Effect of the Grains-to-Solubles Ratio in Diets Containing Wet Distillers Grains ± Solubles Fed to Finishing Steers

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Summary

Wet distillers grains plus solubles (WDGS) were fed at 0%, 20% or 40% (DM basis) with varying ratios of distillers grains (WDG) to distillers solubles (DS) to determine effect of inclusion level and amount of solubles on steer performance and carcass characteristics. There was no interaction between WDG inclusion level and WDG:DS ratio. As WDG ± S inclusion increased from 0% to 40% diet DM, final BW and average daily gain (ADG) increased linearly (P = 0.03), while feed-to-gain ratio (F:G) decreased linearly (P < 0.01). However, performance was not affected by the proportion of DS in WDG ± S (P > 0.10).

Introduction

Distillers grains (DG) and distillers solubles (DS) are produced as separate feeds during ethanol production. The two fractions often are mixed to produce dry distillers grains plus solubles (DDGS) or wet distillers grains plus solubles (WDGS). It has been suggested each ethanol plant's capacity and ability to store DS determines whether all, none or a portion of DS will be added back to produce DDG ± S/WDG ± S. In plants producing WDGS, 0 to 25% of the WDG ± S can be comprised of DS and may average 20% (DM basis) (*2007 Nebraska Beef Report*, pp. 17-18). The DS portion contains a higher percentage of fat compared to DG, so including more DS will increase the fat content of distillers byproducts. It has been determined that variation in fat content of WDGS is greater across ethanol plants than within plant, suggesting plant processing method determines variability rather than consistency within plant (*2008 Nebraska Beef Report*, pp. 113-114). Previous research has indicated the fat level in DDGS may influence performance when DS are included at 14.5% and 22.1% of the DDGS composition (DM basis; *2007 Nebraska Beef Report*, pp. 17-18). In that experiment, ADG and F:G were affected by the supplementation level and composition of DDG ± S. A decrease in steer performance occurred when supplemented between 0.5% and 1.0% BW. This was likely due to the supplemental fat level contained in those high DDGS diets. It is hypothesized that the same interaction may occur in finishing diets containing high inclusion levels of WDGS. The amount of DS added back to WDGS may be detrimental to steer performance, if fat content of the diet is too high. Therefore, the current study was conducted to determine if the proportion of DS in WDG ± S affects cattle performance and carcass characteristics in finishing diets.

Procedure

A 140-day finishing trial was conducted utilizing 336 crossbred yearling steers (BW = 854 ± 30 lb) in a randomized complete block design. Five days prior to the initiation of the trial, steers were limit fed to minimize variation in rumen fill (1:1 ratio of alfalfa hay and wet corn gluten feed at 2% BW). Steers were then weighed individually on days 0 and 1 to determine initial BW. Animals were blocked by BW, stratified within block and assigned randomly to one of seven treatments. Eight steers were assigned per pen, with six replications per treatment.

Dietary treatments were designed as a 2 x 3 + 1 factorial arrangement. Dietary treatments are outlined in Table 1. Diets contained WDG ± S at 20% or 40% of diet DM. Within each WDG ± S level, three ratios of wet distillers grains (WDG) to DS were tested (100:0, 85:15 or 70:30). The WDG and DS were obtained from separate ethanol plants and mixed just prior to feeding to ensure an accurate ratio of WDG:DS in each diet treatment. A diet containing 82.5% corn was included in the experiment as a control (CON). All diets contained a 1:1 ratio of dry-rolled corn (DRC) and high-moisture, ensiled corn (HMC), 7.5% alfalfa hay and 5% dry supplement. Molasses was included in the CON. Soypass™ (Rothschild, Wis.) also was included at 2% of the diet DM, replacing corn from day 1 to day 50 to meet the metabolizable protein requirement of those steers. The ether extract content of WDG and DS used for formulation was 10.0% and 27.8%, respectively, using the Soxhlet procedure. Diets were formulated to contain ether extract at 3.1% for CON; 4.6%, 5.1% and 5.7% for 20% WDG (100:0, 85:15, 70:30, respectively); and 5.9%, 6.9% and 8.0% for 40% WDG (100:0, 85:15, 70:30, respectively).

On day 50 of the experiment, calves were implanted with Revalor-S (Intervet, Millsboro, Del.). All steers were slaughtered on day 140 at Greater Omaha (Omaha, Neb.). On the day of slaughter, hot carcass weights (HCW) and liver abscess data were recorded. Following a 48-hour chill, marbling score, 12th rib fat thickness and LM area data were collected. Final carcass adjusted BW, ADG and feed efficiency were calculated by dividing HCW by a common dressing percentage of 63%. Yield grade was calculated using the USDA yield grade equation (yield grade = 2.5 + 2.5(12th rib fat thickness, in) – 0.32(LM area, in^2) + 0.2(KPH fat, %) + 0.0038(HCW, lb).

