Soybean Hulls in Receiving Diets: The Value of Digestible Fiber

Vern Anderson and Jon Schoonmaker
NDSU Carrington Research Extension Center

Summary
Soyhulls are a co-product of oil extraction from the soybean. The laboratory analysis of soyhulls indicates it is high in fiber, however, the highly digestible fiber is useful to ruminants. The objective of this study was to explore animal performance when soyhulls were substituted for corn at stepped levels in receiving rations for weaned beef calves. One hundred-sixty crossbred steers from 40 different ranches in North Dakota (average wt 635.2 ± 3.3 lbs.) were allotted by weight and source to one of four receiving diets (4 pens per treatment, 10 head per pen) to determine the effects of stepped levels of soyhulls in receiving rations. Diets were formulated to contain 0, 15, 30, and 45% soyhulls, replacing corn in the 70% concentrate receiving diets. The remainder of the diet consisted of field peas, corn silage, vitamin and mineral supplement with Rumensin® and triticale hay. Crude protein concentrations of the diets were 13.3%. Net energy for gain declined with increasing soyhull inclusion (54.8, 51.7, 48.7, 45.6 Mcal/cwt for 0, 15, 30, 45%, respectively soyhull diets). Experimental diets were fed for 42 days, after which cattle were placed on a common finishing diet. Feed intake and efficiency did not differ ($P > 0.77$) at any point during the trial. Gains were greater ($P<.02$) overall for 0% and 15% soyhulls than 30% and 45% soyhulls, however, 30% was not different than 0%. Gains exhibited a linear response ($P<.05$) to increasing soyhulls in the diet. Steers fed the 0, 15, 30, and 45% soyhull diets gained 4.13, 4.33, 3.96, and 3.76 lbs. /d overall, respectively, and consumed 19.0, 19.8, 18.8, and 18.5 lbs. DM/d overall, respectively. In this study, soyhulls appear to be a good substitute for corn and can constitute up to 30% of the diet dry matter.

Introduction
If readily accessible and priced competitively with other feedstuffs, soybean hulls should be considered in feedlot rations. Soybean hulls constitute approximately five percent of the original raw soybean weight for northern grown beans (Pat Wangler, personal communication). Nearly all soybeans are processed by solvent extraction procedures. The solvent extraction process begins with cleaning, cracking with a roller, then removal of the hull from the endosperm by aspiration. Hulls are toasted, ground, and pelleted for marketing. Some hulls may be added back to soybean meal to meet product specifications of either 44 (ruminant) or 48 (non-ruminant) percent protein (Blasi et al., 2000).

High dietary levels of cereal grains, which are high in starch, can decrease forage digestibility. Soybean hulls offer an alternative to high-starch grains, as they contain significant levels of digestible fiber and in many growing diets, can be used as an energy source with similar value to grains. The objective of this trial was to determine the optimum level of soyhull inclusion needed to maximize cattle performance in receiving diets for weaned calves.

Procedures
One hundred-sixty crossbred steers from 40 different ranches in North Dakota (initial wt. 635.2 ± 3.3 lbs.) were allotted by weight and source to one of four receiving diets (4 pens per treatment, 10 head per pen) to determine the optimum level of soyhulls to maximize cattle performance. Steers were housed and fed at the Carrington Research Extension Center feedlot in open drylot pens as part of the Central Dakota Feeder Calf Club feedout project. The Turtle Lake-based project is designed to provide producers with an understanding of their calves' genetic potential to perform in a North Dakota feedlot. Each pen was equipped with automatic waterers and fenceline bunks which allowed for two feet of bunk space per head. Bunks were read each morning and feed was delivered as a totally-mixed ration once daily to appetite. Diets were formulated to contain 0, 15, 30, and 45% soyhulls, replacing corn as the primary concentrate component of the diet (Table 1). The remainder of the 70% concentrate diet consisted of field peas, corn silage, triticale hay, and an ionophore supplement (Rumensin® from Elanco, Indianapolis, IN). The ionophore supplement contained macro and trace minerals and was manufactured by Northern Crops Institute. Experimental diets were fed for 42 days, after which cattle

were placed on a common finishing diet. Feed samples were taken every week and composited for analysis of DM and CP.

Table 1. Receiving diet composition with increasing levels of soy hulls (DM basis)

	0%	15%	30%	45%
Corn	45.92	30.85	15.43	0
Soy-hulls	0.00	14.90	29.92	45.00
Field peas	23.38	22.98	22.57	21.68
Corn silage	17.02	17.47	18.28	19.43
Triticale	11.43	11.5	11.51	11.59
Supplement				
Barley	0.79	0.82	0.82	0.82
Dicalcium phosphate	0.04	0.05	0.05	0.05
Limestone	1.00	1.00	1.00	1.00
Potassium chloride	0.17	0.18	0.18	0.18
Rumensin 80	0.02	0.02	0.02	0.02
Salt	0.10	0.10	0.10	0.10
Urea	0.09	0.09	0.09	0.09
Vitamin A	0.01	0.01	0.01	0.01
Vitamin D	0.01	0.01	0.01	0.01
Vitamin E	0.01	0.01	0.01	0.01
Zinc Sulfate	0.01	0.01	0.01	0.01
Diet Specifications				
Crude protein, %	13.35	13.29	13.36	13.38
NEm, Mcal/cwt	84.0	80.6	77.2	73.7
NEg, Mcal/cwt	55.1	51.9	48.7	45.4
Ca, %	0.56	0.59	0.68	0.75
P, %	0.45	0.4	0.37	0.34

