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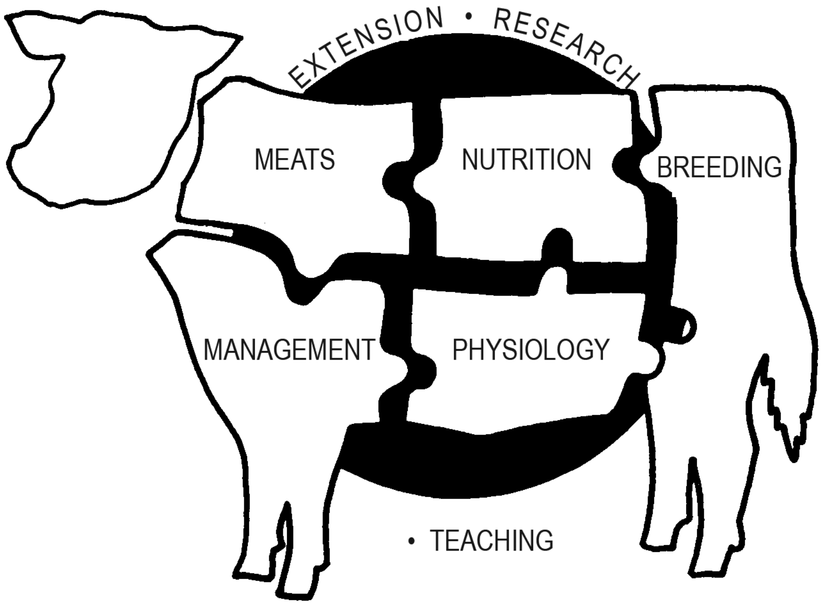

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Feeding Value of De-oiled Wet Distillers Grains Plus Solubles Relative to Normal When Fed with Either Dry-Rolled Corn or Steam-Flaked Corn in Beef Finishing Diets

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Summary

A 128-day finishing study utilized 328 yearling steers to determine the effects of feeding de-oiled wet distillers grains plus solubles (WDGS) in dry rolled corn (DRC) or steam-flaked corn (SFC) diets relative to normal fat WDGS. No significant interactions were observed, but cattle fed DRC had greater DMI and were less efficient than those consuming SFC. Linear improvements in ADG and F:G were observed as concentration of de-oiled WDGS increased from 0 to 35%. Numerically cattle fed normal WDGS were more efficient than cattle fed de-oiled WDGS.

Introduction

A corn kernel is primarily comprised of starch, thus a steer's ability to utilize starch is crucial for optimizing feed efficiency in the feedlot. Corn processing increases the availability of starch for ruminal digestion. The three most common corn processing methods are steam flaking (SFC), dry rolling (DRC), and ensiling high moisture corn (HMC). Corrigan et al., *2007 Nebraska Beef Cattle Report* pg. 33-35, studied the effect of corn processing method with increasing concentrations of wet distillers grains plus solubles (WDGS) in finishing feedlot diets. Dry rolled corn, HMC, and SFC were fed with 0, 15, 27.5, or 40% WDGS. The authors reported that an optimal inclusion of WDGS was 40% with DRC, 27.5% with HMC, and 15% with SFC. More intensely processed corn has a negative associative interaction with distillers grains. Improvements in F:G diminish when distillers grains are fed with more intensely processed corn, thus the concentration of distillers grains needed to see optimal performance also decreases. With over half of Nebraska's ethanol plants currently removing oil from distillers grains via centrifugation of the thin stillage, the question arises as to how corn processing method will interact with de-oiled distillers grains. Thus, the objectives of this study were: 1) to determine the optimal concentration of de-oiled WDGS to feed with either DRC or SFC so as to maximize steer performance in the feedlot and 2) to determine the feeding value of de-oiled WDGS relative to normal WDGS when fed with either DRC or SFC in a beef finishing diet.

Procedure

Three hundred and twenty yearling steers (initial BW = 875 ± 84 lb) were utilized in a 128-day finishing study conducted at the Panhandle Research and Extension Center (PREC) research feedlot near Mitchell, Neb. Prior to the start of the trial, cattle were limit-fed at 2.0% of BW a diet consisting of 15% wheat straw, 35% corn silage and 50% WDGS for five days to minimize the effect of gut fill. Steers were weighed on day 0 and day 1 after the limit feeding period and these weights were averaged for an accurate initial BW. Using initial BW, steers were blocked into three weight blocks (heavy, medium, or light) and then assigned randomly to pen within block. There were 40 total pens with eight head assigned to each pen. Pens were then assigned randomly to one of eight treatments (Table 1) allowing for five replications per treatment.

