Evaluation of Corn Distillers Solubles on Finishing Steer Performance

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Summary with Implications

A finishing study was conducted to evaluate the effects of feeding 0, 8, 16, or 20% corn distillers solubles (CDS), as well as the effects of feeding a combination of 16% CDS and 20% wet distillers grains plus solubles (WDGS) to replace a blend of dry-rolled and high-moisture corn on finishing steer performance. As inclusions of CDS increased, ADG linearly increased and F:G linearly decreased. Feeding value of CDS at 20% inclusion was determined to be 147% compared to the corn blend. The addition of WDGS resulted in a decrease in DMI with similar ADG, resulting in a decrease in F:G. Feeding a combination of CDS and WDGS resulted in a feeding value of 161% compared to corn. Feeding CDS up to 20% or in combination with WDGS displaces corn in finishing diets and improves ADG and F:G.

Introduction

Recent changes to ethanol production, involving the extraction of oil, changes the nutrient profile of corn distillers solubles (CDS). Due to the market value of corn oil, 75% of the ethanol plants are centrifuging and marketing corn oil independently. Previous research with CDS, without oil removal, reported a quadratic decrease in F:G when CDS displaced corn in finishing diets (*2012 Nebraska Beef Report,* pp. 64–65). More recent research involving feeding CDS, with oil extraction, has variable results at inclusions below 10% DM in finishing diets. Therefore, CDS after oil extraction may not improve F:G in finishing cattle. Thus, a trial was conducted to evaluate the feeding value of corn distillers solubles compared to corn on performance and carcass characteristics in finishing diets.

Table 1. Diet composition (DM basis) for varying inclusion of distillers solubles

	CDS[1], % Inclusion				
Ingredient	0	8	16	20	16 + 20[2]
Dry-rolled corn	68	62	55	52	39
High-moisture corn	17	15	14	13	10
Corn distillers solubles	-	8	16	20	16
Wet distillers grains plus solubles	-	-	-	-	20
Alfalfa hay	10	10	10	10	10
Supplement[3]	-	-	-	-	-
Fine Ground Corn	1.169	1.908	2.255	2.603	2.950
Limestone	1.528	1.519	1.518	1.518	1.517
Tallow	0.125	0.125	0.125	0.125	0.125
Urea	1.403	1.040	0.693	0.347	-
Thiamine	-	0.016	0.016	0.016	0.016
Salt	0.300	0.300	0.300	0.300	0.300
Beef Trace Mineral	0.050	0.050	0.050	0.050	0.050
Vitamin A-D-E	0.015	0.015	0.015	0.015	0.015
Rumensin-90®[4]	0.017	0.017	0.017	0.017	0.017
Tylan-40®[5]	0.010	0.010	0.010	0.010	0.010
Nutrient Composition, % of DM					
CP	13.0	13.7	14.4	14.4	18.4
Fat	4.12	4.16	4.24	4.28	6.23
Sulfur	0.13	0.23	0.34	0.39	0.48

[1]CDS=Corn distillers solubles
[2]16 + 20=16% corn distillers solubles + 20% wet distillers grains plus solubles
[3] Supplement fed at 5% diet DM.
[4]Formulated to supply Rumensin-90® (Elanco Animal Health) at 30 g/ton.
[5]Formulated to supply Tylan-40® (Elanco Animal Health) at 8.8 g/ton.

Procedure

A 114-d finishing study was conducted at the Eastern Nebraska Research and Extension Center feedlot in Mead, NE. Six hundred crossbred steers (initial BW = 957 ± 90 lb.) were utilized. Steers were limit fed a common diet at 2.0% of BW for 5 days and weighed for two consecutive days at the beginning of the trial to account for gut fill and establish initial BW. Steers were blocked by BW (n=3), stratified within block, and assigned randomly to pen. Pens were assigned randomly to one of the five treatments with 20 steers/pen and 6 pens/treatment.

Treatments consisted of increasing inclusions of CDS 0, 8, 16, and 20% DM displacing a dry-rolled corn (DRC) and high-moisture corn blend (HMC) (Table 1). A fifth treatment included 16% CDS with 20% wet distillers grains plus solubles (WDGS) to compare normal industry WDGS inclusions with additional CDS, to the performance of the 16% CDS inclusion alone. Steers were adapted to diets over a 21-d step-up period

Table 2. Effects of CDS (corn distillers solubles) inclusion and CDS in combination with WDGS on performance and carcass characteristics.[1]

	CDS, % Inclusion						CDS Effect		WDGS Effect
	0	8	16	20	16 +20[2]	SEM	Lin[3]	Quad[4]	*P*-value
Performance									
Initial BW, lb	960	960	959	958	959	1	0.24	0.49	0.76
Final BW, lb	1,335[c]	1,348[bc]	1,366[a]	1,362[ab]	1,368[a]	5	<0.01	0.40	0.78
DMI, lb/d	25.1	25.2	25.4	24.6	24.8	0.19	0.28	0.06	0.04
ADG, lb	3.42[b]	3.53[b]	3.70[a]	3.67[a]	3.72[a]	0.05	<0.01	0.47	0.73
F:G	7.35[b]	7.14[b]	6.86[a]	6.71[a]	6.66[a]	-	<0.01	0.65	0.08
Energy Values									
NE_m	1.42[d]	1.44[dc]	1.46[bc]	1.47[ab]	1.49[a]	0.01	<0.01	0.93	<0.01
NE_g	0.84[d]	0.85[cd]	0.87[bc]	0.88[b]	0.90[a]	0.01	<0.01	0.95	<0.01
Feeding Values[5]	-	139	146	147	115[6]	-	-	-	-
	-	-	-	-	161[7]	-	-	-	-
Carcass Characteristics									
HCW, lb	841[c]	849[bc]	861[a]	858[ab]	862[a]	3	<0.01	0.40	0.78
LM area, in²	13.1	13.1	13.2	13.2	13.0	0.09	0.11	0.90	0.13
Fat thickness, in	0.49	0.51	0.52	0.51	0.53	0.01	0.05	0.43	0.64
Marbling score[8]	454	460	474	469	461	9	0.15	0.79	0.34
Calculated YG[9]	3.25	3.31	3.34	3.32	3.42	0.04	0.20	0.45	0.18

