THE VALUE OF CORN GLUTEN FEED AS A SUPPLEMENT FOR BEEF CATTLE GRAZING NATIVE RANGE

A.T. Fleck[1], K.S. Lusby[2] and F.T. McCollum[3]

Story in Brief

Corn gluten feed was evaluated as a supplement for beef cows grazing native range in winter and heifers grazing native range in summer. In 1985 and 1986, 72 mature Hereford cows bred to calve in March and April were divided into four treatments. Supplementation began in mid-November and ended as each cow calved. Treatments and daily feed levels (lb/head) from November to January 30 were negative control, 1.1 soybean meal (NC); positive control, 2.0 soybean meal (SBM); 3.1 of 1:2 ratio of soybean meal and corn gluten feed (SBM/CGF); and 4.4 corn gluten feed (CGF). On day 75 of the trial all supplement levels were adjusted based on weight changes of negative and positive control cows. Supplements were prorated and individually fed 6 days per week. NC cows lost more weight and body condition than SBM cows, while SBM/CGF and CGF cows maintained body weight and condition similar to cows receiving SBM. Forty-three Hereford and Hereford X Angus heifers in 1985 and 48 in 1986 were similarly fed 5 days each week from July 16 to October 8 at daily rates of 0, 1.2, 1.9 and 2.8 lb/head for NC, SBM, SBM/CGF, and CGF treatments respectively. Heifers receiving SBM gained more weight than unsupplemented NC heifers; and, heifers receiving SBM/CGF and CGF gained more weight than heifers receiving SBM. Corn gluten feed appears to be an effective energy and protein supplement for beef cows consuming winter native range and for heifers grazing mid- to late-summer range.

(Key words: Corn Gluten Feed, Beef Cattle, Native Range, Energy, Protein, Supplement.)

Introduction

When dormant native range in winter or late summer fails to provide sufficient energy and protein for adequate animal performance, concentrates are often fed. Supplementing low quality roughage diets with protein has a positive effect on forage intake and digestibility, while feeding energy in the form of readily available carbohydrates tends to decrease forage intake and fiber utilization. The use of high fiber, low starch energy feeds may avoid the negative effects encountered when feeding grain-based supplements.

Corn industry by-products have become more available and may, at times, compete with cereal grains and oilseed meals as sources of energy and protein. Corn gluten feed (CGF), a product of the wet corn milling industry marketed at 21% crude protein and 8.5% fiber, is the portion of the kernel that remains after removing the starch, gluten, and germ. The protein content and highly digestible fiber makes CGF a potentially acceptable source of supplemental protein and energy. The following studies were conducted to evaluate CGF as a protein and energy supple-

---

[1]Graduate Assistant [2]Professor [3]Assistant Professor

ment for beef cattle grazing low quality native range in mid- to late-summer or dormant native range in winter.

Materials and Methods

Trial 1. In each of 2 years, 72 mature Hereford cows bred to calve in March and April were blocked by age, weight, body condition, and expected calving date and allotted to four supplement treatment groups. Treatments presented in Table 1 and 2 were negative control, a low level of supplement (NC); and three isonitrogenous treatments made up of soybean meal (SBM), soybean meal plus corn gluten feed in which each provided one-half the protein (SBM/CGF), or corn gluten feed (CGF). Supplementation began mid-November and terminated as each cow calved. On January 30th, supplement levels were adjusted based on observed weight change differences between positive and negative controls. In

Table 1. Composition of supplement used in Trials 1 and 2.

	Treatment			
	NC	SBM	SBM/CGF	CGF
Ingredients, %:				
Soybean meal	84.7	93.1	32.3	.0
Corn gluten feed	.0	.0	62.7	96.4
Molasses	3.6	3.6	3.6	3.6
Dical	9.3	13.2	1.4	.0
Potassium chlor.	2.26	.0	.0	.0
Vitamin A premix	.15	.07	.05	.04

Table 2. Supplement treatments and amounts fed in Trial 1 and 2 (100% of DM).

	Treatment			
	NC	SBM	SBM/CGF	CGF
Trial 1				
Year I, lb/day:				
11/20/84 to 1/29/85	1.1	2.0	3.2	4.6
1/30/85 to 3/26/85	1.6	3.0	4.8	6.9
Average crude protein	.51	1.00	1.00	1.00
Average TDN	.90	1.89	2.90	4.29
Year II, lb/day:				
11/20/85 to 1/29/86	1.1	2.1	3.1	4.4
1/30/85 to 3/4/86	.8	1.4	2.1	2.9
Average crude protein	.35	.70	.70	.70
Average TDN	.62	1.30	1.89	2.51
Trial 2				
Supplement, lb/day	0.0	1.2	1.9	2.8
Crude protein	0.0	.51	.51	.51
TDN	0.0	.90	1.41	2.07

1985 all supplements were increased 50% and in 1986, due to a mild winter, all supplements were reduced by 33% (Table 2). All cows grazed as a group on native tallgrass range. Cows were gathered 6 days per week and individually fed their respective supplements in covered stalls. Daily feeding rates were prorated for a 6 day/week feeding schedule.

