Effects of corn wet distillers grains and corn processing method on performance and carcass characteristics of finishing heifers in the Southern Plains

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Summary

Two hundred sixty four yearling heifers (781 ± 35 lb) were blocked by weight in a 2X2 factorial arrangement of treatments to determine effects of 20% corn wet distiller's grains plus soluble (WDGS) on animal performance in steam-flaked corn (SFC) and dry-rolled corn (DRC) based finishing diets. No corn processing method by WDGS inclusion interactions were detected ($P \geq 0.29$). Heifers consuming SFC-based diets had reduced DMI ($P < 0.01$), similar ADG ($P \geq 0.69$), and improved feed:gain ($P < 0.05$) compared to heifers consuming DRC-based diets. Heifers consuming WDGS tended to have greater final BW (P = 0.10), ADG ($P = 0.14$), and reduced marbling scores (P = 0.18) compared to heifers consuming diets without WDGS. Nutrients in the manure harvested from pens of DRC based diets were greater than SFC based diets (P < 0.05). WDGS increased the quantity of DM, N, P, and K of harvested manure (P < 0.10). Corn processing method had a greater impact on animal performance than WDGS. While including WDGS tended to improve animal performance, manure management must be considered.

Introduction

As more ethanol is produced in the Southern Plains, there is increased competition for the corn traditionally used by the cattle feeding industry. However, the primary by-product of the ethanol industry, distiller's grains may be an economical energy substitute for corn. In the Northern Plains, feeding distiller's grains has resulted in improved feed efficiency (Vander Pol et al. 2006; Huls et al. 2008). However, feeding distiller's grains in the Southern Plains has not improved feed efficiency (Vasconcelos et al. 2007; Silva et al. 2007). Corrigan et al., 2007 noted a corn processing method interaction when feeding corn wet distiller's grains with either dry-rolled, high moisture, or steam-flaked corn. Therefore, our objective was to include 20% corn wet distiller's grains (DM basis) as an energy source from an ethanol plant in the Northern Plains, in a Southern Plains feeding environment.

Experimental Procedures

Two hundred sixty four crossbred yearling heifers (781 ± 35 lb) were blocked by weight in a 2X2 factorial arrangement of treatments. Treatments consisted of a SFC control, SFC with 20% (DM basis) corn wet distiller's grains with solubles (WDGS), a dry-rolled corn (DRC) control, and DRC with 20% WDGS. All diets contained 10% alfalfa hay, 1.2% urea, 2.0% yellow grease, 0.70% Ca, and 4% glycerin (Table 1). Control diets were balanced for 13.5% CP. Urea remained constant in all diets realizing that the DRC-based diets would contain greater CP than required; however, the impact of feeding WDGS on the degradable intake protein (DIP) requirement was unclear. Therefore, it was determined that overfeeding CP was more acceptable than limiting DIP.

The heifers were vaccinated against viral pathogens (Vista 5, Intervet Inc., Millsboro, DE) and clostridial bacterin-toxoid (Vision 7, Intervet, Inc.) and treated for parasites with Ivomec (Merial Ltd., Deluth, GA). The heifers were limit-fed a common diet consisting of 46% SFC, 45% alfalfa hay, 7% glycerin, and 2% supplement for seven consecutive days and weighed three consecutive days to limit variation in gut fill. Heifers were blocked by weight, stratified by weight within blocks, and randomly assigned to pens. Dietary treatments were randomly assigned to pen. Heifers were adapted to a 90% concentrate diet over a 21 day period in three steps containing 35, 25, and 15% alfalfa hay. Heifers were fed an average of 154 days and were implanted with Revalor-H (Intervet, Inc.) approximately 120 days before slaughter. The NEm and NEg of the diets were determined from the NRC (1996) equations and cattle performance while the replacement method was used to determine the energy value of the SFC and WDGS.

Corn WDGS was purchased from Chief Ethanol (Hastings, NE) and stored in plastic silo bags after being mixed with chopped alfalfa hay. The bagged mixture consisted of 75%WDGS and 25% alfalfa hay as suggested by Erickson et al. (2008). Dry-rolled corn was purchased in bulk and stored in a commodity bay for the duration of the trial. The SFC (27 lb/bu.) was purchased 3 or 4 times weekly from a local feedlot. All diets were mixed and fed once daily. Ingredient samples were taken daily for WDGS and SFC and weekly for all other ingredients for DM analysis. Ingredient DM was updated weekly for ration formulation. A composite of the DM samples was created for all ingredients and sent to a commercial laboratory (Servi-Tech Laboratories, Amarillo, TX) for nutrient analysis.

Twenty-four pens (6 pens per treatment) were used in this experiment. The pens housed 8, 10, or 18 heifers and the study was blocked by pen size. Twelve fly ash surfaced environmental pens (3 per treatment) were scraped for

manure at the end of the feeding period. The manure was analyzed for dry matter (DM), organic matter (OM), nitrogen (N), phosphorus (P), and potassium (K).

