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COMBINATIONS OF NONPROTEIN NITROGEN AND NATURAL PROTEIN AFFECT PERFORMANCE OF FINISHING STEERS FED FLAKED CORN DIETS [1]

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Summary

Two hundred crossbred steers (785 lb) were used to evaluate the effects of the relative proportion of supplemental nitrogen derived from soybean meal (SBM) and urea. Treatments included an unsupplemented negative control and four 13% CP diets containing SBM:urea proportions (nitrogen basis) of 100:0, 67:33, 33:67, and 0:100. Steers fed the control diets gained 38% slower (P<.01); ate 4% less feed (P<.10); were 33% less efficient (P<.01); and had lighter carcasses (P<.01) with less backfat (P<.01), less kidney, pelvic, and heart fat (KPH; P<.12), less ribeye area (REA; P<.11), and less marbling (P<.01) than nitrogen-supplemented steers. Among steers fed supplemented diets, feed intake increased linearly as proportion of SBM increased (P<.01). Daily gain (P<.05) and feed:gain (P<.05) responded quadratically and was best for steers fed combinations of the nitrogen sources. Similarly, hot carcass weights and backfat thickness were greater (P<.06) for steers fed the mixed supplements. There was a tendency for a linear increase in KPH as proportion of urea in the diet was increased (P<.14). Yield grade, ribeye area, and marbling were unaffected by SBM:urea proportions. In high-concentrate finishing diets, at least some of the supplemental nitrogen should be derived from a natural, degradable-protein source.

(Key Words: Soybean Meal, Urea, Finishing Steers.)

Introduction

Nitrogen (protein) supplementation of feedlot diets can be viewed as meeting three "requirements": 1) ammonia for ruminal microbes, 2) peptide/amino acid for ruminal microbes, and 3) postruminal digestible amino acids (metabolizable protein) for the animal. Urea can supply ruminal ammonia and, indirectly, digestible amino acids as microbial protein. Because a portion of SBM protein is degraded in the rumen, it can contribute to all three requirements. Some research has shown that starch-digesting bacteria derive two-thirds of their nitrogen from peptides and(or) amino acids. Because corn protein is largely resistant to ruminal degradation, supplying a natural, degradable protein in high-corn finishing diets may be beneficial. Although nitrogen supplementation of feedlot diets has both qualitative and quantitative dimensions, practical formulation still centers on a total nitrogen (crude protein) system with limited consensus on ruminal degradability and on the usefulness of supplying natural, degradable protein to the ruminal ecosystem. Previous research (1994 KSU Cattlemen's Day) showed that urea can meet only part of the total protein needs of feedlot steers. Our objective was to better establish the relative contributions of nonprotein nitrogen and natural protein to performance of steers fed diets based on steam-flaked corn.

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[2]Southwest Research-Extension Center, Garden City.

Experimental Procedures

Two hundred Continental × British steers (785 lb) were allocated to one of four weight blocks. Within each block, steers were allotted to one of five pens. Treatments included an unsupplemented negative control and four 13% CP diets containing SBM:urea proportions (nitrogen basis) of 100:0, 67:33, 33:67, and 0:100 (Table 1). Steers were processed using standard procedures, implanted with Revalor, and stepped up to the final rations in 21 days. Initial weights were the averages of two consecutive, early morning weights. Because treatment affected dressing percentage (control vs. others; P < .01), final weights were calculated from hot carcass weights using the average dressing percent (61.54%). These adjusted final weights were used to calculate overall gain and feed efficiency. Hot carcass weights were taken immediately after slaughter and carcass data obtained following a 48-hour chill. The heaviest block was slaughtered after 126 days on feed, and the remaining three blocks after 150 days. The experiment was conducted from July 1 to November 28, 1994 at the Southwest Research-Extension Center, Garden City. Preplanned orthogonal contrasts compared control vs. supplemented diets and the linear, quadratic, and cubic effects of altering SBM:urea nitrogen.

Results and Discussion

Nitrogen-supplemented steers gained 38% faster (P<.001) than unsupplemented controls, while consuming only 4% more feed (P<.10). Consequently, the supplemented steers were 33% more efficient (P<.01). As a result of their slower growth, steers fed the control diet were 124 lb lighter (P<.01) at slaughter and had 38% less backfat (P<.01), 10% less KPH (P<.12), 5% less ribeye area (P<.11), and lower yield grades (P<.04). In addition, control steers had less marbling (P<.01) and tended to have fewer grading Choice (P<.16).

