Supplemental Abomasal Nutrients For Cattle Fed Weathered Prairie Hay

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Story in Brief

To determine which nutrients limit performance of wintering cattle grazing range grass, five nutrient solutions were infused into the abomasum (the acid stomach past the rumen) of five mature Hereford steers for a period of 10 weeks. Nutrients infused were protein, carbohydrate, fat and the amino acid, methionine. Nutrient infusion did not affect intake of the 48 percent digestibility ration of winter-harvested prairie hay. Nitrogen balance, a measure of protein storage by the animal, was increased with protein but not with methionine or urea infused postruminally. Results suggest that amino acids in protein other than methionine may limit protein status of cattle fed weathered range grass. This is a post-ruminal, not a ration deficiency. But since some intact protein escapes destruction in the rumen, intact proteins such as soybean or cottonseed meal are more beneficial than non-protein nitrogen for wintering cattle.

Introduction

Low performance of cattle fed low quality forages has been associated with a shortage of energy or low feed intake. This has generally been attributed to bulk fill, although an increase in crude protein often increases feed intake and digestibility of cellulose. When protein or starch has been infused into the "true stomach" or abomasum (past the rumen), feed intake and performance of lambs fed a high concentrate (highly digestible) ration was increased.

The objectives of this experiment were to determine the effect of various nutrients abomasally infused on voluntary feed intake, dry matter and protein digestibility, and nitrogen balance (protein status) of mature steers fed weathered prairie hay.

Materials and Methods

Five mature Hereford steers fitted with permanent fistulas into their rumen and abomasum were used in this experiment. The steers had free access to winter-harvested prairie hay containing 2.3 percent crude protein and were fed 2 lb daily of a 14.3 percent crude protein supplement (Table 1). Forage intake was measured.

Nutrients infused (Table 2) included: water, dextrose, corn oil, casein (a protein) and methionine. All treatments had dextrose and urea to equalize energy and crude protein infusion. Methionine and casein provided equal amounts of the sulfur amino acids. The infusions were diluted in 1.4 gallons of water and infused continuously, 24 hr/per day.

Feces and urine were collected for 5 days in each period and analyzed for nitrogen. Blood and rumen samples were taken on the last day of collection. The blood plasma was analyzed for glucose and insulin while the rumen sample was analyzed for ammonia concentration.

Table 1. Ration supplement

Ingredient	Percentage
Rolled corn	53.6
Soybean meal	16.9
Dehydrated alfalfa	15.0
Cottonseed hulls	10.0
Monosodium phosphate	2.7
Deflourinated rock phosphate	.89
Sodium sulfate	.75
Trace minerlized salt	.05
Vitamin A (30,000 IU/g)	.12

Table 2. Abomasal nutrient infusates

Infusate treatment	Infusate composition			
	Dry matter (g)		Urea nitrogen (g)	Energy (kcal)
Water	----		41.2	----
Dextrose	286.2		41.2	1144.8
Oil	127.0		41.2	1143.0
Casein	286.2		----	1144.8
Methionine + dextrose	10	Methionine		
		+	41.2	1144.8
	286.2	Dextrose		

Results and Discussion

Total dry matter intake was not affected by any infusion (Table 3). This supports the theory that voluntary feed intake of a high forage diet is limited by the capacity or "bulk fill" of the rumen. Other factors as exercise, pregnancy, lactation and environment also may regulate forage intake.

Protein and dry matter digestibilities (Table 3) were low and not influenced by infusion. Low dry matter digestibility may be due to a deficiency of ammonia in the rumen.

Plasma glucose concentrations (Table 4) were increased by infusions of high amounts of dextrose alone or with the methionine. Since casein produced no response in plasma, this suggests that catabolism of the protein for energy was not large. Plasma insulin (Table 4) increased with the infusion of casein. Insulin levels are 5 to 20 times higher than this in feedlot steers. Similarly low levels have been reported for ruminants not fed for 24 to 72 hr. Low insulin levels may reflect a negative energy balance for cattle.

Infusion of casein increased nitrogen retention (Table 3) over all other infusions. This suggests that amino acids in casein other than methionine limit the nitrogen status of ruminants fed a low quality roughage ration. If post-ruminal protein supply is marginal, this helps explain the superiority of intact protein over non-protein nitrogen supplements for wintered range cattle. Portions of fed soybean meal and cottonseed meal bypass the rumen undegraded and may help meet this need. Increasing post-ruminal flow of deficient amino acids or protein for wintered range cattle may prove useful.

Table 3. Intake, digestibility and ruminal ammonia of infused steers

	Infusate				
Item	Water	Dextrose	Oil	Casein	Methionine
Total dry matter intake, g/day	5008	5182	4660	5097	5301
Digestibility, %					
Dry matter	49.7	47.6	46.1	48.8	45.1
Nitrogen	66.9	65.9	65.5	66.4	64.4
Nitrogen retention g/day	17.3	19.5	16.6	29.9	16.3
Ruminal ammonia, mg %	2.99	2.00	3.7	2.85	2.82

Table 4. Plasma glucose and insulin levels of infused steers

	Infusate				
Item	Water	Dextrose	Oil	Casein	Methionine
Plasma					
Glucose, mg %	58.1	69.4	57.4	56.4	62.4
Insulin					
uU/ml	1.43	1.28	1.41	2.20	1.51