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Summary

A digestion study was conducted to evaluate the effects of replacing dry-rolled corn (DRC) with a pelleted feed containing treated corn stover, solubles, and distillers grains (DDG). Replacing DRC with the pelleted feed had no effect on intakes. Similarly, total tract digestibilities of DM, OM, or NDF were not affected by dietary treatment. There was a tendency for differences in average ruminal pH between treatments; however, proportions of acetate, propionate, and butyrate were not impacted. It was concluded that the DRC could be replaced with a pelleted stover and distillers in the finishing diet without altering total tract digestion.

Introduction

Over the past 10 years there has been a change in agriculture, with approximately 40-45% of corn production in the U.S. currently being used for ethanol. Increased cereal grain prices resulting from these changes in agriculture have caused livestock producers to find ways to feed less corn in their diets rather than more corn. The increased corn prices also have caused marginal cropland to be converted from forage production to crop production, which has increased the price of forage as well as increased the abundance of corn residue available. Therefore, non-traditional feeds such as corn milling byproducts and low quality forages from crop residues are commonly used in beef cattle diets. Pellet Technology USA (Gretna, Neb.) has developed a proprietary pelleted feed consisting of DGS and treated corn stover to replace corn in the common finishing diet. Their goal is to add value to the abundant corn residue by processing it and producing a pellet that can be shipped and stored like corn. Therefore, the objective of this study was to evaluate the effects of replacing dry-rolled corn (DRC) with a pelleted feed containing treated corn stover and DGS.

Procedure

Four ruminally fistulated steers were utilized in a 4 x 6 Latin rectangle with four treatments fed each period (Table 1). The first treatment was the control (CON) treatment consisting of 50.3% DRC, 40% MDGS, 5% untreated corn stover, and 1.7% limestone. The next three treatments replaced 25% of DRC, but with different feeds. One treatment contained only a calcium oxide (CaO) treated stover pellet (Pellet-A) replacing DRC. The second treatment contained a blend of CaO treated corn stover, DDG, and solubles in a pellet (Pellet-B) replacing DRC. The last treatment (COMP) replaced 25% of DRC with 10% treated stover pellet fed in the Pellet-A treatment, 10% DDGS, and 5% solubles. Limestone was added to the CON and COMP treatment to meet dietary requirements. All diets contained 3% dry meal supplement formulated to supply 375 mg/head/day Rumensin® and 90 mg/head/day Tylan®.

The pellets fed in the Pellet-A and COMP treatment were processed by

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Table 1. Diet (DM basis) fed to finishing steers to evaluate the effect of replacing 25% DRC with a CaO treated corn stover and DDG pellet on total tract digestibility.

Ingredient	Control	Pellet-A	COMB	Pellet-B
DRC	50.3	27	25.9	27
MDGS	40	40	40	40
Corn stalks	5	5	5	5
Treated stover pellet[1]	—	25	10	—
DDGS	—	—	10	—
Solubles	—	—	5	—
Pellet[2]	—	—	—	25
Limestone	1.7	—	1.1	—
Supplement[3]				
Fine ground corn	2.534	2.534	2.534	2.534
Salt	0.300	0.300	0.300	0.300
Tallow	0.075	0.075	0.075	0.075
Beef trace minerals[4]	0.050	0.050	0.050	0.050
Vitamins A-D-E[5]	0.015	0.015	0.015	0.015
Rumensin-90[6]	0.016	0.016	0.016	0.016
Tylan-40[7]	0.009	0.009	0.009	0.009

[1]Stover through Pellet Technology grinding process treated with CaO and water and pelleted.
[2]Pellet containing CaO treated corn stover and DDG produced by Pellet Technology.
[3]Supplement formulated to be fed at 3% of dietary DM.
[4] Premix contained 10% Mg, 6% Zn, 4.5% Fe, 2% Mn, 0.5% Cu, 0.3% I, and 0.05% Co.
[5] Premix contained 1,500 IU of vitamin A, 3,000 IU of vitamin D, and 3.7 IU of vitamin E•g-1.
[6]Formulated to supply 375 mg/head/day.
[7]Formulated to supply 90 mg/head/day.

hydrating corn stover with water, treating the stover with CaO, and pelleting the mixture. The pellets fed in the Pellet-B treatment were processed by hydrating corn stover with solubles instead of water, treating the stover with CaO, mixing in DDG, and pelleting the mixture. Nutrient composition of dietary treatments varied due to different feeds replacing DRC in the Pellet-A, Pellet-B, and COMB treatments (Table 2).

Each period was 14 days in length consisting of a 9-day adaptation and a 5-day collection. Steers were housed in individual slatted floor pens and fed once daily at *ad libitum* intake. Titanium dioxide (10 g/day) was dosed intraruminally at 0800 and 1600 hours on days 3 to 14. Fecal grab samples were collected at 0800, 1200, and 1600 hours on days 10 to 14. Samples were then composited by day, freeze-dried, and composited by steer each collection period. Fecal samples were analyzed for titanium dioxide concentration to predict DM excretion. Fecal and diet samples were analyzed for DM, OM, and NDF to estimate total tract digestibility. Rumen samples were collected at 0800, 1200, and 1600 hours on days 10 to 14 and analyzed for volatile fatty acid (VFA) concentration. Wireless pH loggers (Dascor, Inc., Escondido, Calif.) were placed in the rumen on day 10 prior to feeding, and recorded ruminal pH every minute until day 14.

