Early-Vegetative Meadow Hay Versus Alfalfa Hay as a Supplement for Cattle Consuming Low-Quality Roughages[1]

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SUMMARY: The results obtained by this study suggest that high quality meadow hay is an effective supplement to low-quality forages, particularly in terms of animal performance. However, the addition of supplemental protein failed to improve basal diet intake or digestion. The treatment differences that were observed appeared to be a function of energy provision rather than protein, although the protein probably was necessary to make the supplemented energy available. Improvements in gain and body condition seen in the performance study likely were most related to increases in total intakes and improved dietary digestibilities that came with supplementation. Forage-based protein supplements appears to be a very practical means of improving wintering cow weight and condition maintenance on low-quality forages. Improved maintenance of weight and condition of the cows suggest that it is reasonable to suspect wintering cattle in many areas would require such supplementation in order to maintain acceptable levels of reproductive performance on low-quality diets.

The feeding of low-quality forages, such as crop residues, stockpiled forages, and low-quality hays, to wintering beef cattle is a common practice in the beef cattle industry. Without additional nutritional management, however, these feeds frequently result in low intakes and poor digestion owing to deficiences of host animal, and microbially-available protein and energy. Many studies have documented the benefits of protein supplementation on the intake and digestibility of low-quality forages. Improvements in digestion and intake, in turn, often yield improved cattle weight and condition status throughout the winter feeding period. Ultimately, improved nutritional status through the winter feeding period may provide improved subsequent resproductive efficiency.

Oilseed meals (soybean and cottonseed meal) and alfalfa, the most common forms of supplemental protein in these studies, are often expensive in many parts of the western United States. Cheaper, locally produced forms of supplemental protein would be an advantage to many range cattle operations. Meadow hay is commonly produced for use as a primary winter feed source. Because it is needed in large quantities, production strategies frequently emphasize yield over quality, and most hays are therefore harvested close to phenological maturity. If alternative winter feed resources are utilized, intensive management of hay meadows becomes a viable option to producers. The objective of this study, therefore, was to harvest such an early, high-quality meadow hay and compare its effects to alfalfa hay on the intake, digestion, and subsequent performance of beef cattle fed a low-quality roughage.

Materials and Methods

Hay meadow survey. Two 15 acre tall fescue pastures were grazed by 108 cow/calf pairs from April 19 to May 17, 1991. Cows

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received 17 lbs meadow hay/head on 18 of 28 days. Both pastures had been fertilized with 50 lbs/acre in mid-March. The early-season grazing was used as a management tool to delay forage maturity so that a higher quality stand could be captured at the normal harvest date. Five clipping plots were established in representative areas within one pasture. Ground-level clippings were taken once every week from five random locations within each plot. The clippings were then weighed, dried, re-weighed, and then ground to pass through a 1 mm screen. Total above-ground dry-matter (DM) production was estimated from average DM yields across plots. Samples were then stored for later analysis of crude protein (CP), soluble nitrogen (N), acid detergent insoluble nitrogen (ADIN), acid detergent fiber (ADF), natural detergent fiber (NDF), and insoluble acid detergent fiber (IVDMD). chemical composition of this forage, alfalfa hay supplement, and the tall fescue basal diet can be found in Table 1. both pastures were harvested between July 10 and July 15.

Table 1. Chemical composition of feeds

	Tall Fescue straw	*Meadow hay*	*Alfalfa hay*
CP, %	*4.05*	*11.92*	*18.97*
% Sol Prot	*37.65*	*23.87*	*28.38*
ADIN, %*	*12.93*	*6.76*	*9.32*
ADF, %	*50.38*	*34.95*	*35.26*
NDF, %	*73.63*	*57.01*	*51.71*
IADF, %*	*32.89*	*7.75*	*18.16*

**Expressed as a percentage of total N*
**Indigestible ADF*

Cattle Trials. Endophyte-free tall fescue straw was utilized as the low-quality basal diet for both trials. This straw was ad-libitum. The alfalfa hay supplement was fed at .4 percent body weight (BW), a value suggested by previous low-quality forage at a level that supplied the same amount of protein as the alfalfa hay supplement in order to equalize protein effects on digestion. Both supplement hays and the straw were chopped (2-4) inch length) prior to feeding in the digestion trial. This facilitated handling, weighing, and a reduction in waste resulting from feed pulled out of the bunks. In the cow performance study, the supplement hays and the straw were fed directly from standard rectangular bales.

