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Rumen Degradable Protein Requirements of Gestating Beef Cows Grazing Dormant Native Sandhills Range

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Summary

Two grazing trials were conducted to determine the rumen degradable protein requirement of gestating beef cows grazing dormant native Sandhills range. In Trial 1, 80 crossbred cows (1150 lb) were randomly assigned to one of the following treatments: 1) 50%, 2) 75%, 3) 100%, or 4) 125% of the estimated supplemental rumen degradable protein requirement. In Trial 2, 80 crossbred cows (1150 lb) were assigned to: 1) 29%, 2) 65%, 3) 100%, or 4) 139% of the estimated supplemental rumen degradable protein requirement. In Trial 1, daily gain, and condition score were not significantly different across treatments. In Trial 2, the 65% level increased gain compared to the 29%, 100%, and 139% levels (.40, .11, .13, .02 lb/day, respectively). Condition score was maintained at the 65% level and lost at 29%, 100%, 139% levels (0, -.2, -.4, -.3 respectively). Forage intake was not different in either trial although digestibility increased linearly in Trial 1 and tended to increase linearly in Trial 2. Gestating beef cows grazing native winter Sandhills range need between .31 and .37 lb/day supplemental rumen degradable protein to meet their daily requirement of .95 to 1.1 lb/day.

Introduction

Protein, the most expensive winter supplement, may be overfed because the actual rumen degradable and escape protein requirements are unknown. Rumen degradable protein is protein degraded by the rumen microorganisms and used by them for their growth and protein synthesis. Escape protein is protein which is not degraded in the rumen but enzymatically digested in the small intestine for use by the animal at the tissue level. Metabolizable protein is the combination of digestible microbial protein and escape protein that flows to the small intestine for use by the host animal. Previous Nebraska reports (Karges et al., *1991 Beef Cattle Report*) indicated that the metabolizable protein required for the wintering, gestating beef cow can be met by microbial flow to the small intestine. Therefore, our objective was to determine the rumen degradable protein requirement of gestating beef cows grazing dormant native Sandhills range.

Procedures

Trial 1

Eighty crossbred gestating beef cows were randomly assigned to: 1) 50%, 2) 75%, 3) 100%, or 4) 125% of the estimated supplemental rumen degradable protein requirement. Supplements were combinations of corn steep liquor and soyhulls to provide the varying protein levels while keeping all supplements isocaloric (Table 1). Steep liquor was used as the source of rumen degradable protein because it is a source of protein, peptides, and amino acids which is completely degraded in the rumen. The estimated daily rumen degradable protein requirement was 1.35 lb, of which .60 lb was estimated to be supplied by the forage. The cows were fed daily in groups of 10 hd (2 pastures/treatment) from November to February. Forage intake was measured (eight cows/treatment) in December and in February for five days each. Cows were individually fed during the fecal collection. Cows were given Captec chromium devices that released chromium at a steady rate into the rumen. Fecal output was determined by dividing the amount of chromium released by the Captec chromium device daily by the concentration of chromium in the feces. Forage intake was estimated by dividing fecal output by the indigestibility of the forage diet. Diet samples were collected monthly with eight to ten esophageally-fistulated cows to determine the protein and fiber contents, and digestibility of the range diets. Weights were taken monthly and condition score (CS) was determined in November and in February by palpation of cover over the back and ribs.

Table 1. Supplement composition for gestating cows grazing Sandhills winter range.

	Supplemental rumen degradable protein requirement, % of required			
Trial 1[a]	50%	75%	100%	125%
	lb DM/day			
Steep liquor	.59	1.2	1.8	2.4
Soyhulls	1.9	1.3	.62	——
Trial 2[b]	29%	65%	100%	139%
	lb DM/day			
Steep liquor	——	.57	1.1	1.7
Soyhulls	1.7	1.2	.62	——

[a]50%, 75%, 100%, and 125% of the estimated supplemental rumen degradable protein requirement (.75 lb).
[b]29%, 65%, 100%, 139% of the estimated supplemental rumen degradable protein requirement (.47 lb).

Trial 2

Eighty crossbred gestating beef cows were randomly assigned to 1) 29%, 2) 65%, 3) 100%, or 4) 139% of the estimated supplemental rumen degradable protein requirement. Supplements were similar to those in Trial 1 (Table 1). However, the estimated daily rumen degradable protein requirement was 1.28 lb of which .80 lb was supplied by the forage. Data collection procedures were the same as in Trial 1.

Results

The ADG and CS were not different among treatments in Trial 1 (Table 2). Cows maintained weights and CS suggesting that even the lowest level of steep liquor supplied sufficient rumen degradable protein to meet the needs of the rumen microorganisms. It also suggests that the rumen degradable protein was sufficient to meet the cow's metabolizable protein requirement and additional escape protein would not be required.

In Trial 2, there was a quadratic (P<.01) response in ADG and a cubic response in CS to increasing levels of steep liquor (rumen degradable protein). The CS did not change for cows on the 65% level of rumen degradable protein while CS was lost at all other levels. Daily gains at the 65% level were higher than those at the 29, 100, and 139% levels.

