CORN VS SOYBEAN HULL SUPPLEMENTS FOR BEEF COWS FED LOW QUALITY NATIVE GRASS HAY

W.W. Chan[1], C.A. Hibberd[2], R.R. Scott[1]
and K. Swenson[3]

Story in Brief

Five mature beef cows were supplemented with two levels of corn or soybean hulls to compare the effect of starch vs digestible fiber feeds on intake and site of digestion of low quality native grass hay. Cows had free choice access to coarsely chopped native grass hay (4.6% CP, 81.1% NDF). Supplements given daily included a control (.41 lb mineral plus molasses), low corn (3.3 lb corn), high corn (6.6 lb corn), low soybean hulls (3.3 lb soybean hulls) and high soybean hulls (6.6 lb soybean hulls). Compared to corn, soybean hull supplementation tended to increase hay OM intake. Compared to low corn, other treatments increased total tract OM disappearance. Ruminal and total tract NDF disappearance (lb/day) increased with soybean hull supplementation. Ruminal pH and ammonia concentrations generally were higher for soybean hulls than corn. Although TDN is much greater for corn than for soybean hulls (91 vs 64%), this study suggests that these supplements had similar effects on total energy intake.

(Key Words: Corn, Soybean Hulls, Grass Hay, Intake, Digestibility.)

Introduction

Beef cows grazing native range in winter require supplementation to meet their energy and protein requirements. Supplementation becomes more critical when environmental and physiological stresses also are considered. Energy supplementation may be necessary to reduce cow body weight loss and maintain an adequate calf growth rate. Supplements containing high levels of cereal grain decrease forage intake and digestibility due to the effects of starch (Chase and Hibberd, 1987). Under such circumstances, total energy intake of cows may not be increased.

High fiber feeds such as soybean hulls, being devoid of starch, may enhance forage utilization (Martin and Hibberd, 1990). Although performance

---

[1]Graduate Student [2]Associate Professor [3]Agricultural Technician

studies suggest that soybean hulls are an effective alternative to corn (Trautman, 1987), few studies have compared soybean hulls with corn on the site and extent of digestion of low quality native grass hay. The objective of this study was to compare corn with soybean hull-based supplements on intake and on site and extent of digestion of low quality native grass hay by nonpregnant, nonlactating beef cows.

Materials and Methods

Five mature, nonpregnant Limousin x Hereford x Angus cows (average weight, 1,195 lb), each fitted with permanent ruminal, duodenal and ileal cannulas were allocated randomly to five treatments in a 5 x 5 latin square. Low quality native grass hay chopped through a 2-inch screen and fresh water were supplied free choice. Supplements included a control (minerals only) and two levels (3.3 or 6.6 lb) of either corn or soybean hulls with soybean meal added to provide a total of 1.35 lb supplemental crude protein/day (Table 1).

Twenty-one day experimental periods included 14 days of adaptation and 7 days of sampling. Quantities of hay offered and refused were recorded and sampled on days 16 through 19. Duodenal, ileal and fecal samples were collected eight times during days 16 through 19 to represent every three hours of a 24-hour day. Hay, hay refusal, supplement and digesta samples were analyzed for dry matter, ash, acid-insoluble ash, and neutral detergent fiber. Ruminal fluid was sampled on day 20 at 0, 2, 4, 6, 9, 12, 18 and 24 hour after supplement was fed. Ruminal pH was determined immediately. Ruminal samples were acidified and frozen for later ammonia analysis. Organic matter and NDF flows and digestibilities were calculated from acid-insoluble ash ratios in feed and digesta.

Intake, flow and digestibility data were subjected to least squares analysis of variance with period, animal, source (corn vs soybean hulls), level (3.3 vs 6.6 lb) and source x level included in the model. Orthogonal contrasts were designed to test: 1) Control, control vs all supplements, 2) Source, corn vs soybean hulls, 3) Level, 3.3 vs 6.6 lb/day, and 4) Source x Level interaction. If the source x level interaction was significant, differences among treatment means were detected by LSD. Ruminal data were analyzed by least squares with period, treatment, animal and hour included in the model.

Results and Discussion

Hay OM intake was increased (P=.006) by supplementation (Table 2). Although not significantly affected by level or source of supplement, hay OM intake tended (P=.13) to be higher with soybean hulls than with corn. In

Table 1. Supplement composition and nutrient supply.

