Varying Proportions and Amounts of Distillers Grains and Alkaline-Treated Forage as Substitutes for Corn Grain in Finishing Cattle Diets

Adam L. Shreck
Cody J. Schneider
Brandon L. Nuttelman
Dirk B. Burken
Galen E. Erickson
Terry J. Klopfenstein
Michael J. Cecava[1]

Summary

A 124-day individually fed finishing study was conducted to evaluate corn grain replacement by distillers grain and 5% CaO treated crop residue. Dietary treatments were two ratios (2:1 or 3:1) of modified distillers grains and treated crop residues (DGCR), two types of treated crop residue (corn stover or wheat straw) at 3:1 ratio, and then with three dry rolled corn (DRC) levels (10%, 25%, 40%; DM basis). Steers fed diets containing as little as 25% corn and 3:1 ratios of distillers grains and CaO treated crop residues can achieve similar F:G compared with cattle fed diets containing 5% roughage and 56% corn.

Introduction

Previous studies have reported similar ADG and F:G when replacing up to 15 percentage (Shreck et al., *2012 Nebraska Beef Cattle Report*, pp. 105-107; pp. 108-109) units of corn with inclusion of 20% CaO treated corn stover or wheat straw in diets containing 40% wet or modified distillers grains. The objective of this trial was to test the maximum amount of corn that could be replaced by distillers grains and treated forage, and whether the ratio of distillers grains to treated residue is an important factor.

Procedure

Sixty yearling steers (initial BW: 885 ± 90.9 lb) were individually fed using Calan gates for 124 days. Steers were blocked (n = 2) by BW and assigned randomly to treatments. Steers were limit fed a 50% sweet bran 50% alfalfa hay (DM basis) diet, at 2% of BW for 5 days, and weighed on three consecutive days for initial BW determination. Steers were implanted with Revealor®-S on day 1. Ten dietary treatments (Table 1) were designed as two 2 x 3 factorials. In the first factorial, factors were ratio of distillers grain and corn stalks (2:1 or 3:1; DG:Stalks) with three dry rolled corn (DRC) levels (10%, 25%, 40%; DM basis). In the second factorial, factors were two types of treated crop residue (corn stalks or wheat straw at 3:1 DGCR), with three DRC levels (10%, 25%, 40%; DM basis). Ratios of DGCR replaced DRC and consisted of modified distillers grains plus solubles (MDGS) and treated corn stover at 2:1 or 3:1 of MDGS and treated wheat straw at 3:1. A control was included that contained 35% MDGS, 5% untreated corn stover, and 56% DRC. All diets contained 4% supplement and were formulated for adequate dietary Ca. Chemical treatment consisted of water, CaO (Granular Standard Quicklime, Mississippi Lime Co, Kansas City, Mo.), and ground residue (3-inch screen) weighed and mixed in Roto-Mix feed trucks. The mixture was calculated to be 50% DM (treated wheat straw and corn stalks used during experiment were: 52.7 and 54.7% DM, respectively) with calcium oxide added at 5% of the forage DM. Feed trucks dispensed treated residue into a silage bag and the treatment process was completed at least seven days prior to feeding. The pH of treated wheat straw and corn stalks averaged 8.16 and 7.29, respectively, throughout the feeding period. Calcium oxide treatment solubilized (relative to untreated) 13.6 and 13.7% of the NDF for treated wheat straw and corn stover, respectively. Orts were assessed weekly and the amount of DM refused was subtracted from the DM offered to calculate DMI. Steers were weighed on the day prior to slaughter and live BW was used to calculate dressing percent [HCW/(live BW*0.96)]. Carcass adjusted final BW was calculated from HCW and a 62% dressed yield was assumed. Carcass adjusted final BW was used to calculate ADG. Data were

Table 1. Diet composition offered to individually fed steers.

		2:1 Stalks			3:1 Stalks			3:1 Wheat Straw		
Ingredient, % of DM	Control	Low	Mid	High	Low	Mid	High	Low	Mid	High
DRC	56.00	10.00	25.00	40.00	10.00	25.00	40.00	10.00	25.00	40.00
Stalks-treated[1]	—	28.66	23.66	18.66	21.50	17.75	14.00	—	—	—
Straw-treated[1]	—	—	—	—	—	—	—	21.50	17.75	14.00
MDGS	35.00	57.33	47.33	37.33	64.50	53.25	42.00	64.50	53.25	42.00
Untreated stalks	5.00	—	—	—	—	—	—	—	—	—
Supplement	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00

[1]Treated with 5% CaO and 50% DM.

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Table 2. Effect of 2:1 or 3:1 distillers grains:corn stalks on steer performance and carcass characteristics.

