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# Evaluation of the Relative Contribution of Protein in Distillers Grains in Finishing Diets on Animal Performance

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# Evaluation of the Relative Contribution of Protein in Distillers Grains in Finishing Diets on Animal Performance

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## Summary

*A finishing study evaluated the relative contributions of protein from wet distillers grains plus solubles (WDGS) on feedlot performance and carcass characteristics. The protein portion of WDGS was mimicked by corn gluten meal (CGM). Increasing WDGS inclusion from 0 to 40% increased final body weight and gain, decreased intakes, and improved feed efficiency. When CGM was fed to equal protein concentration as WDGS, final body weight and gain increased, and feed efficiency improved. Adding solubles to CGM did not improve feed efficiency. The feeding value of CGM was similar to distillers grains, suggesting protein has a major role in the feeding value of distillers grains.*

## Introduction

As advances in technology continue in the ethanol industry, the components of distillers grains become more susceptible to change. These changes may influence the use of distillers grains in feedlot diets. Ethanol plants are able to separate a portion of the protein from distillers grains for use in alternative markets. The contributions of protein in WDGS at 40% inclusion has been examined in previous research (*2016 Nebraska Beef Cattle Report*, pp. 122–23) and reported the feeding value of CGM was 109% and WDGS was 137% relative to corn. This indicates that protein has a large role in the feeding value in WDGS at 40% inclusion rate. It is important to further investigate the relative contributions of protein on the feeding value of WDGS at other inclusion rates on feedlot performance and carcass traits.

## Procedure

Crossbred calf-fed steers (n = 324; initial BW = 642; SD = 53 lb) were utilized in a randomized block design at the University of Nebraska Panhandle Research and Extension Center feedlot located near Scottsbluff, Neb. Steers were limit-fed (2% of BW) a diet consisting of 15% straw, 25% alfalfa hay, 35% corn silage, and 25% WDGS (DM basis) for five days prior to 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 two blocks (light and heavy) and stratified by BW within block, and assigned randomly to 36 pens.

Pens were assigned randomly to one of six dietary treatments with six replications per treatment and 9 steers per pen. Dietary treatments are provided in Table 1. In the experimental diets, the protein portion of WDGS was mimicked by CGM to provide similar protein as 20 and 40% WDGS. Diets were formulated to provide 360 mg/steer of Rumensin® (Elanco Animal Health) and 90 mg/steer of Tylan® (Elanco Animal Health) daily.

Steers were implanted on d 1 with Component TE-IS (Elanco Animal Health) and re-implanted with Component TE-S (Elanco Animal Health) on d 90. Steers were harvested at a commercial abattoir (Cargill Meat Solutions, Fort Morgan, Colo.) on d 182 (heavy block) and d 193 (light block). Hot carcass weight and liver scores were recorded on day of harvest. After a 48-h chill, LM area, marbling score, and 12th rib fat were recorded. Yield grade was calculated from the following formula: 2.5 + (2.5 × 12th rib fat) − (0.32 × LM area) + (0.2 × 2.5 [KPH]) + (0.0038 × HCW). Final BW was carcass adjusted using HCW and a common dressing percent (63%) to calculated ADG and F:G. Feeding value was calculated from the following formula: ((compared treatments

**Table 1. Composition of dietary treatments containing protein components of distiller grains fed to steers[a]**

| Ingredient[b] | Treatment | | | | | |
|---|---|---|---|---|---|---|
| | CON[c] | 20WDG | 40WDG | 20PRO | 40PRO | 40PRO-SOL |
| DRC | 75.50 | 59.00 | 39.00 | 70.25 | 61.50 | 51.50 |
| WDGS | — | 20.00 | 40.00 | — | — | — |
| Corn Silage | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 |
| CGM | — | — | — | 8.75 | 17.50 | 17.50 |
| Solubles | — | — | — | — | — | 10.00 |
| SBM | 3.50 | — | — | — | — | — |
| Supplement | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 |
| Nutrient Composition, % | | | | | | |
| DM | 71.5 | 61.1 | 50.8 | 71.1 | 70.8 | 64.3 |
| CP | 13.9 | 13.0 | 17.3 | 14.3 | 20.0 | 21.0 |
| NDF | 14.8 | 18.9 | 23.0 | 14.6 | 14.4 | 13.5 |
| Fat | 2.8 | 3.7 | 4.6 | 2.9 | 2.9 | 2.6 |
| Ca | 0.51 | 0.53 | 0.54 | 0.52 | 0.52 | 0.52 |
| P | 0.28 | 0.37 | 0.49 | 0.28 | 0.30 | 0.45 |
| K | 0.71 | 0.71 | 0.88 | 0.53 | 0.52 | 0.82 |
| S | 0.11 | 0.20 | 0.31 | 0.16 | 0.22 | 0.32 |

