THE INFLUENCE OF SUPPLEMENTAL ALFALFA QUALITY ON THE INTAKE, USE AND SUBSEQUENT PERFORMANCE OF BEEF CATTLE CONSUMING LOW-QUALITY ROUGHAGES

Christoph Weder, Tim DelCurto, Tony Svejcar, John Jaeger, and Roxane Bailey

SUMMARY

Three experiments were conducted to evaluate the influence of supplemental alfalfa quality on beef cattle consuming low-quality meadow grass roughages (hays or fall/winter pasture). Experiment 1 used fifteen ruminally-cannulated steers (550 lbs average weight) assigned to the following three treatments: 1) meadow grass hay (5.2 percent CP), no supplement; 2) meadow grass hay plus high-quality alfalfa (18.8 percent CP); and 3) meadow grass hay plus low-quality alfalfa (15.2 percent CP). Experiments 2 and 3 were cow performance studies conducted at Union and Burns, respectively. All three supplementation experiments suggest that alfalfa hay is an effective protein supplement to low-quality roughages. Alfalfa supplementation increased total intake and digestibility. Improvements in intake and digestibility in alfalfa supplemented cows, in turn, led to improved cow body weight and condition when compared to nonsupplemented cows. However, quality of alfalfa did not dramatically effect body weight and (or) body condition changes when fed on an equal protein basis. Thus, alfalfa hay between 15 and 20 percent CP do not differ in value as a supplemental protein source when supplements are fed on a equal protein basis.

INTRODUCTION

Protein supplementation is a routine practice in the beef cattle industry particularly with cattle grazing dormant / stockpiled forages or fed low-quality hays / straws. Supplementation improves cattle performance by stimulation of voluntary intake. Improvements in voluntary intake are attributed to increased rates of forage digestion and passage rates. Improved intake and utilization of low-quality roughages, in turn, promote improved beef cow body weight and condition, reproductive efficiency, and weaning weights of calves.

Most research on protein supplementation of beef cows has focused on oilseed meals (soybean, cottonseed, and canola meal), nonprotein nitrogen (NPN) or strategies of supplementation such as timing, frequency, and amounts. In addition, alfalfa hay and alfalfa products have been favorably compared to oilseed meals. Most of the alfalfa used in these studies has been high quality (>17 percent crude protein [CP] and <35 percent acid detergent fiber [ADF]). However, the alfalfa traditionally used as a supplement in the beef cattle industry tends to be lower quality alfalfa; not suitable for the high quality alfalfa markets. Therefore, the objective of this study was to compare a range of supplemental alfalfa qualities on the intake, digestion, and subsequent performance of beef cattle consuming low-quality roughages.

MATERIALS and METHODS

Alfalfa Supplements

Two maturities of second-cutting alfalfa (*Medicago sativa*) were obtained for Exp. 1 and

2. The maturity stages were early bud (high-quality) and late bloom (low-quality). The field was divided into two blocks and, within the two blocks, two maturities were randomly obtained by evaluating the phenology of the plant at the time of harvesting (Table 1). In Exp. 3, three stages of second-cutting alfalfa were obtained from the same field. In this case the stages were early bud (high-quality), early bloom (mid-quality) and late bloom (low-quality; Table 1). This field was divided into four blocks, and within the four blocks, three maturities were randomly obtained by evaluating the phenology of the plant to harvest time. All alfalfa supplements were obtained from the same 22-ha field. Treatment maturities of alfalfa were then baled into rectangular bales (55 kg) and randomly mixed during feeding of the supplements. Ground level clippings were taken prior to all cuttings to determine total above-ground biomass. Feed samples were then taken from the baled hay and the samples were analyzed for dry matter (DM), CP, acid detergent insoluble (ADIN), ADF, neutral detergent fiber (NDF), and in vitro dry matter digestibility (IVDMD) (Table 1).