Cattle were vaccinated for protection against IBR, BVD, BRSV, PI3 (Bovishield-4; Pfizer, Exton, PA), and clostridia (7-way + somnus; Pfizer, Exton, PA) ten days prior to the initiation of the trial and were given a prophylactic injection of Micotil®, Indianapolis, IN, upon arrival at the feedlot. Health status of the cattle was monitored daily. Rectal temperatures were measured in animals that were visibly anorexic or had severe nasal mucous drainage and rapid or labored breathing. Sick animals were treated with one of two antibiotics according to label instructions (Micotil, Elanco, Indianapolis, IN; A180, Pfizer, Exton, PA). Micotil was used on first and second pulls, followed by A180 if cattle were unresponsive. Antibiotic treatment continued until animals appeared healthy. Research protocols regarding animal care followed guidelines recommended in the Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching (FASS, 1998).

Data were subjected to a one-way analysis of variance as a completely randomized design using the GLM procedures of SAS (Version 8.0; SAS Inst. Inc., Cary, NC). Pen was the experimental unit.

Results and Discussion

Overall, animal performance during the 42-day receiving period was very satisfactory. Calf weight, dry matter intake, and feed efficiency did not differ (P>.21) among treatments at any time during the trial (Table 2). Average daily gains were greater for the 0%, 15%, and 45% soyhulls diet during period 1

than the 30% diet (P<.10). Period 2 gains favored the 0%, 15%, and 30% diets (P<.01) with a linear decrease in gain with increasing soyhulls level. Overall, gains were similar for the 0% and 15% diet but the 30% diet was not different from the 0% (P<.05). Steers gained 4.13, 4.33, 3.96, and 3.76 lbs. per day for 0%, 15%, 30%, and 45% soyhulls diet, respectively.

No statistics were applied to post-trial performance as cattle were co-mingled, but it appears that receiving treatment did not affect feedlot gains (Table 2).

Table 2. Effect of soyhull inclusion on steer performance.

	0%	15%	30%	45%	St Error	P Value
Weight, lbs.						
October 27, 2004	634.4	635.8	636.4	632.3	12.4	0.99
November 17, 2004	709.1	718.8	706.3	706.4	14.2	0.91
December 8, 2004	807.5	817.6	802.6	790.4	15.7	0.66
January 18, 2005	927.4	937.1	925.1	904.0	-----	-----
Dry matter intake, lbs./d						
Period 1	17.9	18.3	17.4	17.1	0.88	0.77
Period 2	20.1	21.3	20.2	19.8	1.19	0.82
Overall	19.0	19.8	18.8	18.5	0.97	0.79
Post-trial	20.5	20.5	20.5	20.5	-----	-----
Average daily gain, lbs./d						
Period 1	3.56^{ab}	3.95^{a}	3.33^{b}	3.53^{ab}	0.18	0.1
Period 2	4.69^{a}	4.71^{a}	4.59^{a}	4.00^{b}	0.17	0.01
Overall	4.13^{ab}	4.33^{a}	3.96^{bc}	3.76^{c}	0.13	0.02
Post-trial	2.91	2.91	2.99	2.77	-----	-----
Feed conversion, lb./lb.						
Period 1	5.08	4.67	5.27	4.94	0.27	0.47
Period 2	4.33	4.52	4.43	5.00	0.23	0.21
Overall	4.63	4.58	4.76	4.92	0.12	0.27
Post-trial	7.04	7.04	6.85	7.41	-----	-----

^{abc} means on the same line with different superscripts differ, P<.05.

Hsu et al. (1987) researched replacing corn with soyhulls (25 or 50 % of the diet DM) in 35 or 60% forage diets. Inclusion of soyhulls did not affect gain, but increased dry matter intake, and decreased feed efficiency. In contrast, Ludden et al. (1995) observed that when soyhulls replaced corn in 95% concentrate diets (at 0, 20, 40, and 60% of diet DM) gain and efficiency were decreased linearly and dry matter intake was increased linearly. High dietary levels of cereal grains which are high in starch can decrease forage digestibility.

Supplementation with soyhulls, which have a high concentration of digestible fiber, affects ruminal pH relatively less than supplementation with cereal grains (Klopfenstein and Owen, 1987). Soyhulls may also provide more rumen-degradable protein than corn, although protein levels in both of these feeds is not high.

Conclusion

Soybean hulls offer an alternative to high-starch supplements in receiving and growing diets. Results from this study indicate that using soyhulls as a concentrate component in receiving diets was most

effective at the 15 to 30% level. Any potential negative effects associated with corn in a receiving or growing diet may have been reduced by the addition of soyhulls. Soyhulls may have provided the rumen with more digestible fiber and supply more degradable protein compared to corn. At 70% concentrate, it may also be possible that the forage concentration of the diet was not high enough to elicit a negative associative effect.

Literature Cited

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