Treatments were organized in a 2 × 3 + 2 factorial arrangement with factors being corn processing method of DRC or SFC (flake density targeted at 28 lb/bu) and concentration of de-oiled WDGS in the diet of 0, 17.5, or 35% on a DM-basis. Two additional diets containing normal WDGS fed at 35% of the diet were also examined. These additional diets allowed for the analysis of an embedded 2 × 2 factorial with factors of corn processing method (DRC vs. SFC) and

(Continued on next page)

Table 1. Dietary treatments and nutrient analysis.

	SFC[1]				DRC[1]			
De-oiled WDGS[2] Inclusion	0	17.5	35	35[3]	0	17.5	35	35[3]
SFC	74.44	60.75	44.0	44.0	—	—	—	—
DRC	—	—	—	—	74.44	60.75	44.0	44.0
De-oiled WDGS	0.00	17.50	35.00	—	0.00	17.50	35.00	—
Normal WDGS	—	—	—	35.00	—	—	—	35.00
Corn silage	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Soybean meal	3.56	0.10	—	—	3.56	0.10	—	—
Urea	1.00	0.65	—	—	1.00	0.65	—	—
Supplement	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Dietary Composition								
Fat	2.86	3.75	4.54	5.10	3.53	4.29	4.94	5.50

[1]SFC = steam-flaked corn, DRC = dry-rolled corn.
[2]Wet distillers grains plus solubles.
[3]Normal WDGS diets.

Table 2. Effect of corn processing method with increasing concentrations of de-oiled WDGS[1] in the finishing diet.

Item	DRC[2] 0	DRC[2] 17.5	DRC[2] 35	SFC[2] 0	SFC[2] 17.5	SFC[2] 35	SEM	P-values Int.[3]	P-values CPM[3]	P-values Linear[3]	P-values Quadratic[3]
Performance											
Initial BW, lb	858	859	859	855	856	857	3	0.80	0.06	0.39	0.94
Final BW, lb[4]	1282	1315	1334	1302	1316	1336	14	0.57	0.37	<0.01	0.84
DMI, lb/day	27.6	27.1	27.2	26.4	26.5	27.0	0.4	0.25	0.02	0.68	0.42
ADG, lb	3.50	3.76	3.92	3.68	3.79	3.94	0.11	0.53	0.23	<0.01	0.84
F:G[5]	7.87	7.19	6.90	7.14	6.94	6.80	<0.01	0.15	0.01	<0.01	0.50
Net Energy Values[6]											
NE maintenance, Mcal/lb	0.76	0.80	0.82	0.81	0.82	0.83	0.01	0.25	<0.01	<0.01	0.35
NE gain, Mcal/lb	0.48	0.52	0.53	0.52	0.54	0.54	<0.01	0.22	<0.01	<0.01	0.38
Calculated Feeding Value[7]	—	154%	140%	—	116%	114%					
Carcass Characteristics											
HCW, lb	808	828	840	820	829	841	9	0.60	0.37	<0.01	0.82
LM area, in^2	11.3	11.3	11.3	11.3	11.3	11.4	0.2	0.99	0.74	0.77	0.82
Fat depth, in	0.44	0.47	0.52	0.47	0.50	0.51	0.02	0.53	0.21	<0.01	0.91
Marbling Score[8]	416	451	425	440	468	446	15	0.94	0.03	0.47	<0.01
Yield grade	3.46	3.62	3.76	3.52	3.68	3.72	0.13	0.86	0.54	<0.01	0.56
Liver abscesses, %	7	16	10	14	18	22	5	0.97	0.10	0.28	0.26

[1]Wet distillers grains plus solubles.
[2]DRC = dry-rolled corn, SFC = steam-flaked corn.
[3]Int. = interaction between corn processing method and concentration of WDGS In the deti, CPM = main effect of corn processing method of DRC or SFC, Conc. = main effect of concentration f WDGS in the diet, Linear and Quadratic *P*-values for the main effect of concentration of WDGS in the diet.
[4]Calculated from hot carcass weight, adjusted to a common dressing percentage of 63%.
[5]Analyzed as G:F but reported as reciprocal.
[6]Values calculated by pen using 1996 NRC equations.
[7] Feeding Value Calculation = divide treatment G:F value by the 0% WDGS control G:F value within each corn processing method, take that value and subtract 1, and then divide by the concentration of de-oiled WDGS in the diet.
[8] Marbling score: 400 = small°, 500 = modest°.