Meadow Hay

Low-quality meadow grass hay (MG) was utilized as the basal diet in both trials. The hay for Exp. 1 and 2 was obtained from a 12.7 ha field, at the Eastern Oregon Agriculture Research Center in Union (Table 1). While the meadow grass hay for Exp., 3 was obtained from the Eastern Oregon Agriculture Experiment Center in Burns, (Table 1), both hays were at a late maturity at the time of cutting.

Exp. 1 - Digestion Study

Fifteen ruminally cannulated Simmental x Hereford x Angus steers (avg. weight = 550 lbs) were used to assess the influence of supplemental alfalfa quality on the intake and digestibility of low-quality meadow hay. Steers were blocked by weight and within block assigned randomly to one of three treatments: 1) meadow hay - control; 2) meadow hay and low-quality alfalfa (15.5 percent CP) supplement; 3) meadow hay and high-quality alfalfa (18.8 percent CP) supplement. Alfalfa supplements were fed at (DM basis) 0.55 percent body weight (BW) and 0.45 percent BW/steer/d, respectively. Steers were housed in individual pens and provided supplement at 0730 h daily. Following supplement feeding, steers were offered meadow grass hay at 125 percent of their previous 5-d average intake to allow *ad libitum* access. All forages were coarsely chopped (2 cm - 6 cm length) prior to feeding to facilitate feeding and weighing. Steers had *ad libitum* access to water and trace-mineralized salt blocks throughout the experiment. Refused hay was removed prior to feeding alfalfa supplements, weighed and discarded. The 28-d digestion study consisted of a 14-d adaptation, a 6-d intake, and a 6-d fecal collection period, with a rumen profile on d 27 and rumen evacuation on d 28.

Exp. 2 - Cow performance trial, Union Station

Ninety-six gestating Hereford X Simmental cows (average initial BW = 1204 lbs; average initial body condition = 4.84 on a 1-to-9 scale) were stratified by age and body condition, and within stratum, were assigned randomly to four replicates of the three treatments, described in Exp. 1. Alfalfa hay supplements were weighed daily before feeding, and sampled weekly for feed analysis. All cows shared one common pasture and were sorted into assigned replicate/treatment groups at 0900 h to be bunk fed their daily allotted supplement. Treatments were fed for an 84-d period from 22 November to 14 February 1996. For the first 42-d period, cows grazed on a 30-acre stockpiled pasture (avg. production = 2.25 tons per acre). The stockpiled meadow forage was dominated by tall fescue (*Festuca arundinacea)*, reed canary grass (*Phalaris arundinacea*), orchard grass (*Dactylis glomerata*), Kentucky blue grass (*Poa pratensis*), and downy brome (*Bromus tectorum).* During the second 42-d period, cows had *ad libitum* access to baled meadow grass hay, which was fed between 1500 and 1700 h, daily. This was the same source of low-quality meadow hay which was used in Exp. 1 (5.2 percent CP). Meadow hay was baled into round bales and core samples were taken weekly during the feed period, composited and later analyzed for nutritive value. Cows had *ad libitum* access to trace-mineralized salt and water throughout the winter feeding period. Cows were weighed and scored for body condition (BC) (1 to 9 scale) independently by three observers on d 0, 42, 84, 152 (pre-breeding), and 291 (post weaning). At 1600 h the day before each weigh/score date, the cows were gathered and placed in a corral away from feed and water, overnight. The next day, the cows were then weighed and body condition scored at 1000 h. Calving began on d 85 and calves were weighed within 24 h postpartum, d 152 (pre–breed), as well as d 291(weaning).

Exp. 3 - Cow performance trial, Burns Station

Ninety gestating Angus X Hereford cows (average BW = 475 kg; average initial body condition = 4.59) were stratified by age and BC and, within stratum, assigned randomly to one of three supplemental treatments: 1) 16.1 percent CP alfalfa; 2) 17.8 percent CP alfalfa; 3) 20.0 percent CP alfalfa. The level of long-stem alfalfa supplementation (DM basis) was .63 percent, .55 percent, and .50 percent of BW, respectively, which provided isonitrogenous supplemental inputs. All cows shared one common pasture, and were sorted according to their assigned treatment daily between 0700 and 1000 h. Cows were then returned to the same pasture and offered *ad libitum* access to baled meadow grass hay (5.6 percent CP). Core samples from the alfalfa supplements and basal diets were later composited according to feed type, and used for feed analysis. Cows had *ad libitum* access to water and trace mineralized salt throughout the study. Treatment supplements were fed for an 84-d period from 2 December to 24 February 1994. Cows were weighed and scored for body condition independently by two observers on d 0, 42, and 84 of the feeding period. Feed and water were withheld for 18 h before each weigh/score date.