Experiment 1: Digestion Study. Fifteen ruminally cannulated steers (average wt = 860 lbs) were blocked by weight and randomly assigned to one of three treatments: 1) tall fescue straw without supplement (negative control; 2) tall fescue straw plus a meadow hay supplement; 3) tall fescue straw plus an alfalfa hay supplement. The 28 d digestion study was divided into a 14 d adaption period, a 6 d intake period, and a 6 d fecal collection period, with a rumen profile on d 27 and rumen evacuations on d 28.

Experiment 2: Cow performance trial. Ninety gestating Hereford X Angus cows (average wt = 1,056 lbs) were stratified by age and body condition and, within stratum, randomly assigned among three replications of the dietary treatments. All cows shared one common pasture, with the supplemented cows gathered and sorted at 11 a.m. each day to be fed their supplements. Supplemented cows were fed in pens of 10 according to supplement type. Straw was fed from bales scattered across the pasture each day between 7 a.m. and 9 a.m. Supplements were fed for 84 d, from November 19, 1991, to February 11, 1992. Cows were weighed and condition scored (C-scored) on d 0, 28, 56, 84. At 4 p.m. the day before each weigh/scored date, the cows were gathered and placed in a corral away from feed and water overnight. Cow body condition was judged independently by two observers using a 9-point scale (1=extremely thin, 9=extremely fat). Calf weights were estimated according to a formula based upon heart-girth measurements. Cows were weighed and C-scored again on d 204 (June 11) to find any post-calving differences in weight and

Table 2. The influence of sampling date on production and chemical composition of tall fescue meadow forage

	SAMPLING DATE						
	5/23	5/30	6/06	6/12	6/20	6/27	7/04
DM prod.kg/Ha	46.66	86.44	146.86	252.77	392.95	494.61	587.85
CP, %	24.43	21.87	18.90	16.06	11.67	10.98	9.42
% Sol Protein[a]	44.07	46.81	37.39	37.62	42.07	39.53	37.23
ADIN[b], %	3.10	3.10	2.79	3.38	5.14	4.51	5.69
ADF, %	24.02	23.93	24.94	26.95	33.59	31.44	34.10
NDF, %	43.94	45.6	42.25	46.14	52.89	51.99	56.93
IVDMD, %	77.43	77.93	80.52	78.55	72.15	73.55	69.80

[a]Expressed as a percentage of total protein
[b]Expressed as a percentage of total N.

Results and Discussion

Hay meadow survey. Average CP levels across plots ranged from a high of 24 percent to a low of 9 percent (Table 2). The decline in CP is probably due to a progressive accumulation of structural components and leaf losses. The percent soluble N values (Table 2) declined by approximately 7 percent from May 23, through July 4, although these results were quite variable across dates. While the primary forage species in these pastures was tall fescue (*Festuca arundinacea*), a number of other grasses were also present, principally orchardgrass (*Dactylis glomerata*), cheatgrass (*Bromus tectorum*), and Kentucky bluegrass (*Poa pratensis*). Two plots included regions with a substantial cheatgrass component, and as this grass matures much earlier than the other species, quality decline was not completely uniform across plots. It should be noted that the production estimations were made upon the basis of ground level clippings, and do not represent harvestable forage. Likewise, quality determinations on the clipped forage included the lower, leaf-poor and more lignified portions of the the grass plants that would be left behind by harvesting equipment. Therefore the quality estimations of the clipped forage may be somewhat poorer than what the actual harvested forage would have achieved.

