EFFECTS OF ENERGY SOURCE ON METHIONINE UTILIZATION BY GROWING STEERS

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Summary

We evaluated the effect of energy source on amino acid utilization in growing steers. Ruminally cannulated Holstein steers (372 lb) were limit-fed (4.2 lb/day dry matter) a diet based on soybean hulls. A 2 × 5 factorial arrangement of treatments was used: 0 or 3 grams/day of methionine and five sources of energy. The energy sources evaluated were infused in amounts of 1.3 Mcal ME/day and included: control (none), glucose (0.79 lb/day), fat (0.33 lb/day), acetate (0.85 lb/day), and propionate (0.59 lb/day). Acetate and propionate were infused continuously into the rumen, whereas glucose and fat were infused into the abomasum. Nitrogen balance was increased by methionine supplementation, indicating that this amino acid limited protein deposition. Energy supplementation also increased nitrogen balance, with or without supplemental methionine, without differences among energy sources. The results of our study suggest that amino acid utilization by growing steers is improved by energy supplementation, regardless of the source of energy.

Introduction

Based on studies using growing pigs, most of the nutrient-requirement systems for cattle have assumed that when protein is limiting, energy supply does not affect protein deposition. In a recent study, however, we observed that growing steers increased protein deposition in response to increased energy supply, even when methionine limited protein accretion. This indicates that the assumptions of the current nutrient-requirement models for cattle are not correct, and that the amount of energy should be considered to more precisely estimate amino acid utilization. It is unknown if the energy source may also affect amino acid utilization. The objective of our study was to determine the effect of energy source on methionine utilization in growing steers.

Procedures

Ruminally cannulated Holstein steers (372 lb initially) were allocated in double, balanced 6 × 6 Latin-square designs. The steers were limit-fed (4.2 lb/day dry matter) a diet based on soybean hulls (83%), wheat straw (7.6%), cane molasses (4.1%) and vitamin-mineral mix. All steers received supplemental energy by ruminal infusion of 400 grams/day of acetic acid. The treatments were arranged as a 2 × 5 factorial, with the factors being the amount of methionine (0 or 3 grams/day) and five energy sources [control (none), glucose (0.79 lb/day), fat (0.33 lb/day), acetate (0.85 lb/day), and propionate (0.59 lb/day)] each providing 1.3 Mcal ME/day. The amounts of methionine were selected to be in the range of linear response for our experimental model. Ruminal infusion of acetate and propionate, and abomasal infusion of glucose and fat, allowed increases in the energy supply to the cattle without increasing ruminal protein synthesis.

The basal diet was formulated to provide a low protein:energy ratio, small amounts of ruminally undegradable protein, and enough ruminally available nitrogen to support microbial growth. Feed restriction maintained a low supply of amino acids to create a limitation in methionine such that a response to its supplementation could be achieved. A mixture containing all of the essential amino acids except methionine was continuously infused abomasally to prevent limitations in protein synthesis by an amino acid other than methionine. Thus, protein deposition in our model was clearly limited by methionine supply. Nitrogen balance was used as an estimate of protein deposition by the steers.

Results and Discussion

The infusion of methionine increased nitrogen retention (18.8 vs. 23.5 grams/day, Figure 1), indicating that this amino acid limited protein accretion. This increase was related to a decrease in urinary nitrogen excretion. The average increase in nitrogen retention (4.7 grams/day) by methionine supplementation would represent a 0.33-lb increase in the daily gain, if it is assumed that body weight gain of Holstein steers contains 19.7% protein. The estimated efficiency of supplemental methionine utilization was 20%, based on the assumptions that retained nitrogen is directly converted to deposited protein and that deposited protein contains 2% methionine. This efficiency of utilization is much less than values (64%) used by the most recent National Research Council publication for predicting requirements of growing cattle.

Steers supplemented with energy had less urinary nitrogen excretion, resulting in improvements in nitrogen retention, with or without methionine supplementation (Figure 1). No significant differences among the energy sources were observed. Although the interaction between methionine and energy supply was not statistically significant, the effects of energy supply seemed to be greater when the steers received methionine supplementation (Figure 1). The changes in nitrogen balance in response to energy supply would represent increases in daily gain of 0.08 and 0.25 lb when 0 or 3 grams/day of methionine were supplemented, respectively, with no large differences among energy sources. These results suggest that energy supply increases the efficiency of amino acid utilization, regardless of the energy source.

The results of our study suggest that the energy supply affects the efficiency of amino acid utilization. Thus, the use of a single efficiency is not appropriate for growing cattle. Estimates of amino acid requirements in growing cattle may require consideration of the amount of energy supplied. Although the inclusion of energy intake represents an increase in complexity for estimating amino acid requirements, our results indicate that the type of energy source does not greatly affect amino acid utilization.

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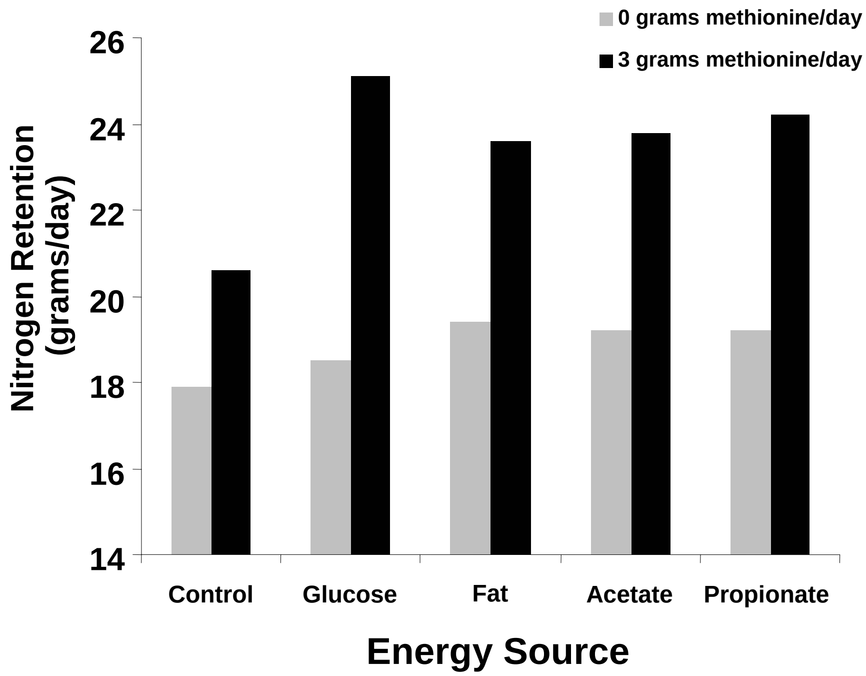

Figure 1. Effects of Energy Source and Methionine Supplementation on Nitrogen Retention in Growing Steers. Effect of methionine ($P<0.01$). Effect of energy supplementation ($P<0.01$). Effect of energy source ($P>0.10$).