Cattle performance and carcass data were analyzed using the MIXED procedures of SAS (SAS Institute, Cary, N.C.). Factors in the model included WDG ± S inclusion level,

(Continued on next page)

Table 1. **Diet composition and nutrient content (% DM basis).**

		20% WDG(± S)[1]			40% WDG(± S)		
Item	CON	100:0	85:15	70:30	100:0	85:15	70:30
Corn[2]	82.5	67.5	67.5	67.5	47.5	47.5	47.5
WDG[3]	0.0	20.0	17.0	14.0	40.0	34.0	28.0
Solubles	0.0	0.0	3.0	6.0	0.0	6.0	12.0
Alfalfa hay	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Molasses	5.0	—	—	—	—	—	—
Supplement[4]	5.0[5]	5.0	5.0	5.0	5.0	5.0	5.0
Nutrient Content							
Crude protein	13.7%	15.1%	14.8%	14.5%	20.1%	19.5%	18.9%
Fat							
— Formulated[6]	3.1%	4.6%	5.1%	5.7%	5.9%	6.9%	8.0%
— Observed[7]	3.1%	4.6%	4.7%	4.9%	5.9%	6.3%	6.7%
Sulfur	0.17%	0.21%	0.24%	0.27%	0.24%	0.30%	0.35%

[1]Dietary treatments = 20% or 40% total WDG ± S inclusion level, with varying ratio of WDG:DS (100:0, 85:15, and 70:30).
[2]Corn = 1:1 ratio of dry-rolled and high-moisture corn (DM basis).
[3]WDG = wet distillers grains without solubles.
[4]Formulated to contain 59.6% fine ground corn, 29.7% limestone, 6.0% salt, 2.6% tallow, 1.0% beef trace mineral premix (10% Mg, 6% Zn, 4.5% Fe, 2% Mg, 0.5% Cu, 0.3% I, and 0.05% Co), 0.30% vitamin premix (1500 IU vitamin A, 3000 IU vitamin D, 3.7 IU vitamin E per g), and 320 mg/head/day monensin, 40g/lb thiamine and 90 mg/head/day tylosin.
[5]CON treatment included 26.7% urea, which replaced fine ground corn.
[6]Formulated fat content of feedstuffs pre-trial determined by Soxhlet procedure. WDG and DS contain 10.0% and 27.8% EE, respectively.
[7]Observed fat content determined using UNL procedure. In this method WDG and solubles contained 10.0% and 16.1% fat, respectively.

Table 2. **Main effect of WDG ± S inclusion level on cattle performance and carcass characteristics.**

Item	0% WDG ± S	20% WDG ± S	40% WDG ± S	SEM	Lin [1]	Quad [2]
Performance						
Initial BW, lb	857	856	857	1	0.66	0.56
Final BW [3], lb	1373	1400	1403	7	0.03	0.17
DMI, lb/d	25.6	25.5	25.1	0.2	0.31	0.45
ADG, lb/d	3.69	3.88	3.90	0.05	0.02	0.17
F:G [4]	6.94	6.58	6.42		< 0.01	0.31
Carcass Characteristics						
HCW, lb	865	882	884	4	0.02	0.17
12th rib fat, in	0.53	0.56	0.62	0.02	< 0.01	0.63
Marbling score [5]	557	558	540	8	0.46	0.33
LM area, in^2	14.0	14.1	13.8	0.1	0.20	0.33
Calculated yield grade [6]	3.12	3.27	3.48	0.07	< 0.01	0.75

[1]Contrast for the linear effect of treatment *P*-value.
[2]Contrast for the quadratic effect of treatment *P*-value.
[3]Calculated from hot carcass weight, adjusted to a 63% yield.
[4]Calculated from total gain over total DMI.
[5]450 = Slight 50; 500 = Small 0; etc.
[6]Yield grade = 2.5 + 2.5(12^{th} rib fat, in) – 0.32(LM area, in^2) + 0.2(KPH fat, %) + 0.0038(HCW, lb).

WDG:DS ratio and the interaction between the two factors. Weight block served as a random variable, and pen was the experimental unit. The CON treatment was not included in the test for interaction. When no interaction was detected (*P* > 0.05), orthogonal contrasts also were used to test the linear and quadratic effects of WDG ± S level (CON was included to determine response of WDG ± S inclusion versus corn-based diet) and WDG:DS.

Results

WDG ± S Level x WDG:DS Ratio

No interaction was detected between WDG ± S inclusion level and WDG:DS ratio (*P* > 0.40). Therefore, WDG ± S inclusion level and WDG:DS ratio within WDG ± S level are presented as main effects.