Data were analyzed as a 2x2 factorial using Mixed procedures of SAS with block considered to be a random variable. The model included corn processing method, WDGS inclusion, and the interaction of corn processing method and WDGS inclusion.

Results and Discussion

Dry matter intake was greater for heifers consuming DRC-based diets than for those consuming SFC-based diets ($P < 0.01$; Table 2). The inclusion of WDGS in the diet did not affect DMI ($P = 0.74$) nor was there an interaction between the addition of WDGS and corn processing method for DMI ($P = 0.76$). Average daily gain was not different for DRC or SFC-based diets ($P \geq 0.69$) while the inclusion of WDGS tended to increase ADG ($P \leq 0.15$). No WDGS x corn processing method interaction was detected for ADG ($P = 0.69$). Since DMI was greater for heifers receiving the DRC-based diets and ADG was not significantly different for either corn type, those heifers receiving the SFC-based diets had improved feed:gain ($P \leq 0.03$; Table 2). Animal performance was calculated both from final live BW which was shrunk 4%, and final BW calculated from HCW using a constant dressing percent. The addition of WDGS did not affect feed efficiency ($P = 0.23$) when calculated from a carcass-adjusted basis. However, when animal performance was calculated using actual final BW which were shrunk 4%, the inclusion of WDGS significantly improved feed:gain ($P = 0.05$). These conflicting observations are caused by numeric differences in the dressing percent of heifers consuming DRC and SFC control diets. However, regardless of the manner in which animal performance was calculated, an interaction between corn processing method and WDGS inclusion did not exist ($P \geq 0.38$). Overall ADG was lower and feed:gain was greater than expected in this study. These heifers were fed during the winter of 2006 and spring of 2007 during which the Texas Panhandle experienced greater than normal precipitation and lower than normal temperatures. These conditions resulted in increased mud in feedlot pens which likely impacted the maintenance energy requirements of the heifers in the current study. While these conditional negatively affected overall animal performance, we have no reason to believe that relative differences between treatments were affected.

There were no differences for fat thickness, ribeye area, yield grade, or dressing percentage ($P \geq 0.27$) for corn processing method, the inclusion of WDGS, or an interaction of the two (Table 3). There were also no differences in HCW or marbling scores for DRC-based diets vs. SFC-based diets or an interaction with WDGS inclusion and corn processing method ($P > 0.83$). However, the inclusion of WDGS tended to increase HCW ($P = 0.16$). This observation is consistent with the increase in final BW. Additionally, there was a slight tendency ($P = 0.19$) for the inclusion of WDGS to reduce marbling score. Since this lower value was not statistically significant, no conclusion can be drawn at this time. More research will be necessary.

The SFC was 110% the energy value of the DRC while the WDGS was 100% the energy value of SFC and 107% the value of DRC (Table 4). It is logical therefore that the heifers consuming SFC-based diets were more efficient than those consuming DRC-based diets and that the inclusion of WDGS minimally affected performance relative to the control diets.

The nutrient content of the pen scrapings are presented in Table 5. There were significantly greater ($P < 0.05$) amounts of DM, OM, N, P, and K in the pen scrapings from heifers consuming DRC-based diets compared to SFC-based diets. The N was much greater in DRC-based diets due to the fact that protein was overfed in those diets. The inclusion of WDGS significantly ($P < 0.10$) increased the amount of DM, N, P, and K in the manure compared to diets with no WDGS, but resulted in only slight increases in OM ($P = 0.16$). This suggests an increase in an inorganic fraction of the manure output. This is supported by the increased P and K fractions. An interaction between WDGS and corn processing method was not observed ($P \geq 72$).

Implications

The addition of distiller's grains tended to improve animal performance relative to the control diets. An interaction between WDGS and corn processing method was not observed for any response variable. We interpret these data to suggest that 20% corn WDGS can be incorporated into SFC-based diets in the southern plains without negatively affecting animal performance provided the WDGS are comparable to those utilized in this study. However, an

increase in manure output, especially the quantity of P, make manure management a consideration when including distiller's grains in finishing diets.

Literature Cited

Corrigan, M.E., G.E. Erickson, T.J. Klopfenstein, K.J. Vander Pol, M.A. Greenquist, and M.K. Lubbe. 2007. Effects of corn processing and wet distiller's grains inclusion level in finishing diets. Nebraska Beef Cattle Report MP90:33-35. Available at: http://beef.unl.edu/beefreports/2007.pdf. Accessed August 24, 2008.

