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Effect of Conventional or High Protein Dry Distillers Grains Plus Solubles in Either Dry- Rolled or Steam- Flaked Corn Based Diets on Finishing Performance of Steers

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Summary with Implications

A 2 × 3 factorial finishing study evaluated feeding 0 or 30% high protein distillers grains or conventionally produced distillers in either steam-flaked or dry-rolled corn based diets. Feeding conventional distillers grains in dry rolled corn based diets resulted in improved feed conversion, with no difference between high protein distillers grains as compared to conventional DDGS when included in dry-rolled corn diets. In steam flaked corn-based diets, feeding high protein distillers and conventional distillers tended to increase feed conversion. Feeding conventional distillers or high protein distillers grains resulted in greater DMI and ADG as compared to diets with no distillers inclusion in both dry-rolled and steam-flaked diets. Cattle consuming SFC had lower DMI than DRC, which lead to improved feed conversions as expected. The response to feeding DDGS is different whether replacing dry-rolled corn or steam-flaked corn, but high protein distillers was fairly similar to conventional DDGS.

Introduction

The protein fraction of dry distillers grains plus solubles (DDGS) is partially attributed to the reason cattle have positive performance when fed distillers grains in dry rolled corn (DRC) based diets (*2016 Nebraska Beef Cattle Report*, pp. 124–127). As the ethanol industry has continued to evaluate changes in the process, their ability to fractionate and improve ethanol yields have improved, resulting in a byproduct in which all other nutrients, including protein, become more concentrated. Removal of fiber in the process helps differentiate two distillers products. These new processes will create a byproduct known as high protein DDGS (HiPro), which is approximately 40% crude protein (CP) as compared to conventional DDGS at 30% CP. The value of this new concentrated product and its effect on growth performance as compared to conventional DDGS has not yet been evaluated. Therefore, the objective of this study was to evaluate the feeding value of HiPro as compared to conventional DDGS in beef cattle finishing diets and how the feeding value is affected when fed in either DRC or steam flaked corn (SFC) based diets. The HiPro DDGS is generally targeted at non-ruminant species, therefore, fed as DDGS. In addition, many yards that steam-flake corn, utilize DDGS as a protein source as they tend to be further away (Southern Plains).

Table 1. Diet composition (DM basis) for steers fed dry-rolled or steam-flaked corn with 0 or 30% distillers grains products.

	Treatment[1]					
	CON		DDGS		HiPro	
Ingredient	DRC	SFC	DRC	SFC	DRC	SFC
Dry-Rolled Corn	87.0	-	57.0	-	57.0	-
Steam Flaked Corn	-	87.0	-	57.0	-	57.0
DDGS	-	-	30.0	30.0	-	-
High Protein DDGS	-	-	-	-	30.0	30.0
Sorghum Silage	8.0	8.0	8.0	8.0	8.0	8.0
Dry Supplement[2]	5.0	5.0	5.0	5.0	5.0	5.0
Nutrient Composition[3]						
Crude Protein, %	12.91	12.64	15.22	15.04	17.50	17.33
Starch	62.68	62.85	44.58	44.70	44.13	44.20
NDF, %	14.35	13.44	21.73	21.73	23.39	22.80
ADF, %	7.53	7.25	10.56	10.37	12.97	12.80
Ether Extract, %	3.96	3.10	5.35	4.79	5.17	4.61

[1]Treatments were control (CON), regularly produced DDGS included in the diet at 30% (DDGS) or high protein DDGS included in the diet at 30% (HiPro), fed with either dry rolled corn (DRC) or steam flaked corn (SFC)

[2]Supplement formulated to be fed at 5.0% of diet DM. Supplement consisted of 1.3925% fine ground corn in the CON supplement and 2.7925% fine ground corn in the DDGS and HiPro supplement, and 1.4% urea in the CON supplement and 0% urea in the DDGS and HiPro supplements, 1.50% limestone, 0.125% tallow, 0.30% salt, 0.05% trace mineral package, 0.015% Vitamin A-D-E package as a percentage of the final diet. It was also formulated for 30 g/ton Rumensin®(Elanco Animal Health, DM Basis) and 8.8 g/ton Tylan® (Elanco Animal Health, DM basis).

[3]Based on analyzed nutrients for each ingredient.

Procedures

A 2 × 3 factorial finishing study evaluated three treatments of DDGS in either DRC- or SFC-based finishing diets. The DDGS treatments were no distillers included in the diet (CON), a diet including conventionally produced DDGS (DDGS), and diets including high protein DDGS (HiPro). Corn processing factors included feeding either SFC or DRC as a grain source. Diets are provided in Table 1. A 202-day finishing trial was conducted at the University of Nebraska feedlot near Mead, Nebraska using 360 crossbred steers (initial BW = 635 ± 1.19 lb) sorted into 3 BW blocks and assigned randomly to one of 36 pens (10 steers/pen; 1 repetition heavy block, 4 repetitions medium block and 1 repetition in the light block). All steers were limit-fed a common diet of 50% alfalfa hay and 50%

Table 2. Simple effects of corn processing when fed with no distillers grains, conventional DDGS, or DDGS with greater protein on growth performance and carcass characteristics of finishing cattle