	Control	Supplement			
		Low corn	High corn	Low SBH	High SBH
Supplement composition, % (DM basis)					
Corn		60.95	80.84		
Soybean hulls				62.55	83.66
Soybean meal		31.57	13.26	29.73	10.15
Dicalcium phosphate	32.12	2.28	1.51	2.34	1.56
Trace mineralized salt	25.81	1.83	1.21	1.88	1.25
Molasses	41.29	3.01	3.02	3.00	3.01
Sodium sulfate		.3	.12	.45	.32
Vitamin A (30,000 IU/g)	.79	.06	.04	.06	.04
Supplement intake, lb/day					
Dry matter[a]	.40	6.13	9.29	5.89	8.80
Corn		3.30	6.60		
Soybean hulls				3.30	6.60
Nutrient supply, lb/day					
Crude protein[a]	.00	1.33	1.34	1.36	1.39
TDN[b]	.11	4.56	7.10	3.55	5.07
Starch[c]		2.14	4.29		

[a] Actual analysis.
[b] Estimated from NRC, 1984.
[c] Starch content of corn estimated to be 65%.

Table 2. Organic matter (OM) and NDF intake, flow and digestion in beef cows fed low quality native grass hay supplemented with corn or soybean hulls.

		Corn		Soybean hulls			Probability[a]			
Item	Control	Low	High	Low	High	SE	Control	Source	Level	S x L
Intake, lb/day										
Supplement OM	.04	5.01	7.75	4.85	7.36					
Hay OM	12.04	14.68	14.23	16.74	14.83	.82	.006	.13	.18	.39
Total OM	12.08	19.69	21.98	21.59	22.19	.82	.006	.13	.18	.39
Total NDF	11.56	14.77	14.49	18.21	18.51	.76	.0001	.0004	.99	.71
Ruminal disappearance, lb/day										
OM[b]	5.01	9.74	11.19	11.39	11.76	.62	.0001	.10	.17	.40
NDF	7.01	9.20	8.77	12.18	12.55	.54	.0001	.0001	.96	.48
Ruminal digestibility, % of intake										
OM[b]	41.02	49.29	51.26	53.38	53.59	2.52	.002	.23	.67	.73
NDF	60.47	61.74	60.65	67.44	68.15	1.94	.09	.005	.92	.65
Total tract disappearance, lb/day										
OM	5.75[c]	11.31[d]	13.34[e]	12.55[de]	12.94[e]	.45	.0001	.37	.02	.09
NDF	6.98	8.94	8.63	11.97	12.22	.50	.0001	.0001	.96	.59
Total tract digestibility, % of intake										
OM	46.71	58.12	61.18	58.76	58.77	2.67	.001	.75	.58	.58
NDF	59.58	60.40	59.80	66.31	66.19	2.48	.22	.03	.89	.92

[a] Probability levels for orthogonal contrasts: Control = Control vs all Supplements, Source = Corn vs Soybean hulls, Level = 3.3 vs 6.6 lb/day, S x L = Source x Level interaction.

[b] OM disapperance uncorrected for microbial OM.

[c,d,e] Means within the same row with different superscripts differ ($P < .05$).

addition, compared to 3.3 lb/day, 6.6 lb/day tended (P=.18) to decrease hay OM intake.

Ruminal and total tract OM digestibilities (%) were not affected (P>.5) by source or level of supplement (Table 2). Ruminal OM disappearance (lb/day) tended to be higher (P=.10) with soybean hulls than with corn. In addition, 6.6 lb/day of supplement tended (P=.17) to increase ruminal OM disappearance. Level of supplementation had a greater effect on total tract OM disappearance with corn than soybean hulls (Source x Level, P=.09). Total tract OM disappearance was significantly higher for 6.6 than 3.3 lb/day of corn suggesting that feeding additional corn had a positive influence on energy intake. Total tract OM disappearance for both levels of soybean hulls were intermediate and not different (P>.05) from 6.6 lb corn. The TDN value is reported to be higher for corn than for soybean hulls (91 vs 64%). This difference in supplemental TDN was not reflected in total tract OM disappearance suggesting that the energy content of these two feeds is not as different as TDN values would suggest when used as components of a range supplement.

Compared to corn, soybean hulls increased (P=.03) ruminal and total tract NDF digestibility (%, Table 2). Soybean hulls increased (P<.0001) NDF disappearance (lb/day) both in the rumen and in the total tract. Corn supplementation has been suggested to reduce NDF digestion but differences in NDF digestibility between the control and corn supplements were not detected in this study suggesting that added starch did not reduce NDF digestion. Because soybean hulls contain a high concentration of unlignified NDF, the increased NDF digestion may be attributable to increased digestible NDF intake rather than negative associative effects.

Treatment differences in ruminal pH were dependent on sampling time (treatment x sampling time, P=.06, Figure 1). Ruminal pH was higher (P=.0001) for the control than for the mean of the other supplements at each sampling time. With soybean hull supplements, ruminal pH was lowest at 2 hour after feeding whereas the lowest pH with corn supplements was observed later (4 to 6 hour after feeding). Compared to soybean hulls, corn supplementation decreased ruminal pH at 4 (P=.005), 6 (P=.04), 9 (P=.03) and 24 (P=.03) hour postsupplementation. The higher supplement level (6.6 vs 3.3 lb/day) reduced (P=.01) ruminal pH only for the 18 hour sample.

