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Effect of Ruminally-Protected Lysine Supplementation to Growing Cattle on Growth and Subsequent Finishing Performance

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Effect of Ruminally-Protected Lysine Supplementation to Growing Cattle on Growth and Subsequent Finishing Performance

Abstract

Objective: The objective of this study was to evaluate the effects of ruminally-protected lysine supplementation fed during the growing phase to cattle limit-fed a corn-based diet, and to evaluate the subsequent finishing performance.

Study Description: For 77 days, a group of 338 steers limit-fed at 2.4% of body weight daily on a dry matter basis were allocated to treatments providing 0, 3, or 6 g/day of lysine from Smartamine ML (Adisseo, Alpharetta, GA), or containing blood meal plus ruminally-protected methionine from Smartamine M. Growth performance was measured over the growing period. Cattle were then shipped to a commercial feedlot and fed without treatment until slaughter. Finishing performance was gathered from carcass data.

Results: Steers supplemented with 3 g/day of lysine appeared to have the greatest response during the growing phase, having the heaviest body weights on day 77, and greatest average daily gains and gain:feed ratios. In the finishing phase, cattle that received 3 g/day of lysine during the growing phase maintained the weight advantage, relative to the control, established during the growing phase. Cattle receiving 6 g/day of lysine during the growing phase performed best during the finishing phase. Cattle receiving 3 and 6 g/day of lysine during the growing phase had carcasses that were 8 and 16 lb greater, respectively, than the control.

The Bottom Line: When fed corn-based diets, supplementation of ruminally-protected lysine during the growing phase may improve growth performance of cattle during the growing and/or finishing phase, leading to improvement in greater carcass weights.

Keywords

lysine, growing cattle, corn-based

Cover Page Footnote

The authors thank Adisseo (Alpharetta, GA) for financial support and for providing the Smartamine ML and Smartamine M used in this experiment. The support of Bill Hollenbeck and the staff at the Kansas State University Beef Stocker Unit was invaluable in enabling this research. Appreciation is extended to Pratt Feeders (Pratt, KS) for providing cattle used in this experiment and feeding the cattle during the finishing phase.

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K-STATE Research and Extension

CATTLEMEN'S DAY 2022

KANSAS STATE UNIVERSITY CATTLEMEN'S DAY

Effect of Ruminally-Protected Lysine Supplementation to Growing Cattle on Growth and Subsequent Finishing Performance

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Abstract

Corn-based diets are especially poor in providing lysine to cattle, so supplementation of ruminally-protected lysine may improve performance of growing cattle. The objective of this study was to evaluate the effects of supplementing ruminally-protected lysine to growing cattle limit-fed a corn-based diet. A group of 338 steers was allocated among 32 pens and fed at 2.4% of body weight (BW) daily on a dry matter (DM) basis for 77 days. Pens were assigned to one of four treatments: no supplementation (control), 3 g/day metabolizable lysine from Smartamine ML (Lys-3), 6 g/day metabolizable lysine from Smartamine ML (Lys-6), or blood meal at 0.89% of dietary DM plus 2 g/day of metabolizable methionine from Smartamine M (BM). Cattle were weighed by pen on days 0 and 77 to measure performance during the growing phase. Following the growing period, cattle were shipped to a commercial feedlot where they were fed until slaughter. Cattle received no treatments while at the feedlot. Performance during the finishing phase was measured using carcass data gathered from the slaughter facility. Steers supplemented with Lys-3 appeared to have the greatest response during the growing phase, had the heaviest BW on day 77, and greatest average daily gains and gain:feed ratios. In the finishing phase, Lys-3 maintained the weight advantage, relative to control, established during the growing phase. Cattle receiving Lys-6 during the growing phase performed best during the finishing phase. Cattle receiving Lys-3 and Lys-6 during the growing phase had carcasses that were 8 and 16 lb greater, respectively, than control.

Introduction

Lysine is an essential amino acid, meaning it is not synthesized in the body in adequate quantities to support the body's demand and, therefore, must be supplied through the diet. However, some feedstuffs, including corn, do not provide lysine at a sufficient level to meet animal requirements. As a result, lysine may become a limiting amino acid for the animal. Because corn is a primary ingredient in cattle diets, lysine may be deficient and limit growth performance. Supplemental lysine may improve performance in deficient cattle, but because lysine is extensively degraded in the rumen, it is not bene-

[1] Adisseo, Alpharetta, GA.

ficial to add lysine in an unprotected form to the diet. Commercially available ruminally-protected lysine products (e.g., Smartamine ML) can escape ruminal degradation and allow for absorption of lysine from the small intestine. The objective of this study was to evaluate the effects of ruminally-protected lysine supplementation fed during the growing phase to cattle limit-fed a corn-based diet, and to evaluate the subsequent finishing performance.