Experiment 1: Steer Digestion Study. Intake and digestibility. Total DMI ranged from 13 to 26 percent greater ($P<.01$) for the supplemented treatments than for the negative control group (Table 3). Likewise, total DMI was 12 percent greater ($P<.10$) for the meadow hay supplemented treatment than it was for the alfalfa hay supplemented treatment. In contrast, straw DMI tended to be lower for the supplemented treatments compared to the nonsupplemented control group ($P=.18$). Dry matter digestibility was 8 to 19 percent greater for supplemented treatments than for the control ($P<.05$), and, within supplement treatments, was greater for meadow hay supplemented steers than for alfalfa hay supplemented steers ($P<.10$). Likewise, digestible DMI was more than 22 percent greater ($P<.001$) for steers on the supplement treatments that for animals on the control diet, and 24 percent greater for steers on the meadow hay supplement treatments than for steers supplemented with alfalfa hay ($P<.01$). In situ extent of digestion was slightly greater (2%) in steers supplemented with alfalfa hay relative to the

meadow hay fed steers (P<.05). However, this difference does not appear large enough to have biological significance. In addition, in situ rate of digestion did not differ with supplementation or between the supplement sources (P>.10). These results seem to indicate that the additional protein provided by the supplements did not aid digestion of the basal diet. Therefore, the improvement in total diet digestion appears to be largely a function of each supplement's own relative digestibility and quantity of supplement fed.

Experiment 2: Cow performance trial. The results of this study described pronounced effects, both of supplementation and type of supplement on cow weight gains and body condition changes over the winter. Supplemented cows in this study gained more weight (P<.001) than nonsupplemented cows over the 84 d supplement feeding period, and the meadow hay supplemented cows gained more weight (P<.10) than the alfalfa hay treatment. In the same way, cows on supplements lost 50 percent less body condition than their control counterparts. (P<.01), and the meadow hay cows tended to lose less condition than the alfalfa hay fed cows (P=.23).

The potential production advantage conferred by supplementation, especially through periods of physiological stress, is clear. Without supplementation, cattle on such low-quality diets are unable to meet their nutritional needs and consequently may manifest symptoms of poor nutrition in terms of impaired reproductive performance.

Table 3. Effects of early-vegetative meadow hay and alfalfa hay supplementation on the intake and digestion of low-quality roughages

Item	Treatments			SE[a]	Contrasts	
	Control	Meadow hay	Alfalfa hay		Supplement vs non-supplement	Meadow hay vs Alfalfa hay
Total DMI	1.71	2.12	1.97	.08	.0099	.2107
Straw DMI	1.71	1.53	1.59	.08	.1511	.6227
Supp DMI	-	.59	.38	-	-	-
DDMI[b] (kg/day)	2.89	4.36	3.53	.14	.0003	.0036
DMD[c], %	44.00	52.2	47.4	1.68	.0225	.0781
NDF dig, %	41.05	49.38	42.71	1.76	.0494	.0281
Basal diet in situ digestion kinetics:						
Lag, h	3.84	3.84	3.86	.04	.8691	.8519
Rate (% /h)	1.08	1.08	1.09	.05	.9752	.9141
Extent, %	57.67	57.26	58.57	.35	.5875	.0315

[a]SE = Standard error of the means (n = 5)
[b]Digestible DMI
[c]Apparent DM digestibility

Table 4. Influence of early-vegetative meadow hay versus alfalfa hay supplementation on cow weight, condition score changes and calf birth weight

	Treatments				Contrasts	
	Control	Meadow hay	Alfalfa hay	SE*	Supplement vs non-supplement	Meadow hay vs Alfalfa hay
Initial						
Body weight, lbs	1054.7	1056.4	1064.4	-	-	-
Condition score	5.47	5.42	5.33	-	-	-
d 0-84						
Weight change, lbs	+16.6	+69.2	+52.1	5.84	.0009	.0844
C-score change	-1.43	-.40	-.71	.16	.0054	.2311
d 84-204						
Weight change, lbs	-7.3	-37.7	-28.1	7.52	.0325	.4097
C-score change	+.67	+.02	+.44	.14	.0377	.0763
d 0-204						
Weight change, lbs	+10.3	+34.6	+25.7	10.7	.1749	.5741
C-score change	-.74	-.30	-.31	.11	.0151	.9791
Calf Birth Wt, lbs	80.7	80.8	79.9	1.19	.8394	.6400
Calf ADG, lbs	1.78	1.80	1.79	.04	.8505	.8898

*SE = Standard error of the means (n = 3)