Effects of Replacing a Traditional Growing Diet with a Complete Pelleted Feed on Total Tract Digestibility of Growing Diets

Jana L. Harding, Melissa L. Jolly, Galen E. Erickson, and Jim C. MacDonald

Summary

A digestion study evaluated the effects of replacing traditional growing diets containing 60% untreated corn stover \or 60% alkaline treated corn stover, with one of two types of complete pelleted feeds (Pellet C or Pellet S) containing alkaline treated corn stover and dry distillers grains. Pellet C and S were harvested using different methods. Pellet S had the greatest OM and NDF digestibility, while the untreated stover had the lowest. Pellet C and the treated stover fell intermediate. Replacing a traditional growing diet with a complete pelleted feed resulted in similar or improved diet digestibility, depending on stover harvesting method.

Introduction

Increased crop production has resulted in increased corn residue available to be utilized as feed. Traditionally corn residue has been considered low quality due to its low digestibility, which varies among the different parts of the corn stover. The stalk and cob were the least digestible parts of the corn plant; however, they made up the largest portion (60.11%) of the plant DM (*2012 Nebraska Beef Report*, pp. 11–12). Advancements in corn harvesting methods have allowed producers to alter which parts of the corn stover are baled and used as feed. Corn stover harvested using a John Deere 569 round baler with the Hillco single pass round bale system (primarily husk, cob, and leaf baled) compared to traditional harvesting methods resulted in an improvement in feed efficiency (*2015 Nebraska Beef Report*, pp. 42–44). Additionally, digestibility of corn residue can be improved with processing and alkaline treatment. A previous study found that feeding a complete pelleted feed containing CaO treated corn stover and distillers by-products resulted in increased ending BW, ADG, and DMI; however, the pellet negatively impacted F:G compared to the un-pelleted diet (*2015 Nebraska Beef Cattle Report*, pp. 36–37). Therefore, the objective of this study was to evaluate the effects of corn stover harvesting method, chemical treatment, and processing on total tract digestibility of growing cattle.

Procedure

Six steers (initial BW = 788 ± 15 lb) were utilized in a 4 × 6 Latin square with four treatments fed each period (Table 1). Steers were assigned randomly to one of four treatments using a row × column transformation. The negative control (NEGCON) consisted of 60% untreated corn stover, 18% modified distillers grains plus solubles (MDGS), 18% distillers solubles, and 4% supplement. The positive control (POSCON) contained 60% CaO treated corn stover, 18% MDGS, 18% distillers solubles, and 4% supplement. The third treatment (Pellet C) contained a complete pelleted feed containing CaO treated corn stover, solubles, dry distillers grains (DDG), and supplement in the same proportion as the control diets. The fourth treatment (Pellet S) was also a complete pelleted feed containing CaO treated corn stover, solubles, DDG, and supplement in the same proportion as the control diets. The difference between pellets A and B were the harvesting method used to collect the corn stover.

The corn stover used in Pellet C was harvested using a rake and conventional baler, while the corn stover used in Pellet S was harvested using a single pass round baler pulled behind the combine (John Deere, Moline, IL; Hillco Technologies, Inc.,Nexperce, ID). Pellet C and S did not

Table 1. Diet (DM basis) fed to growing steers to evaluate the effects of replacing a traditional growing diet with a CaO treated stover and DDG pelleted complete feed on total tract digestibility

Ingredient	NEGCON	POSCON	Pellet C	Pellet S
MDGS	18	18	—	—
Solubles	18	18	—	—
Corn Stover	60	—	—	—
CaO Treated Corn Stover	—	60	—	—
Pellet C[a]	—	—	100	—
Pellet S[b]	—	—	—	100
Supplement[c]	—	—	—	—
Fine Ground Corn	2.408	3.524	3.524	3.524
Limestone	1.116	—	—	—
Salt	0.300	0.300	0.300	0.300
Tallow	0.100	0.100	0.100	0.100
Beef Trace Minerals[d]	0.050	0.050	0.050	0.050
Vitamin A-D-E[e]	0.015	0.015	0.015	0.015
Rumensin-90[f]	0.011	0.011	0.011	0.011

