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# Effects of Modified Distillers Grains and Corn Ratios as Supplements in Diets Varying in Forage Quality on Performance of Growing Beef Steers

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## Summary with Implications

*Distillers grains (DG) have been intensively used for beef production, but prices relative to corn vary such that it may be beneficial to displace a portion of DG with corn in certain circumstances. Four ratios of supplemental energy (40% of diet DM) from modified distillers grains and corn (100:0, 80:20, 60:40, and 40:60) were supplemented in one of 3 forage diets (56% of diet DM) and evaluated for performance. Forages were high (brome hay + sorghum silage) or low quality. Low quality forages were corn residue baled through conventional rake and bale, or by disengaging the spreader on the combine and baling the tailings (easy bale). Steers fed the high quality forage had greater ADG due to greater DMI, but similar F:G as both residue forage diets, which were not different. Decreasing the ratio of modified DG:corn linearly decreased ADG and resulted in poorer F:G.*

## Introduction

Ethanol production in the US increased from 6.1 billion gallons in 2007 to 13.5 billion gallons in 2014. Since then, corn residue and distillers grains (DG) have been intensively used for beef production. Corn residue is composed of plant parts with distinct digestibilities, with the husk being the most digestible, followed by leaf blade, cob and lastly stem (2015 Nebraska Beef Cattle Report, pp. 59-61). The proportion of plant parts in the windrow to be baled plays an important role on performance, since it determines the digestibility of forage consumed by the animal.



In the past, DG was included in ruminant diets due to its low price, but the increasing export demand in recent years has raised the price. However, it is not known if corn can displace a portion of DG as supplemental energy in forage diets for growing steers. We hypothesize that corn may replace 60% of distillers grains without negatively impacting performance because DG will still meet the protein requirements of the steers. The objective of this research was to determine the effects of displacing the supplemental energy from modified DG in diets of different forage qualities on performance of growing beef steers.

## Procedure

The experiment was conducted at the University of Nebraska—Lincoln Eastern Nebraska Research and Extension Center near Mead, Neb. One hundred twenty individually fed crossbred beef steers (initial BW = 620; ± 32 lb) were used in a randomized complete block design with a 4 × 3 factorial treatment arrangement (n = 10 steers per simple effect treatment). Factors included 4 ratios of supplemental energy from modified distillers grains (MDG) and dry-rolled corn and 3 forage types (Table 1). Ratios of MDG:corn were 100:0, 80:20, 60:40 or 40:60 as supplemental energy comprising 40% of the diet DM. Energy supplements were fed in diets consisting of high quality (HQ; 70% brome hay and 30% sorghum silage) or one of two low quality forages. Low quality forages consisted of corn residue baled through conventional rake and bale system (CB), or by disengaging the spreader on the combine and baling the tailings (easy bale-EZB). Four samples of each type of bale were collected and separated into cobs, shanks and husks, leaf blades and leaf sheaths, and stems. Plant parts were weighted and proportions calculated (Table 1).

Steers were fed a common diet at 2% of BW composed of 60% forage and 40% wet corn gluten feed (Sweet Bran, Cargill Wet Milling, Blair, Neb) for 5 d at the beginning and end of the trial and weighed on 3 consecutive days to minimize differences in gut fill. Steers were blocked by initial BW, identified with numbered tags and implanted with 36 mg zeranol (Ralgro; Merck Animal Health). The experimental diets contained 56% forage, 40% supplemental energy from different ratios of dry-rolled corn or MDG and 4% supplement with urea, vitamins, minerals and Rumensin (14 mg/hd/d) on a DM basis. Animals were individually fed using Calan gates for 84 days.

Feed delivery and refusals were weighed daily and recorded. Response variables included initial BW, ending BW, DMI, ADG and F:G ratio.

Data were analyzed using the MIXED procedure (SAS Inst. Inc., Cary, NC) with steer as the experimental unit, therefore 10 replications per treatment. The experiment was designed as a 3 X 4 factorial with 3 forage types (HQ, CB, and EZB) and four MDG:corn ratios (100:0, 80:20, 60:40, and 40:60). Orthogonal comparisons across MDG levels were analyzed to determine linear, quadratic or cubic trends for varying MDG:corn ratios in the diet. Interactions between supplemental energy ratios and forage type were also tested. Data were considered statistically significant when $P < 0.05$.