RESULTS and DISCUSSION

Exp. 1 - Digestion Study

Intake and Digestibility. Total intake increased by 18 and 30 percent (P < .01) for low and high-quality alfalfa supplemented steers, respectively, compared to controls (Table 2). However, there was no difference (P > .10) in intake between steers receiving 18.8 percent CP high-quality alfalfa supplement (AHS) versus steers receiving 15.2 percent CP low-quality alfalfa supplement (ALS). Intake of meadow grass hay did not differ (P > .10) between treatments. Dry matter digestibility (DMD) was 5 to 9 percent greater for supplemented steers than for the steers receiving only low-quality meadow hay (P < .01, Table 2). However, there was again no difference in DMD between steers receiving AHS and ALS supplements (P > .10). Likewise intake of total digestible nutrients (TDN) was 30 percent to 38 percent greater (P < .01) for alfalfa supplemented steers. The improvements in DM intake and total diet digestion seem to be a function of digestibility, palatability and quantity of supplement fed. The lower levels of ADF and indigestible acid detergent fiber (IADF) for the alfalfa supplements suggest that alfalfa was less fibrous and more digestible than the meadow grass hay. Therefore, when the alfalfa component was factored in at 20-to-25 percent of the daily diet a larger proportion would be digestible compared to meadow grass hay by itself. Improved palatability of the alfalfa supplements may also have stimulated intake, which resulted in an additive effect on the meadow hay consumption.

Exp. 2 - Cow performance trial, Union Station

Cows consuming supplemental alfalfa demonstrated improved BW and BC status during the winter period (Table 3). Supplemented cows gained more BW (P < .01) over the 84-d supplement feeding period than nonsupplemented cows. Likewise, supplemented cows had 8 percent more BC at weaning (P < .01) the following fall compared to nonsupplemented cows. In contrast, no difference (P > .10) between the low and high-quality alfalfa supplements for overall BW change and BC were observed. Body weight gains for all treatments were greatest d 0 to 42. However, alfalfa supplemented cows still gained more than twice as much BW (P < .01) as compared to nonsupplemented cows. Increases in BC for control treatments were negligible for the first 42-d period; however, alfalfa supplemented cows increased in BC by more than .25 units (P < .01). Body weight gain during d 43 to 84 was reduced in all treatments. However, alfalfa supplemented cows still had an average of 50 percent better BW gain (P < .01). All treatments experienced losses in BC during this period; however, alfalfa supplemented cows lost 35 percent less (P < .01) than nonsupplemented cows. Although alfalfa supplemented cows experienced less loss in BC than control cows, low-quality alfalfa supplemented cows lost more BC (P < .05), than high-quality alfalfa supplemented cows. Day 43-84 also coincided with an 8-d period of below average temperatures and above average precipitation. Postpartum BW and BC were greater at d 152 (P < .05) for alfalfa supplemented cows than control cows (Table 3). However, during d 152 to 291 nonsupplemented cows clearly showed substantial compensatory gain. Control cows gained 44 lbs more body weight (P < .01) and .2 units of BC (P < .05) compared to alfalfa supplemented cows (Table 4). At d 291, there were no differences in BW or BC (P >.10) between the treatment groups. There were no treatment effects (P > .10) for birth date between treatments (Table 5). However, there was a strong relationship (P < .01) between alfalfa supplementation and calf birth weight. Calves from the alfalfa supplemented treatments were 6.4 lbs heavier than calves from the nonsupplemented treatment. However, subsequent calf average daily gain (ADG) and final weaning weights showed no effect (P >.10) due to alfalfa supplementation.

