RUMINAL ESCAPE METHIONINE AND LYSINE FOR FINISHING STEERS

J.J. Martin[1], D.R. Gill[2], F.N. Owens[3], L.E. Deetz[4] and C.A. Strasia[5]

Story in Brief

Two hundred forty feedlot steers (319 kg) were stratified into 6 weight groups, placed in 30 pens and fed an 86% cracked corn, 7% cottonseed hull, urea supplemented 10.5% protein diet containing 5 different levels of coated D,L-methionine (0 to 20 g/d) plus L-lysine (0 to 16 g/d) for 130 days. Plasma levels of these two amino acids at day 56 was increased with supplementation indicating that the Kodak polymer coating delivered amino acids to the small intestine. But plasma lysine and methionine concentrations increased even with the lowest level of supplemental amino acids. This suggests that these two amino acids were not deficient for these cattle. No responses in gain or feed efficiency to supplemental amino acids were detected. Results indicate that the polymer coating system increased supply of amino acids to the small intestine, but with a urea supplemented corn diet, supply of lysine and methionine did not limit rate or efficiency of gain by yearling steers.

(Key Words: Methionine, Lysine, Ruminal Escape, Steers)

Introduction

The amino acids available for production by ruminant animals are provided by both dietary protein which bypasses or escapes fermentation in the rumen plus microbial protein which is synthesized within the rumen. Protein from corn is notably low in lysine while microbial protein is deficient in methionine plus cystine. If these two amino acids actually are deficient for production, rate of production should increase if they are supplemented. Because these amino acids are rapidly destroyed in the rumen (Schelling et al., 1967), they need to be protected by a coating to escape ruminal fermentation as has been developed by chemists at Eastman Kodak (Papas et al., 1984). The objective of this experiment was to determine the responses in growth rate and feed efficiency by finishing feedlot steers to several levels of supplemental coated lysine and methionine.

Materials and Methods

Two hundred forty Charolais and Charolais crossbred steers averaging 703 lb were divided into 6 weight groups (633, 668, 686, 715, 739 and 777 lb means) for feeding at Goodwell, Oklahoma. Each weight block was subdivided into 5 different pens of 8 steers each and fed different levels of a mixture of methionine plus lysine coated to increase ruminal escape. The coating is an experimental compound being

[1]Chairman, Division of Agriculture, Panhandle State University
[2]Regents Professor [3]Professor [4]Eastman Research Laboratories
[5]Area Specialized Agent

Table 1. Diet dry matter ingredients and composition.[a]

Ingredient	Percentage	
Corn, cracked	87.0-86.4	
Cottonseed hulls	7.0	
Protected amino acids	0-.575	
Supplement pellet	6.0	
Milo, ground		2.55
Wheat middlings		.70
Molasses, dried		.45
Urea		.50
Calcium carbonate		.90
Dicalcium phosphate		.25
Potassium chloride		.30
Salt		.30
Rumensin-60		.03
Vitamin A		.01
Trace minerals		.01

[a]Designed to provide 60.9 mcal NEg per hundred pounds, 10.5% protein, .61% potassium, .47% calcium, .32% phosphorus.
[b]D,L-Methionine levels were 0, .05, .10, .15 and .20% with L-lysine levels of 0, .04, .08, .12 and .16% of the diet for the 5 treatments, respectively.

produced and tested by Eastman Kodak, Kingsport, Tennessee. A total of 6 pens (48 steers), one from each weight group, received each level of the supplemental amino acids. Respective levels of supplemental D,L-methionine and L-lysine were 0 and 0; 5 and 4; 10 and 8; 15 and 12; and 20 and 16 grams per animal per day based on a mean feed intake of 22 lb of dry matter for the trial. Steers were weighed shrunk initially and at the end of the 130 day trial, and full at 28 day intervals. Full weight was multiplied by .96 to determine shrunk weights to calculate rate of gain. Final weight also was calculated from carcass weight by dividing by .62. On day 56, blood samples were obtained from two steers per pen and plasma was analyzed for free methionine and lysine content.

Results and Discussion

Performance results by supplemental level of escape amino acids are presented in Table 2. Supplemental amino acids had no significant effect on weight gain, feed intake or feed efficiency of these steers. However, plasma concentrations of both methionine and lysine increased with supplemental coated amino acids. Simply supplementing the diet with uncoated methionine and lysine does not increase their plasma concentrations in ruminants due to destruction of these amino acids in the rumen (Schelling et al., 1967). Hence, this elevation is proof that coating increased the amount of these two amino acids absorbed by the animal. Therefore, the coating must have delivered these amino acids to the small intestine for absorption as suggested from incubation of the coated amino acids in buffer versus in acid (Papas et al., 1984).