## Results

No interactions (linear or quadratic; $P > 0.32$) were observed between forage quality and ratio of MDG:corn supplementation for ADG and F:G. A significant quadratic interaction ($P < 0.01$) was observed for DMI (data not shown). The differences in DMI across ratios were small within each forage quality. However, the interaction was due to a quadratic increase, then decrease in DMI as MDG was replaced with corn within the HQ diets (range in DMI from 18.7 to 20.6 lb / d). For steers fed EZB, a cubic response to ratio of MDG:corn was observed with DMI of 12.2, 11.0, 12.2, and

**Table 1. Ingredient composition of experimental diets fed to steers (DM basis)**

| Item | HQ[1] | | | | EZB | | | | CB | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 100[2] | 80 | 60 | 40 | 100 | 80 | 60 | 40 | 100 | 80 | 60 | 40 |
| Forage | 56.0 | 56.0 | 56.0 | 56.0 | 56.0 | 56.0 | 56.0 | 56.0 | 56.0 | 56.0 | 56.0 | 56.0 |
| MDG[3] | 40.0 | 32.0 | 24.0 | 16.0 | 40.0 | 32.0 | 24.0 | 16.0 | 40.0 | 32.0 | 24.0 | 16.0 |
| DRC[4] | 0.0 | 8.0 | 16.0 | 24.0 | 0.0 | 8.0 | 16.0 | 24.0 | 0.0 | 8.0 | 16.0 | 24.0 |
| Supplement | | | | | | | | | | | | |
| Ground corn | 2.1 | 2.1 | 2.1 | 2.1 | 2.60 | 2.60 | 2.54 | 2.28 | 2.60 | 2.60 | 2.54 | 2.28 |
| Limestone | 1.46 | 1.46 | 1.46 | 1.46 | 0.92 | 0.92 | 0.82 | 0.39 | 0.92 | 0.92 | 0.82 | 0.39 |
| Tallow | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.1 | 0.10 | 0.10 | 0.10 | 0.1 | 0.10 |
| Salt | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.3 | 0.30 | 0.30 | 0.30 | 0.3 | 0.30 |
| Urea | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.15 | 0.85 | 0.0 | 0.0 | 0.15 | 0.85 |
| Minerals | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| Vitamin A-D-E | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 |
| Rumensin-90 | 0.014 | 0.014 | 0.014 | 0.014 | 0.014 | 0.014 | 0.014 | 0.014 | 0.014 | 0.014 | 0.014 | 0.014 |

[1] HQ = high quality forage, 70% brome hay and 30% sorghum silage; EZB = easy bale, corn residue baled by disengaging the spreader on the combine and baling the tailings; CB = conventional rake and bale system
[2] Percent modified distillers grains in the supplement
[3] MDG = modified distillers grains
[4] DRC = dry rolled corn

**Table 2. Effects of forage type on cattle performance**

| Item | Forage type[1] | | | SEM | *P*-value |
|---|---|---|---|---|---|
| | HQ | EZB | CB | | Forage |
| Initial BW, lb | 620 | 620 | 620 | 1.25 | 0.98 |
| Ending BW, lb | 865[a] | 763[b] | 772[b] | 4.73 | <0.01 |
| DMI, lb/d | 19.67[a] | 11.46[c] | 12.22[b] | 0.27 | <0.01 |
| ADG, lb | 2.89[a] | 1.68[b] | 1.79[b] | 0.05 | <0.01 |
| F:G[2] | 6.85 | 6.71 | 6.76 | - | 0.92 |

[1] HQ = high quality forage, 70% brome hay and 30% sorghum silage; EZB = easy bale, corn residue baled by disengaging the spreader on the combine and baling the tailings; CB = conventional rake and bale system
[2] Analyzed as G:F, the reciprocal of feed conversion (F:G).
[a,b,c] Means within a row with different superscripts differ.

**Table 3. Proportions of the parts of the corn residue in each type of bailing method.**

| Item | CB[1] | | EZB[2] | |
|---|---|---|---|---|
| | % | SD[3] | % | SD |
| Stem | 46.32 | 1.59 | 41.90 | 3.08 |
| Cob | 5.29 | 0.76 | 13.96 | 3.28 |
| Husk | 9.53 | 0.58 | 14.45 | 1.02 |
| Leaf | 38.86 | 1.00 | 29.69 | 1.98 |

[1]EZB = easy bale, corn residue baled by disengaging the spreader on the combine and baling the tailings;
[2]CB = conventional rake and bale system;
[3]SD = Standard deviation.

