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Supplementing Metabolizable Protein to Yearling Heifers Grazing Winter Range

Trey Patterson
University of Nebraska-Lincoln

Don C. Adams
University of Nebraska-Lincoln, dadams1@unl.edu

Terry J. Klopfenstein
University of Nebraska-Lincoln, tklopfenstein1@unl.edu

Jacqueline A. Musgrave
University of Nebraska-Lincoln, jmusgrave1@unl.edu

Andy Applegarth
Gudmundsen Sandhills Laboratory, Whitman, andy.applegarth@unl.edu

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Trey Patterson
Don Adams
Terry Klopfenstein
Jacki Musgrave
Andy Applegarth[1]

Supplementing metabolizable protein to grazing heifers in the winter improved performance in one of two years, and forage intakes declined with increasing stage of gestation.

Summary

Two experiments were conducted with pregnant yearling heifers grazing Sandhills winter range to evaluate response of supplementing to meet the metabolizable protein requirement of the heifers versus conventional supplementation based on crude protein. Supplements were fed from October to February (pre-calving) both years. Intake was measured in November, January and February of the first year. Supplementing to meet metabolizable protein requirement improved the heifers' ability to maintain weight in year one, but not in year two. Heifer intakes ranged from 2.2% of BW in November to 1.5% in February. Feeding hay reduced body weight loss compared to no hay feeding in year two.

Introduction

Nutritional systems that facilitate economical management of yearling heifers over winter to subsequently improve two-year-old pregnancy rate potentially could improve ranch profitability. Due to high protein requirements for growth and pregnancy, metabolizable protein (MP) may become limiting to heifers during the winter. Metabolizable protein is the sum of digestible rumen escape protein (UIP) and microbial crude protein (MCP) flowing to the small intestine. The production of MCP is dependent upon the energy content of the diet and is thus decreased as forage quality declines in the winter. Forage samples collected in the Sandhills of Nebraska during the winter with esophageally fistulated cows have less than 1% of DM as UIP, thus MP will become deficient in situations where the requirements are relatively high. Conventional protein supplementation strategies are based on the CP system, which erroneously assumes equal rumen degradability of all protein. In situations where supplemented protein sources are primarily degraded in the rumen, supplements may not supply adequate UIP to meet the animals' MP requirement. Supplementing to meet MP requirements during the winter using sources of protein high in UIP potentially could improve performance (weight and body condition) and reproduction of heifers.

A critical step in determining supplemental requirements of grazing heifers is an accurate estimate of forage intake (FI). Data have not been published on FI of pregnant heifers grazing Sandhills winter range, nor how FI changes as the heifers progress in gestation. Therefore, the objectives of this study were to evaluate the body weight, body condition score (BCS), and FI of pregnant heifers either supplemented to meet their MP requirement or supplemented with a conventional protein supplement, and to determine how FI of heifers changes over the winter.

Procedure

Experiment 1

Twelve pregnant, yearling heifers (average calving date March 1) grazing native range at Gudmundsen Sandhills Laboratory were stratified by weight and body condition score on Oct. 2, 1997 and randomly allotted to one of two supplemental treatments (six per treatment). Treatments were 1) a supplement designed to meet the MP requirement of the heifers through the winter (MPS) and 2) a conventional protein supplement fed to meet the CP requirement of the heifers (CONT). Feather meal was used for the UIP source in the MPS supplement (Table 1), with the supplement DM being composed of 49% CP and 27% UIP. The CONT supplement was composed of 49% CP and 13% UIP (DM basis). Supplements were individually fed three times weekly starting in mid-October. The CONT supplement was fed at the rate of .89 lbs/day (DM) throughout the trial, supplying 53 grams of UIP/day. The MPS supplement feeding rate increased gradually from .70 lb/day in October to 1.1 lb/day in February to meet MP requirements, supplying 86 grams UIP/day in October, 120 grams UIP/day in November, December, and January, and 135 grams UIP/day in February. No hay was offered during the

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Table 1. Composition of supplements fed to heifers in Experiments 1 and 2 (% of DM).[a]

Ingredient	MPS	CONT
Cottonseed Meal	—	58.8
Feather Meal	40.2	—
Soybean Meal	—	17.8
Sunflower Meal	30.2	13.7
Wheat Middlings	26.2	—
Dist. Grains	—	3.4
Molasses (Cane)	2.1	2.1
Urea	—	2.8
Minerals/Vitamins	1.3	1.4

[a]Supplements were provided as range cubes fed 3 times weekly. MPS: designed to meet the metabolizable protein requirement; CONT: designed as conventional protein supplement.

experiment. Beginning Oct. 22, weights were taken twice weekly and BCS once monthly. Weights were taken with no prior shrink at the same time each weigh-day (approximately 1:00 pm), and BCS were assigned by two trained technicians. The heifers were weighed and BCS off-test on Feb. 13, 1998.

