SUPPLEMENTING GROWING HOLSTEIN STEERS FED A CORN-UREA DIET WITH A MIXTURE OF ESSENTIAL AMINO ACIDS INCREASES PERFORMANCE

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Summary

Six ruminally cannulated Holstein steers (550 lb) implanted with Revalor-S were infused abomasally with water or a mixture of six amino acids in a crossover experiment (two 14-day periods) to evaluate effects on nitrogen balance. The mixture was comprised of amino acids that potentially may be limiting in lightweight steers, namely (g/day): lysine (5.3), methionine (3.3), threonine (3.2), tryptophan (1.0), histidine (2.1), and arginine (5.5). Steers were fed at levels just below ad libitum intake. The diet contained 86% rolled corn, 10% prairie hay, 3% mineral and vitamin premixes, and 1% urea (as-fed). Amino acid infusion increased nitrogen retention by 17.9% over the control, from 27.9 g N/day to 32.9 g N/day. This indicates that implanted steers fed a high concentrate diet are able to respond to amino acid supplementation, suggesting that at least one of the infused amino acids was limiting in the basal corn-urea diet.

(Key Words: Holstein Steers, Corn, Urea, Amino Acids.)

Introduction

For optimum growth performance, cattle need adequate amounts of metabolizable protein (i.e., protein available for absorption in the small intestine). Also, for cattle to make efficient use of metabolizable protein, that protein must have an amino acid composition that closely matches the animal's amino acid requirements. The amino acids most likely to be in short supply in typical feedlot diets are lysine, followed by methionine, tryptophan, histidine, and threonine (in no particular order of importance), and possibly arginine. When high corn diets are fed to rapidly growing implanted steers with urea as the sole protein supplement, the adequacy of essential amino acid supply may be of concern. Thus, our objective was to see if we could increase performance of implanted steers fed a corn-urea diet by supplementing postruminally with potentially limiting amino acids.

Experimental Procedures

Six Holstein steers (550 lb) fitted with rumen cannulas were implanted with Revalor-S (120 mg trenbolone acetate, 20 mg estradiol; Hoechst-Roussel) and housed in an environmentally controlled room (constant temperature, humidity, and lighting) in metabolism crates to facilitate total collection of feces and urine. Feed was offered to each steer individually in equal portions twice daily (6 AM and 6 PM) with individual intakes set at a level slightly less than ad libitum. The diet consisted of (as-fed basis) 86% rolled corn, 10% prairie hay, 3% mineral and vitamin premixes, and 1% urea (Table 1). Steers were adapted to the high grain diet before the start of the first experimental period. The design was a simple crossover, with two 14-day periods (6-day adaptation and 8-day collection of all feces and urine). Steers were subjected to two treatments: continuous abomasal infusion of either a mixture of six amino acids in 4 l/day water (amino acid treatment) or water alone (control treatment). The amino acid treatment contained (g/day) methionine (3.3), lysine (5.3), threonine (3.2), tryptophan (1.0), histidine (2.1), and arginine (5.5). Abomasally infusion was done with tubes running through the ruminal cannula and into the abomasum via the reticulo-omasal orifice. Amino acid levels were calculated, using the Cornell Net Carbohydrate and Protein model, as the amounts needed by 550 lb steers to gain .55 lb/day more than gains on the basal diet. The amount of methionine we infused was

double the calculated requirement, in order to avoid any possible cysteine deficiency. As a safety measure, we also infused twice the calculated amount of tryptophan because of the large variation in estimates of tryptophan requirement.

Results and Discussion

Infusing amino acids directly into the abomasum bypasses the confounding influences of ruminal fermentation, thereby eliminating guesswork as to the nutrient profile arriving at the small intestine. Thus, we could increase the metabolizable protein supply to the animal with confidence and be assured of supplying an amino acid profile that closely matched animal needs.

Amino acid infusion increased nitrogen retention by 17.9% over the control, from 27.9 g N/day to 32.9 g N/day (Table 2). Nitrogen retention is a sensitive measure of lean growth. Assuming that the protein content of live weight gain was 18%, the 5 g increase in retained nitrogen amounts to an additional weight gain of about .4 lb/day. Thus, we conclude that a high corn diet with urea as the only protein supplement does not supply adequate metabolizable protein to support maximal gains in steers; at least one essential amino acid is deficient.

Table 1. Diet Composition

Item	%, Dry Matter Basis
Ingredient:	
Rolled corn	85.2
Prairie hay	10.4
Urea	1.1
Limestone	1.5
Dicalcium phosphate	.5
Trace mineral salt [1]	.5
Sulphur	.1
Potassium chloride	.6
Vitamin ADE [2]	.1
Monensin [3]	+
Tylosin [4]	+
Nutrient:	
Dry matter	89.0
Crude protein	12.4
Calcium	.72
Phosphorus	.42
Potassium	.73

Table 2. Nitrogen Balance of Holstein Steers Infused Abomasally with a Mixture of Six Potentially Limiting Amino Acids

Nitrogen, g/day	Control	Amino Acids [1]	SEM
Feed	90.1	89.9	1.4
Infused	--	4.2	
Fecal	31.6	30.9	.3
Urinary	30.5	30.3	1.2
Retained [2]	27.9	32.9	2.0

[1]5.3 g lysine, 3.3 g methionine, 3.2 g threonine, 1.0 g tryptophan, 2.1 g histidine, and 5.5 g arginine per day.
[2]Means differ (P=.15).