[a]Contained corn stover harvested conventionally.
[b]Contained corn stover harvested with a Hillco single pass round bale system.
[c]Supplment supplied at 4% of dietary DM.
[d]Premix contained 10% Mg, 6% Zn, 4.5% Fe, 2% Mn, 0.5% Cu, 0.3% I, and 0.05% Co.
[e]Premix contained 1,500 IU of vitamin A, 3,000 IU of vitamin D, and 3.7 IU of vitamin E·g-1.
[f]Formulated to supply 200 mg/hd/d.

contain corn stover harvested from the same field; however, fields were in the same region. After the corn stover was harvested using the different methods, bales were taken to Pellet Technology (Gretna, NE) and processed. Both pellets C and S were produced by processing the corn stover to a smaller particle size, hydrating it with distillers solubles, treating with CaO, mixing in DDG, and pelleting the mixture. Corn stover used in the NEGCON and POSCON treatments was harvested from the same location as the stover used to produce Pellet C. The corn stover used in the POSCON and NEGCON treatments was processed through a tub grinder fitted with a 3 inch i.d. screen. The POSCON corn stover was then treated with 5% CaO (DM basis), hydrated with water (targeting 50% DM), and mixed in a Roto-Mix feed truck. The treated corn stover was then dispensed into 200 L barrels and stored for 7 d prior to feeding to ensure the treatment process was complete. Calcium oxide used to treat the corn stover in the POSCON treatment was the same CaO used to treat the stover within pellets C and S.

Each period was 14 d in length consisting of a 9-d adaptation and a 5-d collection. During the first 7 d of the adaptation phase, steers were fed *ad libitum* intake. The remaining 2 d the steers were fed 98% of *ad libitum* intake to minimize refusals. Steers remained at 98% *ad libitum* intake for the 5 d collection period. Steers were housed in individual slatted floor pens. All steers were fitted with total fecal collection bags at the start of the collection period (d 10) to measure total fecal output. Bags were emptied twice daily (0700 and 1600 h). Once the bags were emptied, feces were weighed, and both morning and afternoon collections were composited by day for each steer. Composites were made by mixing the morning and afternoon collection times in a mixer, and then sub-sampling the mixture. Two sub-samples of the fecal day composite were taken. One sub-sample was dried in a 60°C forced air oven to calculate total fecal output on a DM basis, while another sub-sample was freeze dried, and ground through a Wiley mill (1-mm screen). The freeze dried and ground day composites were composited on a dry weight basis by steer each collection period. Fecal samples were analyzed for OM and NDF to estimate total tract digestibility.

Table 2. Nutrient composition of dietary treatments[a]

	NEGCON	POSCON	Pellet C	Pellet S
DM, %	64.55	46.32	86.60	85.90
OM, %	91.36	86.40	90.47	90.28
NDF, %	61.24	55.42	48.26	48.22
CP, %	15.47	15.18	21.46	20.55

[a]DM basis

Table 3. Effects of dietary treatment on intake and total tract digestibility of DM.

	NEGCON	POSCON	Pellet C	Pellet S	SEM	P-Value
DM						
Intake, lb/d	13.16	12.51	11.76	11.84	0.77	0.42
Total tract digestibility, %	64.69[c]	67.98[b]	71.87[a]	74.4[a]	1.15	< 0.01
OM						
Intake, lb/d	11.47	10.62	10.41	10.49	0.67	0.55
Total tract digestibility, %	67.58[c]	71.67[b]	73.32[ab]	75.55[a]	1.07	< 0.01
NDF						
Intake, lb/d	7.98[a]	6.89[a]	5.62[b]	5.66[b]	0.44	< 0.01
Total tract digestibility, %	54.36[b]	60.09[ab]	59.73[ab]	63.93[a]	2.24	< 0.01

[abc]Means with differing superscripts are different.

