EVALUATION OF THE POTENTIAL OF SUPPLEMENTS TO SUBSTITUTE FOR RANGE FORAGE [1]

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Summary

Thirteen, ruminally fistulated, Angus × Hereford, yearling steers were used to evaluate the effect of feeding different types and amounts of supplements on the likelihood of observing a substitution of supplement for range forage. Steers had ad libitum access to low-quality range forage and were fed a supplement comprised of sorghum grain (SG) and soybean meal (SBM) that contained 18% CP (SG/SBM 18%), a SG/SBM supplement that contained 36% CP (SG/SBM 36%), long-stem alfalfa hay (18% CP), or alfalfa-pellets (18% CP) in amounts that provided .05, .10, and .15 % BW of CP/day. In general, supplementation increased the intake and digestibility of low-quality range forage. No substitution effect was observed for the SG/SBM 36% supplement or the alfalfa pellets. However, the SG/SBM 18% supplement did substitute for forage at the high level of supplementation. A similar trend appeared to exist for the long-stem alfalfa hay.

(Key Words: Supplementation, Alfalfa, Range Forage, Pellets.)

Introduction

Providing supplements with moderate to high protein content has been shown to be beneficial for beef cows maintained on dormant, native range. Increased intake of range forage by supplemented cattle compared with nonsupplemented cattle is a major factor contributing to the positive effect of such supplements. However, the likelihood that a supplement substitutes for range forage increases as the amount of supplement fed increases. Furthermore, the amount required to elicit substitution effects may vary for supplements with different physical properties and (or) with different effects on digestive physiology. Therefore, our objective was to observe the influence of varied types and amounts of supplements on the likelihood that supplement will substitute for forage. In addition, associated effects on digestion and fill were monitored.

Experimental Procedures

Thirteen ruminally fistulated Angus × Hereford steers (avg initial wt = 574 lb) were used in an incomplete Latin square with 13 treatments and four periods. Steers were maintained in individual tie stalls and fed dormant, bluestem-range forage (CP ~2%) once daily at 130% of their previous 5-day average intake. Treatments were arranged as a 3 × 4 factorial plus a negative control treatment. Steers on the negative control treatment were unsupplemented. The first factor, amount of supplement, was designed so that steers received a daily amount of each supplement providing .05, .10, or .15 % body weight (BW) as crude protein (CP). The second factor, supplement type, was set such

[1]The authors express their appreciation to Gary Ritter, Wayne Adolph, Gary Breault, and Mike Scheffel for their invaluable assistance in conducting this experiment.

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that each of four supplements was fed within each supplementation level. The supplements were: 1) a sorghum grain (SG) and soybean meal (SBM) mixture that contained 18% CP (SG/SBM 18%); 2) a SG/SBM mixture that contained 36% CP (SG/SBM 36%); 3) long-stem alfalfa hay (LSAH); 4) alfalfa pellets (AP). The LSAH and AP were from the same source. The pellets were made by grinding through a 3/16" screen and pressing into a 1/4" pellet. The CP concentrations of the LSAH and AP were approximately the same as that of the SG/SBM 18%. Because the supplement amount was set relative to the amount of protein provided per unit of BW and because the SG/SBM 36% supplement contained twice the CP as the other supplements, the amount of supplement dry matter (DM) fed for the SG/SBM 36% supplement was half that for the other supplements. If expressed as the amount of DM fed per unit of BW, the SG/SBM 18%, LSAH, and AP supplements received approximately .28, .56, and .83 % BW daily, corresponding to 2.8, 5.6, and 8.3 lbs of supplement DM for a 1000 lb cow. Steers were adapted to each treatment for 16 days. Forage intake was measured during the 7-day period immediately following adaptation. Total fecal collections began 2 days after the beginning of intake measurements and ended 2 days after the last intake measurement. At the end of total fecal collection, total ruminal evacuations were performed (before feeding, 0 h, and 4 h after feeding) on each animal to determine ruminal fill.

Results and Discussion

Range forage intake increased linearly ($P<.01$) with increasing amounts of the SG/SBM 36% and AP (Table 1). In contrast, range forage intake for steers fed SG/SBM 18% increased up to the .10% supplementation level and then declined when steers were fed the .15% level ($P = .03$). This suggests that for every unit of additional supplement fed above the intermediate level, there was a decrease of .54 units of range forage. That is, for a 1000 lb cow, about .54 lb decrease in range forage intake would occur for each additional 1.0 lb of SG/SBM 18% DM fed above about 5.6 lbs. Although not statistically significant ($P = .37$), the trend for the LSAH group was similar. For LSAH, a decrease of .48 units of range forage occurred for each additional unit of LSAH fed above the intermediate level of supplementation. Similar substitution ratios have been observed for LSAH supplements in other research at Kansas State University. Because substitution was only partial in those treatments where it occurred, total dry matter intake (DMI) increased for all treatments in response to increasing supplementation.

