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Modifying Different Components of Distillers Grains and the Impact on Feedlot Performance

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Summary

A finishing study evaluated the effects of altering distillers grains composition on feedlot performance and carcass characteristics. Replacing dried distillers grains with isolated bran, solubles, and protein did not result in performance similar to commodity dried distillers grains. Exchanging bran for non-pelleted treated corn stover increased intake, reduced efficiency, and decreased 12th rib fat. Cattle fed pelleted treated corn stover had decreased intakes, but similar efficiency and gain as non-pelleted treated corn stover. As solubles increased and replaced protein, intakes increased quadratically and 12th rib fat linearly decreased however, all other performance and carcass characteristics were not different.

Introduction

The composition of distillers grains has potential to change as corn nutrient components are removed during ethanol production. Advancements in fermentation of fiber via secondary fermentation systems and separation of protein may change the composition of distillers grains and alter use in feedlot diets. Limited data are available characterizing the effects of feeding distillers grains from advanced ethanol production systems. Use of alternative feeds, such as corn residue, have become more common in recent years as a result of higher corn prices. Pellet Technology USA (Gretna, Neb.) has developed a proprietary pelleted feed consisting of distillers grains and treated corn stover to replace corn in finishing beef cattle diets. Pelleted distillers grains and treated corn stover can replace up to 20% of corn in the diet with 40% modified distillers grains plus solubles without affecting performance (2015 Nebraska Beef Cattle Report, pp. 86–87). The objectives of this study were to determine the effect of replacing isolated corn bran

in distillers grains, from the dry milling industry, with calcium oxide treated corn stover and determine the effect of exchanging protein in distillers grains with isolated bran and solubles on feedlot performance and carcass traits.

Procedure

Crossbred yearling steers ($n = 448$; initial BW = 803; SD = 39 lb) were utilized in a randomized block design at the University of Nebraska-Lincoln Agricultural Research and Development Center feedlot located near Mead, Neb. Steers were limited (2% of BW) a diet consisting of 50% Sweet Bran® (Cargill, Blair, Neb), and 50% alfalfa hay (DM basis) for five days before weighing to equalize gut fill. Steers were weighed two consecutive days (d 0 and 1) to establish initial BW. Steers were blocked by BW into three blocks, and stratified by BW within block and assigned randomly to 56 pens. Pens were assigned randomly to one of seven dietary treatments with eight replications per treatment and eight steers per pen. Two blocks contained 2 replications each and the remaining block contained 4 replications.

All byproducts replaced dry-rolled corn in the diet (Table 1). Nutrient composition for byproduct feeds are listed in Table 2. All diets contained 31.5% high-moisture corn, 5.5% alfalfa hay, 4% corn silage, 5% liquid molasses, 5% supplement formulated with 30 g/ton Rumensin® (Elanco Animal Health) and 90 mg/steer of Tylan® (Elanco Animal Health) daily. Treatments included: 1) negative control (CON) with 50% dry-rolled corn; 2) positive control (DDGS) replaced corn at 50% of diet with dried distillers grains plus solubles; 3) pelleted corn stover (PEL-STV), treated with calcium oxide, contained 18.75% solubles, 12.5% treated corn stover, and 18.75% high-protein dried distillers grains plus solubles (HPDDGS) pelleted together; 4) non-pelleted corn stover, treated with calcium oxide, contained treated corn sto-

ver, solubles, and HPDDGS (STV) at same DM inclusion as PEL-STV; 5) component (COMP) included 18.75% solubles, 12.5% isolated bran from the dry milling process and is not purified bran (contains more protein), and 18.75% HPDDGS; 6) component medium protein (COMP-MED) contained 24.4% solubles, 16.2% isolated bran, and 9.4% HPDDGS; and 7) component low protein (COMP-LOW) had 30% solubles and 20% isolated bran (DM basis). The COMP, COMP-MED, and COMP-LOW treatments were designed to determine the optimal proportion of bran, protein, and solubles in distillers grains.

Steers were implanted on d 1 with Ralgro® and re-implanted with Revalor®-200 on d 36 and 38 by implanting four replicates each day. Steers were harvested at a commercial abattoir (Greater Omaha Pack, Omaha, Neb.) on d 149 (2 reps) and d 156 (6 reps). Upon day of harvest, HCW was collected. After a 48-h chill, LM area, fat depth, and marbling scores were collected. Final BW was calculated from carcass weight, adjusted to 63% common dressing percent, for ADG and F:G.

