

EFFECT OF SUPPLEMENTAL PROTEIN OR GRAIN ON
INTAKE AND UTILIZATION OF MEDIUM QUALITY
PRAIRIE HAY BY STEERS

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Story in Brief

Sixteen 1,053 lb two-year-old Hereford steers were used in four replications of a 4 x 4 Latin square to determine the effect of different protein and grain supplementation programs on intake and digestibility of medium quality prairie hay (4.2 percent CP, dry matter basis). Prairie hay was fed free choice. The four treatments (dry matter basis) were: 1) Control, hay only, plus minerals-vitamins; 2) Low level of supplemental protein (LL), .8 lb of 32 percent CP supplement/day; 3) High level of supplemental protein (HL), 1.4 lb of 34 percent CP supplement/day; 4) Corn grain based supplement containing low level of protein (GR), 3.1 lb supplement/day, 13 percent CP. The HL treatment was selected to provide twice the supplemental protein as the LL treatment, and at an equal hay intake, the LL and GR treatments provided equal total dietary protein.

All three supplementation programs increased ($P < .01$) daily prairie hay intake, dry matter (DM) intake, DM digestibility, apparent CP digestibility, and acid detergent fiber (ADF) digestibility compared with the control. Moreover, the HL protein treatment increased ($P < .01$) daily hay intake, DM intake, DM digestibility and apparent CP digestibility compared to the LL protein treatment. The HL treatment also increased ($P < .02$) ADF digestibility compared to the LL treatment. The GR treatment increased ($P < .01$) DM intake compared to the LL treatment; moreover, the level of grain fed was not detrimental to digestibility parameters. Digestible DM intakes averaged 4.98, 7.96, 10.2 and 9.09 lb per day on the control, LL, HL and GR treatments, respectively.

Introduction

A positive effect of protein supplementation on low quality forage intake, utilization and weight responses has been documented previously. Low quality forages include cereal straws, winter range pastures, or marginal quality grass hays. Several recent Oklahoma studies have shown positive weight gain responses in stocker calves grazing mid to late summer native ranges. Traditionally, if a supplement has been used in the summer months for stocker calves on grass, a grain rather than a protein supplement has been fed. On the other hand, protein supplements have been used in the winter to supplement very low quality native range pastures. The objective of this research was to evaluate intake and digestibility when medium quality prairie hay (harvested in July) was fed to steers with two levels of a high protein supplement and a grain supplement. The supplements and levels were chosen to be similar to those which have been used in supplementation programs for stocker cattle grazing native range pastures during late summer months.

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Materials and Methods

Sixteen two-year-old Hereford steers (1,053 lb) were blocked into four groups by weight and utilized in four simultaneous 4 x 4 Latin squares. The treatments were: prairie hay, plus 1) Minerals and Vitamin A (control); 2) Low level of supplemental protein (LL) using a soybean meal based protein supplement (32 percent CP); 3) High level of supplemental protein (HL) using a soybean meal based supplement (34 percent CP) and 4) Corn grain (GR) based supplement containing low (13 percent CP) level of protein.

The ingredient composition of the supplements is shown in Table 1 and nutrient composition of the hay and supplements in Table 2. Medium quality prairie hay was available *ad libitum* in all treatments. The LL, HL and GR supplements were fed once daily to provide 0.8, 1.4 and 3.1 lb supplement dry matter per day. The HL treatment was selected to provide twice the supplemental protein as the LL treatment. At an equal hay intake, the LL and GR treatments were selected to provide equal total dietary protein. A small amount of labeled cottonseed hulls was fed twice daily to administer the indigestible marker, chromic oxide, for digestibility determinations.

After a five-day diet adaptation period, fecal samples were collected twice daily (am and pm) for four days. Prairie hay (fed and rejected) was weighed daily and sampled on days 5-8. Samples were composited, dried and ground for analyses. On the tenth day of sampling, body weight was recorded.

Table 1. Ingredient composition of the supplements (DM basis).

Ingredient	Control	.8 lb/day ^a	1.4 lb/day ^a	3.1 lb/day ^a
		32% CP ^b	34% CP ^b	13% CP ^b
Soybean meal, %	--	77.7	89.1	14.6
Corn, %	--	--	--	79.7
CaCO ₃ , %	--	1.45	2.06	.57
Dicalcium phosphate, %	42.3	9.48	3.01	1.67
KCl, %	17.9	.97	--	.71
TM salt, %	28.1	7.33	4.12	1.91
Na ₂ SO ₄ , %	11.2	2.93	1.64	.76
Vitamin A, %	.57	.15	.08	.04

^a1b supplement fed/day (DM basis).

^bCP% of supplement (DM basis).

Table 2. Nutrient compositions of hay and supplements.^a

Item	Prairie	Control	.8 lb/day	1.4 lb/day	3.1 lb/day
	hay		32% CP	34% CP	13% CP
Dry matter, %	90.8	98.3	92.2	90.8	88.8
Crude protein, %	4.20	.18	31.7	34.4	13.5
Acid detergent fiber, %	48.6	.70	6.91	7.57	4.42

^aDM basis.

Results and Discussion

Daily intakes of prairie hay and total DM were higher ($P < .01$) on all three supplementation treatments (LL, HL, GR) compared to the control (Table 3). Forage intake and total DM intake were increased ($P < .01$) on the HL supplementation treatment compared with LL. Intake of DM also was higher ($P < .01$) for the GR compared to LL treatment. Dry matter digestibilities were increased ($P < .01$) from 49.6 percent on the control treatment to 54.3, 58.4 and 56.0 percent on the LL, HL and GR treatments, respectively. In addition, the DM digestibility for the HL treatment was higher ($P < .01$) than for LL.

