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Summary

The effect of crude protein level and source on production rates of yearling steers was evaluated during an 88-day finishing period. The overall average daily gain of 240 steers implanted with Revalor was 4.35 lb. Diets were formulated to contain 11.25 and 13.5% crude protein. Protein sources included urea, soybean meal, an isonitrogenous blend of blood meal-corn gluten meal (BM-CGM) and dried distillers grains with solubles (DDGS). Increasing dietary crude protein from 11.5 to 13.3% with all urea supplements depressed ($P<.05$) dry matter intake without compromising average daily gain or feed efficiency. Feeding soybean meal in 11.1% crude protein diets improved the energetic efficiency of steers. The BM-CGM supplement depressed ($P<.05$) dry matter intake and average daily gain when compared to the 11.5% crude protein soybean meal diet. The 13.6% crude protein diet containing 11% DDGS and urea supported performance comparable to the 11.1% soybean meal diet at a lower cost.

Key Words: Steers, Crude Protein, Feedlot

Introduction

The new generation estradiol-trenbolone acetate implants cause marked increases in the average daily gain of feedlot cattle. Previous studies indicated that steer performance, although improved, was being limited by either the amount or source of dietary crude protein. Diets formulated to provide varying levels of metabolizable protein do not necessarily support increased performance. Specifically, using urea, blood meal, and corn gluten meal supplements did not stimulate production rates. This experiment was designed as a screening test to evaluate the potential of supplemental crude protein sources that have substantially different chemical characteristics to affect growth traits of yearling steers.

Materials and Methods

Mixed yearling steers were purchased during June and July. The receiving-holding diet was a chopped, high moisture ear corn-liquid supplement-soybean meal mix, limit fed to restrict average daily gain to less than 2 lb per day. At the time of arrival, steers were vaccinated for 7 clostridia sp., IBR, BVD, PI_3, and Haemophilus s. Ivermectin was used for parasite control. Sorting to 8 head pens was based on allotment weights determined 4 days prior to the start of the test. The range of body weights was stratified within each of 30 pens. These pens were then blocked within the feedlot and randomly assigned to one of six diets (Table 1). Diets were formulated to contain 11.25 or 13.5% crude protein, using various feed sources (urea, soybean meal, blood meal, corn gluten meal, and dried distillers grain (corn) with solubles). Hay content and dry to high moisture corn ratios were held constant among diets. Minor ingredients were included as a pelleted feed ingredient that provided 11 g tylosin per ton diet (DBM). Macro- and micro-minerals and vitamins were included in a custom liquid supplement. The liquid also contained monensin at a level that provided 26.8 g monensin per ton of diet.

Initial body weight of steers and subsequent 28-day, 56-day, and 88-day body weights were determined in the morning before steers were fed. Revalor implants were administered to all steers during initial body weight measurement.

[1]Professor.

Table 1. Diet formulation

Treatment	1	2	3	4	5	6
Crude protein, %	11.25	13.5	11.25	13.5	13.5	13.5
Source	Urea	Urea	SBM	Urea/SBM	Urea BM-CGM[a]	Urea/DDGS[b]
Ingredient						
Grass hay	8.000	8.000	8.000	8.000	8.000	8.000
Whole shelled corn	49.201	48.702	50.414	49.208	49.207	42.643
High moisture corn	32.801	32.468	33.610	32.805	32.804	28.429
Liquid supplement[c]	3.600	3.600	3.600	3.600	3.600	3.600
DDGS						10.961
Ground corn[d]	5.500	5.500			2.250	5.500
Urea[d]	.622	1.449		.622	.622	.622
SBM[d]			4.159	5.548		
Blood meal[d]					1.394	
Corn gluten meal[d]					1.886	
Limestone[d]	.157	.157	.157	.157	.177	.185
Dicalcium phosphate[d]	.059	.064				
Fat[d]	.060	.060	.060	.060	.060	.060

[a]Blood meal-corn gluten meal.
[b]Dried distillers grain (corn) with solubles.
[c]Included supplemental minerals and vitamins, contained 744 g/T monensin (DMB).
[d]Included as a pelleted supplement.

Feed was delivered once daily. On day 1 of the experiment, the diet assigned (Table 1) was fed at a rate of 14 lb per head. Subsequent feed deliveries were gradually increased such that ad libitum feed consumption was possible for most pens of steers by day 21.

Feed ingredient composition and dry matter intake data were collected and summarized weekly throughout the experiment. The initial source of soybean meal used was found to contain high urease activity. The supplements containing this product were replaced after 21 days. After the day 88 weights were determined, steers remained on experimental diets for 5 days awaiting slaughter. Treatment identification was maintained during the slaughter process to allow comparisons of population distribution among yield and quality grades.

Feedlot performance data were statistically analyzed by procedures appropriate for a completely random design. Mean separations were accomplished via Duncan's New Multiple Range test. Pen mean data were used in this analysis. Carcass yield grade distribution and percentage of choice were tested by Chi square analysis.

Results and Discussion

Dietary crude protein values were close to calculated values and treatment imposed differences were consistent (Table 2). The dietary neutral detergent fiber content was higher ($P<.05$) for treatment 6 where relatively higher fiber dried distillers grains with solubles (DDGS) replaced corn.

