

INFLUENCE OF SUPPLEMENTAL SOYBEAN MEAL, CORN GLUTEN FEED OR BLENDS OF
SOYBEAN MEAL AND CORN GLUTEN ON INTAKE AND UTILIZATION OF PRAIRIE
HAY BY BEEF HEIFERS.

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Story in Brief

Fifteen crossbred beef heifers were used in three simultaneous 5 x 5 latin squares to determine the effect of supplementation with soybean meal, corn gluten feed or blends of these two on intake and digestibility of medium quality prairie hay. Prairie hay (4.9% crude protein, dry matter basis) was cut during the first half of July from a meadow harvested annually and was fed ad libitum. Treatments included: 1) Control, hay plus a mineral-vitamin mixture; 2) soybean meal supplement (1.4 lb of 49% protein per day); 3) a blend with 2/3 of the supplemental protein from soybean meal plus 1/3 from corn gluten feed (1.9 lb of 38.9% protein); 4) a blend with 1/3 of the protein from soybean meal plus 2/3 from corn gluten feed (2.4 lb of 28.5% protein); and 5) corn gluten feed (3.1 lb at 23.0% protein). Each supplement was fed to provide .67 lb or 300 grams of supplemental crude protein per day. Fifty grams (.11 lb) of a mineral-vitamin mix was fed daily on each treatment. Daily hay intakes were 12.8, 19.0, 18.1, 17.1 and 15.5 lb on the Control, soybean meal, 1/3 corn gluten feed, 2/3 corn gluten feed and corn gluten feed treatments, respectively. Total dry matter intakes (hay plus supplement) followed the same pattern, being 12.9, 19.5, 20.1, 19.6 and 18.7 lb on the same treatments. Ration dry matter digestibilities were 48.5, 55.5, 55.2, 54.7 and 54.2%, and total daily digestible dry matter intakes were 6.5, 11.6, 11.4, 11.1 and 10.4 lb on the Control, soybean meal, 1/3 corn gluten feed, 2/3 corn gluten feed and corn gluten feed treatments, respectively. Supplementation increased intake and digestibility on all treatments over the Control. However, a linear decrease in improvements was noted as corn gluten feed replaced soybean meal. Supplementation increased both hay intake and passage rate of hay approximately 50%.

(Key Words: Prairie Hay, Soybean Meal, Corn Gluten Feed, Protein.)

Introduction

Corn gluten feed (CGF) is a by product of wet-milling corn to produce corn syrup. It includes the corn bran and condensed steepwater solubles. CGF contains about 22 to 23% CP, 2% ether extract, 9% crude fiber and is high in phosphorus and potassium. CGF has become more widely available in recent years. As the corn refining industry has grown and as the export market has diminished, CGF has found wider use in the U.S. as a protein supplement.

Some studies have been conducted with CGF, primarily in beef finishing or dairy rations, but very limited work has been done investigating the use of CGF in range supplements for beef cattle. Even less work has been conducted to determine the effects of CGF or

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blends of CGF with proteins like soybean meal (SBM) on intake and digestibility of medium quality range forages similar to those grazed by cattle during summer months. Therefore, this study was done to investigate the effects of providing equal amounts of supplemental protein from SBM, CGF or blends of SBM and CGF on forage intake, digestibility, ruminal $\text{NH}_3\text{-N}$, rumen pH and rate of passage when fed with medium quality prairie hay to beef heifers.

Materials and Methods

Fifteen yearling crossbred Angus-Hereford heifers (approx. 700 lb) used in three simultaneous 5 x 5 latin squares. All animals were fed medium quality prairie hay ad libitum. Hay was harvested the first half of July from a meadow harvested annually. The treatments were: 1) Control, consisting of hay; 2) a SBM supplement; 3) a blend with one-third of the supplemental CP from CGF and two-thirds from SBM (1/3 CGF); 4) a blend with two-thirds of the supplemental CP provided by CGF and one-third from SBM (2/3 CGF), and 5) a CGF supplement.

A mineral and vitamin A mixture was fed at a level of 50 g/day (.11 lb) to all animals on all treatments. Supplements were fed once daily to provide 300 g (.67 lb) of supplemental protein per day. The SBM, 1/3 CGF, 2/3 CGF and CGF supplements (Table 1) were fed at rates of 1.41, 1.91, 2.43 and 3.08 lb per day, respectively.

Table 1. Intake of the supplements (DM basis).