Intake and digestibility data were analyzed using the MIXED procedures of SAS (SAS Institute, 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. Volatile fatty acid and pH data were analyzed as repeated measures using the GLIMMIX procedures of SAS.

Results

There were no ($P \geq 0.15$) differences observed for DM, OM, or NDF intakes (Table 3) between the four treatments. Similarly, treatment did not affect the total tract digestibilities of DM, OM, or NDF ($P \geq 0.50$). There was a tendency ($P = 0.09$) for differences in average ruminal pH, with Pellet-A having the greatest average pH (6.01), Pellet-B having the lowest average pH (5.30), and the CON and COMB falling intermediate (Table 4). Correspondingly, there was a difference ($P < 0.05$) in maximum ruminal pH recorded, with treatment differences following the same trend as the average ruminal pH data. These differences in pH are attributed to the differing composition of the two pellets (Table 5). The treatment with the greatest ruminal pH, Pellet-A, contained 25% of the pelleted CaO and water treated stover (pH = 7.0). The treatment with the lowest ruminal pH, Pellet-B, contained 25% of the pellet consisting of DDG and corn stover treated with solubles and CaO (pH = 6.0). Dietary treatment had a tendency ($P = 0.06$) to impact minimum ruminal pH recorded, with the CON and Pellet-B having the lowest

Table 2. Nutrient composition of dietary treatments.

	Control	Pellet-A	COMB	Pellet-B
DM, %	64.6	63.6	60.6	63.8
OM, %	94.0	90.8	91.2	92.2
NDF, %	20.2	28.3	26.3	25.8
CP, %	16.9	16.0	19.1	19.9

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

	Treatment[1]					
Item	Control	Pellet-A	COMB	Pellet-B	SEM	*P*-value
DM						
Intake, lb/day	22.26	16.42	18.72	18.78	2.55	0.21
Total tract digestibility, %	75.95	74.27	73.86	77.46	2.62	0.71
OM						
Intake, lb/day	20.88	14.90	17.01	17.34	2.36	0.15
Total tract digestibility, %	78.59	78.81	77.40	79.98	2.27	0.86
NDF						
Intake, lb/day	5.49	6.44	5.75	5.69	0.71	0.32
Total tract digestibility, %	62.35	72.63	68.35	68.11	4.74	0.50

[1]Control = 40% MDGS 50% DRC; Pellet-A = 25% treated stover pellet; COMB = 10% treated stover pellet, 10% DDGS, and 5% Solubles; Pellet-B = 25% treated stover/DDG pellet.

Table 4. Effect of dietary treatment on ruminal pH.

	Treatment[1]					
	Control	Pellet-A	COMB	Pellet-B	SEM	F-test
Average pH	5.54[ab]	6.01[a]	5.56[ab]	5.30[b]	0.16	0.09
Minimum pH	4.85[b]	5.38[a]	5.04[ab]	4.71[b]	0.14	0.06
Maximum pH	6.30[ab]	6.66[a]	6.29[ab]	5.96[b]	0.13	0.03
Variance	0.097	0.082	0.069	0.083	0.017	0.74

[a-d] means with differing superscripts are different.
[1]Control = 40% MDGS 50% DRC; Pellet-A= 25% treated stover pellet; COMB= 10% treated stover pellet, 10% DDGS, and 5% Solubles; Pellet-B=25% treated stover/DDG pellet.

Table 5. Nutrient composition of Pellet A and B.

%, DM basis	Pellet A	Pellet B
DM	82.70	84.30
OM	79.11	85.17
CP	5.06	20.65
NDF	47.48	35.7

Table 6. Effects of dietary treatment on rumen volatile fatty acid proportions.

	Treatment[1]					
	Control	Pellet-A	COMB	Pellet-B	SEM	*P*-value
Acetate, mMol/100 mMol	54.14	56.32	54.37	54.39	1.57	0.62
Propionate, mMol/100 mMol	27.32	24.84	28.01	26.26	2.00	0.51
Butyrate, mMol/100 mMol	11.78	12.16	11.39	13.12	0.87	0.36
Acetate : Propionate	2.32	2.42	2.01	2.23	0.26	0.55

[a-d]Means with differing superscripts are different.
[1]Control = 40% MDGS 50% DRC; Pellet-A= 25% treated stover pellet; COMB= 10% treated stover pellet, 10% DDGS, and 5% Solubles; Pellet-B=25% treated stover/DDG pellet.

minimum ruminal pH recorded (4.85 and 4.71, respectively), while Pellet-A had the greatest (5.38, respectively). Dietary treatment had no effect ($P \geq 0.36$) on ruminal acetate, propionate, or butyrate molar proportions (Table 6). Correspondingly, acetate to propionate ratio (A:P) was not influenced by dietary treatment ($P = 0.55$).

Throughout the duration of the study it was observed that the pellets treated with CaO and water were not as aerobically stable as the pellets treated with solubles and CaO. The CaO and water pellets tended to mold when stored, while the pellets treated with CaO and solubles were able to be stored at room temperature without any mold. Pellet A was stored in the cooler to minimize/eliminate any mold that was occurring.

In conclusion, replacing DRC with the pelleted stover and distillers had some impact on ruminal pH. However, using the pelleted treated corn stover and DDGS to replace DRC had no effect on intake or total tract digestibility. These data suggest that the pelleted corn residue and distillers could be a viable option for replacing DRC in finishing diets.

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