment groups.

[2]Calculated by back calculating from the USDA YG equation

[3]Marbling Score 400 = Small00, 500 = Modest00

Results

Results showed that feeding increasing amounts of rumen-protected lysine throughout the entire feeding period linearly decreased dry matter intake *(P* = 0.04; Table 2) and carcass adjusted average daily gain (*P* = 0.04) with no effect on feed conversion (*P* ≥ 0.23). Dry matter intake was lower for the 3 g/d treatment compared to the control (*P* = 0.03). Decreases in dry matter intake suggest a potential aversion to the Smartamine ML product. Carcass adjusted final body weight and thus hot carcass weight tended to linearly decrease (*P* = 0.07) as Smartamine ML increased in the diet, with no effect on other carcass measures including LM area, 12th rib fat, and marbling score (*P* ≥ 0.18).

During the first 64 days of the trial, average daily gain linearly decreased (*P* = 0.05) as Smartamine ML increased with a trend for feed conversion to linearly increase (*P* = 0.08) with no other impacts on performance (*P* ≥ 0.20). During the Optaflexx feeding period (d 163–195), dry matter intake linearly decreased (*P* = 0.01) as lysine increased in the diet. In addition, dry matter intake was lower for the 2 g/d treatment compared to the control (*P* = 0.01). Despite lower DMI, there was no effect on carcass adjusted average daily gain (*P* ≥ 0.51) or feed conversion (*P* ≥ 0.34).

Conclusion

Feeding supplemental lysine in finishing beef cattle diets that contained 15% modified distillers' grains plus solubles did not improve performance. Supplemental lysine reduced feed intake suggesting that excess lysine can impede performance in beef cattle. These results also suggest that with 15% modified distillers grains plus solubles in the diet (DM basis), cattle are supplied with enough lysine from rumen undegradable protein and microbial crude protein to satisfy lysine requirements.

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