Heifers were managed in one 81 acre pasture throughout the experiment at a stocking rate of .70 AUM/acre. The pasture was located on a sands range site in good to excellent condition which was dominated by little bluestem *(Schizachyrium scoparium)*, prairie sandreed *(Calamovilfa longifolia)*, sand bluestem *(Andropogon hallii)* and switchgrass *(Panicum virgatum)*. Estimates of standing herbage taken from a similar, adjacent pasture in October (during a simultaneous study; 1999 Nebraska Beef Report, pp. 5-6) were used to calculate cumulative grazing pressure (total AUM per ton of DM forage initially available), which was about .59 AUM/ton.

Intake measurements were taken in three, six-day periods beginning Nov. 10, 1997, Jan. 5, 1998 and Feb. 9, 1998. Chromium sesquioxide from time release boluses was used for determination of fecal output in each animal, and predictions were validated with four steers using total fecal collection. Diets were collected with esophageally fistulated cows during each intake period, and samples were used to determine IVDMD. Forage intake was calculated as: daily fecal output from forage/1-forage IVDMD. Instantaneous grazing pressure (animal units (AU) per ton of DM forage at any instant in time) was about .13, .14 and .15 AU/ton for the November, January and February intakes, respectively.

Experiment 2

On Oct. 21, 1998, 18 pregnant heifers at Gudmundsen Sandhills Laboratory were stratified by weight and BCS and randomly allotted to one of three supplemental treatments. Supplements were the same as those described in Experiment 1, and treatments were 1) heifers supplemented to meet MP requirement and receiving hay beginning in January (MPS/Hay), 2) heifers supplemented with conventional supplement and receiving hay beginning in January (CONT/Hay), and 3) heifers supplemented to meet MP requirement and offered no hay during the experiment (MPS/No Hay). Heifers were managed on the same pasture described for Experiment 1, with a stocking rate of 1.06 AUM/acre and an approximate cumulative grazing pressure of .83 AUM/ton (adjusted for hay that was fed). Hay was individually fed three times weekly at the rate of 4 lbs/day beginning Jan. 4, 1999. The amount was gradually worked up to 6.5 lbs/day by the first of February. The hay was late June harvested meadow hay containing 7.5% CP and was 65.6% digestible (determined by five day in-vivo trial with five yearling steers). Supplements were fed as described in the first experiment. The cattle were weighed twice weekly and BCS every other month. Heifers were weighed and BCS off-test on Feb. 20 and 21, 1999.

Results

Experiment 1

Heifers receiving the CONT supplement lost 26 lb over the winter, but heifers receiving the MPS treatment gained 10 lb (Table 2; P = .04). Considering fetal weight (fetus, placenta, fluids) was substantial during the time the experiment was conducted, all heifers lost body weight over the course of the experiment. Figure 1 shows body weights of each treatment group throughout the experiment. Both treatment groups gained weight from early October to late December, and during this period the MPS heifers appeared to gain weight faster than the CONT heifers. All heifers lost weight in January and Febru-

Table 2. Weight, BCS, and forage intake (FI) of heifers grazing winter Sandhills range from October 1997 to February 1998 (Experiment 1).[a]

Item	MPS	CONT	SD[b]
Beginning wt, lb	955	948	54
Final wt, lb[c]	965	921	49
Wt change, lb[d]	10	-26	27
Beginning BCS	6.4	6.3	.5
Final BCS	4.9	4.8	.3
BCS change	1.5	1.5	.7
November FI,[e,f]			
lb	22.1	20.6	2.5
% BW	2.2	2.2	.2
January FI,[e,f]			
lb	17.5	15.8	4.3
% BW	1.8	1.7	.4
February FI,[e,f]			
lb	14.8	14.3	2.6
% BW	1.5	1.6	.3

[a]MPS: heifers supplemented to meet metabolizable protein requirement; CONT: heifers supplemented with conventional protein supplement. No hay fed during the experiment.
[b]Standard deviation, n = 12.
[c]Treatments differ, P = .16.
[d]Treatments differ, P = .04.
[e]Dry matter basis.
[f]Intake declined linearly over time (P = .0001).