Ingredient	-----Supplement ^a -----				
	C	SBM	1/3 CGF	2/3 CGF	CGF
	-----g/day (lb/day)-----				
Soybean meal		640 (1.41 lb)	406 (.89 lb)	198 (.44 lb)	
Corn gluten feed			464 (1.02 lb)	902 (1.99 lb)	1400 (3.08 lb)
Mineral and Vitamin mixture ^b	50 (.11 lb)	50	50	50	50
Total supplement	50 (.11 lb)	690 (1.52 lb)	920 (2.01 lb)	1150 (2.53 lb)	1450 (3.19 lb)

^aC = Control; SBM = soybean meal; 1/3 CGF = corn gluten feed used to supply 1/3 of supplemental crude protein, balance from SBM; 2/3 CGF = corn gluten feed supplied 2/3 of supplemental crude protein, balance from SBM; CGF = corn gluten feed.

^bContained: Dicalcium phosphate 42.2%, KCl 18.1%, trace minerals 27.4% (.25% Mn, .2% Fe, .033% Cu, .0025% Co, .007% I, .005% Zn), Na_2SO_4 11.8% and vitamin A .5% (220 USP units/g).

Each period in the latin square lasted 14 d, with days 1 to 8 being used for adaptation. Prairie hay, fed and rejected, and supplements were weighed and sampled daily. Fecal grab samples were collected twice daily in each collection period. Chromic oxide was fed as an indigestible marker to estimate digestibilities. All samples for each animal in each period were placed in an individual plastic container and refrigerated until the end of the period. Hay, supplements and fecal samples were analyzed for moisture and chemical determinations. Rate of particulate passage values for hay were determined using Ytterbium. Chopped hay was labeled with Yb and fed as a single pulse dose on day 9 of each period according to the procedure of Teeter et al. (1984). The rumen of each animal was sampled via stomach tube on the last day of each period within two to four hours after feeding supplement. The pH of the ruminal fluid was measured immediately; then 200 ml fluid was acidified and frozen for later $\text{NH}_3\text{-N}$ analysis.

Results and Discussion

Supplementation increased ($P<.01$) the intake of prairie hay from 12.8 lb (Control) to 19.0, 18.1, 17.1 and 15.5 lb on the SBM, 1/3 CGF, 2/3 CGF and CGF treatments, respectively (Table 2). Moreover, a significant linear ($P<.01$) decline was noted in forage intake as CGF

Table 2. Intake of prairie hay and measures of digestibility as influenced by supplementation with soybean meal (SBM), corn gluten feed (CGF) or blends of SBM and CGF.

Item	Control	SBM	1/3CGF	2/3CGF	CGF	SE ^d
Hay intake, lb ^{abc}	12.8	19.0	18.1	17.1	15.5	.43
%Body wt.	1.10	2.69	2.56	2.43	2.19	.061
Supplement intake, lb ^a	.1	1.5	2.0	2.5	3.2	
Total dry matter intake, lb ^{bc}	12.9	19.5	20.1	19.6	18.7	.43
%Body wt.	1.89	2.98	2.92	2.87	2.72	.061
Dry matter dig. % ^b	48.5	55.5	55.2	54.7	54.2	.75
Dig. dry matter intake, lb ^{bc}	6.5	11.6	11.4	11.1	10.4	.59
%Body Wt.	.88	1.65	1.62	1.57	1.47	.039
Apparent CP dig, % ^{bc}	23.6	51.9	50.5	46.5	45.1	1.38
Acid detergent fiber dig, % ^{bc}	37.7	44.6	44.5	43.8	43.4	.87

^aDry matter basis.

^bSignificant increase ($P<.01$) for supplemented diets vs Control diet.

^cSignificant linear decline ($P<.01$) with decreasing SBM and increasing CGF in the supplement.

^dStandard error.

replaced SBM in the supplement. The increase in prairie hay intake was 48.4, 41.4, 33.6, and 21.1% on the same treatments, respectively. The 48% increase in forage intake on the SBM treatment is in agreement with previous studies by Guthrie et al. (1984).

Total ration dry matter digestibility was increased from 48.5% on the Control to 55.5, 55.2, 54.7 and 54.2% on the SBM, 1/3 CGF, 2/3 CGF and CGF, respectively. The improvements noted with the different supplementation programs are illustrated in Figure 1. Calculated or anticipated digestibilities were based upon the value obtained for prairie hay on the Control treatment and an assumed digestibility of 80% for the protein supplement. The addition of supplement should improve total ration digestibility since supplement is more digestible than hay. With the SBM treatment, the observed digestibility (55.5%) exceeded the calculated or anticipated digestibility (50.7%) showing the positive effect of supplemental protein on digestibility of prairie hay. Improvements in digestibility also were noted on the two blend treatments. The observed digestibility was close to the expected digestibility on the CGF treatment.

