January 1997

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Cysteine from Feather Meal And Sulfur Amino Acid Requirements for Growing Steers

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Cysteine from feather meal can provide a portion of the supplemental sulfur amino acids required by growing cattle. However, additional methionine may further improve performance.

Summary

Ninety individually fed steers were used to determine how cysteine from feather meal could replace dietary methionine in meeting their requirements for sulfur amino acids. Treatment proteins included blood meal, blood meal plus incremental levels of feather meal or blood meal plus incremental levels of rumen-protected methionine. Addition of sulfur amino acids to blood meal from feather meal or rumen-protected methionine improved average daily gain ($P < .05$). Rumen-protected methionine elicited a greater gain response than feather meal ($P < .05$). Feather meal can provide some of the sulfur amino acids lacking in blood meal. However, additional methionine may further improve performance.

Introduction

Growing calves consuming forage diets often are deficient in metabolizable protein. To meet the animal's metabolizable protein requirement, escape protein sources are generally supplemented. However, sources of escape protein vary markedly in amino acid content, influencing supply of metabolizable amino acids available for the animal, and, ultimately affecting protein efficiency. Blood meal (BM) is an excellent source of escape protein (89 percent of CP), but may be deficient in sulfur amino acids (SAA). Feather meal (FTH) is also an excellent source of escape protein (60 percent of CP) and SAA. However, FTH contributes primarily cysteine rather than methionine. Addition of FTH to BM has resulted in improved daily gain and protein efficiency in growing steers, likely the result of a complementary array of amino acids in FTH and BM.

A physiological requirement exists for both methionine and cysteine. A dietary requirement, however, exists only for methionine, since cysteine can be synthesized from methionine. The reverse reaction does not occur. Dietary sources of cysteine such as FTH, however, can be utilized; dietary cysteine can spare some dietary methionine, allowing dietary methionine to be used with greater efficiency. Our objective was to determine the extent to which dietary cysteine could replace dietary methionine.

Procedure

A calf growth trial was conducted using 90 medium-framed crossbred beef steers (535 lb) individually fed diets (DM basis) of 44 percent sorghum silage, 44 percent corncobs and 12 percent supplement (Table 1). The steers were assigned randomly to one of two treatments, either a BM supplement plus incremental levels of FTH or a BM supplement plus incremental levels of rumen-protected methionine (Smartamine M®; Rhône-Poulenc Animal Nutrition). Inclusion of BM (2.6 percent of diet DM) was equal between supplements and formulated to supply 106 g/day of metabolizable protein. NRC (1996) equations predicted 2.6 percent BM to provide adequate amounts of all essential amino acids, except methionine and SAA. Supplements were mixed at feeding to provide incremental levels of SAA from either FTH or rumen-protected methionine. These levels were 0, .25, .5, 1, 1.5, 2, 4

Table 1. Composition of diets (percent of DM) fed to growing steers.

	Treatment		
Ingredient	Blood meal control	Blood meal + feather meal[a]	Blood meal + methionine[a]
Sorghum silage	44	44	44
Ground corncobs	44	44	44
Dry supplement	12	12	12
Blood meal	2.60	2.60	2.60
Soybean hulls	6.52	3.04	6.39
Urea	1.17	.70	1.14
Dicalcium phosphate	.92	.81	.92
Feather meal	—	4.06	—
Smartamine M	—	—	.16
Salt	.30	.30	.30
Tallow	.20	.20	.20
Ammonium sulfate	.20	.20	.20
Trace mineral premix	.05	.05	.05
Vitamin premix	.03	.03	.03
Selenium premix	.01	.01	.01

[a]Supplements were formulated based upon calculated values to provide 6 g sulfur amino acids per day from either feather meal or rumen-protected methionine and were mixed at feeding with the blood meal control supplement to supply incremental levels of additional sulfur amino acids (0, .25, .50, 1, 1.5, 2, 4 and 6 g/day).

Table 2. Daily gain of growing steers fed a blood meal supplement with incremental levels of metabolizable sulfur amino acids from either feather meal or rumen-protected methionine.

			Source of sulfur amino acids			
	Blood meal (control)		Blood meal + feather meal		Blood meal + rumen-protected methionine	
Added sulfur amino acid level (g/day)	n	ADG[a]	n	ADG	n	ADG[b]
0	20	.86				
.25			0	—	7	1.08
.50			7	.99	7	1.06
1.0			7	1.01	7	1.08
1.5			7	1.08	4	1.14
2.0			4	.75	4	1.19
4.0			4	1.14	4	1.23
6.0			4	1.08	4	1.43
Overall[c]				1.01		1.14
SEM		.06		.05		.04

[a]Control vs addition of sulfur amino acids ($P < .05$).
[b]Linear effect for rumen-protected methionine addition ($P < .05$).
[c]Feather meal vs rumen-protected methionine ($P < .05$).