Statistical Analysis

Performance and carcass characteristics were analyzed using the PROC MIXED procedures of SAS (SAS Institute, Inc., Cary, N.C.) with dead or chronic steers removed from analysis. One steer from COMP, one steer from COMP-MED, and three steers from COMP-LOW diets were removed from the experiment due to diagnosis of sulfur induced polioencephalomalacia by the Nebraska Veterinary Diagnostic laboratory. Pen was the experimental unit and block was treated as a fixed effect. Linear and quadratic contrasts were developed for steers fed COMP, COMP-MED, COMP-LOW to determine the impacts of removing protein from distillers grains. Additionally, pairwise comparisons were pre-planned to determine the following effects: 1) replacing corn with commodity

Table 1. Composition of dietary treatments containing modified components of distillers grains fed to steers^a

Ingredient ^b	Treatment						
	CON ^c	DDGS	PEL-STV ^d	STV	COMP	COMP-MED	COMP-LOW
HMC	31.50	31.50	31.50	31.50	31.50	31.50	31.50
DRC	50.00	—	—	—	—	—	—
DDGS	—	50.00	—	—	—	—	—
Solubles	—	—	18.75	18.75	18.75	24.40	30.00
Treated Corn Stover ^e	—	—	12.50	12.50	—	—	—
Isolated Bran ^f	—	—	—	—	12.50	16.20	20.00
High-Protein DDGS	—	—	18.75	18.75	18.75	9.40	—
Alfalfa hay	5.50	5.50	5.50	5.50	5.50	5.50	5.50
Corn Silage	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Liquid Molasses	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Supplement	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Nutrient Composition, %							
DM	81.7	82.2	71.0	70.1	65.3	60.0	54.7
OM	94.4	92.3	91.5	91.5	91.2	90.6	89.9
CP	15.5	22.7	22.0	21.6	22.1	21.5	20.8
NDF	12.2	25.8	23.4	23.7	23.8	22.5	21.3
ADF	8.2	12.8	15.2	15.2	16.9	17.7	18.5
Fat	3.66	6.10	5.28	5.33	5.33	5.14	4.95
Ca	0.78	0.97	0.55	0.58	1.01	1.02	1.03
P	0.26	0.60	0.71	0.72	0.69	0.78	0.87
K	0.74	1.17	1.42	1.43	1.32	1.47	1.61
S	0.16	0.31	0.41	0.41	0.40	0.42	0.44

^aAll values presented on a DM basis.

^bHMC = high-moisture corn; DRC = dry-rolled corn; DDGS = dried distillers grain plus solubles.

^cSupplemented with urea at 1.36% of diet to meet the DIP requirement.

^dTreated corn stover, solubles, and high-protein dried distillers grains plus solubles pelleted by Pellet Technology USA, LLC, Gretna, Neb.

^eCorn stover treated with CaO by Pellet Technology USA, LLC, Gretna, Neb.

^fIsolated bran is isolated from dry milling process and is not purified bran (contains more protein).

distillers grains as an internal validation (CON vs DDGS); 2) replacing distillers grains with a composite product (DDGS vs. COMP); 3) replacing isolated bran with treated corn stover (COMP vs. STV); and 4) pelleting the treated corn stover (PEL-STV vs. STV). Treatment differences were considered significant when $P \leq 0.05$ with tendencies between $P > 0.05$ and $P \leq 0.10$.

Results

Performance and carcass data are provided in Table 3 with results organized below using pre-planned contrasts.

CON vs. DDGS

Steers fed DDGS instead of CON (i.e. replacing 50% dry-rolled corn with DDGS) had increased carcass adjusted final BW (1442 vs. 1390 for DDGS and CON, respectively $P < 0.01$), increased DMI (28.4 vs. 26.2; $P < 0.01$) and increased ADG (4.17 vs. 3.83; $P < 0.01$). However, F:G was not different for CON and DDGS (6.83 vs. 6.80; $P = 0.75$). While feeding distillers grains will normally improve F:G, feeding DDGS leads to a poorer F:G compared to wet or modified distillers grains. Likewise, feeding 50% of diet DM is a high inclusion, which impacts F:G response compared to lower inclusions of distillers grains (2011 *Nebraska Beef Cattle Report*, pp. 50–52). Therefore, no difference in F:G may be due to high inclusion of DDGS. However, 50% inclusion allowed us to include individual feed ingredients at a large enough inclusion rate so that treatment differences could be detected when comparing smaller components of DDGS. Hot carcass weight was 33 lb more for steers fed DDGS ($P < 0.01$) compared to CON. There were no differences ($P = 0.34$) for LM area between CON and DDGS. Steers fed DDGS had increased 12th rib fat (0.63 vs. 0.56; $P < 0.01$) compared to CON. Marbling was not different between DDGS and CON ($P = 0.25$).