Experimental Procedures

A 77-day growth trial was conducted using 338 crossbred steers of Arkansas, Missouri, and Nebraska origin (560 lb initial weight) at the Kansas State University Beef Stocker Unit, Manhattan, KS. Cattle were blocked by truck load (4) and stratified by individual arrival body weight to eight pens per block (32 pens total) containing nine to 12 steers each. Steers were implanted with Revalor G (40 mg trenbolone acetate, 8 mg estradiol; Merck Animal Health, Madison, NJ), at initiation of the trial. Within block, pens were allocated to one of four experimental treatments: no supplemental amino acids/protein (control); 3 g/day metabolizable lysine from Smartamine ML (Adisseo, Alpharetta, GA; Lys-3); 6 g/day metabolizable lysine from Smartamine ML (Lys-6); or supplemental blood meal (AAdvantage; Perdue Agribusiness, Kings Mountain, NC; BM) at 0.89% of dietary dry matter (DM) plus 2 g/day metabolizable methionine provided from Smartamine M (BM). The BM treatment was designed to match the supplemental metabolizable lysine of Lys-3 and ensure methionine was not limiting for the BM treatment. Supplemental levels were formulated to provide 3 or 6 g/day metabolizable lysine or 2 g/day metabolizable methionine when cattle consumed a target of 14.33 lb/day DM. Cattle were limit-fed a corn-based diet (Table 1) once daily at 2.4% of body weight (BW) on a DM basis. Therefore, as BW increased during the trial, cattle received 77 to 142% of targeted treatment amounts due to feed intakes being lesser or greater than the target intake.

Throughout the experiment, treatments were incorporated into the ration during feed mixing. Cattle were weighed on the initial day (day 0) and on the final day of the experiment (day 77) to measure growth performance and efficiency of gain. After 77 days, cattle were shipped to a commercial feedlot and mixed into two finishing pens. At the feedlot, cattle did not receive any treatment. One finishing pen was fed for an average of 185 days and the other for 206 days. After the finishing period, cattle were slaughtered at a commercial facility and carcass data were acquired, including hot carcass weight, ribeye area, back fat depth, and quality grades of each carcass. Slaughter weights were calculated using hot carcass weights and the average dressing percentages of the two finishing pens.

Results and Discussion

Statistical analyses were used to determine the linear and quadratic effects of lysine supplementation during growing and finishing phases. Linear responses demonstrate increases (or decreases) in response as the amount of lysine increased. Quadratic responses indicate the middle treatment (Lys-3) has a different response than the average of control and Lys-6.

During the growing phase, lysine supplementation tended to improve average daily gain compared to the control, with Lys-3 yielding the greatest growth response (quadratic effect, $P = 0.12$; Table 2). Supplementation with Lys-3 increased daily gains by

0.25 lb/day above the control. The Lys-3 treatment also tended to improve feed efficiency (quadratic effect, $P = 0.08$; Table 2). Control and BM led to similar responses during the 77-day growing period.

In the finishing phase, when treatments were no longer supplemented, steers that had received Lys-6 during the growing period had the greatest daily gains (linear effect, $P = 0.17$; Table 3). During the finishing phase, the Lys-6 group had daily gains that were 0.11 lb/day greater than control and Lys-3.

The net effect of the growing and finishing phases combined was that lysine supplementation during the growing phase resulted in a tendency for linear increases in hot carcass weight (linear effect, $P = 0.20$; Table 3) and subsequent calculated slaughter BW (linear effect, $P = 0.20$; Table 3). Supplementation with Lys-6 led to 16 lb more carcass weight and 25 lb more slaughter weight than control. Relative to control, Lys-3 maintained the advantage in BW gained during the growing phase, as shown by 8 lb more carcass weight and 12 lb more BW at slaughter compared to control. However, the greater gains for Lys-6 than for Lys-3 during the finishing period allowed Lys-6 to exceed Lys-3 for carcass weight and slaughter weight.

Treatments Lys-3 and Lys-6 led to greater muscling than control, as indicated by the increases in ribeye areas (linear effect, $P = 0.05$; Table 3). In addition, Lys-3 cattle had leaner carcasses with the least amount of back fat (quadratic effect, $P = 0.04$; Table 3). Control and BM both had lower slaughter weights, hot carcass weights, and ribeye areas than cattle supplemented with lysine from Smartamine ML.

Implications

When fed corn-based diets, supplementation of ruminally-protected lysine during the growing phase tended to improve growth performance of cattle during the growing and/or finishing phase, leading to tendencies for greater carcass weights.