Supplementation increased (P<.04) ruminal ammonia concentrations at all sampling times except at 9 hour (Figure 2). Compared to corn, soybean hulls increased ruminal ammonia at 2 (P=.05), 4 (P=.005) and 6 (P=.08) hour postfeeding. In addition to decreased ruminal pH, reduced ruminal ammonia concentrations with corn supplements may also contribute to decreased NDF digestion. Compared to 6.6 lb/day, feeding 3.3 lb/day resulted in higher ruminal ammonia at 2 (P=.05), 6 (P=.16), 9 (P=.006), 12 (P=.01) and 18 (P=.01) hour postsupplementation. Because the 3.3 lb/day

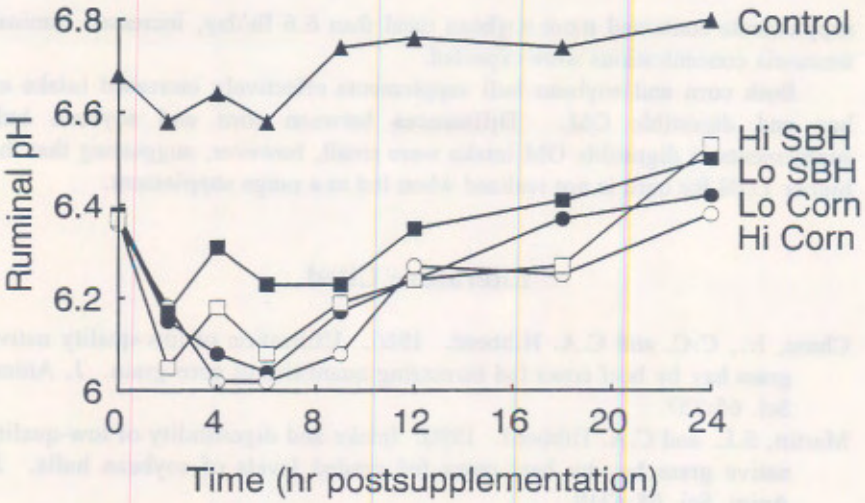

Figure 1. Changes in ruminal pH in beef cows fed low quality native grass hay supplemented with soybean hulls or corn.

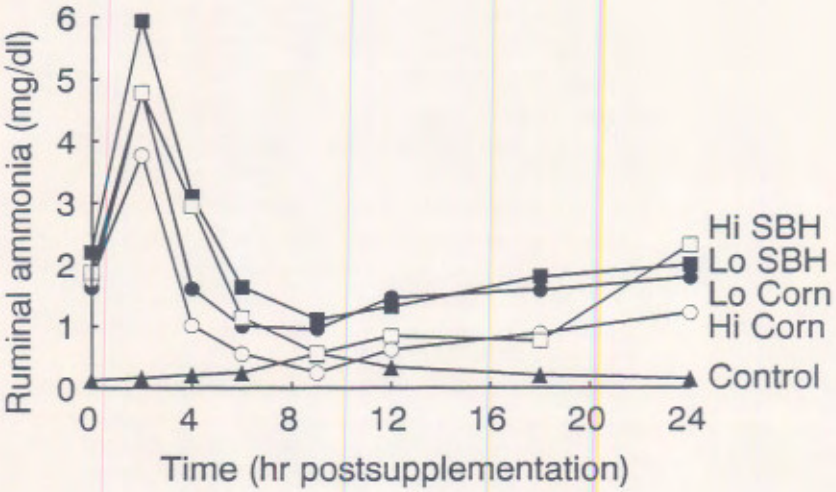

Figure 2. Changes in ruminal ammonia concentrations in beef cows fed low quality native grass hay supplemented with soybean hulls or corn.

supplements contained more soybean meal than 6.6 lb/day, increased ruminal ammonia concentrations were expected.

Both corn and soybean hull supplements effectively increased intake of hay and digestible OM. Differences between corn and soybean hull supplements in digestible OM intake were small, however, suggesting that the higher TDN for corn is not realized when fed in a range supplement.

Literature Cited

Chase, Jr., C.C. and C.A. Hibberd. 1986. Utilization of low-quality native grass hay by beef cows fed increasing quantities of corn grain. J. Anim. Sci. 65:557.

Martin, S.L. and C.A. Hibberd. 1990. Intake and digestibility of low-quality native grass hay by beef cows fed graded levels of soybean hulls. J. Anim. Sci. 68:4319.

Trautman, B.D. 1987. Forage utilization and productivity of lactating beef cows fed cottonseed meal, corn or soybean hull supplements during the winter. M.S. Thesis, Oklahoma State Univ., Stillwater.