		2:1 Stalks			3:1 Stalks						
		DRC level, % of DM							DRC[1]		
Item	Control	10%	25%	40%	10%	25%	40%	SEM	Linear	Quad	F-Test
Performance											
Initial BW, lb	882	880	888	885	890	888	879	12.9	—	—	0.99
DMI, lb/day	24.9	25.3	25.2	25.0	24.7	24.3	24.1	0.67	0.52	0.99	0.81
ADG, lb[2]	3.77	3.12	3.27	3.46	3.00	3.48	3.40	0.21	0.07	0.46	0.45
F:G[3]	6.60	8.11	7.71	7.23	8.23	6.98	7.09	—	0.04	0.46	0.27
Live BW[4], lb	1368	1345	1369	1397	1339	1359	1364	23.7	0.08	0.84	0.54
Carcass Characteristics											
HCW, lb	836	799	815	828	795	831	819	17.4	0.12	0.38	0.57
Dressing, %[5]	60.9	59.6	59.6	59.3	59.5	61.3	60.2	0.0068	0.77	0.20	0.36
LM area, in[2]	13.08	13.77	14.65	14.55	15.17	14.07	13.30	0.68	0.34	0.73	0.22
12th Rib fat, in	0.45	0.36	0.40	0.30	0.42	0.42	0.47	0.063	0.86	0.59	0.05
Calc YG	3.20	2.52	2.40	2.23	2.22	2.72	2.97	0.2993	0.36	0.74	0.05
Marbling[6]	500	468	452	452	487	503	472	29.9	0.56	0.73	0.63

[1]Contrast of DRC level pooled across ratio (no interaction found between ratio and corn level; $P > 0.10$).
[2]Calculated from carcass adjusted final BW by HCW/0.62.
[3]Analyzed as G:F, reciprocal of F:G.
[4]Pencil shrink of 4% applied.
[5]Calculated as HCW/Live BW.
[6]400=Slight [00], 500=Small [00].

Table 3. Effect of 3:1 distillers grains:corn stalks or wheat straw on steer performance and carcass characteristics.

		3:1 Stalks			3:1 Wheat Straw						
		DRC level, % of DM							DRC[1]		
Item	Control	10%	25%	40%	10%	25%	40%	SEM	Linear	Quad	F-Test
Performance											
Initial BW, lb	882	890	888	879	891	887	893	12.9	—	—	0.99
DMI, lb/day	24.9	24.7	24.3	24.1	22.8	24.2	24.8	0.64	0.28	0.15	0.29
ADG, lb[2]	3.77	3.00	3.48	3.40	3.17	3.44	3.60	0.22	0.04	0.02	0.41
F:G[3]	6.60	8.23	6.98	7.09	7.19	7.03	6.89	—	0.16	0.13	0.55
Live BW[4],lb	1368	1339	1359	1364	1355	1359	1375	23.2	0.24	0.13	0.82
Carcass Characteristics											
HCW, lb	836	795	831	819	808	827	844	17.2	0.08	0.05	0.46
Dressing, %[5]	60.9	59.5	61.3	60.2	59.8	60.8	61.1	0.0074	0.15	0.18	0.57
LM, area in[2]	13.08	15.17	14.07	13.30	13.28	13.73	13.73	0.73	0.21	0.51	0.29
12th Rib fat, in	0.45	0.42	0.42	0.47	0.45	0.47	0.44	0.070	0.73	0.49	0.99
Calc YG	3.20	2.22	2.72	2.97	2.96	2.91	2.92	0.323	0.15	0.56	0.31
Marbling[6]	500	487	503	472	518	482	470	33.7	0.25	0.23	0.91

[1]Contrast of DRC level pooled across ratio (no interaction found between ratio and corn level; $P > 0.10$).
[2]Calculated from carcass adjusted final BW by HCW/0.62.
[3]Analyzed as G:F, reciprocal of F:G.
[4]Pencil shrink of 4% applied.
[5]Calculated as HCW/Live BW.
[6]400=Slight [00], 500=Small [00].

analyzed using the MIXED procedure of SAS (SAS Inst., Inc.; Cary, N.C.). Initial BW block was considered as a fixed effect. The following tests were included in the data analysis: F-test (used to compare control to the set of each six diets in each factorial), the interaction term of each factorial, which if not significant, data were pooled across corn level, to test linear and quadratic contrasts of corn across 2:1 or 3:1 DG:stalks (factorial 1.) or DG:CR (factorial 2.). An alpha of $P < 0.10$ was considered significant.

Results

No interactions were detected in either factorial; therefore, data were pooled across corn level. Increasing DRC improved ($P = 0.04$) F:G and increased ADG ($P = 0.07$) linearly in treated stalks diets (Table 2). Increasing DRC quadractically increased ($P=0.02$) ADG and HCW ($P = 0.05$), but had no effect on F:G ($P \geq 0.15$) with 3:1 ratios (Table 3). No differences were detected compared to the control. The results of this study suggest that a 3:1 ratio of distillers grains and treated stover or straw, a maximum of 20% treated residue (DM basis), and at least 25% DRC are needed to support feed efficiency similar to that of a 56% DRC, 5% roughage diet.

[1]Adam L. Shreck, research technician; Cody J. Schneider, research technician; Brandon L. Nuttelman, research technician; Dirk B. Burken, research technician; Galen E. Erickson, professor; Terry J. Klopfenstein, professor, University of Nebraska–Lincoln Department of Animal Science, Lincoln, Neb.; Michael J. Cecava, Archer Daniels Midland Company Research Division, Decatur, Ill.

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