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

K. J. Hazlewood
Kansas State University, khazl@ksu.edu

M. S. Grant
Kansas State University, msgrant@k-state.edu

D. A. Blasi
Kansas State University, dblasi@ksu.edu

See next page for additional authors

Follow this and additional works at: https://newprairiepress.org/kaesrr

Part of the Beef Science Commons

Recommended Citation
Hazlewood, K. J.; Grant, M. S.; Blasi, D. A.; Ducharme, G. A.; and Titgemeyer, E. C. (2022) "Effect of Ruminally-Protected Lysine Supplementation to Growing Cattle on Growth and Subsequent Finishing Performance," Kansas Agricultural Experiment Station Research Reports: Vol. 8: Iss. 1. https://doi.org/10.4148/2378-5977.8235

This report is brought to you for free and open access by New Prairie Press. It has been accepted for inclusion in Kansas Agricultural Experiment Station Research Reports by an authorized administrator of New Prairie Press. Copyright 2022 the Author(s). Contents of this publication may be freely reproduced for educational purposes. All other rights reserved. Brand names appearing in this publication are for product identification purposes only. No endorsement is intended, nor is criticism implied of similar products not mentioned. K-State Research and Extension is an equal opportunity provider and employer.
Effect of Ruminally-Protected Lysine Supplementation to Growing Cattle on Growth and Subsequent Finishing Performance

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.

Authors
K. J. Hazlewood, M. S. Grant, D. A. Blasi, G. A. Ducharme, and E. C. Titgemeyer

This beef cattle nutrition is available in Kansas Agricultural Experiment Station Research Reports: https://newprairiepress.org/kaesrr/vol8/iss1/16
Effect of Ruminally-Protected Lysine Supplementation to Growing Cattle on Growth and Subsequent Finishing Performance

K.J. Hazlewood, M.S. Grant, D.A. Blasi, G.A. Ducharme, and E.C. Titgemeyer

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-

\textsuperscript{1} Adisseo, Alpharetta, GA.
ficial to add lysine in an unprotected form to the diet. Commercially available rumi-
nally-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 indi-
vidual 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 metab-
olizable 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 exper-
iment (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,
rieye 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.

*Brand names appearing in this publication are for product identification purposes only. No endorsement is intended, nor is criticism implied of similar products not mentioned. Persons using such products assume responsibility for their use in accordance with current label directions of the manufacturer.*
Table 1. Diet composition (% of DM)

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Control</th>
<th>Lys-3</th>
<th>Lys-6</th>
<th>BM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smartamine ML</td>
<td>0</td>
<td>0.129</td>
<td>0.259</td>
<td>0</td>
</tr>
<tr>
<td>Smartamine M</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.051</td>
</tr>
<tr>
<td>Blood meal</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.89</td>
</tr>
<tr>
<td>Dry-rolled corn</td>
<td>10.0</td>
<td>9.87</td>
<td>9.74</td>
<td>9.06</td>
</tr>
<tr>
<td>Steam-flaked corn</td>
<td>29.5</td>
<td>29.5</td>
<td>29.5</td>
<td>29.5</td>
</tr>
<tr>
<td>Sweet Bran</td>
<td>40.0</td>
<td>40.0</td>
<td>40.0</td>
<td>40.0</td>
</tr>
<tr>
<td>Alfalfa hay</td>
<td>6.5</td>
<td>6.5</td>
<td>6.5</td>
<td>6.5</td>
</tr>
<tr>
<td>Prairie hay</td>
<td>6.5</td>
<td>6.5</td>
<td>6.5</td>
<td>6.5</td>
</tr>
<tr>
<td>Supplement</td>
<td>7.5</td>
<td>7.5</td>
<td>7.5</td>
<td>7.5</td>
</tr>
</tbody>
</table>

1DM = dry matter.
2Control = 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.
3Cargill Corn Milling (Blair, NE).
4Supplement 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), and 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

<table>
<thead>
<tr>
<th>Item</th>
<th>Control</th>
<th>Lys-3</th>
<th>Lys-6</th>
<th>BM</th>
<th>SEM</th>
<th>Linear</th>
<th>Quad</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body weight, lb</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day 0</td>
<td>549</td>
<td>547</td>
<td>548</td>
<td>548</td>
<td>3.2</td>
<td>0.83</td>
<td>0.60</td>
</tr>
<tr>
<td>Day 77</td>
<td>868</td>
<td>885</td>
<td>877</td>
<td>866</td>
<td>8.5</td>
<td>0.45</td>
<td>0.26</td>
</tr>
<tr>
<td>DM intake, lb/day</td>
<td>16.89</td>
<td>17.04</td>
<td>16.93</td>
<td>16.82</td>
<td>0.13</td>
<td>0.77</td>
<td>0.41</td>
</tr>
<tr>
<td>Daily gain, lb/day</td>
<td>4.14</td>
<td>4.39</td>
<td>4.28</td>
<td>4.12</td>
<td>0.09</td>
<td>0.32</td>
<td>0.12</td>
</tr>
<tr>
<td>Gain:feed, lb/lb</td>
<td>0.247</td>
<td>0.259</td>
<td>0.254</td>
<td>0.247</td>
<td>0.0040</td>
<td>0.25</td>
<td>0.08</td>
</tr>
</tbody>
</table>

1Control = 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.
2SEM = standard error of the mean.
Table 3. Finishing phase - cattle performance

<table>
<thead>
<tr>
<th>Item</th>
<th>Treatment¹</th>
<th>Lysine (P-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
<td>Lys-3</td>
</tr>
<tr>
<td>Daily gain, lb/day</td>
<td>3.02</td>
<td>3.02</td>
</tr>
<tr>
<td>Slaughter weight,³ lb</td>
<td>1483</td>
<td>1495</td>
</tr>
<tr>
<td>Carcass weight, lb</td>
<td>957</td>
<td>965</td>
</tr>
<tr>
<td>Ribeye area, sq in</td>
<td>14.7</td>
<td>15.1</td>
</tr>
<tr>
<td>Back fat, in</td>
<td>0.74</td>
<td>0.66</td>
</tr>
<tr>
<td>USDA Choice + Prime, %</td>
<td>98.3</td>
<td>97.1</td>
</tr>
</tbody>
</table>

¹Cattle 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.

²SEM = standard error of the mean.

³Calculated from hot carcass weights and average dressing percentages.