Individual ingredients were dried in 60°C forced air oven weekly to ensure that accurate DM's were used when mixing dietary treatments. Samples of individual ingredients were taken prior to mixing diets, composited by period, freeze dried, and ground through a 1-mm screen using a Wiley mill. Feed samples were analyzed for OM, CP, and NDF to calculate nutrient composition of dietary treatments (Table 2). Nutrient composition of dietary treatments and feces were used to calculate total tract digestibility of DM, OM, and NDF using the following equation: 1-((fecal output * nutrient concentration) / (feed intake * nutrient concentration)).

All data were analyzed using the MIXED procedures of SAS (SAS Inst., Inc., Cary, N.C.). Steer was the experimental unit. The model included period as a fixed effect. Steer and steer * treatment were included in the random statement. Probabilities less than or equal to alpha ($P \leq 0.05$) were considered significant.

Results

There was no significant difference ($P = 0.42$) observed for DMI between all four treatments (Table 3). The DMI response to the pelleted treatments differed from previous observations with similar products in production settings. A pellet similar to Pellet C resulted in an increased DMI compared to the un-pelleted treatment (*2015 Nebraska Beef Cattle Report*, pp. 36–37). Increased intake for pelleted diets may be attributed to a greater passage rate due to smaller particle size. The increased passage rate may result in reduced total tract digestibility. However, Pellet C and Pellet S had the greatest DMD (74.4 and 71.87%, respectively), and the NEGCON (64.69%) had the least DMD ($P < 0.01$). The POSCON fell intermediate (67.98%). Total tract digestibility of OM followed a similar pattern, with Pellet S (75.55%) having the greatest OMD and the NEGCON (67.58) having the least ($P < 0.01$). However, the POSCON treatment and Pellet C treatment had similar OM digestibilities (71.67 and 73.32%, respectively; $P = 0.22$). Similar to DMI, there was no difference observed ($P = 0.55$) for OM intake between the four treatments.

Intake of NDF was different among the four treatments ($P < 0.01$). The NEGCON and POSCON treatments consumed 7.98

and 6.89 lb of NDF/d, respectively. Both Pellet C and Pellet S treatments consumed 5.62 and 5.66 lbs of NDF/d, respectively. The lower NDF intake of the POSCON, Pellet C, and Pellet S treatments was due to lower dietary NDF (Table 2), which is a result of the CaO treatment solubilizing portions of the fiber in the corn stover. Steers on the Pellet S treatment had the greatest (63.93%) NDF digestibility, while steers on the NEGCON treatment (54.36%) had the least ($P \leq 0.01$). The POSCON and Pellet C treatments fell intermediate (60.09 and 59.73%, respectively). Chemically treating corn residue solubilizes portions of the fiber content. Consequently, solubilized fiber is not accounted for in the NDF digestibility of the POSCON, Pellet C, or Pellet S treatments. The residue in the Pellet C and POSCON treatments is the same residue in the NEGCON. Therefore, the NDF content of the untreated corn stalks was used to recalculate dietary NDF of the POSCON and Pellet C treatments. Re-calculating dietary NDF to include the solubilized fiber resulted in increased NDF digestibility values for the POSCON and Pellet C treatments (64.0% and 67.5%, respectively).

In conclusion, replacing a traditional growing diet with a complete pelleted feed resulted in similar or improved digestibilities. Harvesting method (i.e. plants parts harvested) can also impact digestibility, as Pellet S (contained corn stover harvested with a single-pass round baler behind the combine) had greater OM and NDF digestibility compared to Pellet C (contained corn stover harvested using a rake and conventional baler).

Jana L. Harding, research technician

Melissa L. Jolly, research technician

Galen E. Erickson, professor

Jim C. MacDonald, associate professor, University of Nebraska-Lincoln Department of Animal Science