Within the supplemented diets, daily gain responded quadratically (P<.05), with greater gains for diets containing both protein sources. As the proportion of SBM nitrogen increased, feed intake increased linearly (P<.02). Consequently, feed efficiency improved curvilinearly (P<.05) as the proportion of urea increased. The lowest feed:gain ratio was at 33% SBM:67% urea. The increased gain on the mixed-nitrogen supplements translated into 17 lb additional carcass weight or 28 lb additional final live weight (P<.06) compared to those supplemented with only SBM or urea. Backfat also responded quadratically (P<.05) to the increasing proportion of urea, with 20% greater fat depth for steers fed SBM-urea combinations vs. SBM or urea alone. In contrast, KPH tended to increase linearly (P<.14) as urea increased. Although small increases occurred in ribeye area for steers fed the mixed-nitrogen sources, they were not statistically significant. Yield grades, marbling, and percent grading choice were similar among steers fed the supplemented diets.

Steers fed combinations of SBM and urea in 13% CP flaked corn-based diets performed better than those supplemented with SBM or urea alone. Although fat thickness also increased for these intermediate levels, yield grade was unaffected. Because carcass weight also increased, these data suggest that the composition of the extra gain is similar to gains of steers fed single-source supplements. The greater feed intake observed with SBM agrees with previous research (1994 KSU Cattlemen's Day). Soybean meal has less utilizable energy than steam-flaked corn and this likely caused poorer efficiency as the proportion of SBM was increased. The diet supplemented with only urea probably had greater utilizable energy, but performance was improved by small additions of SBM, which may have contributed to the supply of protein postruminally or alternatively may have provided needed peptides and(or) amino acids to the rumen microbes. These data suggest that, in high-concentrate finishing rations, at least some of the supplemental nitrogen should be derived from a natural, degradable-protein source such as SBM.

Table 1. Composition of Experimental Diets [a]

		Soybean Meal:Urea			
Item	Control	100:0	67:33	33:67	0:100
Flaked corn	80.0	69.2	73.0	76.7	80.0
Ground corn [b]	7.1	7.6	6.8	6.0	5.5
Silage [c]	10.0	10.0	10.0	10.0	10.0
Soybean meal [d]	----	10.8	7.0	3.3	----
Urea [b]	----	----	.6	1.2	1.7
Vit-min mix [be]	2.9	2.4	2.6	2.8	2.8
Crude protein [f]	8.3	13.0	13.0	13.0	13.0

[a]Dry matter basis.
[b]Ground corn, urea, and vitamin-mineral mix were mixed into a supplement included at 10% of diet dry matter.
[c]Sorghum silage was fed from day 0 to 83, then corn silage to end of trial.
[d]Contained 44% CP (as-fed basis).
[e]Formulated so that complete diets contained .7% Ca, .35% P, .7% K, 1465 IU/lb Vitamin A, 16 IU/lb Vitamin E, 27 ppm monensin, 10 ppm tylosin, and a N:S ratio of 10:1.
[f]Calculated.

Table 2. Effect of Soybean Meal:Urea Nitrogen on Performance and Carcass Traits of Steers Fed a Steam-Flaked Corn-Based Diet

		Soybean Meal:Urea					Statistical Contrasts [a]		
Item	Control	100:0	67:33	33:67	0:100	SEM	C vs. S	L	Q
No. pens	4	4	4	4	4				
No. steers	40	40	40	40	40				
Initial wt, lb	785	787	786	783	783	2.7			
Final wt, lb [b]	1118	1226	1255	1257	1230	13.3	.001	---	.06
ADFI, lb	19.6	20.8	20.7	20.1	19.7	.33	.10	.02	---
ADG, lb	2.31	3.05	3.26	3.29	3.11	.08	.001	---	.05
Feed:gain	8.53	6.82	6.33	6.11	6.33	.16	.001	.04	.05
Carcass									
Hot wt, lb	688	754	772	773	757	8.2	.001	---	.06
Dressing %	60.6	61.6	61.9	61.9	61.8	.24	.001	---	---
Backfat, in	.36	.44	.52	.56	.46	.04	.01	---	.05
KPH, %	1.79	1.88	1.94	1.98	2.10	.10	.12	.13	---
REA, sq. in	11.71	12.13	12.48	12.50	12.05	.29	.11	---	.20
Yield grade	2.61	2.95	3.14	3.24	3.01	.17	.04	---	---
Marbling [c]	4.82	5.28	5.23	5.26	5.22	.09	.01	---	---
Choice, % [d]	45	60	68	65	70				

[a]Statistical contrasts: C vs. S = control vs. supplemented, L = linear effect of SBM:urea, Q = quadratic effect of SBM:urea. Dashes indicate (P>.20). All cubic effects were nonsignificant (P>.60).
[b]Final weight = hot carcass weight/.6154.
[c]Marbling scores: 4 = slight^0, 5 = small^0, 6 = modest^0.
[d]Analyzed by chi-square analysis, treatment difference (P<.16).