Cane molasses was added to aid pelleting and supplements were balanced so that all provided equal daily amounts of calcium, phosphorus, potassium, and vitamin A. A mineral mix containing 55% dicalcium phosphate and 45% salt was provided free choice in the pasture. Grass hay was fed only when snow or ice covered the ground and when extreme cold (less than 10F windchill) was encountered.

Cow weights and body condition scores were taken after overnight shrink at 28 day intervals until cows neared calving at which time measurements were taken every 14 days. As cows calved, they were removed from the trial and the 14 day record nearest to calving was used as the final measurement. After calving all cows were maintained on native range until weaning. Calf birth date and weight, sex, and weaning weight were recorded. Cows were bred by natural service and pregnancy was determined by rectal palpation in mid-October. Cow fall weight and body condition were recorded at weaning (October 16).

On day 114 of the 1985 trial (March 12), rumen fluid samples were obtained via stomach tube from 32 randomly selected cows at 1 and 4 hours after feeding supplement. Fluid pH was recorded immediately before samples were acidified with 20% sulfuric acid (1 ml/100 ml of fluid) and refrigerated for laboratory analysis. Rumen fluid was analyzed for ammonia and volatile fatty acid concentration.

Trial 2. Forty-three Hereford and Hereford X Angus heifers in 1985 and 48 in 1986 (678 lb and 16 mo old) were allotted by breed and weight to the same four supplement treatments described for Trial 1. Supplement amounts are presented in Table 2. The treatment period began July 16 and ended October 8. All heifers grazed as a group on native tallgrass prairie and were individually fed their respective supplements prorated for a 5 day per week feeding schedule. Heifers were weighed at 28 day intervals after overnight shrink. A mineral mix containing 55% dicalcium phosphate and 45% salt was provided free choice to all heifers.

Data from both trials were pooled over year and subjected to least squares analysis of variance. The least significant difference technique was used to separate means for characteristics in which treatment differences were significant ($P<.05$).

Results and Discussion

Trial 1. Rumen fluid pH was similar between treatments 1 hour after feeding supplements (Table 3). At 4 hour after feeding supplement, pH was lower ($P<.01$) when CGF was the sole source of supplemental protein. This suggests that high fiber feeds may be fed at relatively high levels to increase the energy status of the diet without lowering pH to levels expected to reduce fiber digestion and intake.

Rumen ammonia levels at 1 hour after feeding supplement tended ($P<.07$) to be higher for the SBM and SBM/CGF treatments (Table 3). At 4 hour post supplementation rumen ammonia was higher ($P<.05$) for SBM cows but no different between other treatments. The observed ammonia levels in this study suggest that adequate nitrogen existed for microbial growth and replication.

Table 3. Ruminal pH and ammonia concentration at 1 and 4 hours post supplementation.

	Treatment[d]				
	NC	SBM	SBM/CGF	CGF	SE
No. cows sampled	8	7	6	11	
Rumen pH:					
1 hour	7.5	7.3	7.2	7.0	.08
4 hour	7.5^{a}	7.4^{a}	7.2^{b}	6.8^{c}	.09
Rumen ammonia, mg/dl:					
1 hour	13.7	18.8	17.5	13.7	2.10
4 hour	14.5^{b}	20.9^{a}	14.8^{b}	10.9^{b}	1.90

[abc]Means in same row with different superscripts differ ($P<.05$).
[d]Least squares means.

Total VFA concentrations were similar between treatment groups at 1 and 4 hours after feeding supplement (Table 4). However at both collection periods, when SBM was replaced by CGF the molar proportion of acetate decreased ($P<.01$) and the proportion of propionate and butyrate increased ($P<.01$). If the increased ruminal VFA concentrations observed in this study reflect increased ruminal production of propionate and butyrate, CGF supplementation may increase efficiency of utilization of dietary energy and decrease loss of energy as methane from the rumen.

Cow body weight and condition loss was greater ($P<.01$) for the NC treatment group than the SBM positive control, demonstrating a protein deficiency did exist (Table 5). Replacing one-half of the supplemental protein with CGF (SBM/CGF) or all of the supplemental protein (CGF), maintained body weight and condition similar to the SBM treatment group.

Table 4. Ruminal VFA concentration at 1 and 4 hours post supplementation.