WDG ± S Inclusion Level

Performance and carcass characteristics for main effect of WDG ± S inclusion level are presented in Table 2. Carcass adjusted final BW increased linearly as steers consumed increasing amounts of WDG ± S (*P* = 0.03). No significant difference in DMI for steers consuming an increasing amount of WDG ± S was observed (*P* > 0.05). However, ADG increased linearly, while F:G decreased linearly as WDG ± S inclusion increased from 0% to 40% of diet DM (*P* < 0.02). Steers fed increasing amounts of WDG ± S, regardless of proportion of WDG:DS, had a 5.5% to 6.0% advantage in ADG and a 5.5% to 8.3% improvement in F:G compared to CON-fed steers. HCW increased linearly as WDG ± S inclusion level increased from 0% to 40% inclusion (*P* = 0.02). Similarly, 12^{th} rib fat depth linearly increased with WDG ± S inclusion level (*P* < 0.01). Calculated yield grade increased as a result of increased fat depth, although numerically the difference is small (*P* < 0.05). The increase suggests when steers are fed WDG ± S (equal number of days), an increased degree of finish can be expected. No effect on marbling score was observed with increased WDG ± S inclusion (*P* > 0.33).

WDG:DS Ratio

Performance and carcass characteristics for main effect of the ratio of WDG:DS across WDG ± S level are presented in Table 3. There was no effect of varying proportions of DS in WDG ± S on carcass adjusted final BW (*P* > 0.23). Interestingly, ADG and F:G were similar as the proportion of DS increased in WDG ± S (*P* > 0.22). Additionally, HCW, marbling score and LM area were not significantly different (*P* > 0.15). Although not statistically significant, marbling score tended to respond quadratically, with diets containing 15% DS having the lowest numerical marbling score ($P = 0.10$). The numerical differences in marbling score corresponded to a statistically quadratic response in calculated yield grade ($P = 0.03$).

Results of this study indicate that steer performance is improved by the increased energy content of WDG ± S, rather than the ratio of WDG:DS, compared to corn. However, our hypothesis was incorrect in that a higher proportion of DS at the 40% WDG ± S inclusion level did not detrimentally affect performance. Observed dietary fat content was lower than formulated dietary fat content. A new laboratory fat analysis has recently been established for DS, which resulted in DS fat content of 16.1% (observed) versus 27.8% (formulated). Therefore, observed dietary fat was 3.1% for CON; 4.6%, 4.7% and 4.9% for 20% WDG (100:0, 85:15, 70:30, respectively); and 5.9%, 6.3% and 6.7% for 40% WDG (100:0, 85:15, 70:30, respectively). As a result, the difference between 0%, 15% and 30% DS is probably too small for differences in performance to be observed. Additionally, it has been shown finishing steers can consume a total dietary fat content of 7% for WDGS diets without compromising performance. In this study, the highest dietary fat content was observed in the 40% WDG inclusion level (70:30; 6.7% dietary fat). This result also may have contributed to a lack of response, since the upper range of dietary fat tolerance was not reached. Therefore, if ethanol plants add back DS at a proportion of 30% of the total WDGS composition, then presumably cattle performance will not be negatively affected due to dietary fat content when fed diets containing 40% WDGS.

Table 3. Main effect of WDG:DS ratio on cattle performance and carcass characteristics.

Item	100:0	85:15	70:30	SEM	Lin[1]	Quad[2]
Performance						
Initial BW, lb	856	857	857	1	0.11	0.69
Final BW[3], lb	1399	1394	1412	8	0.28	0.23
DMI, lb/d	25.4	25.1	25.5	0.3	0.89	0.30
ADG, lb/d	3.88	3.84	3.96	0.05	0.33	0.23
F:G[4]	6.54	6.49	6.41		0.25	0.61
Carcass Characteristics						
HCW, lb	882	878	889	5	0.28	0.24
12th rib fat, in	0.60	0.57	0.60	0.02	0.79	0.10
Marbling score[5]	545	541	560	10	0.30	0.36
LM area, in^2	13.8	14.1	13.9	0.1	0.87	0.15
Calculated yield grade[6]	3.41	3.25	3.46	0.01	0.60	0.03

[1]Contrast for the linear effect of treatment *P*-value.
[2]Contrast for the quadratic effect of treatment *P*-value.
[3]Calculated from hot carcass weight, adjusted to a 63% yield.
[4]Calculated from total gain over total DMI.
[5]450 = Slight 50; 500 = Small 0; etc.
[6]Yield grade = 2.5 + 2.5(12^{th} rib fat, in) – 0.32(LM area, in^2) + 0.2(KPH fat, %) + 0.0038(HCW, lb).

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