[1]Superscripts represent the main effect of treatment.
[2]16+20=16% CDS + 20% WDGS
[3]Lin=Linear response to CDS inclusion.
[4]Quad=Quadratic response to CDS inclusion.
[5]Feeding value=% change in feed efficiency/% inclusion by-product.
[6]Feeding value of 16+20 compared to 16.
[7]Feeding value of 16+20 compared to 0.
[8]Marbling score: 400=Slight[00], 450=Slight[50], 500=Small[00], etc.
[9]Calculated as: YG=2.50 + (2.5 * rib fat thickness) + (0.2 * 2.5% KPH) + (0.0038 * HCW)–(0.35 * REA)

where by-product inclusions were held constant, while the corn blend replaced alfalfa hay. The average nutrient profile of the CDS (Aurora Pacific Ethanol, Aurora, NE and Green Plains Ethanol, Wood River, NE) utilized in this study contained 29.7% DM, 30.2% CP, 5.4% fat, and 1.4% S. The average nutrient profile of WDGS (Abengoa Ethanol, York, NE) was 30.6% DM, 37.9% CP, 14.4% fat, and 0.8% S. Incidences of sulfur-induced polioencephalomalacia (n=4) were observed during the first 60 days of the trial due to dietary concentrations of sulfur of 0.50% or greater for the 24% CDS diet, as well as the 16% CDS with 20% WDGS combination diet. Steers diagnosed were removed from the trial. Alfalfa hay inclusion was increased from 7.5% to 10%, the original 24% CDS diet was reduced to 20% CDS, 150 mg/steer daily of thiamine was added to all diets containing CDS, and source of CDS was changed. The original source of CDS averaged 1.6% S and the second source of CDS averaged 1.1% S. All diets included alfalfa hay at 10% and dry supplement at 5%. Supplements were formulated to provide 30 g/ton Rumensin® (Elanco Animal Health) and 8.8 g/ton Tylan® (Elanco Animal Health). Thiamine was added to diets containing CDS, but not to the 0% CDS supplement. Urea was added at 1.40% in the 0% CDS supplement and 1.04% in the 8% CDS supplement to ensure rumen degradable protein requirement was met.

On day 1, steers were implanted with Component-TE 200 (Elanco Animal Health). Steers were harvested on day 110 (heaviest 2 blocks) and day 117 (lightest block) at Greater Omaha (Omaha, NE). During harvest, HCW were recorded and a common (63%) dressing percentage was assumed to calculate final BW. Following a 48-hr chill, fat thickness, LM area, and USDA marbling score were recorded.

Data were analyzed using the MIXED procedure of SAS as a generalized randomized block design. Pen was the experimental unit and BW block was analyzed as a fixed effect. Orthogonal contrasts were used to analyze linear and quadratic effects of CDS displacing corn. Due to unequal spacing between treatments, coefficients were determined using the IML function of SAS. A pairwise comparison was used to analyze the effect of the 16% CDS with 20% WDGS diet to that of the 16% CDS diet.

Feeding values for each treatment were calculated by dividing percentage change in G:F by percentage by-product in each respective treatment. Then multiplying that value by 100 and adding 100 gives the feeding value of each inclusion of by-product compared to the DRC and HMC blend. Energy values were calculated for each treatment using equations from the NRC (1996), on a per pen basis. Energy values were analyzed using the MIXED procedure of SAS to establish treatment averages.

Results

Increasing concentrations of CDS increased ADG ($P < 0.01$) and decreased

F:G ($P < 0.01$) linearly. Increased ADG led to HCW and final BW to increase linearly ($P < 0.01$). Cattle tended to decrease DMI ($P = 0.06$) as CDS increased with cattle fed 20% CDS having the lowest DMI, which may be related to sulfur or an increase in NE_g. Addition of WDGS decreased DMI ($P = 0.04$) and tended to improve F:G ($P = 0.08$). Carcass characteristics, except fat depth, were not affected by treatment ($P \geq 0.11$). Fat thickness increased linearly ($P = 0.05$) with increasing concentrations of CDS (Table 2).

Feeding values were 139, 146, and 147% for 8, 16, and 20% CDS inclusions, respectively. Comparing the combination diet (16% CDS with 20% WDGS) to that of the 16% CDS diet, a 115% feeding value was calculated for the WDGS. When comparing the combination diet to the 0% CDS diet, a 161% feeding value was calculated for the two by-products in combination compared to the corn blend. Energy values increased linearly for NE_m and NE_g ($P < 0.01$) as CDS concentrations increased and the addition of WDGS further increased NE_m and NE_g ($P < 0.01$).

Feeding CDS at inclusions up to 20% increases ADG and improves F:G, with feeding values up to 147% compared to corn. Feeding a combination of CDS and WDGS maximized ADG while decreasing DMI, resulting in the lowest F:G, with a feeding value of 161% compared to corn. Energy values increased linearly with increasing CDS concentrations and were maximized in the combination diet. Although dietary sulfur needs to be monitored, the relative response to feeding CDS illustrates a greater energy content compared to corn in finishing diets, despite removal of fat from CDS. Even though fat content has decreased with “new” CDS, these changes do not seem to affect performance of CDS in finishing diets.

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