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Optimal urea level in corn-based finishing diets containing alfalfa as the roughage source

Abstract

One hundred medium-growth potential, crossbred yearling steers (766 lb) were used to identify the optimal level of urea in finishing diets, based on growth and carcass traits. The corn-base d diets had no urea o r contained .35, .70, 1.05, or 1.40% urea (dry matter basis) and no other supplemental protein. Alfalfa hay (10% of DM) was the roughage source and contained 16% crude protein. Feed efficiency and gain were improved by .35% urea, with little improvement from higher additions. Regression analysis indicated that the optimal level of urea for gain and feed efficiency was .5% of dietary dry matter. Hot carcass weight and dressing percentage responded quadratically, being highest for steers receiving .7 and 1.05% urea. Fat thickness and yield grade responded cubically to the addition of urea; these traits were also highest for steers receiving .7 and 1.05% urea. Loineye area decreased linearly with increased urea in the diet. Marbling scores and KPH fat were unaffected by urea addition. The increased growth, carcass weight, and finish, with no improvements in loineye area, indicate that urea enhance d diet digestibility but did not increase metabolizable protein supply. Optimal urea levels (.5%) were less than those previously indicate d for diets containing prairie hay as the roughage source (.9%), suggesting that alfalfa may supply a portion of the rumen degradable nitrogen requirement when utilized as a source of roughage in high grain diets.

Keywords

Cattlemen's Day, 1995; Kansas Agricultural Experiment Station contribution; no. 95-357-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 727; Beef; Urea; Finishing steers; Performance; Metabolizable protein

OPTIMAL UREA LEVEL IN CORN-BASED FINISHING DIETS CONTAINING ALFALFA AS THE ROUGHAGE SOURCE

C. T. Milton and R. T. Brandt, Jr.

Summary

One hundred medium-growth potential, crossbred yearling steers (766 lb) were used to identify the optimal level of urea in finishing diets, based on growth and carcass traits. The corn-based diets had no urea or contained .35, .70, 1.05, or 1.40% urea (dry matter basis) and no other supplemental protein. Alfalfa hay (10% of DM) was the roughage source and contained 16% crude protein. Feed efficiency and gain were improved by .35% urea, with little improvement from higher additions. Regression analysis indicated that the optimal level of urea for gain and feed efficiency was .5% of dietary dry matter. Hot carcass weight and dressing percentage responded quadratically, being highest for steers receiving .7 and 1.05% urea. Fat thickness and yield grade responded cubically to the addition of urea; these traits were also highest for steers receiving .7 and 1.05% urea. Loineye area decreased linearly with increased urea in the diet. Marbling scores and KPH fat were unaffected by urea addition. The increased growth, carcass weight, and finish, with no improvements in loineye area, indicate that urea enhanced diet digestibility but did not increase metabolizable protein supply. Optimal urea levels (.5%) were less than those previously indicated for diets containing prairie hay as the roughage source (.9%), suggesting that alfalfa may supply a portion of the rumen degradable nitrogen requirement when utilized as a source of roughage in high grain diets.

(Key words: Urea, Finishing Steers, Performance, Metabolizable Protein.)

Introduction

Current information regarding requirements of finishing cattle for rumen degradable protein and metabolizable protein remains limited. Urea is a common source of rumen degradable protein in finishing diets. Previous research (Cattlemen's Day, 1994) suggested that the optimal level of urea for rate and efficiency of gain in corn-based finishing diets utilizing native grass hay for roughage (10% of dietary DM) was .91% of dietary dry matter.

Alfalfa is used commonly in finishing diets as a source of dietary roughage. Compared to native grass hay, alfalfa contains more rumen degradable protein. Although typically included as 10% or less of finishing diets, alfalfa may reduce the amount of dietary urea needed to meet microbial demands for ammonia. Our objective was to identify the optimal level of urea for performance and carcass traits of finishing yearling steers fed high grain diets containing alfalfa hay as the roughage source.