Table 2. Influence of amino acid supplementation on steer performance.

	Amino Acid Level (Methionine/Lysine)				
	0/0	5/9.4	10/18.7	15/28.1	20/37.5
Weight, lb:					
Starting	701	704	704	704	702
56 days	909	913	905	903	899
130 days	1098	1096	1085	1083	1091
Carcass	694	692	686	685	690
Gain, lb/day:					
Live	3.06	3.02	2.93	2.91	3.00
Carcass	3.22	3.17	3.10	3.08	3.16
DM intake, lb/day:					
0-56	22.1	21.8	21.4	21.0	21.2
57-130	22.9	22.6	22.4	22.5	23.2
0-130	22.6	22.3	22.0	21.9	22.3
Feed/gain:					
0-56	7.24	7.13	7.27	7.35	7.37
57-130	7.52	7.61	7.69	7.73	7.52
0-130, live	7.39	7.39	7.50	7.54	7.45
0-130, carcass	7.02	7.02	7.11	7.14	7.06
Plasma lysine, ng/ml	11.9[a]	15.9[bc]	13.3[ab]	14.7[abc]	17.3[c]
Plasma methionine, ng/ml	4.1[a]	7.7[b]	7.2[b]	7.9[b]	10.3[c]

[ab]Means with different superscripts differ ($P<.05$).

Plasma concentrations of amino acids will increase only if the quantity supplied exceeds the amount required. Hence, the increase in plasma concentrations at the lowest level of supplementation implies that the basal diet probably was not deficient in these two amino acids. This can explain why performance was not improved by increasing the supply of these amino acids. The need for these amino acids should be much greater for lactating cows and younger growing animals which secrete or deposit protein at faster rates. If the diet were lower in methionine (corn protein is quite high) or bacterial protein supply were reduced (bacterial protein is high in lysine), response might have been positive. Responses to supplemental amino acids have been more favorable with diets not containing cottonseed hulls.

Table 3 presents carcass characteristics of these steers. Again, no favorable responses to supplemental amino acids were detected.

Performance of steers which were grouped into different starting weights is presented in Table 4. Rate of gain early in the feeding period, especially the first 28 days, favored cattle weighing over 675 lb, but weight gains of the heaviest cattle slowed during the last part of the feeding period. Feed intake was consistently higher for heavier cattle. The difference in feed intake between the lightest and heaviest group averaged 5.6 pounds per day during the first 28 days but decreased to 1.6 pounds during the final 14 days on feed.

Table 3. Carcass measurements by amino acid treatment.

	Amino Acid Level (Methionine/Lysine)				
	0/0	5/9.4	10/18.7	15/28.1	20/37.5
Dressing percentage	63.2	63.1	63.1	63.2	63.2
Rib eye area, sq. inches	12.6^{ab}	12.3^{ab}	12.7^{a}	12.4^{ab}	12.2^{b}
Fat thickness at 12th rib, in.	.50^{b}	.56^{ab}	.51^{ab}	.58^{a}	.57^{ab}
Kidney, heart, pelvic fat, %	2.35	2.36	2.38	2.32	2.43
Marbling score^{c}	13.4	13.4	13.0	13.1	13.5
Yield grade	2.81	3.07	2.78	3.06	3.12
Liver abscess:					
Incidence, %	33	17	31	36	31
Score^{d}	.62	.35	.73	.83	.73
Choice, %	73	81	77	77	69

^{ab}Means with different superscripts differ (P<.05).
^{c}Choice minus = 13; good plus = 12.
^{d}Minor abscess = 1; severe abscess = 3.

Table 4. Performance by inital weight group.