Dry matter digestibility (DMD) increased linearly ($P<.01$) with increasing levels all supplements. Provision of nitrogen and other microbial nutrient requirements, as well as higher digestibility for the supplement than the hay, were probably responsible for that increase. No difference was seen in DMD for the groups receiving concentrate supplements compared with those receiving alfalfa supplements; however, DMD was greater ($P<.01$) for the LSAH group than for the AP group. The larger, coarser particles in the LSAH likely would allow for longer ruminal retention time than for the AP, thus providing the opportunity for increased ruminal disappearance of DM. Because all supplement groups displayed increased (although variable) total DMI and DMD with increasing supplementation, the digestible DMI also increased ($P<.01$). Thus, even in those cases where substitution occurred, overall nutrient input increased with increasing supplementation level.

Ruminal dry matter fill measured just before feeding (0 h) for the SG/SBM 18%, SG/SBM 36%, and LSAH groups decreased linearly ($P \leq .07$) with increasing amount of supplement. The AP group tended ($P = .11$) to display the same trend. However, at 4 hours after feeding, ruminal DM fill remained fairly constant for the nonsupplemented group but increased substantially from the 0 hour measurement for most groups receiving supplement. Increases in ruminal fill, DMD, and possible increases in passage rate at least partially explain the ability of the supplemented steers to increase the intake of

range forage compared with the nonsupplemented group.

Table 1. Effect of Supplemental Type and Amount on Forage Intake, Digestion, and Fill

Item[a]	18% SG/SBM	36% SG/SBM Alfalfa Pellets[b]			Alfalfa Hay				Statistically Significant						SEM	Contrasts[c]
	Ctrl.	.05	.10	.15	.05	.10	.15		.05	.10	.15		.05	.10	.15	
Hay DMI[d] %BW/d	1.15	1.46	1.59	1.71	1.34	1.48	1.33	1.39	1.47	1.54	1.17	1.22	1.09	0.07	1,2,4,5,8,10, 11,12	
Total DMI %BW/d	1.15	1.60	1.89	2.15	1.60	2.05	2.17	1.66	2.00	2.35	1.44	1.76	1.90	0.07	1,2,4,5,6,8,11	
DDMI[e] %BW/d	0.44	0.65	0.87	1.10	0.65	0.90	1.09	0.70	0.85	1.06	0.63	0.87	0.97	0.03	1,2,4,6,8,11	
DMD[f],%	38.1	41.1	46.0	53.0	40.9	42.9	49.9	41.9	42.8	45.3	43.4	49.9	51.4	1.46	1,2,4,6,8,10,11	
DM fill %BW																
0 h	2.5	2.6	2.2	2.2	2.4	1.9	2.0	2.3	2.2	2.1	2.1	1.8	1.9	0.18	1,2,4,6	
4 h	2.6	2.9	2.7	2.5	2.7	2.7	2.9	3.0	2.9	2.7	2.3	2.3	2.5	0.13	3,9,11	
Liquid fill %BW																
0 h	15.6	16.5	15.2	12.4	14.8	14.3	12.8	15.0	14.9	14.6	14.4	14.0	14.1	0.88	2,3,4	
4 h	16.2	17.6	16.4	14.0	16.1	15.2	15.2	17.1	17.6	16.2	16.4	16.4	16.7	0.78	2,3,12	

[a]SG/SBM = Supplement comprised of sorghum grain (SG) and soybean meal (SBM).

[b]Alfalfa pellets and hay were from the same source of alfalfa.

[c]Statistically significant ($P \leq .10$) contasts were: 1 = Supplemented vs nonsupplemented; 2 = Linear response for those receiving the SG/SBM 36% supplement; 3 = Quadratic response for those receiving the SG/SBM 36% supplement; 4 = Linear response for those receiving the SG/SBM 18% supplement; 5 = Quadratic response for those receiving the SG/SBM 18% supplement; 6 = Linear response for those receiving the LSAH supplement; 7 = Quadratic response for those receiving the LSAH supplement; 8 = Linear response for those receiving the AP supplement; 9 = Quadratic response for those receiving the AP supplement; 10 = SG/SBM 36% vs SG/SBM 18%; 11 = AP vs LSAH; 12 = Concentrate supplements vs alfalfa supplements.

[d]DMI = dry matter intake

[e]DDMI = digestible dry matter intake

[f]DMD = dry matter digestibility