DDGS vs. COMP

Replacing DDGS with similar proportions of solubles, isolated bran, and HPDDGS (COMP) decreased final BW (1442 vs. 1373; $P < 0.01$) and decreased DMI (28.4 vs. 27.4; $P = 0.05$). Daily gain was greater for cattle fed DDGS (4.17 vs.

Table 2. Nutrient analysis for ingredients

Nutrient Composition, %	Ingredient ^a						
	DRC ^b	DDGS ^b	Pelleted Treated Corn Stover ^c	Treated Corn Stover ^d	Isolated Bran ^e	High-Protein DDGS	Solubles
DM	89.9	91.1	85.1	77.4	37.0	92.3	35.5
OM	98.4	95.0	87.1	87.1	97.6	97.2	85.3
CP	11.1	34.4	21.8	19.1	24.1	37.7	34.8
NDF	8.7	35.9	52.7	55.1	56.3	40.3	7.4
ADF	2.8	12.1	37.3	39.9	53.1	14.9	4.0
Fat	3.9	8.7	4.5	5.0	5.5	8.4	7.0
Ca	0.03	0.04	1.36	1.61	0.09	0.05	0.09
P	0.26	0.94	0.55	0.65	0.39	0.50	2.23
K	0.38	1.19	1.03	1.36	0.35	0.50	2.94
S	0.10	0.40	0.40	0.42	0.25	0.42	0.92

^aAll values presented on a DM basis.

^bDRC = dry-rolled corn; DDGS = dried distillers grains plus solubles

^cPellet containing CaO treated corn stover, high-protein dried distiller grains plus solubles, and solubles produced by Pellet Technology USA, LLC, Gretna, Neb.

^dStover through Pellet Technology grinding process treated with CaO and water, contains corn stover, solubles, and high-protein dried distillers grains plus solubles.

^eIsolated bran is isolated from dry milling process and is not purified bran (contains more protein).

Table 3. Effects of modifying different components of distillers grains on animal performance and carcass characteristics.

Item	Treatment ^a							SEM	P-value					
	CON	DDGS	PEL-STV	STV	COMP	COMP-MED	COMP-LOW		CON vs. DDGS	DDGS vs. COMP	COMP vs. STV	STV vs PEL-STV	Lin ^b	Quad ^c
Performance														
Initial BW, lb	809	810	810	810	809	809	809	2	0.65	0.65	0.52	0.74	0.11	0.43
Final BW, lb ^d	1390	1442	1359	1376	1373	1400	1386	18	< 0.01	< 0.01	0.88	0.35	0.48	0.19
DMI, lb/d	26.2	28.4	28.1	29.2	27.4	28.1	27.2	0.5	< 0.01	0.05	< 0.01	0.03	0.66	0.04
ADG, lb ^d	3.83	4.17	3.63	3.73	3.72	3.89	3.79	0.11	< 0.01	< 0.01	0.91	0.37	0.58	0.16
F:G ^{d,e}	6.83	6.80	7.74	7.82	7.36	7.23	7.18	—	0.75	<0.01	0.01	0.60	0.22	0.72
Carcass Traits														
HCW, lb	876	909	856	867	865	882	873	11	< 0.01	< 0.01	0.88	0.35	0.48	0.19
LM area, in ^b	13.2	13.0	13.1	13.0	12.9	13.5	13.3	0.04	0.34	0.83	0.79	0.56	0.10	0.08
12th Rib fat, in	0.56	0.63	0.53	0.54	0.60	0.56	0.54	0.01	0.01	0.02	0.02	0.73	0.02	0.67
Marbling ^f	529	511	482	511	514	512	497	16	0.25	0.82	0.82	0.07	0.28	0.67

^aCON = 50% dry-rolled corn; DDGS = 50% dried distillers grains plus solubles; PEL-STV = pelleted 18.75% solubles, 12.5% treated corn stover, and 18.75% high-protein dried distillers grains plus solubles; STV = 18.75% solubles, 12.5% treated corn stover, and 18.75% high-protein dried distillers grains plus solubles; COMP = 18.75% solubles, 12.5% isolated bran, and 18.75% high-protein dried distillers grains plus solubles; COMP-MED = 24.4% solubles, 16.2% isolated bran, and 9.4% high-protein dried distillers grains plus solubles; COMP-LOW = 30% solubles and 20% isolated bran.