Analysis of blood serum progesterone levels indicated no effect (P >.10) of alfalfa supplementation on cow cyclicity before breeding (Table 5). Similarly, there were also no differences on cow pregnancy rates (P < .10) or calving interval (P < .10). What is indicated by these results is that cows do have the ability to be resilient in the short term and when permitted access to good quality forage in the summer can make up for short-term nutrition deficiency by compensatory gains.

Exp. 3 - Cow performance trial, Burns Station

Over the 84-d feeding period, cow BW was influenced quadratically ($P < .05$) by the quality of supplemental alfalfa (Table 4). Cows supplemented with 18 percent CP alfalfa had the highest BW gain. Likewise cow BC was also affected quadratically ($P < .10$) and again the 18 percent CP alfalfa had the greatest gain (Table 4). Increases in cow BW were greatest for d 0-42 ($P < .05$), but no differences ($P > .10$) in cow BC were noted. However, d 43-84 showed quadratic changes in cow BC ($P < .01$) and no difference in cow BW ($P > .10$). No differences ($P > .10$) between treatment groups for both date of calving (avg. = April 1) and birth weight (87.3 lbs) were detected (Table 4). Cow BW gain before breeding tended to display a slight quadratic effect ($P = .12$); however, the BW differences were negligible.

IMPLICATIONS

The success of any beef operation is reliant on maximizing cattle production and minimizing input costs. Protein supplementation of low-quality roughages can have a tremendous impact on cow BW and BC score. Evaluation of previous research using different protein supplements in comparison to alfalfa, indicate similar winter performance could be realized with alfalfa hay or pellets versus oilseed supplements. In addition, alfalfa hay often compares favorably to other protein sources in terms of price per unit protein. However, the cost of alfalfa varies according to quality. In this study, 16-to-18 percent CP alfalfa performed as well as high-quality alfalfa (20 percent CP) when fed on an isonitrogenous basis.

Table 1. Chemical composition of basal diets and alfalfa hay supplements used in Exp. 1, 2, and 3.[a]

	CP%	ADIN, % of total N	ADF, %	NDF, %	IADF, %
Exp.1					
Meadow grass hay	5.2	28.7	38.8	60.5	19.2
Low-quality alfalfa hay	15.2	29.5	45.1	31.9	15.0
High-quality alfalfa hay	18.8	25.3	40.2	29.7	13.7
Exp.2					
Stockpiled meadow	6.8	33.4	67.2	43.0	23.0
Meadow grass hay	5.2	28.7	38.8	60.5	19.2
Low-quality alfalfa hay	17.1	29.5	37.7	27.7	15.0
High-quality alfalfa hay	19.9	25.3	38.3	28.0	15.2
Exp.3					
Meadow grass hay	5.6	-	36.4	59.2	-
Low-quality alfalfa hay	16.1	-	36.2	48.7	-
Mid-quality alfalfa hay	17.8	-	32.3	42.8	-
High-quality alfalfa hay	20.0	-	29.8	41.4	-

[a] CP = crude protein; ADIN = acid detergent insoluble protein; ADF = acid detergent fiber, NDF = neutral detergent fiber; and IADF = Indigestible ADF; based on a 144 h in vitro followed by ADF extraction.

Table 2. Effects of low-quality versus high-quality alfalfa hay supplementation on intake and digestibility of beef steers consuming low-quality roughages, (Exp. 1).

	Treatments					
		Alfalfa Quality			Contrasts	
	Control	Low	High	SE[a]	Supplement vs. non-supple.	Low-quality vs. high-quality
No. of animals	5	5	5			
DMI, %BW						
Total DMI	1.85	2.18	2.41	.12	.0156	.1898
Meadow DMI	1.85	1.63	1.96	.12	.8602	.0479
Supp DMI	-	.55	.45	-	-	-
TDN[b] (kg/day)	2.36	3.07	3.28	.18	.0058	4355
DMD[c], %	51.8	56.4	54.6	.87	.0081	.1685
NDF dig, %	47.5	47.6	52.0	1.03	.1005	.0159

[a] SE = Standard error of the means.
[b]Total digestible nutrients (TDN).
[c]Apparent DM digestibility (DMD).
[b]Indigestable ADF.

