Corn Addition in Fiber-Based Supplements to Grazing Cattle

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Sara Morine, Graduate Student;
Mary Drewnoski, Assistant Professor in Animal Science, University of Idaho;
Stephanie Hansen, Assistant Professor in Animal Science

Summary and Implications

Producers typically supplement energy to growing cattle on forage-based diets to improve cattle performance. However, high starch content of the energy-based supplements has been shown to have negative effects on forage intake and fiber digestion when fed in large amounts. The addition of small amounts of corn may further increase performance beyond that of fiber-based supplements alone. The addition of starch may have a positive associative effect with fiber digestion on overall ruminal digestion by stimulating greater bacterial growth. Fiber digestion was not negatively affected in a previous study where steers were fed ad-libitum bromegrass hay alone or were supplemented at 1% BW with soyhulls or a mixture of soyhulls and corn. The objective of this study was to determine the effect of inclusion of corn at 20 or 40% in a soyhull-based supplement on growing cattle weight gain when supplemented at 1% of body weight. Under the conditions of the study, the results suggest that adding cracked corn at 20 or 40% of a fiber-based energy supplement does not affect forage intake and may have potential to increase growth of grazing cattle when dietary protein is not limiting.

Introduction

At high rates of supplementation, grain-based supplements have been shown to be detrimental to fiber digestion and often result in lower than expected performance. This has resulted in the preferential feeding of low starch energy supplements consisting of highly digestible fiber such as soyhulls, distillers grains, or corn gluten feed to forage-fed cattle. While both corn and soyhulls provide supplemental energy to the grazing calf the microbial end products of ruminal digestion differ. The digestion of corn is more energetically favorable for ruminants and thus would lead to greater gains if negative associative effects on fiber digestion and intake did not occur. While it is true that a large amount of starch can be detrimental to fiber digestion, small amounts of starch would not be expected to have adverse effects on fiber digestion. When feeding fiber and starch feedstuffs together, a positive associative effect on ruminal digestion has been observed. This may be due to the feedstuffs having different rates of digestion perhaps supporting bacterial growth for an increased period of time.

In a previous study, 8 ruminally-fistulated steers were fed ad-libitum bromegrass hay alone or were supplemented at 1% BW with soyhulls alone, or a mixture of 80% soyhulls and 20% cracked corn or a mixture of 60% soyhulls and 40% cracked corn in a replicated 4 x 4 Latin square design with 14 d periods. Effect of treatment on forage digestion was measured by 48 h in situ incubation of hay on the last two days of each period. The results suggest that adding cracked corn at 20 or 40% of a fiber-based energy supplement at 1% of BW did not negatively affect fiber digestion. The objective of the current research was to determine the effect of inclusion of corn at (20 or 40%) in a soyhull-based supplement on weight gain of cattle grazing stockpiled bromegrass pastures when supplemented at 1% of BW.

Materials and Methods

Five acre bromegrass plots (n = 3 per treatment) were blocked according to forage mass and were randomly assigned within block to one of three energy supplements: 100% soybean hull pellets (SH), 80% soybean hull pellets and 20% cracked corn (C20), or 60% soybean hull pellets and 40% cracked corn (C40). The soyhull pellets used in this study was calculated to contain 10.1% CP, 0.59 Mcal/lb NE_g, and 2% starch. The C20 and C40 supplements were calculated to contain 9.8% CP, 0.59 Mcal/lb NE_g, 15.3% starch and 9.5% CP, 0.59 Mcal/lb NE_g, and 28.6% starch, respectively. Fifty-four crossbred steers (761 ± 27 lb) were stratified by BW and randomly assigned to one plot within a particular block of plots and within a weight block (1 plot per treatment of light, medium, and heavy weight steers; 6 steers per plot). The cattle were adapted for 7 days to pasture before the start of the trial and supplemented with soyhulls at 1% BW on a DM basis. During the last 2 days of adaptation, cattle BW were collected prior to supplement feeding and averaged to become the initial BW; BW was also collected on day 28, 55, and 56 (day 55 and 56 were averaged to become the end BW) prior to supplement feeding. Beginning on day 1 steers received an energy supplement at 1% BW on a DM basis, based on the initial BW with feeding rates adjusted after day 28 weights were collected. The bromegrass plots were strip grazed and fencing was moved every 7 days immediately after supplement was fed on the 7^{th} day. The amount to be strip grazed was determined by pre-grazing pasture mass estimates calculated to allocate steers forage at 3.5% BW. Forage intake was estimated 3 times during the trial by determining forage disappearance in the weekly allocations. Blood samples were collected from 3 steers per plot on day 1, 28, and 55, prior to supplement feeding, from the jugular vein for analysis of plasma urea nitrogen (PUN).

Data were analyzed using the MIXED procedure of SAS (SAS Institute Inc, Cary, NC). Repeated measures

were used for forage offered, forage intake, supplement intake, and residual forage mass data.

