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EFFECT OF METHIONINE ADDITION TO A UREA-GRAIN BASED SUPPLEMENT ON DIGESTIBILITY OF MATURE PRAIRIE GRASS HAY

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Summary

A digestibility trial was conducted to determine the effect of methionine addition to a grain-urea based supplement on the digestibility of mature prairie hay. Ad libitum hay supplemented with .1 lb supplemental crude protein from either a (1) soybean meal, (2) methionine + urea-grain, (3) sulfur + urea-grain or (4) urea-grain supplement was fed to 20 Hampshire ram lambs. Dry matter, neutral detergent fiber and acid detergent fiber disappearances tended to be higher with methionine or sulfur-urea supplements over urea alone. Diet digestibilities between soybean meal, methionine and sulfur treatments were similar. Methionine increased apparent nitrogen digestibility of the diet compared to other treatments. Dry matter intake, urinary nitrogen excretion and nitrogen retention were not affected by supplementation. It appears that methionine and sulfur enhance utilization of mature prairie grass hay when added to a urea-grain based supplement.

(Key Words: Methionine, Urea, Prairie Hay, Digestibility.)

Introduction

Nonprotein nitrogen supplementation of ruminant animals consuming dormant low protein forages has met with limited success. Sulfur which is associated with the microbial fixation of ammonia has been shown to increase utilization of urea when added to the diet. Recent studies have suggested that methionine (a sulfur containing amino acid) when added to urea based protein supplements may increase dry matter and fiber disappearance of mature low protein forages. The objective of this trial was to determine the effects of methionine addition to a grain-urea based protein supplement on digestibility of mature prairie hay.

Materials and Methods

Hampshire ram lambs (mean weight 116.5 lb \pm 7.3) fed mature prairie grass hay were assigned to one of four supplemental protein treatments (Table 1). Supplements were balanced to meet crude protein requirements for a mature 120-lb ewe during maintenance assuming 1.2 lb of crude protein were derived from the prairie hay (2.5 lb of 5.5% crude protein hay per head each day). Urea-grain supplements were balanced to provide equal daily intake of energy, calcium, phosphorus and sulfur as the soybean meal supplement (Table 2). Methionine and sulfur urea-grain supplements were balanced to provide equal levels of sulfur per head each day. Mature prairie grass hay was fed ad libitum and intakes were stabilized over a 21-day pretrial period. Hay was composed of 63% (\pm 10) western wheatgrass, 35% (\pm 11) Japanese brome and 2% (\pm 3) unidentified forage as determined by sorting 15 random subsamples. Prairie hay composition is listed in Table 3. Total fecal and urine collections were carried out over two 3-day collection periods. Fecal subsamples were frozen and later oven dried at 60 °C. Ten percent aliquots of HCl treated urine were frozen for later Kjeldahl nitrogen determinations. Feed refusals were incorporated into the next days feed during the collection periods. Final feed refusals were weighed and oven dried for later lab analysis. Dry matter, acid detergent fiber, neutral detergent fiber and Kjeldahl nitrogen analyses were completed on feed and fecal samples.

Data was pooled over the two collection periods. Treatment effects were analyzed by least squares procedures using General Linear Model (GLM) of the Statistical Analysis System (SAS). Means were separated by the Predicted Difference option (Pdiff). Dry matter intake was included in the model as a

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TABLE 1. SUPPLEMENTS FED TO LAMBS DURING DIGESTIBILITY TRIAL^a

Ingredients	Supplements			
	1 Soybean meal	2 Urea + methionine	3 Urea + sulfur	4 Urea
Soybean meal	91.0	20.0	20.0	21.5
Corn	3.5	58.5	58.75	60.0
d-L-methionine	--	3.0	--	--
Urea	--	7.5	7.5	7.5
Na ₂ SO ₄	--	--	2.75	--
Binder	1.5	5.0	5.0	5.0
Liquid molasses	4.0	4.0	4.0	4.0
Potassium chloride	--	1.0	1.0	1.0
Dicalcium phosphate	--	1.0	1.0	1.0

^aPercent, dry matter basis.