^bLin = P-value for the linear response of protein with COMP, COMP-MED, COMP-LOW.

^cQuad = P-value for the quadratic response of protein with COMP, COMP-MED, COMP-LOW.

^dCalculated from carcass weight, adjusted to 63% common dressing percent.

^eAnalyzed as G:F, the reciprocal of F:G.

^fMarbling score: 400 = Small¹⁰.

3.72; $P < 0.01$) compared to COMP. Steers fed DDGS had improved F:G compared to COMP (6.80 vs. 7.36; $P < 0.01$). Hot carcass weights were heavier for cattle fed DDGS compared to COMP (909 vs. 865; $P < 0.01$). There were no differences ($P = 0.83$) in LM area between DDGS and COMP. There was increased 12th rib fat (0.63 vs. 0.60; $P = 0.02$) for DDGS compared to COMP. There were no differences ($P = 0.82$) in marbling between DDGS and COMP. Combining solubles, isolated bran, and HPDDGS did not replicate performance of DDGS.

COMP vs. STV

There were no differences ($P = 0.88$) in final BW between COMP and STV. Exchanging isolated bran for non-pelleted treated corn stover increased DMI (27.4 vs. 29.2; $P < 0.01$) with no difference in ADG (3.72 vs. 3.73; $P = 0.91$) of steers, resulting in steers fed STV being 5.9% less efficient in comparison to steers fed COMP (7.82 vs. 7.36; $P < 0.01$). There was no difference ($P \geq 0.79$) in HCW and LM area between COMP and STV. However, when treated corn stover replaced isolated bran, 12th rib fat decreased (0.54 vs. 0.60; $P < 0.02$). Marbling was not different ($P = 0.82$) for COMP and STV.

PEL-STV vs. STV

There were no differences ($P = 0.35$) for final BW between PEL-STV and STV.

Pelleting the treated corn stover, solubles, and high-protein distillers grains decreased DMI, with steers fed PEL-STV consuming 28.1 lb/d in comparison to 29.2 lb/d for steers fed STV ($P = 0.03$). However, there were no differences between PEL-STV and STV for ADG (3.63 vs. 3.73; $P = 0.37$) and F:G (7.74 vs. 7.82; $P = 0.60$). There were no differences ($P \geq 0.35$) in HCW, LM area, and 12th rib fat between PEL-STV and STV. Marbling had a tendency to decrease for steers fed PEL-STV compared to STV (482 vs. 511; $P = 0.07$).

Linear and Quadratic Responses for COMP, COMP-MED, and COMP-LOW

There were no differences ($P = 0.19$) for final BW between COMP, COMP-MED, and COMP-LOW. As HPDDGS was replaced with solubles and isolated bran between COMP, COMP-MED, and COMP-LOW, DMI quadratically increased ($P = 0.04$) with COMP-MED increasing and COMP-LOW decreasing, compared to COMP. There were no significant differences ($P \geq 0.16$) in ADG and F:G due to changing portion of protein. Decreasing proportions of protein did not affect F:G, perhaps due to solubles concentrations increasing with decreasing protein inclusion. There were no differences ($P = 0.19$) for HCW between COMP, COMP-MED, and COMP-LOW. Removing protein tended to increase LM area quadratically ($P = 0.08$)

and linearly decrease 12th rib fat ($P = 0.02$). There were no differences ($P = 0.28$) for marbling. Displacing half the protein with solubles and isolated bran caused increased DMI and tended to increase LM area. When protein was completely displaced by a combination of solubles and isolated bran (from dry milling), DMI, ADG, and F:G were not different from COMP.

This study suggests that replacing bran normally found in distillers grains with treated corn stover increased intake, resulted in poorer feed conversions, and decreased 12th rib fat. Pelleting treated corn stover decreased intake without impacting F:G or carcass quality. Dried distillers grains increased final BW, ADG, DMI, HCW and 12th rib fat compared to corn based diets. As solubles and isolated bran (from dry milling) replaced protein, DMI quadratically increased and 12th rib fat linearly decreased. Isolated ingredients of distillers grains did not mimic performance of distillers grains suggesting some component(s) was missing.

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