10.5 observed as MDG:corn ratio decreased from 100:0 to 40:60, suggesting simply that intakes varied as MDG:corn differed. No difference in DMI was observed due to ratio of MDG:corn within CB diets. Performance due to main effects of either ratio of MDG:corn or forage quality are presented.

The HQ forage increased ending BW by 12.7% ($P < 0.01$), ADG by 60.0% ($P < 0.01$) and DMI by 62.73% ($P < 0.01$) compared to the low quality forages (Table 2). There were no differences between the two corn residue forages for ending BW and ADG. Feeding EZB treatment decreased DMI compared to CB. As expected, husk proportion was increased by the EZB method, being 14.45 vs. 9.53% for EZB and CB, respectively. But, the proportion of stem + cob (the parts of the plant with lowest digestibilities) was actually slightly greater for the EZB (55.9 *vs*. 51.6% Stem + cob for EZB and CB, respectively; Table 3) which can explain the lack of difference between the low quality forages on performance. However, the F:G ratio was not affected by type of forage ($P = 0.92$) despite changes in DMI and ADG.

There was a linear decrease in ending BW ($P < 0.01$) and ADG ($P < 0.01$) as MDG was displaced with corn (Table 4).

**Table 4. Effects of MDG level on cattle performance**

| Item | MDG Level[1] | | | | SEM | *P*-value | |
|---|---|---|---|---|---|---|---|
| | 100 | 80 | 60 | 40 | | Linear | Quad |
| Initial BW, lb | 620 | 620 | 620 | 620 | 1.44 | 0.98 | 0.99 |
| Ending BW, lb | 813 | 804 | 799 | 784 | 5.46 | <0.01 | 0.58 |
| DMI, lb/d | 14.78 | 14.42 | 14.71 | 13.88 | 0.54 | 0.09 | 0.45 |
| ADG, lb | 2.27 | 2.17 | 2.11 | 1.93 | 0.06 | <0.01 | 0.55 |
| F:G[2] | 6.54 | 6.54 | 6.90 | 7.19 | - | 0.03 | 0.58 |

[1] Percent modified distillers grains (MDG) in the supplement.
[2] Analyzed as G:F, the reciprocal of feed conversion (F:G).

Similarly, the F:G ratio increased linearly ($P = 0.03$) and DMI ($P = 0.09$) tended to decrease linearly as MDG inclusion decreased in the diet and corn increased. The F:G response to ratio of MDG:corn was not quadratic ($P = 0.58$) even though F:G was similar at 100:0 and 80:20 ratios and then F:G increased as corn replaced more MDG. When wet distillers grains or dry distillers grains were evaluated at two different inclusions (15 or 30% in the diet) with grass hay and sorghum silage based diets, the highest distillers inclusion improved ending BW, ADG and F:G ratio regardless of the form of distillers grains fed (*2011 Nebraska Beef Cattle Report, pp. 20-21*). Another trial (*2011 Nebraska Beef Cattle Report, pp. 24-25*) evaluated the performance of growing steers grazing smooth bromegrass supplemented with dry distillers grains at 0.6% of BW per day and supplementation increased ADG by 1.4 lb / d compared to non-supplemented cattle. The improved performance of cattle supplemented distillers grains can be attributed to the energy from fat and rumen undegradable protein of the distillers grains *(2006 NebraskaBeef Cattle Report, pp. 27-29)*. In the current study, steers fed the 40:60 ratio of MDG:corn should have met their metabolizable protein requirements, suggesting that the response in ADG and F:G is due to energy differences between MDG and corn, and not a protein requirement response. The 40% inclusion of modified distillers grains resulted in greater performance compared to the other levels.

## Conclusions

As expected, the high quality forage increased steer performance compared to the two corn residue bailing methods. However, while it was expected that the easy bale treatment would result in improved residue quality, there was no difference between the easy bale and conventional rake and bale systems for average daily gain or feed efficiency. Additionally, when distillers grains was displaced with dry-rolled corn, cattle performance decreased.

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