Table 3. Influence of low-quality hay versus high-quality alfalfa hay supplementation on cow weight, condition changes, calf weights and cow reproduction, (Exp. 2).

	Treatments				Contrasts	
		Alfalfa Quality				
	Control	Low	High	SE[a]	Supplement vs. non-supple.	Low-quality vs. high-quality
No. of cows	32	32	32			
Initial						
Body weight, lbs	1188	1177	1176	4.6	-	-
Condition score	4.88	4.85	4.87	.08	-	-
Days 0-42						
Weight change, lbs	38.1	80.0	67.2	6.4	.0038	.2105
C-score change	.00	.21	.28	.07	.0310	.4978
Days 43-84						
Weight change, lbs	27.3	51.1	58.0	6.0	.0093	.4514
C-score change	-.28	-.24	-.12	.03	.0219	.0152
Days 0-84						
Weight change, lbs	65.5	129.0	125.2	5.5	.0001	.6608
C-score change	-.28	.04	.09	.08	.0154	.6816
Days 84-152						
Weight change, lbs	42.5	4.6	-8.6	12.6	.0243	.5670
C-score change	.46	.33	.10	.07	.0262	.0618
Birth weight[b], lbs	86.9	92.0	94.6	.65	.0100	.2465
Calf birth date[c]	62.2	63.5	59.2	2.2	.2235	.7013
Weaning weight, lbs	534.2	538.6	550.0	11.7	.5014	.5091
Cows cycling[e], %	48.3%	46.7%	58.6%	9.2%	-	-
Pregnancy rate[e] %	89.6%	89.3%	85.7%	4.2%	-	-
Calving interval, [d]	364.5	358.9	362.0	4.2	.4446	.6224

[a]SE = Standard error of the means
[b]Based on weight within 24h of birth.
[c]Julian days
[d]Calf weights correspond to avg. d postpartum
[e]CATMOD procedure, SAS (1991)

Table 4. Influence of 16.1%, 17.8%, and 20.0% CP alfalfa hay supplementation on cow weight, body condition score changes, and calf birth weights, (Exp. 3).

	Treatments					
	Alfalfa Quality				Contrasts	
	16.1% CP	17.8% CP	20.0% CP	SE[a]	Linear	Quadratic
No. of cows	30	30	30			
Initial						
Body weight, kg	474.3	474.4	475.4	7.3	-	-
Condition score	4.53	4.54	4.79	.11	-	-
Days 0-42						
Weight change, kg	47.3	53.6	51.0	1.8	.1526	.0469
C-score change	.14	0.0	.08	.07	.6150	.2491
Days 43-84						
Weight change, kg	25.3	26.1	24.0	1.6	.5572	.4654
C-score change	-.01	.31	.04	.08	.6659	.0048
Days 0-84						
Weight change, kg	72.7	79.7	75.0	2.3	.4744	.0412
C-score change	.13	.31	.13	.09	.9720	.0937
Days 0-157 (breeding)						
Weight change, kg	18.0	13.8	11.5	4.4	.3058	.1238
C-score change, kg	-.05	.02	.02	.11	.7456	.2568
Days 0-295 (weaning)						
Weight change, kg	-8.5	-6.2	-11.5	4.5	.6360	.5044
C-score change, kg	-.15	-.17	-.11	.13	.4562	.6043
Conception rate[d],%	83.3	100.0	92.3	4.2	-	-
Calf Birth Wt, kg[b]	40.7	39.1	38.9	.93	.1748	.5568
Calf Birth Date[c]	91.8	88.9	88.9	2.6	.4219	.6512

[a]SE = Standard error of the means
[b]Based on weight within 24h of birth.
[c]Julian days
[d] CATMOD procedure, SAS (1991)