TABLE 2. NUTRIENT INTAKE FROM SUPPLEMENTS FED LAMBS DURING DIGESTIBILITY TRIAL^a

Item	Supplements			
	Soybean meal	Urea + methionine	Urea + sulfur	Urea
Dry matter, %	87.79	88.61	89.68	87.99
Crude protein	.10	.10	.10	.10
Nonprotein nitrogen	.0002	.0089	.0095	.0094
Calcium	.0009	.0010	.0011	.0011
Phosphorus	.0013	.0012	.0013	.0014
Potassium	.0053	.0036	.0037	.0038
Sulfur	.0010	.0019	.0020	.0005
Methionine	.0015	.0085	.0007	.0008
Mcal ME ^b	.257	.259	.263	.261

^a Lb per head each day.

^b Calculated values.

TABLE 3. COMPOSITION OF PRAIRIE HAY FED LAMBS DURING DIGESTIBILITY TRIAL^a

Item	%
Dry matter	84.10
Crude protein	5.83
Calcium	.40
Phosphorus	.11
Sulfur	.10
Neutral detergent fiber	70.2
Acid detergent fiber	39.0
Alkaline peroxide lignin	1.57

^a Percent, dry matter basis.

covariate for all digestibility and nitrogen utilization analyses except nitrogen biological value.

Results and Discussion

Dry matter intake was not affected by supplemental treatments (Table 4). Average intake of prairie hay during the collection period was highly variable between lambs and ranged from 1.8 to 3.0 lb dry matter per day. Apparent dry matter digestibility tended ($P = .16$) to be lower for lambs supplemented with urea alone. Diet digestibility between methionine, sulfur and soybean meal supplemented lambs were similar. Differences in diet digestibility can be explained by fiber digestibility differences between treatments. Neutral detergent fiber and acid detergent fiber digestibilities of the urea fed lambs tended ($P = .11$ and $.08$, respectively) to be higher when methionine or sulfur were added to the supplements. Diet fiber digestibilities for soybean meal supplemented lambs were similar to the methionine and sulfur treatments.

TABLE 4. EFFECT OF SUPPLEMENTATION ON INTAKE AND DIGESTIBILITY OF MATURE PRAIRIE GRASS HAY

Item	Supplements				Prob. ^a
	Soybean meal	Urea + methionine	Urea + sulfur	Urea	
No. of lambs	5	5	5	5	
Dry matter intake, lb/day	2.25	2.33	2.39	2.28	
Dry matter disappearance, %	45.5 ^b	46.7 ^b	46.8 ^b	43.4 ^c	.16
Neutral detergent fiber disappearance, %	53.8 ^{bc}	55.2 ^b	55.6 ^b	51.9 ^c	.11
Acid detergent fiber disappearance, %	51.3 ^{bc}	52.6 ^b	52.8 ^b	49.1 ^c	.08
Apparent nitrogen digestibility, %	58.2 ^b	60.3 ^c	58.0 ^b	55.8 ^d	.01
Fecal nitrogen, g/day	7.0	6.7	6.9	7.0	
Urinary nitrogen excretion, g/day	8.5	9.2	8.6	8.9	
Nitrogen retention, g/day	1.2	.9	.9	.0	
Nitrogen biological value ^e	11.0	9.4	10.0	-1.0	

^a Prob. = probability of a significant treatment effect.

^{b,c,d} Means within row with uncommon superscripts differ ($P =$ listed value).

^e Biological value = $100 \times (1 - (\text{g urinary N} / (\text{g N intake} - \text{g fecal N})))$.

Nitrogen digestibility of the diet for lambs fed urea supplements was higher ($P < .01$) with methionine or sulfur addition (Table 4). Urea was fed at similar levels for all three diets and nitrogen from urea would be nearly 100% degradable, resulting in higher apparent nitrogen digestibility. Methionine supplementation increased ($P < .05$) nitrogen digestibility over sulfur treatment. Nitrogen retention (dietary nitrogen retained in the body), urinary nitrogen and fecal nitrogen were not different between treatments. Biological value of dietary nitrogen (percentage of nitrogen absorbed in the gastrointestinal tract that is retained in the body) reflected nitrogen retention values and were not different between supplements.

It appears that the usefulness of urea-grain based protein supplements for ruminants fed low protein mature forages can be improved with the addition of methionine or sulfur. Diet dry matter and fiber digestibility tended to be higher compared to urea alone supplementation. With an increase in diet utilization an animal's ability to maintain body weight while grazing dormant winter forage would be improved. Ongoing research will study the effects of these same four supplemental treatments on diet digestibility and intake for cows grazing dormant winter range.