[a]All values presented on a DM basis.
[b]DRC = dry-rolled corn; WDGS = wet distillers grains plus solubles; CGM = corn gluten meal; SBM = soybean meal.
[c]Supplemented with urea at 1.30% of diet to meet the DIP requirement.

**Table 2. Effect of protein in wet distillers grains on finishing performance and carcass characteristics**

| Item | Treatment[a] | | | | | | SEM | *P*-value | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CON | 20WDG | 40WDG | 20PRO | 40PRO | 40 PRO-SOL | | WDG Lin.[b] | WDG Quad.[c] | Protein Lin.[d] | Protein Quad.[e] | 40PRO vs. 40 PRO-SOL | 20WDG vs. 20PRO[f] | 40WDG vs. 40PRO[f] |
| Performance | | | | | | | | | | | | | | |
| Initial BW, lb | 642 | 643 | 644 | 641 | 643 | 640 | 1 | 0.23 | 0.95 | 0.58 | 0.41 | 0.11 | 0.32 | 0.51 |
| Final BW, lb[g] | 1323 | 1338 | 1350 | 1314 | 1356 | 1326 | 10 | 0.06 | 0.86 | 0.02 | 0.04 | 0.04 | 0.09 | 0.65 |
| DMI, lb/d | 22.6 | 21.6 | 21.4 | 22.1 | 22.6 | 21.9 | 0.2 | < 0.01 | 0.21 | 0.85 | 0.13 | 0.08 | 0.16 | < 0.01 |
| ADG, lb[g] | 3.63 | 3.71 | 3.77 | 3.59 | 3.81 | 3.65 | 0.05 | 0.06 | 0.83 | 0.02 | 0.04 | 0.04 | 0.08 | 0.61 |
| F:G[g,h] | 6.22 | 5.83 | 5.67 | 6.17 | 5.92 | 6.00 | — | < 0.01 | 0.12 | < 0.01 | 0.19 | 0.32 | < 0.01 | 0.01 |
| Feeding Value | — | 134 | 125 | 110 | 129 | 121 | — | — | — | — | — | — | — | — |
| Carcass Traits | | | | | | | | | | | | | | |
| HCW, lb | 833 | 843 | 851 | 828 | 855 | 835 | 6 | 0.06 | 0.87 | 0.02 | 0.04 | 0.04 | 0.09 | 0.66 |
| Dressing, % | 63.5 | 63.3 | 63.6 | 63.1 | 63.5 | 63.0 | 0.2 | 0.64 | 0.21 | 0.95 | 0.12 | 0.06 | 0.64 | 0.69 |
| LM area, $in^2$ | 13.5 | 13.6 | 13.8 | 13.3 | 13.8 | 13.5 | 0.2 | 0.26 | 0.62 | 0.24 | 0.10 | 0.21 | 0.32 | 0.95 |
| Calculated YG | 2.93 | 2.96 | 2.95 | 3.04 | 3.00 | 2.85 | 0.09 | 0.91 | 0.85 | 0.61 | 0.50 | 0.24 | 0.53 | 0.69 |
| 12th Rib fat, in | 0.48 | 0.48 | 0.49 | 0.50 | 0.51 | 0.46 | 0.02 | 0.58 | 0.81 | 0.22 | 0.75 | 0.05 | 0.41 | 0.49 |
| Marbling[i] | 422 | 428 | 429 | 433 | 443 | 426 | 9 | 0.60 | 0.85 | 0.10 | 0.94 | 0.19 | 0.65 | 0.26 |
| Liver abscess, % | 21.2 | 18.5 | 14.8 | 9.3 | 11.3 | 11.8 | 0.5 | 0.41 | 0.89 | 0.19 | 0.27 | 0.94 | 0.17 | 0.60 |