Digestible dry matter intake was increased ($P < .01$) by supplementation from 6.5 lb on the Control to 11.6, 11.4, 11.1 and 10.4 lb on the SBM, 1/3 CGF, 2/3 CGF and CGF treatments, respectively. This is an average increase of more than 70% in digestible dry matter intake above the Control. A linear ($P < .01$) decline in digestible dry matter

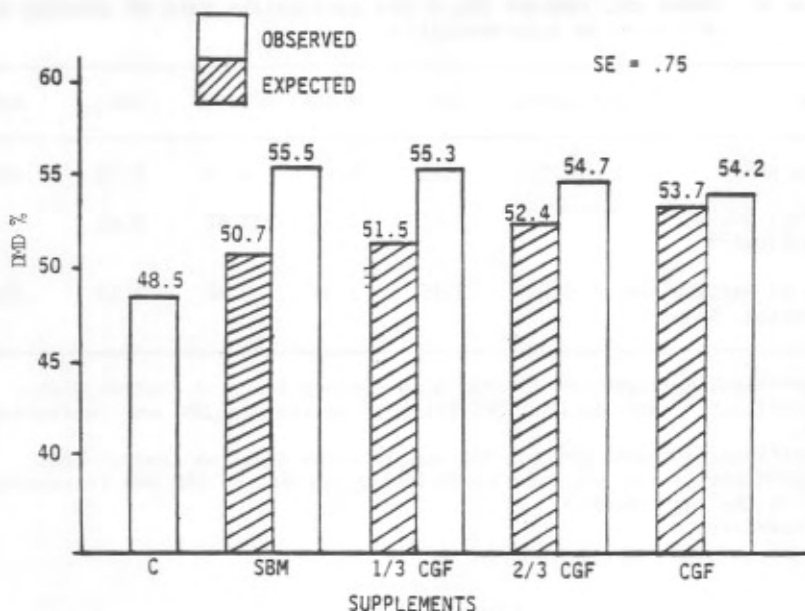


Figure 1. Comparison of observed vs. expected diet dry matter (DM) digestibilities. Expected digestibilities are based upon values obtained for the hay on the control treatment and 80% DM digestibility for the supplement.

intake was noted on the supplementation treatments as CGF replaced SBM in the supplement. Acid detergent fiber and apparent protein digestibilities were increased ($P < .01$) by supplementation. Protein, showed a linear decrease in digestibility, as did dry matter, as CGF replaced SBM in the supplement. Corrections for metabolic fecal nitrogen losses would yield higher protein digestibilities than noted herein, but the relative treatment differences would be similar to those noted.

Rumen pH was decreased ($P < .01$) by supplementation, but the actual amount appeared minimal, being 6.89 on the Control vs an average of 6.78 on the supplementation treatments (Table 3). The decrease reflects increased fermentation. Ruminal $\text{NH}_3\text{-N}$ values were increased ($P < .01$) greatly by supplementation. A linear ($P < .01$) increase in ruminal $\text{NH}_3\text{-N}$ was noted as CGF replaced soybean meal in the supplement. This implies protein in CGF was more rapidly or extensively degraded in the rumen than that in SBM or that $\text{NH}_3\text{-N}$ was less completely utilized for microbial synthesis with CGF than with SBM supplements. Rate of particulate passage was increased ($P < .01$) an average of 53% by supplementation. Feeding of either SBM, blends of SBM and CGF, or CGF increased forage intake, improved digestibility of dry matter, protein and acid detergent fiber, and enhanced total digestible dry matter intake and rate of passage. However, improvements were generally greater with SBM than CGF.

Table 3. Rumen pH, ruminal $\text{NH}_3\text{-N}$ and particulate rate of passage as influenced by supplementation.

Item	Control	SBM	1/3 CGF	2/3 CGF	CGF	SE ^e
Rumen pH ^{ab}	6.89	6.81	6.80	6.79	6.72	.030
Ruminal $\text{NH}_3\text{-N}$, mg/100ml ^{cd}	.57	2.31	2.55	3.42	3.63	.250
Rate of particulate passage, %/hour ^c	2.09	3.35	3.34	2.96	3.13	.185

^aSignificant decrease ($P < .01$) for supplemented diets vs Control diet.

^bSignificant linear decline ($P < .05$) with decreasing SBM and increasing CGF.

^cSignificant increase ($P < .01$) for supplemented diets vs Control diet.

^dSignificant linear increase ($P < .01$) with decreasing SBM and increasing CGF in the supplement.

^eStandard error.

Literature Cited

- Guthrie, M.J., D.G. Wagner and D.S. Buchanan. 1984. Effect of level of protein supplementation on intake and utilization of medium quality prairie hay by heifers. Okla. Agri. MP 116;156.
- Teeter, R.G., F.N. Owens and T.L. Mader. 1984. Ytterbium chloride as a marker for particulate matter in the rumen. J. Anim. Sci. 58;465.