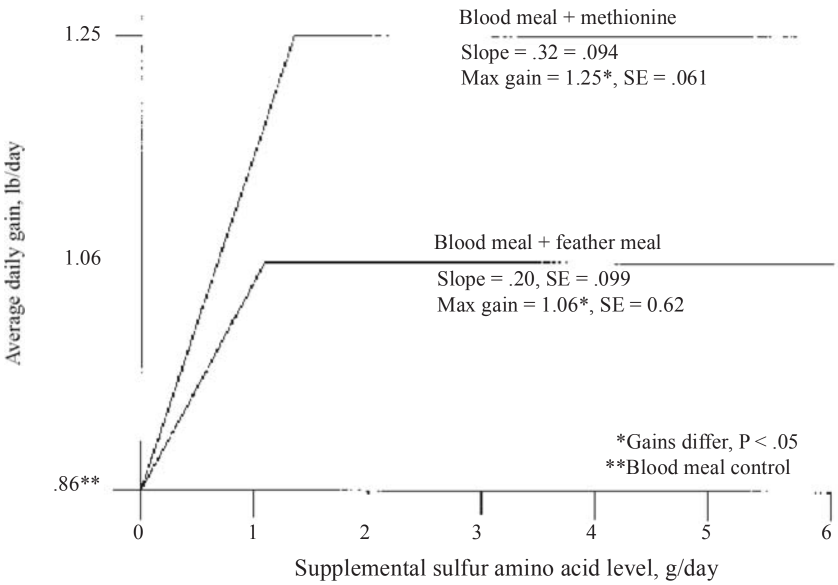

Figure 1. Efficiency of sulfur amino acid utilization.

or 6 g/day of metabolizable SAA. Of the 90 steers, 20 were fed the BM, 33 were fed BM plus incremental levels of FTH and 37 were fed BM plus incremental levels of rumen-protected methionine (Table 2).

Steers were individually fed, at an equal percentage of body weight, once daily with Calan electronic gates (American Calan, Northwood, NH). The DM fed as a percentage of body weight was adjusted as needed to minimize orts while maintaining intake near ad libitum. Average DMI for the trial was 2.1 percent of body weight. Weight data were collected before feeding every 28 days and intakes were recalculated based on current weights. Weights were taken on three consecutive days at the beginning on day 56 and at end of the 84-day trial. Steers were implanted with estradiol-17β at the beginning of the study. Animal performance was measured in terms of ADG. Efficiency of SAA utilization was calculated for each treatment as gain versus supplemental SAA intake, using the slope-ratio technique.

Results

Steers supplemented with BM alone gained .86 lb/day. Addition of SAA to BM improved daily gain ($P < .05$; Table 2), suggesting BM is deficient in SAA. Averaged across levels of SAA supplementation, steers fed rumen-protected methionine had greater gains than steers fed FTH ($P < .05$; Table 2). Inclusion of rumen-protected methionine as a source of SAA linearly improved ADG ($P < .05$; Table 2).

Nonlinear analysis predicted a maximum gain of 1.06 lb/day for steers supplemented with FTH as the source of SAA, which was less than 1.25 lb/day for steers supplemented with rumen-protected methionine ($P < .05$; Figure 1). Efficiency of SAA utilization was .20 lb gain/g SAA and .32 lb gain/g SAA for FTH and rumen-protected methionine, respectively (Figure 1).

Under the conditions of this trial, the maximum gain response for FTH was 51 percent the maximum gain response for rumen-protected methionine [(1.06-.86)/(1.25-.86)]. Although FTH improved gains, the greater gain achieved with rumen-protected methionine suggests methionine rather than cysteine may still be limiting. However, FTH can provide 51 percent of the supplemental SAA required for maximum gain. Research in other species has estimated cysteine's contribution to meeting the total SAA requirement at 50 percent.

A slope response would suggest rumen-protected methionine is used with greater efficiency for gain than are the SAA in FTH. The slope response for FTH was 62 percent the slope response for rumen-protected methionine (.20/.32); however, these differences are not significantly different ($P > .10$). Greater efficiency for gain would be expected if methionine is the first limiting amino acid and FTH provides primarily cysteine.

Results indicate FTH and rumen-protected methionine can provide SAA lacking in BM. While FTH can provide up to 51 percent of the SAA lacking in BM, greater gains achieved with rumen-protected methionine suggest methionine rather than cysteine is first-limiting.

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