Metabolism of Finishing Diets Containing Condensed Distillers Solubles and WDGS

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Summary

A metabolism study was conducted to evaluate the effects of feeding wet distillers grains (WDGS) and condensed distillers solubles (CDS), both separately and in combination, on the metabolism characteristics of feedlot steers. Diet had no impact on nutrient digestibility. Average ruminal pH was lower for steers fed CDS than for those fed WDGS alone, and steers fed WDGS spent less time below pH 5.6 than steers fed diets with no WDGS. Inclusion of CDS decreased ruminal acetate concentration and acetate to propionate ratio compared to diets with less or no CDS.

Introduction

Previous research (*2012 Nebraska Beef Cattle Report,* pp. 64-65) indicates that relatively high levels of condensed distillers solubles (CDS) can replace a portion of corn in the diet while improving finishing performance. Additionally, distillers solubles are higher in fat, lower in protein, and competitively priced. Thus, the opportunity may exist to include CDS alone or in combination with wet distillers grain plus solubles (WDGS) in feedlot diets. Limited data have been collected on the metabolic characteristics of diets containing blends of WDGS and CDS, but previous research has shown that steers fed CDS have lower ruminal pH and greater DM digestibility than steers fed corn. Therefore, the current study was conducted to determine effects of feeding WDGS and CDS, both separately and in combination, on metabolism characteristics of steers on finishing diets.

Table 1. Dietary treatments utilizing combinations of WDGS and CDS (DM basis).

	Treatment[1]				
Ingredient, %	CON	20WDGS	27CDS	LoMix	HiMix
Dry-rolled corn	43.75	33.75	30.25	29.5	25.25
High-moisture corn	43.75	33.75	30.25	29.5	25.25
WDGS	—	20.0	—	20.0	20.0
CDS	—	—	27.0	8.5	17.0
Alfalfa Hay	7.5	7.5	7.5	7.5	7.5
Supplement	5.0	5.0	5.0	5.0	5.0
Diet					
Fat, %	4.1	5.3	7.4	6.3	7.4
NDF, %	15.3	19.5	14.2	19.2	18.9

[1]CON = corn-based control; 20WDGS = 20% wet distillers grains diet; 27CDS = 27% condensed distillers solubles diet; LoMix = 20% WDGS plus 8.5% CDS; HiMix = 20% WDGS plus 17% CDS.

Procedure

Five ruminally cannulated steers were utilized in a 5 × 5 Latin Square designed study. Steers were assigned randomly to one of five treatments (Table 1). The control (CON) diet was a dry-rolled and high-moisture corn-based diet with no byproduct. One diet contained 20% WDGS (20WDGS). Another diet contained 27% CDS (27CDS), a level found to be near the optimum inclusion in diets containing no other byproducts (*2012 Nebraska Beef Cattle Report,* pp. 64-65). The final two diets were blends of 20% WDGS and either 8.5% CDS (LoMix), or 17% CDS (HiMix). The level of CDS in HiMix blend was chosen so that CDS and HiMix diets would be isofat, with dietary fat at 7.4% of diet DM. All diets contained 7.5% alfalfa hay and Rumensin®, thiamine, and Tylan® at 300, 130, and 90 mg per steer daily, respectively.

Steers were housed in individual, slatted floor pens and fed once daily at *ad libitum* intake. The CDS fed for the entire trial were from a single load (BioFuel Ethanol Energy Corp., Wood River, Neb.) and were 36% DM, 16.6% fat, and 7.9% NDF. The WDGS used in the trial (Abengoa Bioenergy, York, Neb.) were 35% DM, 10.6% fat, and 33% NDF.

Period length was 18 days with a 13-day adaptation period. Chromic oxide (7.5 g/dose) was dosed intraruminally at 0700 and 1700 hours on days 10 to 18. Fecal grab samples were collected at 0700, 1200, and 1700 hours on days 14 to 18, composited by steer and period and used for calculation of fecal output. Fecal samples and diet ingredients were analyzed to determine intake of DM, organic matter (OM), NDF, and fat. Fecal samples were analyzed for chromium to determine DM excretion, and from this, nutrient digestibility could be calculated. Rumen fluid samples were collected at 0, 3, 6, 9, 12, and 15 hours post-feeding on day 18 and analyzed for volatile fatty acid profile. Wireless pH probes (Dascor, Inc., Escondido, Calif.) collected pH measurements continuously for the entire period, with the last 7 days used for rumen pH analysis.

Ruminal pH data were analyzed as a crossover design using the GLIMMIX procedure of SAS (SAS Inst., Inc., Cary, N.C.) , and the compound symmetry covariance structure was used with day as a repeated measure. The MIXED procedure was used to analyze intake, digestibility, and VFA profile. An unstructured covariance structure was used for VFA analysis with time as a repeated measure. Steer

Table 2. Effects of dietary treatment on intake and total tract digestibility of DM, organic matter, fat, and NDF.