Results and Discussion

The addition of cracked corn did not negatively affect cattle performance. The amount of forage offered, forage intake, and supplement intake did not differ ($P \geq 0.21$; Table 1) due to supplement treatment. The residual forage mass did not differ ($P \geq 0.77$) due to supplement treatment. Forage intake decreased ($P \leq 0.01$) after d 21 of the trial averaging 14.6, 12.4, and 13.1 lbs/d for d 21, 41, and 55, respectively. The average daily gain and final body weight of steers did not differ ($P \geq 0.11$; Table 2) due to supplement treatment. Over the first half of the trial steers fed corn-containing supplements tended ($P = 0.11$) to have greater ADG than steers fed SH supplement. The crude protein of the bromegrass pastures decreased ($P < 0.01$; Figure 1) over time, averaging 11.3, 8.5, and 7.4% on d -7, 21, and 49, respectively. As an indicator of nitrogen status of the steers, plasma urea nitrogen was measured. Cattle would be considered deficient in dietary protein with a PUN concentration less than 7 mg/dL. At the onset of the study PUN did not differ ($P = 0.40$) among supplement treatments. However, on d 28 there was a tendency ($P = 0.06$) for the steers fed corn-containing supplements to have lesser PUN than the SH supplemented steers, and the PUN of C40 supplemented steers tended ($P = 0.10$) to be lesser than C20 supplemented steers. Plasma urea nitrogen on d 55 decreased across all treatments, with steers fed C40 supplement having the lowest PUN. This resulted in lesser PUN ($P < 0.01$) in steers consuming corn-containing supplements compared with SH and in C40 vs C20 steers. The decrease in crude protein of the bromegrass pastures may have influenced the decrease in PUN in the treatments. Furthermore, the decrease in the nitrogen status of the steers may explain why there was a lack of effect of corn addition to the supplement on ADG during the second half of the study, because a deficiency in nitrogen can limit nutrient utilization and dry matter intake. Without sufficient nitrogen for microbial protein synthesis the rumen microbes may have been unable to take advantage of the readily available energy from the corn supplements. In conclusion, adding cracked corn at 20 or 40% of a fiber-based energy supplement did not affect forage intake and may have potential to increase growth of grazing cattle when dietary protein is not limiting.

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Table 1. Forage offered, estimated forage intake and residual forage mass of steers grazing bromegrass pastures and supplemented with soyhulls (SH), 80% SH and 20% cracked corn mix (C20) or 60% SH and 40% cracked corn mix (C40) at 1% of BW.

	Treatment[1]				*P*-value[2]		
Item, DM basis	SH	C20	C40	SEM	Trt	SH vs C	C20 vs C40
Forage offered[3], lbs/d	25.2	28.36	27.03	1.641	0.46	0.27	0.59
Forage offered[3], % steer BW	2.97	3.32	3.13	0.181	0.43	0.28	0.49
Estimated forage intake[3,4], lbs/d	13.04	14.63	12.51	1.085	0.41	0.70	0.21
Estimated forage intake[3,4], % BW	1.55	1.69	1.45	0.132	0.48	0.91	0.24
Supplement intake[3], lbs/d	8.04	8.08	8.07	0.266	--	--	--
Residual forage mass[3], lbs/ac	2651	2719	2806	293.5	0.93	0.77	0.84

[1] n = 3 per treatment (6 steers per plot)

[2] Effect of dietary treatment (Trt), SH versus the corn supplements C20 and C40 (C), and C versus hay.

[3] Repeated measures analysis; treatment × month ($P \geq 0.09$); month ($P < 0.01$).

[4] Forage intake was estimated three times during the study by determining forage disappearance in the weekly allocations of forage through strip grazing management.

Table 2. Average daily gain and plasma urea nitrogen (PUN) status of steers grazing bromegrass pastures and supplemented with soyhulls (SH), 80% SH and 20% cracked corn mix (C20) or 60% SH and 40% cracked corn mix (C40) at 1% of BW for 56 d.

	Treatment[1]				*P*-value[2]		
Item	SH	C20	C40	SEM	Trt	SH vs C	C20 vs C40
Initial BW, lbs	767	760	758	27.2	0.98	0.84	0.97
Final BW, lbs	889	907	895	51.3	0.91	0.72	0.77
ADG, lbs/d							
First 28 d	2.32	2.89	2.84	0.496	0.22	0.11	0.91
Second 28 d	2.77	2.64	2.65	0.206	0.89	0.64	0.97
Overall 56 d	2.54	2.76	2.74	0.138	0.50	0.26	0.93
PUN, mg/dL							
d 1	9.41	10.18	10.28	1.412	0.64	0.40	0.93
d 28	9.04	8.44	7.26	0.429	0.07	0.06	0.10
d 55	7.47	7.47	5.95	0.249	<0.01	0.01	<0.01

[1] n = 3 per treatment (6 steers per plot)
[2]Effect of dietary treatment (Trt), SH versus the corn supplements C20 and C40 (C), and C versus hay.

Figure 1. Nutrient content of bromegrass pastures steers strip grazed on and supplemented with soyhulls (SH), 80% SH and 20% cracked corn mix (C20) or 60% SH and 40% cracked corn mix (C40) at 1 % of BW; CP (■) and TDN (◇); treatment ($P \geq 0.65$); day ($P \leq 0.13$); treatment × day ($P \geq 0.43$).