	Treatment[1]							P-Value[2]		
	Control		DDGS		HiPro					
Item	DRC	SFC	DRC	SFC	DRC	SFC	SEM	Corn	Distiller	Int
Performance										
Initial BW, lb	636	636	637	636	636	634	1.2	0.26	0.73	0.69
Final BW, lb[3]	1267	1284	1343	1323	1315	1317	10.8	0.94	<0.01	0.22
DMI, lb/day	19.95	18.40	21.54	19.97	21.01	19.88	0.370	<0.01	<0.01	0.80
ADG, lb[3]	3.16	3.24	3.54	3.44	3.39	3.41	0.053	0.99	<0.01	0.22
Feed:Gain	6.37[a]	5.71[c]	6.13[b]	5.85[c]	6.21[ab]	5.85[c]	-	<0.01	0.73	0.02
Carcass Characteristics										
HCW, lb	798	809	846	834	829	830	6.8	0.95	<0.01	0.22
LM Area, in^2	12.98[a]	13.65[c]	13.56[bc]	13.82[c]	13.41[bc]	13.19[ab]	0.154	0.06	0.02	0.02
Marbling Score[4]	513	505	499	490	533	515	16.7	0.40	0.20	0.95
Backfat Thickness, in	0.48	0.48	0.50	0.53	0.56	0.52	0.022	0.90	0.03	0.37
Yield Grade[5]	2.97	2.81	3.03	2.96	3.16	3.14	0.080	0.19	<0.01	0.65
Liver Abscesses, %[6]	3.57	3.45	1.79	1.72	3.57	0.00	-	-	-	-

[1]Treatments were control (CON), regularly produced DDGS included in the diet at 30% (DDGS) or high protein DDGS included in the diet at 30% (HiPro), fed with either dry rolled corn (DRC) or steam flaked corn (SFC)

[2]Int = *P*-value for the interaction of corn processing method and DGS treatment. Corn = *P*-Value for the main effect of corn processing effect. Distiller = *P*-Value for the main effect of DGS treatment

[3]Calculated from hot carcass weight, adjusted to a common 63% dressing percentage

[4] Marbling Score 400-Small00, 500 = Modest00

[5] Calculated YG (yield grade) = [2.5 + (6.35 × fat thickness, cm) + (0.2 × 2.5% KPH) + (0.0017 × HCW, kg)—(2.06 × LM area, cm^2)]; (USDA, 2016).

[6]Did not converge

SweetBran® at 2% of BW for 5 days prior to trial initiation to minimize gastrointestinal fill. Initial BW was measured on two consecutive days (d0 and d1) and averaged. Steers were fed a supplement that included 30 g/ton DM of Rumensin® (Elanco Animal Health) and 8.8 g/ton of Tylan® (Elanco Animal Health). Cattle were implanted with Revalor-XS® (Merck Animal Health) on d1 of the experiment.

Steam flaked corn was processed to a flake density of 26 lb/bu and was obtained from a nearby feedlot (Raikes Feedlot, Ashland, NE) and obtained approximately every three days. Dried distillers grains plus solubles and the HiPro were obtained from ICM (St. Jospeh, MO) and delivered prior to trial initiation. All diets were fed once daily, with refusals being assessed prior to feeding each morning at approximately 0530. Refusals were subsampled and dried in a 60°C oven for 48 hours to determine DMI. Cattle were slaughtered on d 202 at a commercial abattoir (Greater Omaha, Omaha, NE). Carcass-adjusted final body weight was determined using 63% dressing percentage based on the HCW recorded at the commercial abattoir, the carcass adjusted values were used to determine ADG and feed conversion. Other carcass characteristics included marbling score, 12th rib fat thickness and LM area, which were recorded after a 48-h chill.

Data were analyzed using the MIXED procedures of SAS as a randomized block design with pen as the experimental unit and block as a fixed effect. Liver scores were analyzed using a binominal distribution with the GLIMMIX procedure of SAS. Data were first analyzed for an interaction, and main effects of each factor were analyzed if an interaction was not observed.

Results

There was an interaction ($P = 0.02$) between DGS treatment and corn processing for F:G (Table 2). In DRC-based diets, F:G improved 4.4% with 30% DDGS in the diet. However, in SFC-based diets, feed conversion tended ($P = 0.10$) to increase approximately 2.3% with the inclusion of either DDGS or HiPro in the diet as compared to the CON. Typical response of feeding DDGS in SFC-based diets has been either no change or negative impact on ADG and F:G However, in DRC-based diets, the feeding DDGS is typically positive, with improvements observed in ADG and F:G. In this study, F:G was improved when DDGS were fed in DRC-based diets, but was not imprved in SFC-based diets. There was an interaction ($P = 0.02$) in Longissimus muscle (LM)area, with cattle consuming DRC-CON having the smallest LM area, and SFC DDGS having the greatest LM area, with all other treatments being intermediate. No other interactions ($P > 0.22$) in growth performance or carcass characteristics were observed.