As more supplement is added, digestibility of the ration should increase because supplement is more digestible than hay, and the percent of hay in the diet is being diluted. Comparison of observed versus expected ration dry matter digestibilities on the various treatments (Figure 1) shows a very positive synergistic effect for enhancing ration digestibility (observed > expected) for the two protein supplement treatments, but also of importance, the comparison shows the absence of

Table 3. Daily intake of hay and supplements and digestibility parameters (DM basis).

Item	Control	LL ^a	HL ^b	GR ^c	SE
Hay intake, lb ^{de}	9.1	13.1	15.2	12.4	.34
Supplement intake, lb	.21	.81	1.43	3.08	0
Supplemental protein, lb	.04	.26	.49	.40	0
Dry matter intake, lb ^{degh}	10.0	14.7	17.4	16.2	.34
Dry matter digestibility, % ^{de}	49.6	54.3	58.4	56.0	1.02
Digestible dry matter intake, lb	4.98	7.96	10.2	9.09	--
Apparent crude protein dig, % ^{de}	16.4	43.7	53.4	43.6	2.09
Acid detergent fiber dig, % ^{df}	49.7	53.2	57.1	51.2	1.08

^a .8 lb of supplement (soybean meal based) @ 32% CP.

^b 1.4 lb of supplement (soybean meal based) @ 34% CP.

^c 3.1 lb of supplement (corn based) @ 13% CP.

^d Control vs. all supplemental treatments ($P < .01$).

^e LL vs. HL ($P < .01$).

^f LL vs. HL ($P < .02$).

^g LL vs. GR ($P < .01$).

^h Total dry matter intake includes hay, supplement and 352 g (400 g as fed) of cottonseed hulls.

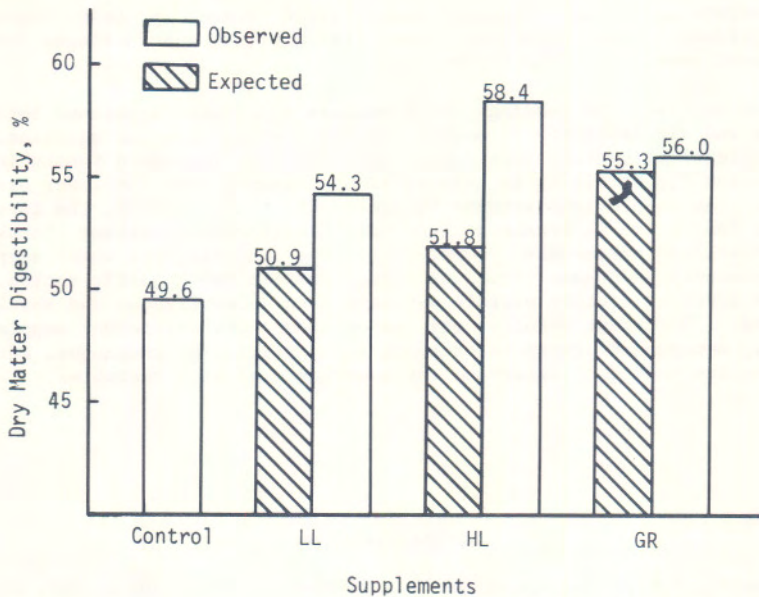


Figure 1. Comparison of observed vs expected diet dry matter digestibilities. Expected digestibilities are based upon values obtained for hay on the control treatment and 80% DM digestibility for the supplement. Treatments were: 1) Control, hay only, plus .2 lb mineral-vitamin mix; 2) Low level of supplemental protein (LL), .8 lb of 32% CP supplement/day; 3) High level of supplemental protein (HL), 1.4 lb of 34% supplement/day; 4) Corn grain based supplement containing low level of protein (GR), 3.1 lb of 13% CP supplement/day.

any negative effects of the grain supplement on digestibility parameters for the level fed in this study. This can be further illustrated by calculations showing that the supplements had apparent digestibilities of 135, 159 and 82 percent for the LL, HL and GR supplements, respectively -- if one assumes the same digestibility for the hay as noted on the control treatment. Regardless of the values one might select in making calculations for expected digestibility, the relative response pattern noted among treatments would remain the same. The calculated 82 percent digestibility value for the GR supplement is about as should be expected and suggests some substitution of digestible energy from corn for hay compared to the SBM treatments.

Total digestible DM intakes were increased substantially on the three supplementation programs, with digestible DM intakes being 4.98, 7.96, 10.2 and 9.08 lb per day on the control, LL, HL and GR treatments, respectively. Apparent CP digestibilities and acid detergent fiber digestibilities were also higher ($P < .01$) on the three supplementation treatments compared to the control. Apparent CP digestibility on the HL treatment was higher ($P < .01$) compared to the LL treatment. Corrections

for metabolic fecal nitrogen would yield higher protein digestion coefficients. Acid detergent fiber digestibility was increased ($P < .02$) on the HL compared to the LL treatment.

In general, the feeding of a protein supplement increased both the intake and digestibility of medium quality prairie hay. In addition, the higher level of protein supplementation further increased forage intake and ration digestibility in this trial as compared with the lower protein level. As in previous studies by Arelovich et al. (1983), the level of starch fed in the GR treatment was not detrimental to either intake or digestibility parameters compared to the LL treatment which supplied approximately the same level of total protein in the daily ration. A higher level of dietary protein may have been advantageous and should be studied. Different results may be obtained with different supplement levels, management practices or types and qualities of roughages. Further studies are needed to determine the importance of such variables.

Literature Cited

- Arelovich, H.M., D.G. Wagner and C.A. Hibberd. 1983. Okla. Agr. Exp. Sta. Res. Rep. MP-114:323.