inclusion of 35% WDGS (normal fat vs. de-oiled). The remainder of all diets consisted of 15% corn silage, and 6% supplement with increasing concentrations of WDGS replacing corn, urea, and soybean meal. Urea and soybean meal were added to diets containing 0 or 17.5% WDGS to meet or exceed the metabolizable protein requirements of the steers. Monensin and tylosin were fed with a micro-machine at 360 mg/head/day and 90 mg/head/d, respectively. Normal and de-oiled WDGS were received from two different plants for this study.

Steers were implanted on day 1 with Revalor®-XS. On day 109 the heavy block was shipped to a commercial abattoir (Cargill Meat Solutions, Fort Morgan, Colo.) for harvest. The medium and light blocks were shipped to the same plant on day 128. Hot carcass weights and liver scores were collected on the day of harvest and after a 48-hour chill the LM area, fat thickness, and marbling score data. Yield grade was calculated using the USDA YG equation [YG = 2.5 + 2.5 (fat thickness, in) – 0.32 (LM area, in^2) + 0.2 (KPH fat, %) + 0.0038 (HCW, lb)]. A standard 2% KPH was used in the yield grade calculation.

Data were analyzed using a GLIMMIX procedure of SAS with pen as the experimental unit. No interaction between corn processing method and concentration of de-oiled WDGS was detected for the 2 × 3 factorial ($P > 0.15$). Thus linear and quadratic contrasts were used to evaluate the effect of concentration of de-oiled WDGS in the diet on performance and carcass characteristics. The embedded 2 × 2 factorial was analyzed to determine if an interaction existed between corn processing method and type of WDGS (de-oiled vs. normal fat) with significance declared at ($P < 0.05$).

The feeding value of increasing concentrations of de-oiled WDGS in comparison to both DRC and SFC controls was calculated as the difference between the G:F observed for each WDGS concentration and 0% WDGS divided by the G:F value of the 0% WDGS diet. This value was then divided by the concentration of WDGS in the corresponding diet and multiplied by 100, for the feeding value relative to DRC or SFC replaced (Bremer et al., *2011 Nebraska Beef Cattle Report*, pp. 40-41). Treatment NE_m and NE_g values were also calculated, using equations found in the 1996 NRC, on a per pen basis. These energy values were also analyzed using the GLIMMIX procedure of SAS so that treatment averages could be determined.

Results

No WDGS concentration by corn processing method interaction was observed when evaluating the 2 × 3 factorial ($P \geq 0.15$); (Table 2). For the main effect of corn processing method, steers fed DRC had greater DMI ($P = 0.02$) and similar ADG ($P = 0.23$) when compared to those

Table 3. Comparing De-oiled and Normal WDGS at 35% Concentration in DRC and SFC diets.

	DRC[1]		SFC[2]			*P*-values		
Item	De-oiled WDGS[3]	Normal WDGS[3]	De-oiled WDGS[3]	Normal WDGS[3]	SEM	Int.[4]	CPM[5]	Type[6]
Performance								
Initial BW, lb	859	860	858	859	2	0.86	0.53	0.46
Final BW, lb[7]	1334	1345	1335	1355	13	0.69	0.59	0.12
DMI, lb/day	27.2	26.9	27.0	26.5	0.5	0.54	0.26	0.12
ADG lb	3.92	3.99	3.94	4.01	0.11	0.62	0.46	0.18
F:G[8]	6.94	6.76	6.80	6.45	<0.01	0.43	0.05	0.14
Net Energy Values[9]								
NE maintenance, Mcal/lb	0.83	0.83	0.83	0.87	0.01	0.15	0.18	0.06
NE gain, Mcal/lb	0.53	0.54	0.54	0.58	0.01	0.18	0.07	0.03
Calculated Feeding Value[10]	92%	—	85%	—				
Carcass Characteristics								
HCW, lb	840	848	841	854	8	0.69	0.58	0.12
LM area, in[2]	11.33	11.40	11.37	11.53	0.23	0.80	0.61	0.52
Fat depth, in	0.52	0.52	0.51	0.54	0.03	0.37	0.52	0.37
Marbling score[11]	427	462	488	455	18	0.29	0.58	0.11
Yield grade	3.8	3.8	3.7	3.8	0.2	0.58	1.0	0.58
Liver abscesses, %	10.0	22.0	6.0	10.0	4	0.61	0.14	0.06