	Treatment[1]						
Item	CON	20WDGS	27CDS	LoMix	HiMix	SEM	*P*-value
DM							
Intake, lb/day	27.5	26.3	25.1	27.8	28.8	2.6	0.87
Total tract digestibility, %	79.6	79.4	79.0	78.2	81.9	3.0	0.90
OM							
Intake, lb/day	25.7	24.2	23.0	25.4	26.4	2.4	0.87
Total tract digestibility, %	80.5	80.3	80.4	79.1	82.9	2.9	0.89
NDF							
Intake, lb/day	4.2[b,c]	5.1[b]	3.6[a,c]	5.3[b]	5.4[b]	0.4	0.02
Total tract digestibility, %	50.6	53.8	49.7	54.7	62.3	7.6	0.71
Fat							
Intake, lb/day	1.1a	1.4[a]	1.9[b]	1.8[b]	2.1[b]	0.1	<0.01
Total tract digestibility, %	89.0	86.9	88.1	79.0	89.5	4.4	0.46

[1]CON = corn-based control; 20WDGS = 20% wet distillers grains diet; 27CDS = 27% condensed distillers solubles diet; LoMix = 20% WDGS plus 8.5% CDS; HiMix = 20% WDGS plus 17% CDS.

Table 3. Effects of dietary treatment on ruminal pH parameters.

	Treatment[1]						
Item	CON	20WDGS	27CDS	LoMix	HiMix	SEM	*P*-value
Average pH	5.26[a]	5.55[b]	5.34[a,c]	5.48[b,c]	5.31[a,c]	0.13	0.04
Maximum pH	6.06	6.22	6.10	6.33	6.13	0.13	0.34
Minimum pH	4.79	5.02	4.89	4.93	4.83	0.12	0.16
pH change	1.33	1.25	1.27	1.45	1.27	0.11	0.66
pH variance	0.099	0.071	0.078	0.100	0.074	0.015	0.43
Time < 5.6, min/day	1153[a]	885[b,c]	1170[a]	878[b,c]	1080[a,c]	120	0.02
Area < 5.6, min/day	667[b,c]	329[a]	488[a,c]	356[a]	508[a,c]	133	0.06

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Table 4. Effects of dietary treatment on rumen volatile fatty acid parameters.

	Treatment[1]						
Item	CON	20WDGS	27CDS	LoMix	HiMix	SEM	*P*-value
Total, mM	116.0	115.8	124.7	108.5	117.6	7.7	0.70
Acetate, mol/100 mol	50.9[a]	51.3[a]	47.0[b,c]	53.4[a]	49.7[a,c]	1.6	0.09
Propionate, mol/100 mol	33.9	35.5	36.9	28.8	36.8	3.0	0.31
Butyrate, mol/100 mol	9.7	8.8	8.8	11.9	11.5	2.2	0.78
Acetate:Propionate	1.66	1.79	1.39	1.91	1.34	0.22	0.32

[1]CON = corn-based control; 20WDGS = 20% wet distillers grains diet; 27CDS = 27% condensed distillers solubles diet; LoMix = 20% WDGS plus 8.5% CDS; HiMix = 20% WDGS plus 17% CDS

was treated as a random effect for all analyses. Treatment differences were considered significant at $P \leq 0.10$.

Results

No differences due to treatment were observed for DMI or OM intake; however, intakes were numerically highest for steers fed HiMix and lowest for steers fed 27CDS. Intake of NDF was greater for steers fed diets containing WDGS than for steers fed CON and 27CDS diets ($P = 0.02$), due to the higher NDF content in WDGS. Similarly, fat intake was higher for steers fed diets containing CDS than for steers fed CON and 20WDGS diets, due to the high fat content of CDS. Treatment had no effect on digestibility of DM, OM, NDF, or fat (Table 2).

Average ruminal pH was lower for steers fed diets containing CDS than for steers fed WDGS alone ($P = 0.04$). Likewise, steers fed diets not containing WDGS spent a greater amount of time below pH 5.6 than steers whose diets included WDGS (Table 3). Ruminal concentration of acetate was lower for steers fed higher levels of CDS (27CDS and HiMix) than for steers fed WDGS only. While concentration of propionate was not impacted by diet, acetate to propionate ratio was numerically lower for steers fed diets with the highest CDS inclusions (27CDS and HiMix), indicating a slight shift away from acetate production (Table 4).

These data suggest that feeding a combination of 20% WDGS and up to 17% CDS, or 27% CDS alone, has no impact on digestibility of the ration and is a viable option to replace a portion of dry-rolled and high-moisture corn in finishing diets.

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