Acknowledgments

The authors thank Adisseo (Alpharetta, GA) for financial support and for providing the Smartamine ML and Smartamine M used in this experiment. The support of Bill Hollenbeck and the staff at the Kansas State University Beef Stocker Unit was invaluable in enabling this research. Appreciation is extended to Pratt Feeders (Pratt, KS) for providing cattle used in this experiment and feeding the cattle during the finishing phase.

Table 1. Diet composition (% of DM[1])

	Treatment diet[2]			
Ingredient	**Control**	**Lys-3**	**Lys-6**	**BM**
Smartamine ML	0	0.129	0.259	0
Smartamine M	0	0	0	0.051
Blood meal	0	0	0	0.89
Dry-rolled corn	10.0	9.87	9.74	9.06
Steam-flaked corn	29.5	29.5	29.5	29.5
Sweet Bran[3]	40.0	40.0	40.0	40.0
Alfalfa hay	6.5	6.5	6.5	6.5
Prairie hay	6.5	6.5	6.5	6.5
Supplement[4]	7.5	7.5	7.5	7.5

[1]DM = dry matter.
[2]Control = No supplemental amino acids/protein; Lys-3 = 3 g/day metabolizable lysine from Smartamine ML (Adisseo, Alpharetta, GA); Lys-6 = 6 g/day metabolizable lysine from Smartamine ML; BM = supplemental blood meal (AAdvantage; Perdue Agribusiness, Kings Mountain, NC) at 0.89% of dietary DM plus 2 g/day metabolizable methionine provided from Smartamine M.
[3]Cargill Corn Milling (Blair, NE).
[4]Supplement pellet formulated to contain (DM basis): 8.4% calcium, 5% sodium chloride (NaCl), and 360 mg/kg monensin. Supplement ingredients (DM basis): 72.15% wheat middlings, 22.0% calcium carbonate, 5.0% NaCl, 0.35% soybean oil, 0.18% Rumensin 90 (Elanco), 0.11% zinc sulfate, 0.08% manganese (Mn) sulfate (32% Mn), 0.06% vitamin E premix (500,000 IU/kg), 0.05% copper sulfate, 0.01% selenium (Se) premix (0.99% Se), 0.007% ethylenediamine dihydriodide (EDDI) premix (11.4% EDDI), and 0.004% vitamin A premix (650,000 IU/g).

Table 2. Growing phase - cattle performance

	Treatment[1]					Lysine (*P*-value)	
Item	**Control**	**Lys-3**	**Lys-6**	**BM**	**SEM[2]**	**Linear**	**Quad**
Body weight, lb							
Day 0	549	547	548	548	3.2	0.83	0.60
Day 77	868	885	877	866	8.5	0.45	0.26
DM intake, lb/day	16.89	17.04	16.93	16.82	0.13	0.77	0.41
Daily gain, lb/day	4.14	4.39	4.28	4.12	0.09	0.32	0.12
Gain:feed, lb/lb	0.247	0.259	0.254	0.247	0.0040	0.25	0.08

[1]Control = No supplemental amino acids/protein; Lys-3 = 3 g/day metabolizable lysine from Smartamine ML (Adisseo, Alpharetta, GA); Lys-6 = 6 g/day metabolizable lysine from Smartamine ML; BM = supplemental blood meal (AAdvantage; Perdue Agribusiness, Kings Mountain, NC) at 0.89% of dietary dry matter (DM) plus 2 g/day metabolizable methionine provided from Smartamine M.
[2]SEM = standard error of the mean.

Table 3. Finishing phase - cattle performance

	Treatment[1]					Lysine (*P*-value)	
Item	Control	Lys-3	Lys-6	BM	SEM[2]	Linear	Quad
Daily gain, lb/day	3.02	3.02	3.13	3.04	0.13	0.17	0.39
Slaughter weight,[3] lb	1483	1495	1508	1482	13.0	0.20	0.98
Carcass weight, lb	957	965	973	956	8.4	0.20	0.99
Ribeye area, sq in	14.7	15.1	15.1	14.9	0.2	0.05	0.18
Back fat, in	0.74	0.66	0.71	0.70	0.02	0.36	0.04
USDA Choice + Prime, %	98.3	97.1	99.2	95.5	2.3	0.75	0.53

[1]Cattle received treatments only through 77-day growing phase. Control = No supplemental amino acids/protein; Lys-3 = 3 g/day metabolizable lysine from Smartamine ML (Adisseo, Alpharetta, GA); Lys-6 = 6 g/day metabolizable lysine from Smartamine ML; BM = supplemental blood meal (AAdvantage; Perdue Agribusiness, Kings Mountain, NC) at 0.89% of dietary dry matter (DM) plus 2 g/day metabolizable methionine provided from Smartamine M.
[2]SEM = standard error of the mean.
[3]Calculated from hot carcass weights and average dressing percentages.