	Treatment[d]				
	NC	SBM	SBM/CGF	CGF	SE
No. cows sampled	8	7	6	11	
One Hour:					
Total VFA, (umoles/ml)	55.2	63.6	60.1	59.6	5.46
Acetate, %	75.5^{a}	72.1^{ab}	69.7^{b}	64.0^{c}	1.45
Propionate, %	13.5^{b}	15.5^{b}	17.0^{b}	22.8^{a}	1.14
Butyrate, %	6.9^{b}	7.5^{b}	9.2^{a}	9.8a	.56
Four Hour:					
Total VFA, (umoles/ml)	57.7	66.5	60.6	70.7	6.52
Acetate, %	71.8^{a}	67.9^{ab}	66.8^{b}	60.7^{c}	1.43
Propionate, %	17.5^{b}	17.7^{b}	18.3^{b}	24.5^{a}	1.00
Butyrate, %	6.3^{c}	8.3^{bc}	10.3^{ab}	11.3^{a}	.71

[abc]Means in same row with different superscripts differ ($P<.05$).
[d]Least squares means.

Table 5. Cow and calf performance for Trial 1.

	Treatment[c]				
	NC	SBM	SBM/CGF	CGF	SE
No. cows	36	35	36	35	
Initial weight, lb	1016	1012	1023	1019	19.4
Weight change, lb	-59[a]	3[b]	0[b]	3[b]	15.7
Initial condition[d]	5.6	5.5	5.6	5.6	.10
Condition change	-0.87[a]	-0.46[b]	-0.46[b]	-0.33[b]	.08
No. cows exposed	36	33	36	32	
Conception rate, %	72	79	83	84	
Calf weight, lb:					
Birth	76	79	80	80	2.3
Weaning[e]	367	413	398	396	15.4
ADG	1.4	1.6	1.5	1.5	.09
Weight at weaning[f]	990	997	994	1019	13.42
Condition at weaning	5.1	5.2	5.2	5.2	.05

[ab]Means in same row with different superscripts differ (P<.05).
[c]Least squares means.
[d]Condition scoring system used was 1 through 9 (1=very thin, 9=very fat).
[e]Calf weaning weights adjusted for sex, age of calf, and age of cow.
[f]Cow weights and body condition in the fall following winter supplement treatment.

Initial fall body weights of the SBM, SBM/CGF, and CGF treatment groups were maintained through the winter period, while fall body condition decreased an average of .37 units. Similar precalving cow weight changes observed between the CGF treatment group and the SBM/CGF group in which 30% less total supplement was fed, suggest that CGF may lack a protein constituent that is supplied by the addition of SBM. CGF may also slightly reduce forage intake due to the larger amount of supplement fed (approximately 22% of the diet DM). Winter supplement treatment had no affect on following fall cow weight or body condition.

Cow conception rates and calf performance are presented in Table 5. The percent of cows conceiving within the breeding season was lower for the NC treatment group compared to cows supplemented with SBM, SBM/CGF, and CGF precalving (72 vs 81%, respectively). Calf weaning weights and average daily gain to weaning were slightly reduced in the NC treatment group compared to calves of cows supplemented with SBM, SBM/CGF, or CGF (P<.08 and P<.19, respectively).

Trial 2. Heifers grazing native range in mid- to late-summer and supplemented with SBM gained more weight (P<.01) than unsupplemented heifers, demonstrating a nutrient deficiency existed (Table 6). When CGF was fed with SBM or as the sole source of supplement, heifers had greater (P<.01) weight gains than the SBM positive control. The increased gain from feeding a small amount of SBM supplement was likely the result of increased fiber digestibility and forage intake. Supplement conversions of 3.23, 2.97, and 4.70 kg of supplement per kg of added gain for the SBM, SBM/CGF, and CGF treatments, respectively, strongly suggest that all supplements were positively effecting forage digestibility and intake. The consumption of higher levels of supplemental energy from CGF or CGF/SBM would be expected to efficiently increase the total energy intake of the grazing animal.

Table 6. Performance of heifers in Trial 2.

	Treatment[d]				
	NC	SBM	SBM/CGF	CGF	SE
No. heifers	22	23	23	23	
Initial weight, lb	689	667	667	667	
Weight gain, lb	86[c]	117[b]	139[a]	136[a]	4.9
Average daily gain, lb	1.0[c]	1.4[b]	1.7[a]	1.6[a]	
Lb of supplement per lb of added gain		3.23	2.97	4.70	

[abc]Means in same row with different superscripts differ (P<.05).
[d]Least squares means.

Cows and heifers receiving the SBM/CGF supplement performed similar to the CGF group although they received 30% less supplement, indicating that the corn gluten feed was more efficiently utilized when SBM was added to the supplement. These trials suggest that corn gluten feed can be fed alone or with soybean meal as an effective energy and protein supplement for beef cattle consuming low quality forage in mid- to late-summer or dormant native forage in winter.