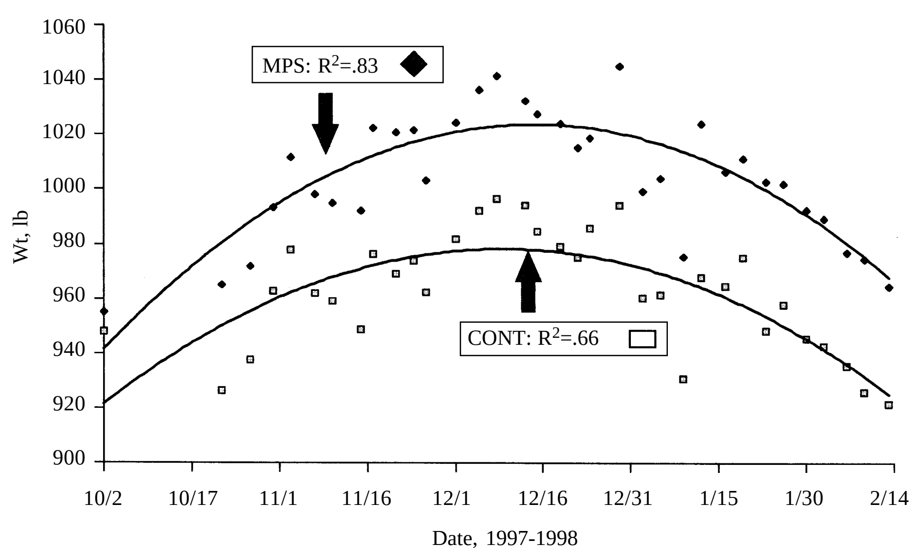

Figure 1. Weight change of heifers in 1997-1998 (Exp. 1).

Table 3. Weight and BCS of heifers grazing winter Sandhills range from October 1998 to February 1999 (Experiment 2).[a]

Item	MPS/Hay	CONT/Hay	MPS/No Hay	SD[b]
Beginning Wt, lb	940	945	923	41
Final Wt, lb[c]	914	921	808	69
Wt change, lb[d]	-26	-23	-114	48
Beginning BCS	6.1	6.0	6.1	.4
Final BCS[e]	5.7	5.4	5.0	.5
BCS change[f]	-.4	-.6	-1.0	.6

[a]MPS/Hay: heifers supplemented to meet metabolizable protein requirements and fed hay (average 5 lb/day) in January and February; CONT/Hay: heifers supplemented with conventional protein supplement and fed hay in January and February; MPS/No Hay: heifers supplemented to meet metabolizable protein requirements and fed no hay.
[b]Standard deviation, n = 18.
[c]MPS/Hay and CONT/Hay versus MPS/No Hay, P = .001.
[d]MPS/Hay and CONT/Hay versus MPS/No Hay, P = .0001.
[e]MPS/Hay versus MPS/No Hay, P = .01; CONT/Hay versus MPS/No Hay, P = .10.
[f]MPS/Hay versus MPS/No Hay, P = .10.

ary. It appears that MP was limiting growth of the heifers during the fall, while energy became first limiting in late December. There were no differences in BCS loss over the winter between the MPS and CONT heifers (P=.83), with both groups losing about 1.5 BCS. Most of this condition loss (approximately 66%) occurred after late December, when weights were declining.

Diets collected by the esophageally fistulated cows during each intake period had IVDMD averaging 52% in November, 49% in January, and 50% in February. Heifer FI was not different between treatments when expressed as lb/day or as a percentage of body weight for any of the three intake periods (Table 2). However, FI declined linearly across measurement dates (P = .0001). Heifer FI averaged 21.4 lb/day (2.2 % of BW) in November, 16.7 lb/day (1.8%) in January, and 14.5 lb/day (1.5%) in February. The 1996 NRC model predicted the heifers to have a DMI of 22 lb/day, which was similar to the FI measured in these heifers in November. However, the NRC model did not predict a reduction in intake across the measurement dates.

A reduction in the amount of forage available for grazing and/or stressful environmental conditions can cause reductions in intake. In addition, heifer intakes tend to decline as stage of gestation progresses and the fetus and fluids begin to compress the rumen, which reduces rumen volume. Because rumen fill likely limits intake on low quality diets, reduced rumen volume results in lower intake. However, the decline in FI over time measured in this study was more severe than expected, and the 1.5% of BW intakes measured in February were much lower than intakes measured in cows grazing similar Sandhills winter range during late gestation. With actual intakes used as inputs, the NRC model predicted the heifers to lose .2 BCS in November, .7 BCS in December, and 1.4 BCS in January. The heifers actually lost .3 BCS in November, .5 BCS in December, and .6 BCS in January. Therefore, the actual performance was better than predicted performance. However, the November intake data yielded predicted BCS losses similar to actual when modeled in the NRC. Sources of variation within actual and predicted BCS estimates and the lack of performance measurements in late February and early March (the trial ended) could account for the difference in NRC predicted performance and actual heifer performance in January (and early February). The data show that heifer intakes declined as stage of gestation increased. The decline in intake prior to calving was more severe than expected and predicted by the NRC.