Increasing dietary crude protein from 11.1 to 13.3% with urea reduced ($P<.01$) dry matter intake without affecting average daily gain or feed conversion (Table 3). This response was consistent throughout each interim period of the experiment. Using soybean meal rather than urea in 11.1% crude protein diets increased ($P<.05$) average daily gain and reduced ($P<.05$)

Table 2. Diet composition[a]

Treatment	1	2	3	4	5	6	SEM
Dry matter, %	82.6[b]	82.7[b]	82.7[b]	82.8[b]	82.8[b]	83.2[c]	.10
Crude protein, %	11.11[b]	13.33[cd]	11.10[b]	13.26[c]	13.42[cd]	13.60[d]	.097
Neutral detergent fiber, %	13.0[b]	13.1[b]	13.3[b]	13.1[b]	13.1[b]	17.9[c]	.24

[a]n = 13, back calculated from daily batch sheets and weekly ingredient analysis.
[b,d,d]Means without common superscripts differ ($P<.05$).

Table 3. Cumulative feedlot performance

Treatment	1	2	3	4	5	6	
Crude protein, %	11.25	13.5	11.25	13.5	13.5	13.5	
Source	Urea --	Urea --	SBM --	Urea SBM	Urea BM-CGM[a]	Urea DDGS[b]	SEM
Initial body wt	801	796	799	799	801	799	4.4
Final body wt	1176[cde]	1162[c]	1196[ef]	1173[cd]	1187[def]	1198[f]	6.9
Avg daily gain	4.26[c]	4.16[c]	4.51[d]	4.25[c]	4.39[cd]	4.54[d]	.083
Dry matter intake	22.74[d]	21.57[c]	22.80[d]	21.78[c]	21.77[c]	22.80[d]	.256
Feed/gain	5.35[c]	5.20[cd]	5.06[d]	5.13[cd]	4.98[d]	5.03[d]	.089

[a]Blood meal-corn gluten meal.
[b]Dried distillers grain (corn) with solubles.
[c,d,e,f]Means without common superscripts differ ($P<.05$).

feed/gain. The dry matter intake associated with these two treatments were virtually identical, indicating an energetic efficiency response due to feeding soybean meal.

Steers fed a 13.26% crude protein urea-soybean meal combination (treatment 4) had lower ($P<.05$) average daily gain and higher ($P<.05$) feed/gain than steers fed 11.1% crude protein soybean meal (treatment 3). It should be noted that in the 11.1% CP SBM diet SBM provided two percentage points of dietary CP or 18% of total CP intake. Theoretically the response to this diet should have been equal or better performance. The lower ($P<.01$) dry matter intake for treatment 4 may have been caused by urea degradation in the urea-soybean meal pellet, although urease activity was detected in soybean meal only during the initial feeding period.

Treatment 5 was the highest metabolizable protein diet and should have allowed maximum performance responses. The dry matter intake of steers fed treatment 5 was comparable to steers on treatments 2 and 4 and lower ($P<.05$) than when steers were fed diets 1, 3, or 6. The numerical feed/gain value was lower for treatment 5 and comparable to treatments 2, 3, 4, and 6.

When DDGS were added to the base 11.1% crude protein urea diet, average daily gain increased ($P<.05$) and feed/gain decreased ($P<.05$) without affecting dry matter intake. This performance response was quite similar to replacing urea with soybean meal in 11.1% crude protein diets. The higher neutral detergent fiber content of treatment 6 did not cause increased dry matter intake that would be predicted by some intake models.

The carcass weights followed the same trend as final body weight (Table 4). There were more ($P<.01$) yield grade 3 steers and fewer yield grade 1 steers on treatments 1 and 6. The percentage of choice steers varied from 35 to 60% among treatment groups. The numerical

Table 4. Carcass weight and grade distributions

Treatment	1	2	3	4	5	6	
Crude protein, %	11.25	13.5	11.25	13.5	13.5	13.5	
Source	Urea --	Urea --	SBM --	Urea SBM	Urea BM-CGM[a]	Urea DDGS[b]	SEM
Carcass wt, lb	705[de]	694[d]	712[ef]	712[ef]	709[def]	721[f]	7.0
Yield grade[c]							
1, %	7.5	12.5	17.5	22.5	12.5	15.0	
2, %	45.0	72.5	57.5	52.5	57.5	25.0	
3, %	45.0	15.0	25.0	25.0	30.0	60.0	
4, %	2.5	0	0	0	0	0	
Choice, %	52.5	60.0	47.5	50.0	35.0	52.5	

[a]Blood meal-corn gluten meal.
[b]Dried distillers grain (corn) with solubles.
[c]Yield grade distribution varied among treatments ($P<.01$).
[d,e,f]Means without common superscripts differ ($P<.10$).

differences in percentage of choice carcasses could not be related to diet, yield grade, or feedlot average daily gain of steers.

Protein source does affect the energetic efficiency of steers capable of high production rates. Current models are not effective in predicting the appropriate source of supplemental crude protein or the optimum dietary crude protein levels.