Distillers Grains Plus Solubles Treatment

Including DDGS or HiPro in the diet increased ($P < 0.01$) final body weight, DMI and ADG over the CON treatment (Table 3). Final carcass adjusted body weight increased ($P < 0.01$) 58.4 lb with DDGS and 40.8 lb with HiPro over CON. The greater final carcass adjusted body weight for HiPro and DDGS was in response to the greater ADG and DMI observed, with cattle consuming DDGS gaining 9% more daily as compared to CON, and 6.3% greater with HiPro, with DDGS tending ($P = 0.10$) to have greater ADG than HiPro. Average daily gain was likely increased due to the increase in DMI, which increased ($P < 0.01$) 8.0% with DDGS and 6.3% for HiPro over the CON treatment. The response to excess protein flowing into the duodenum likely created the growth response, as cattle derived energy from the breakdown of excess amino acids in the small intestine for growth purposes. This has been well documented in previous research (*2016 Nebraska Beef Cattle Report*, pp. 124–127). Marbling score was unaffected by DGS treatment in the diet; however, backfat thickness increased ($P < 0.01$) from 0.48-in for CON to 0.52-in for DDGS and 0.55-in for HiPro, resulting in a greater USDA yield grade for steers fed HiPro.

Table 3. Main effect of DGS treatment on growth performance and carcass characteristics of finishing cattle

	Treatment[1]				
Item	CON	DDGS	HiPro	SEM	*P*-Value[2]
Pens	12	12	12		
Performance					
Initial BW, lb	636	636	635	0.86	0.73
Final BW, lb[3]	1275[a]	1333[b]	1316[ab]	7.95	<0.01
DMI, lb/day	19.17[a]	20.76[b]	20.45[b]	0.262	<0.01
ADG, lb[3]	3.20[a]	3.49[b]	3.40[b]	0.038	<0.01
Carcass Characteristics					
HCW, lb	804[a]	840[b]	829[b]	5.0	<0.01
Marbling Score[4]	509	494	524	12.29	0.20
Backfat Thickness, in	0.48[a]	0.51[ab]	0.54[b]	0.016	0.03
Yield Grade	2.89[a]	3.00[ab]	3.15[b]	0.059	<0.01
Liver Abscesses, %	3.51	1.75	1.79	-	-

[a,b]Means with different superscripts differ ($P < 0.05$).

[1] Treatments were control (CON; no DDGS inclusion), a conventional DDGS included in the diet at 30% (DDGS), and high protein DDGS included in the diet at 30% (HiPro)

[2]*P*-value for the main effect of DGS treatment

[3]Calculated from hot carcass weight, adjusted to a common 63% dressing percentage

[4]Marbling Score 400-Small[00], 500 = Modest[00]

Corn Processing Treatment

Steam flaked corn resulted in a reduction in DMI from 20.8 lb/d for DRC to 19.4 lb/d (Table 4). Despite lower DMI, SFC-based diets had similar ($P = 0.98$) ADG to DRC, averaging 3.36 lb/d for both treatments. This is a typical energetic response observed with SFC compared to DRC, as the energy derived from the more digestible starch in SFC reduces DMI requirements to meet energetic requirements of the animal. Final carcass adjusted body weight and hot carcass weight were not different ($P \geq 0.92$) between SFC and DRC-based treatments. Cattle on the different corn processing treatments were slaughtered at comparable endpoints, as there was no statistical difference ($P = 0.90$) on backfat thickness of 0.51 in of backfat for both treatments, similar marbling ($P = 0.40$) and similar ($P = 0.19$) yield grade scores. Lack of differences in carcass characteristics were attributed to the fact cattle did not have different ADG, which likely resulted in similar carcass deposition, despite lower DMI for SFC based diets.

Table 4. Main effect of corn processing method on growth performance and carcass characteristics

	Treatment[1]			
Item	SFC	DRC	SEM	*P*-value[2]
Pens, n	18	18		
Performance				
Initial BW, lb	636	635	0.73	0.26
Final BW, lb[3]	1309	1308	6.7	0.94
DMI, lb/day	20.83	19.42	0.214	<0.01
ADG, lb[3]	3.36	3.36	0.031	0.99
Carcass Characteristics				
HCW, lb	824	824	4.2	0.95
Marbling Score[4]	515	503	10.4	0.40
Backfat Thickness, in	0.51	0.51	0.014	0.90
Yield Grade	3.05	2.97	0.050	0.19
Liver Abscesses, %	2.976	1.734	-	-

[1]Treatments were steam flaked corn (SFC) or dry rolled corn (DRC) as a grain source in the diet

[2]*P*-Value for the main effect of corn processing treatment

[3]Calculated from hot carcass weight, adjusted to a common 63% dressing percentage

[4]Marbling Score 400 = Small[00], 500 = Modest[00]

Conclusions

Feeding DDGS in DRC-based diets increases ADG and improves F:G. Feeding DDGS in SFC-based diets slightly increases F:G but improves ADG. Feeding HiPro DDGS, despite the higher CP content, resulted in similar performance to cattle consuming conventionally produced DDGS. In SFC-based diets, feeding a higher protein byproduct such as DDGS and HiPro resulted in no improvements in feed conversion, and did not give the same response observed in DRC-based diets.

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