Experiment 2

There were no differences between the MPS/Hay and the CONT/Hay in body weight change nor BCS change (Table 3). Heifers on the MPS/No Hay treatment lost more weight over the course of the winter than heifers on the other treatments (P = .0001). Heifers on the MPS/Hay treatment had higher BCS in February than those on the MPS/No Hay treatment (5.7 versus 5.0; P = .01), and tended to lose less BCS over the course of the experiment (P = .10). Heifers on the CONT/Hay treatment tended to have higher BCS than the MPS/No Hay treatment in February (5.4 versus 5.0; P = .10) and tended to lose less BCS over the course of the experiment (P = .16). With weight losses averaging 114 lbs for the MPS/No hay treatment compared to 26 and 23 lb for the MPS/Hay and CONT/Hay respectively, BCS differences would be expected to be greater between the hay and no hay treatments. It is possible, however, that less rumen fill in cattle on the MPS/No Hay treatment could cause final weights to be lower in this treatment relative to treatments receiving hay.

The addition of MP to the hay-supplemented diets did not improve the heifers' ability to maintain weight or BCS over conventional supplementation. The addition of energy to low-quality ruminant diets will increase MCP production if adequate degradable protein is available. This increases the flow of MP to the small intestine, and thus will decrease the need for supplemental UIP. However, this may not fully explain the lack of response to MP in Experiment 2 that was noticed in Experiment 1. Yearly variation in diet quality can be a factor.

Previous work in the Sandhills has shown that diet quality can change rather markedly between years (1998 Nebraska Beef Report, pp. 20-21). This can cause variation in intake and performance of cattle. Figure 2 illustrates that all cattle were losing weight until hay was fed to the MPS/Hay and CONT/Hay groups. Heifers were able to maintain body weight when hay was fed while heifers on the MPS/No Hay treatment continued to lose weight. This is unlike the response noted in Experiment 1 where cattle gained weight in the fall. When energy is not limiting, one would expect a growth response in the fall from supplying UIP, before gestation requirements and environmental factors begin to play a larger role in the winter months. In Experiment 2, energy could have been limiting performance in the fall. Reduced

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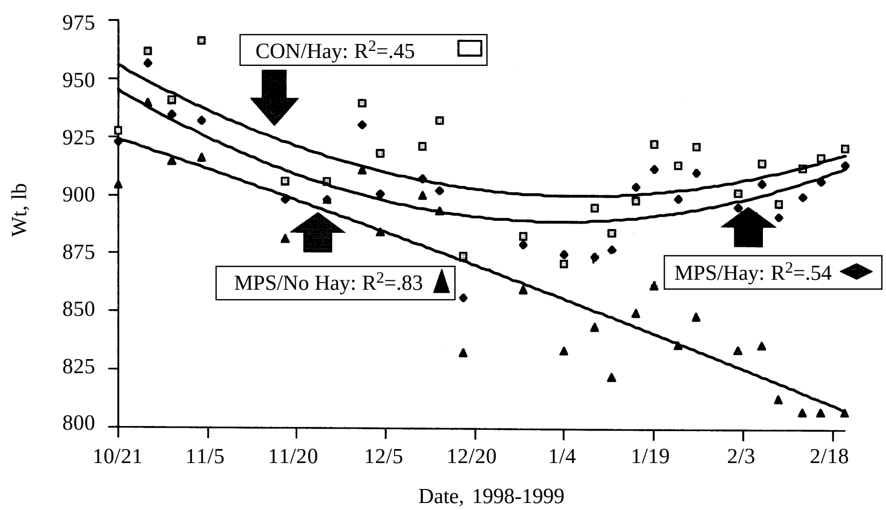

Figure 2. Weight change of heifers in 1998-1999 (Exp. 2).

energy intake was likely due to forage quality and/or the amount of forage available for grazing, as the grazing pressure was higher in year two. This is further supported by the fact that cattle on the MPS/No Hay treatment, which was an identical treatment to the MPS treatment in Experiment 1, lost substantially more weight in Experiment 2. Nevertheless, body condition losses were less in Experiment 2 than in Experiment 1. Rumen-fill differences, error associated with comparing BCS data on small groups of animals across years and composition of weight-loss differences could account for some of the year to year variation.

In conclusion, heifers supplemented with UIP (balanced MP requirement) maintained more weight in the fall of one year, but heifers did not respond to UIP supplementation in the fall of a second year. Year to year variation in forage quality or availability, environment, or other factors could have caused the year differences. Heifer intakes declined as stage of gestation increased. Managing heifers on native range without feeding hay resulted in large losses in body weight.

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[1]Trey Patterson, research technician, Animal Science, Lincoln; Don Adams, professor, West Central Research and Extension Center, North Platte; Terry Klopfenstein, professor, Animal Science, Lincoln; Jacki Musgrave, research technician, Andy Applegarth, manager, Gudmundsen Sandhills Laboratory, Whitman.