The decrease in gains and CS as level of degradable protein was increased from 65% to 100 and 139% may be due to a reduced supply of energy for the rumen microorganisms. Even though the diets were formulated to be isocaloric, the soyhulls provide digestible energy for the microbes while the steep liquor supplies organic acids for the energy needs of the host animal but little or no energy for the microbes. As steep liquor replaced soyhulls, microbial energy decreased and microbial protein synthesis likely decreased. The positive weight gain and maintenance of CS also suggest the metabolizable protein requirement was met at the 65% supplemental level but not at the higher levels. We concluded the supplemental need for rumen degradable protein must be between the 50% level (.37 lb; 170 g) in Trial 1 and the 65% level (.31 lb; 140 g) in Trial 2.

Forage intake was not different (P >.10) across treatments in Trial 1 or Trial 2 with the average intake being 2.2 and 2.0% BW respectively. The protein fractions for both trials were similar (Table 3), however the fiber content appeared to be higher and in vitro digestibility lower in Trial 2. Possibly this difference in fiber content was due to summer grazing on the pastures, and therefore, regrowth, before Trial 1. No summer grazing was incorporated before Trial 2. In Trial 1 in vivo OM digestibility increased with increasing

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Table 2.Weight and condition score (CS) change of gestating beef cows grazing winter Sandhills range.

	Supplemental rumen degradable protein, % of required			
Trial 1[a]	50%	75%	100%	125%
ADG, lb	.13	.09	.20	.14
Initial wt, lb	1160	1145	1159	1127
CS change[b]	-.6	-.9	-.8	-.8
Supplemental RDP intake, lb	.37	.56	.75	.94
Total RDP intake, lb	1.06	1.32	1.43	1.66
Trial 2[c]	29%	65%	100%	139%
ADG, lb[d]	.10	.39	.14	.02
Initial wt	1166	1158	1166	1165
CS change[e]	-.2	0	-.4	-.3
Supplemental RDP intake, lb	.14	.31	.47	.66
Total RDP intake, lb	.75	.95	1.09	1.25

[a]50%, 75%, 100%, and 125% of the estimated supplemental rumen degradable protein (RDP) requirement (.75 lb).
[b]Initial condition score = 5.7.
[c]29%, 65%, 100%, 139% of the estimated supplemental rumen degradable protein requirement (.47 lb).
[d]Quadratic effect (P < .01).
[e]Initial CS = 5.2; cubic effect (P<.01).

Table 3. Crude, escape, and rumen degradable protein, acid and neutral detergent fiber, and in vitro OM disappearance of Sandhills winter range (% of OM) (Trial 1 and 2)

	CP[a]	EP[b]	RDP	ADIN[c]	ADF	NDF	IVOMD
Trial 1							
November	5.6	1.10	3.6	.90	40.7	66.9	60.5
December	4.3	.81	2.7	.79	42.3	72.3	55.8
January	4.7	.84	3.1	.76	43.0	72.3	60.7
February	4.4	.85	2.7	.85	46.4	77.1	55.1
Trial 2							
November	5.7	.88	3.8	1.0	49.6	75.9	57.8
December	4.4	.54	2.5	1.4	51.6	74.0	54.0
January	4.8	.71	2.4	1.7	50.9	73.8	55.3
February	4.5	.71	2.7	1.1	52.5	80.1	56.1

[a]CP=crude protein, EP=escape protein, RDP=rumen degradable protein, ADF=acid detergent fiber, NDF=neutral detergent fiber, IVOMD=in vitro organic matter disappearance.
[b]EP is corrected for microbial attachment and ADIN, calculations were made from 8, 16, 24 hr in situ rumen incubation and a 2%/hr rate of passage.
[c]ADIN = acid detergent insoluble nitrogen, assumed to be unavailable to the animal.

Table 4. In vivo OM digestibility (%) of native Sandhills winter range as affected by rumen degradable protein supplementation (Trial 1 and 2).

	December	February
Trial 1[a]		
50%	48.2	52.6
75%	52.8	53.7
100%	52.6	54.7
125%	52.9	55.2
Trial 2		
29%	48.8	54.3
65%	49.8	54.9
100%	50.0	55.7
139%	51.2	55.7

[a]Period effect (P< .05) in both trials, Linear effect (P< .05) of treatment in Trial 1.

levels of supplemental rumen degradable protein ($P < .01$), while in Trial 2 treatment had no affect on in vivo OM digestibility (Table 4). In both trials, in vivo OM digestibility increased from December to February ($P < .05$), but not enough to affect forage intake.

Conclusions and Implications

We conclude that the rumen degradable protein requirement for gestating beef cows grazing winter Sandhills range is .95 to 1.1 lb/day and .31 to .37 lb/day of supplemental rumen degradable protein is required. Supplemental protein may be overfed to gestating beef cows grazing winter native range in many production systems. The cost of supplementing gestating beef cows could be reduced by choosing a highly degradable protein source and supplementing to meet the rumen degradable protein needs of the gestating beef cow grazing native range. It is critical to know the amount of rumen degradable protein supplied by the forage. This value may vary from year to year and across production systems. Therefore, it is important to know the protein fractions of the forage so supplements can be fed accordingly.

A rancher could provide .3 lb of rumen degradable protein by supplementing 1.1 lb (as is basis) of soybean meal. However, because the protein in SBM is only 70% degradable, unnecessary escape protein is also being fed. Sunflower meal protein is approximately 80% degradable and 1.1 lb/day of sunflower meal would supply .3 lb rumen degradable protein. Steep liquor protein is all degraded in the rumen and 1.95 lb (as is) would supply .3 lb rumen degradable protein. Steep liquor is 60% moisture and is the least expensive per unit of rumen degradable protein.

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