Experimental Procedures

One hundred medium-growth potential, crossbred steers (766 lb) were received from Flint Hills grass in July 1994. Steers were allotted to one of four weight replicates and stratified into one of five pens within each replicate. They were stepped up to an 80% concentrate diet prior to beginning the experiment. A single initial weight was taken following a 3-day period of equalized intake. Steers were implanted with Revalor-S® and fed diets without urea or containing .35,

.70, 1.05, or 1.40% urea (dry matter basis). Diets contained no other supplemental protein. All diets contained alfalfa (16% crude protein) at 10% of the dietary dry matter and were formulated to contain .75% Ca, .35% P, .7% K, and a 10:1 N:S ratio. Steers were fed 275 mg Rumensin® and 90 mg Tylosin® per head daily. Crude protein levels ranged from 9.9 to 13.9%. Experimental diets were fed for an average of 144 days. The largest weight block was slaughtered following 109 days on feed, and the three remaining blocks were fed for an additional 44 days. Because the smallest block was not ready for slaughter when the trial was terminated, carcass data were collected for only three of the four weight blocks. Final weights were pencil shrunk 4% for calculation of daily gain and feed efficiency. Steers were slaughtered at a commercial plant, and carcass data were obtained following a 24-hour chill.

Results and Discussion

Daily gain ($P<.05$), feedintake ($P=.11$), and feed efficiency ($P<.05$) responded quadratically to the addition of urea (Table 1). Both daily gain and feed efficiency were improved by the first increment of urea (.35%) with little or no improvement from subsequent urea additions. As dietary urea increased, hot carcass weight responded quadratically ($P<.05$), being greatest at .7% dietary urea. A quadratic trend ($P=.11$) also was observed for dressing percentage, which was also greatest at 7% dietary urea. Fat thickness (12^{th} rib) and calculated yield grade responded cubically ($P<.05$) to the addition of urea, a reflection of lower intake and performance for the higher urea levels. Loineye area decreased linearly ($P<.02$) with dietary level of urea. Kidney, heart, and pelvic fat and marbling scores were unaffected ($P>.18$) by the addition of urea. Predicted crude protein requirements of steers in this study (1.87 lb/day) were met by the control diet. Improvements in performance and increases in carcass weight and finish, with no improvement in loineye area, suggest that urea enhanced energy utilization (diet digestibility) but did not increase protein supply to the small intestine. These results are consistent with previous research conducted at Kansas State (Cattlemen's Day, 1994).

The Iowa State metabolizable protein system predicted the urea fermentation potential for the basal diet in this study to be .7%. Regression analysis (model $Y=\text{urea} + \text{urea}^2$) predicted the optimal level of urea for gain ($r^2=.30$) and feed efficiency ($r^2=.40$) to be .5% of dietary dry matter. When final weight was determined as carcass weight adjusted by a 62% dressing percentage, the optimal level of urea for gain and feed efficiency was .57% of dietary dry matter ($r^2=.27$ and .35, respectively). Optimal levels of urea (.5%) were less than those previously reported for diets containing prairie hay as the roughage source (.91%), suggesting that alfalfa, used as source of roughage in high grain diets, can supply a portion of the degradable protein requirement for finishing steers.

Table 1. Effect of Dietary Urea Level on Performance and Carcass Traits of Finishing Yearling Steers

	Urea (% of Dry Matter)					
Item	0	.35	.70	1.05	1.40	SEM
No. pens	4	4	4	4	4	
No. steers	20	20	20	20	20	
Initial wt, lb	766	753	771	771	766	3.5
Final wt[a], lb	1140	1148	1169	1152	1101	19.0
Daily feed[b], lb	20.15	19.95	20.55	20.95	19.36	.46
Daily gain[a,c], lb	2.67	2.80	2.83	2.70	2.36	.12
Feed/gain[c,d]	7.59	7.14	7.29	7.75	8.26	.25
Carcass traits						
Hot carcass wt, lb	742	743	762	753	701	11.3
Dressing %[b]	62.9	63.2	64.8	64.2	63.3	.66
Fat 12th rib[e], in	.32	.31	.40	.45	.29	.04
KPH, %	2.17	2.05	2.13	2.20	2.10	.10
Loin eye area[f], in^2	14.2	14.0	14.3	12.9	13.1	.30
Marbling score[g]	4.87	4.81	4.80	4.67	4.82	.17
Yield grade[e]	2.02	1.99	2.29	2.76	2.09	.13

[a]Final live weight pencil shrunk 4%.
[b]Quadratic (P=.11).
[c]Quadratic (P<.05).
[d]Feed/gain was analyzed as gain/feed and reported as the reciprocal.
[e]Cubic (P<.05).
[f]Linear (P<.02).
[g]4= slight, 5= small.