[1]DRC = dry-rolled corn.
[2]SFC = steam-flaked corn.
[3]WDGS = wet distillers grains plus solubles.
[4]Int. = interaction between corn processing method and WDGS type.
[5]CPM = main effect of corn processing method (DRC or SFC).
[6]Type = main effect of type of WDGS (de-oiled or normal fat).
[7]Calculated from hot carcass weight, adjust to a common dressing percentage of 63%.
[8]Analyzed as G:F but reported as reciprocal.
[9]Values calculated by pen using 1996 NRC equations.
[10]Feeding Value Calculation = divide treatment G:F value by the 0% WDGS control G:F value within each corn processing method, take that value and subtract 1, and then divide by the concentration of de-oiled WDGS in the diet.
[11]Marbling score: 400 = small°, 500 = modest°.

cattle consuming SFC diets. However, F:G was improved in steers fed SFC ($P = 0.01$) over DRC diets. When comparing the control diets of each corn processing method, a 10.2% improvement in F:G was observed in cattle fed SFC over DRC. This improvement in F:G agrees nicely with previous research, (Nichols et al., *2012 Nebraska Beef Cattle Report,* pp. 70-71) where the difference in F:G between corn processing methods was 10.0%. In further comparisons, steers fed SFC had greater marbling scores than those fed DRC diets ($P = 0.03$). Diets containing SFC had significantly greater NE_m and NE_g values compared to DRC diets ($P < 0.01$). Final BW,HCW, LM area, and fat depth ($P \geq 0.21$) did not differ between steers fed DRC or SFC diets.

For the main effect of concentration of WDGS in the diet, a linear increase in final BW, ADG, HCW and fat depth ($P < 0.01$) was observed as WDGS concentration in the diet increased (Table 2). Furthermore, a linear improvement in F:G was detected as the concentration of WDGS in the diet increased ($P = <0.01$.) Increasing the concentration of WDGS from 0 to 17.5% caused a 5.2% improvement in F:G and increasing the concentration of WDGS from 17.5 to 35% caused a 3.5% improvement in F:G. A linear increase in NE_m and NE_g for both DRC and SFC diets was observed as de-oiled WDGS was increasingly added to the diet ($P < 0.01$). Marbling scores increased quadratically ($P = 0.01$) with increasing concentrations of WDGS. Cattle fed 17.5% de-oiled WDGS marbled the highest.

Looking at the embedded 2 × 2 factorial (Table 3), which compared de-oiled WDGS (7.9% fat content) to normal WDGS (11.3% fat) fed at 35%, there were no corn processing method by WDGS type interactions ($P \geq 0.29$). Type of WDGS did not significantly impact F:G ($P = 0.14$) but numerically cattle fed normal WDGS were 2.7% more efficient than their de-oiled WDGS counterparts in DRC diets and numerically 5.2% more efficient in SFC-based diets. There was a tendency for cattle consuming normal fat WDGS diets to have greater final BW, HCW , DMI ($P = 0.12$), and marbling scores ($P = 0.11$) compared to cattle consuming de-oiled WDGS diets. Average daily gain, LM area, and fat depth ($P \geq 0.18$) did not significantly differ between WDGS types. There was a tendency for the normal WDGS diet to have a greater NE_m value compared to the de-oiled WDGS diet ($P = 0.06$), conversely the calculated NE_g value for the normal WDGS diet was significantly greater than for de-oiled WDGS diet ($P = 0.03$).
The main effect of corn processing method showed that steers fed SFC had improved F:G ($P = 0.05$) compared to those fed DRC. No differences in final BW, DMI, ADG, HCW, LM area, fat depth, or marbling scores ($P \geq 0.26$) was observed when comparing SFC and DRC diets. This study suggests that increasing the concentration of de-oiled WDGS in the diet while feeding either SFC or DRC improves F:G. However, as the intensity of corn processing increases the concentration of distillers grains in the diet should decrease due to the negative associative affect that is apparent between corn processing intensity and increasing concentrations of WDGS Removing a portion of the oil, via centrifugation of the thin stillage, did not significantly impact F:G in this study. Feeding normal WDGS, however, numerically improved F:G by 4.0% suggesting oil removal may have a small effect on the energy value of WDGS and subsequently on the effects of feed efficiency in finishing cattle.

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