[a]CON = 75.5% DRC; 20WDG = 20% wet distillers grains plus solubles; 40WDG = 40% wet distillers grains plus solubles; 20PRO = 8.75% corn gluten meal to mimic the protein portion of 20WDG; 40PRO = 17.5% corn gluten meal to mimic the protein portion of 40WDG; 40PRO-SOL = 17.5% corn gluten meal and 10% solubles.
[b]WDG Lin. = *P*-value for the linear response of wet distillers grains inclusion for CON, 20WDG, 40WDG.
[c]WDG Quad. = *P*-value for the quadratic response of wet distillers grain inclusion for CON, 20WDG, 40WDG.
[d]Protein Lin. = *P*-value for the linear response of corn gluten meal for CON, 20PRO, 40PRO.
[e]Protein Quad. = *P*-value for the quadratic response of corn gluten meal for CON, 20PRO, 40PRO.
[f]Comparison of the protein portion of WDGS, mimicked by corn gluten meal, and WDGS.
[g]Calculated from carcass weight, adjusted to 63% common dressing percent.
[h]Analyzed as G:F, the reciprocal of F:G.
[i]Marbling score: 400 = Small$^{00}$.

G:F-corn G:F) / corn G:F) / compared treatment's inclusion rate).

Performance and carcass characteristics were analyzed using the PROC MIXED procedure of SAS and liver abscesses were analyzed using the GLIMMIX procedure of SAS (SAS Institute, Inc., Cary, N.C.) with dead or chronic steers removed from analysis. Five steers were removed from the experiment due to injury or respiratory issues. Pen was the experimental unit and block was treated as a fixed effect. Linear and quadratic contrasts were developed to compare distillers grains level (20 vs. 40) and protein concentration. Pairwise comparisons were pre-planned to determine the addition of solubles (40PRO vs. 40PRO-SOL) and feeding value of protein from distillers grains (20WDG vs. 20PRO; 40WDG vs. 40PRO). Treatment differences were considered significant when $P \leq 0.05$ with tendencies between $P > 0.05$ and $P \leq 0.10$.

## Results

### *Linear and Quadratic Responses for CON, 20WDG, and 40WDG*

There was a tendency for a linear increase for final BW (1323 vs. 1350 for CON vs. 40WDG, respectively; $P = 0.06$) due to WDGS (Table 2). As WDGS inclusion increased from 0 to 40%, DMI decreased linearly (22.6 vs. 21.4 for CON vs. 40WDG, respectively; $P < 0.01$) with a tendency for a linear increase in ADG (3.63 vs. 3.77 for CON vs. 40WDG, respectively; $P = 0.06$). Increasing WDGS inclusion linearly decreased F:G (6.22 vs. 5.67 for CON vs. 40WDG, respectively; $P < 0.01$). Cattle fed 20WDG and 40WDG had a feeding value of 134% and 125% relative to corn, respectively. All carcass traits, except HCW ($P = 0.06$), were not impacted ($P \geq 0.21$) by WDGS inclusion.

### *Linear and Quadratic Responses for Protein*

The protein portion of WDGS was mimicked by CGM at inclusion concentrations equal to the protein contained in 20 and 40% WDGS. Increasing protein concentrations quadratically increased ($P = 0.04$) final BW. Cattle fed 40PRO were 33 lb heavier compared to CON. There were no differences ($P \geq 0.13$) in DMI between CON, 20PRO, and 40PRO. Gain increased quadratically ($P = 0.04$) as CGM increased. Cattle fed 17.5% CGM (protein concentration equal to 40% WDGS) gained 3.81 lb/d compared to CON which gained 3.63 lb/d. As protein increased in the diet, F:G decreased linearly (6.22 vs. 5.92 for CON vs. 40PRO, respectively; $P < 0.01$). There was a quadratic increase ($P = 0.04$) for HCW with steers fed 40PRO having the greatest HCW at 855 lb compared to CON and 20PRO. There were no differences ($P = 0.12$) in dressing percent as protein increased. There tended to be a quadratic increase ($P < 0.10$) in LM area with 40PRO having the largest LM area, CON intermediate, and 20PRO with the smallest. There were no differences ($P \geq 0.22$) in calculated yield grade and 12th rib fat among CON, 20PRO, and 40PRO. Marbling tended to increase linearly ($P = 0.10$) as protein concentration increased. There were no differences ($P = 0.19$) for liver abscesses between CON, 20PRO, and 40PRO. These results indicate an energy response for CGM, not a protein response.