	Weight Grouping						
	1	2	3	4	5	6	Weight Effect^{a}
Weight, lb:							
Starting	633^{b}	668^{c}	686^{d}	715^{e}	739^{f}	777^{g}	L
56 days	825^{b}	873^{c}	895^{cd}	911^{d}	942^{e}	987^{f}	L
130 days	1016^{b}	1055^{c}	1089^{cd}	1094de	1028^{e}	1163^{f}	L
Carcass	632^{b}	663^{c}	690^{d}	694^{d}	718^{e}	738^{e}	L
Gain, lb/day:							
0-56	2.84	3.02	3.10	2.85	2.96	3.05	
57-130	3.02	2.94	3.11	2.96	3.01	2.91	
0-130, live	2.94	2.97	3.11	2.91	2.99	2.97	L
0-133, carcass	2.90	3.02	3.21	3.04	3.15	3.11	LQ
DM intake, lb/day:							
0-56	19.0^{b}	21.0^{c}	22.5^{d}	20.8^{c}	21.7^{d}	23.9^{e}	
57-130	22.1	22.3	23.1	22.3	22.9	23.6	l
0-130	20.8^{b}	21.8^{cd}	22.9^{de}	21.7^{cd}	22.4^{de}	23.8^{e}	L
Feed/gain:							
0-56	6.70^{b}	7.01^{b}	7.29^{bc}	7.31^{bc}	7.37^{bc}	7.95^{c}	L
57-130	7.34^{b}	7.598^{b}	7.45^{b}	7.54^{b}	7.63^{b}	8.13^{c}	L
0-130, live	7.06^{b}	7.33^{bc}	7.36^{bc}	7.44^{bc}	7.51^{c}	8.02^{d}	L
0-130, carcass	6.98^{b}	7.07^{b}	6.96^{b}	6.97^{b}	6.97^{b}	7.49^{c}	LQ

^{a}L=Linear effect (P<.05); l=Linear effect (P<.10); Q=Quadratic effect (P<.05); q=Quadratic effect (P<.10).
^{b,c,d,e,f,g}Means with different superscripts differ (P<.05).

Overall feed intake was increased by over 2 lb/100 lb difference in starting weight. Maximum feed intake occurred during the third month on feed for all weight groups and declined thereafter, especially for the heavier cattle. Intake curves were quite similar to those developed previously (Thornton et al., 1985).

Feed efficiency on a live weight basis favored cattle with a lighter starting weight by up to 13%. But expressed on a carcass weight basis, feed efficiency differences were smaller with a maximum difference of less than 8%. This reduction is due to the higher dressing percentage of heavier cattle (Table 5). Usually attributed to increased fatness, the increased dressing percentage in this study could not be completely attributed to increased fat thickness or internal fat. Yield grade, an inverse index of the percentage of the carcass in closely trimmed lean cuts, did not decrease markedly for heavier steers. These relationships suggest that feed efficiency on a carcass weight or product basis is altered less by initial weight than is efficiency as expressed on a live weight gain basis. These differences in dressing percentage altered live value by over 12% in this study. Rather than having cattle buyers attempt to predict dressing percentage of live cattle, producers would be more legitimately rewarded for cattle with a higher dressing percentage if a reward-discount system were available to adjust for dressing percentage. This would be one step toward grade and yield pricing but would avoid grading and re-grading inconsistencies.

Table 5. Carcass measurements by weight group.

	Weight Grouping						Weight Effect[a]
	1	2	3	4	5	6	
Dressing percent	62.3[b]	62.8[bc]	63.4[cd]	63.5[cd]	63.7[d]	63.5[cd]	LQ
Rib eye area, in^2	11.9[b]	12.2[bc]	12.6[cd]	12.6[cd]	12.7[d]	12.7[d]	Lq
Fat thickness, in	.48[b]	.55[bc]	.58[c]	.55[bc]	.55[bc]	.54[bc]	Q
Kidney, heart, pelvic fat, %	2.35	2.45	2.39	2.39	2.34	2.30	
Marbling score	13.0	13.1	13.3	13.2	13.5	13.5	l
Yield grade	2.8	3.0	3.0	3.0	3.0	3.0	l
Liver abscess:							
Incidence, %	32	38	25	30	15	38	
Score	.75	.92	.55	.53	.30	.85	
Choice, %	70	72	68	78	85	80	

[a]L=Linear effect (P<.05); l=Linear effect (P<.10); Q=Quadratic effect (P<.05); q=Quadratic effect (P<.10).
[b,c,d]Means in a row with different superscripts differ (P<.05).

Literature Cited

Schelling, G.T., et al. 1967. Effect of dietary protein levels, amino acid supplementation and nitrogen source upon the plasma free amino acid concentrations in growing lambs. J. Nutr. 92:339.

Papas, A.M., et al. 1984. Effectiveness of rumen-protected methionine in delivering methionine postruminally in dairy cows. J. Dairy Sci. 67:545.

Thornton, J.H., et. al. 1985. Feed intake by feedlot steers: Influence of initial weight and time on feed. Okla. Agr. Exp. Sta. Res. Rep. MP-117:320.