### *40PRO vs. 40PRO-SOL*

The addition of 10% solubles (40PRO-SOL) decreased final BW (1326 vs. 1356; $P = 0.04$) compared to 40PRO. Dry matter intake tended to be lower ($P = 0.08$) for cattle fed 40PRO-SOL compared to 40PRO. Average daily gain decreased for 40PRO-SOL, with steers gaining 3.65 lb/d in comparison to 3.81 lb/d for steers fed 40PRO ($P = 0.08$). However, there were no differences ($P = 0.32$) in F:G between 40PRO and 40PRO-SOL. Therefore, supplementing solubles decreased ADG and DMI at a similar rate, which did not change F:G. Compared with 40PRO, feeding 40PRO-SOL decreased HCW (835 vs. 855; $P = 0.04$) and tended to decrease dressing percent (63.0% vs. 63.5%; $P = 0.06$). There were no differences ($P \geq 0.21$) in LM area and calculated yield grade between 40PRO and 40PRO-SOL. There was a decrease in 12th rib fat (0.46 vs. 0.51; $P = 0.05$) for 40PRO-SOL compared to 40PRO. There were no differences ($P \geq 0.19$) in marbling and liver abscesses between both 40PRO and 40PRO-SOL.

### *20WDG vs. 20PRO*

Isolating the protein portion of 20% WDGS by feeding 8.75% CGM (20PRO) decreased final BW (1314 vs. 1338; $P = 0.05$) compared to 20WDG. However, there were no differences ($P = 0.16$) in DMI between 20WDG and 20PRO. Steers fed 20PRO tended to have decreased ADG (3.59 vs. 3.71; $P = 0.09$) compared to 20WDG. This resulted in steers fed 20PRO being 5.8% less efficient than steers consuming 20WDG (6.17 vs. 5.83; $P < 0.01$). The feeding value for protein was less than that of WDGS (110 vs. 134 for 20PRO vs. 20WDG, respectively) relative to corn. There was a tendency for decreased HCW ($P = 0.09$) for 20PRO compared to 20WDG. However, all carcass traits were not different ($P \geq 0.17$) between 20WDG and 20PRO.

### *40WDG vs. 40PRO*

When comparing 40% WDGS to 40PRO, there were no differences ($P = 0.65$) in final BW, however, steers fed 40PRO consumed 1.2 lb/d more than 40WDG (22.6 vs. 21.4; $P < 0.01$). There were no differences ($P = 0.61$) for ADG between 40WDG and 40PRO. This translated into steers consuming 40WDG being lower in F:G than 40PRO (5.67 vs. 5.92; $P < 0.01$). Unlike the 20PRO vs. 20WDG comparison, the feeding value of protein was higher than WDGS (129 vs. 125 for 40PRO vs. 40WDGS, respectively). There were no differences ($P \geq 0.26$) for carcass traits between 40WDG and 40PRO.

Inclusion of 26–50.9% (DM basis) corn grain in calf-fed diets leads to improved feed conversions (*2016 Nebraska Beef Cattle Report*, pp. 89–90). The CGM diets replaced only 8.75 and 17.5% of corn compared to the WDGS diets which replaced 20 and 40%. According to Watson, higher levels of corn grain result in poorer feed conversions. This did not affect the comparison between 20WDG and 20PRO. However, this may have had an impact on F:G between the 40PRO and 40WDG comparison since 40WDG has considerably less corn grain in the diet.

This study suggests that inclusion of WDGS increased final BW, ADG, and HCW, while decreasing F:G compared to CON. Similarly, increasing protein concentration increased final BW, ADG, HCW, LM area, and marbling with improved F:G compared to CON when fed to mimic 40% WDGS. The addition of solubles to corn gluten meal decreased final BW, ADG, DMI, HCW, and marbling but did not affect F:G. The average feeding value for CGM at inclusion rates equal to the protein in WDGS at 20 and 40% was 122. Wet distillers grains plus solubles had an average feeding value of 128 at 20 and 40% inclusion rates. Suggesting, protein accounts for the majority of the feeding value response.

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