Erickson, G.E., T. Klopfenstein, R. Rasby, A. Stalker, B. Plugge, D. Bauer, D. Mark, D. Adams, J. Benton, M. Greenquist, B. Nuttleman, L. Kovarik, M. Peterson, J. Waterbury and M. Wilken. 2008. Storage of wet corn co-products. University of Nebraska publication. Available at: http://beef.unl.edu/byprodfeeds/corn_coproducts_storage_manual_may_2008.pdf. Accessed August 9, 2008.

Huls, T.J., M.K. Lubbe, G.E. Erickson, T.J. Klopfenstein. 2008. Effects of inclusion level of modified distiller's grains plus soluble in finishing steers. NE Beef Cattle Report. MP91:41-42. Available at: http://beef.unl.edu/beefreports/2008.pdf. Accessed August 24, 2008.

NRC. 1996. Nutrient requirements of beef cattle, 7th ed. National Academy Press, Washington, D.C.

Silva, J.C., N.A. Cole, M.S. Brown, C.H. Ponce, D.R. Smith. 2007. Effects of dietary fat and wet sorghum distiller's grains plus soluble on feedlot performance and carcass characteristics of finishing heifers. Beef Cattle Research in Texas pp.83-87. Available at: http://beef.tamu.edu/academics/beef/bcrt/2007.pdf. Accessed August 24, 2008.

Vander Pol, K.J., G.E. Erickson, T.J. Klopfenstein, M.A. Greenquist, T. Robb. 2006. Effects of dietary inclusion of wet distiller's grains on feedlot performance of finishing cattle and energy value relative to corn. NE Beef Cattle Report MP89:51-53. Available at: http://beef.unl.edu/beefreports/2006.pdf. Accessed August 24, 2008.

Vasconcelos, J.T., L.M. Shaw, K.A. Lemon, N.A. Cole, and M.L. Galyean. 2007. Effects of graded levels of sorghum wet distiller's grains and degraded intake protein supply on performance and carcass characteristics of feedlot cattle fed steam-flaked corn-based diets. Prof. Anim. Sci. 23:467-475.

Table 1. Diet composition of dry rolled corn and steam-flaked corn based diets with and without corn wet distiller's grains plus solubles (WDGS) fed to heifers.

	0% WDGS		20% WDGS	
Item	SFC[1]	DRC	SFC	DRC
Ingredient (% DM)				
Steam-flaked corn	76.00	----	60.80	----
Dry-rolled corn	----	76.00	----	60.80
WDGS	----	----	20.00	20.00
Cottonseed meal	4.80	4.80	----	----
Alfalfa hay	10.00	10.00	10.00	10.00
Glycerin	4.00	4.00	4.00	4.00
Yellow grease	2.00	2.00	2.00	2.00
Limestone	1.40	1.40	1.40	1.40
Urea	1.20	1.20	1.20	1.20
Premix[2]	0.60	0.60	0.60	0.60
Chemical Composition, % DM				
CP	13.8	14.3	15.8	16.3
Ether extract	4.68	5.82	6.55	7.46
Ca	0.71	0.71	0.68	0.68
P	0.25	0.33	0.33	0.39
K	0.55	0.60	0.66	0.70
S	0.12	0.12	0.24	0.25

[1]Corn processing method; SFC = steam-flaked corn; DRC = dry rolled corn.

[2]Formulated to provide a dietary DM inclusion of 0.30% salt, 60 ppm Fe, 40 ppm 30 ppm Mg, 25 ppm Mn, 10 ppm Cu, 1 ppm I, 0.15 ppm Co, 0.10 ppm Se, 1.5 IU/g vitamin A, 0.15 IU/g vitamin D, 8.81 IU/kg vitamin E, 33 mg/kg monensin, and 8.7 mg/kg tylosin.

Table 2. Effects of corn processing method and dietary wet distiller's grains plus solubles (WDGS) inclusion on animal performance of yearling heifers.

	0% WDGS		20% WDGS			Probability[1]		
Item	SFC[2]	DRC	SFC	DRC	SE	Corn	WDGS	Interaction
Live performance[3]								
Initial BW, lb	781	780	781	781	35	0.91	0.75	0.34
Final BW, lb	1185	1174	1195	1196	18	0.62	0.10	0.55
DMI, lb/d	19.9	21.6	20.2	21.6	0.54	<0.01	0.74	0.76
ADG, lb	2.63	2.59	2.71	2.72	0.07	0.77	0.14	0.69
Feed:gain[4]	7.56	8.35	7.43	7.93	0.16	<0.01	0.05	0.38
Carcass-adjusted performance[5]								
Final BW, lb	1204	1208	1223	1224	17	0.83	0.15	0.89
ADG, lb	2.76	2.82	2.90	2.90	0.07	0.69	0.15	0.69
Feed:gain[4]	7.24	7.63	6.93	7.42	0.21	0.03	0.23	0.83

[1]Overall treatment F-test; Corn = main effect of corn processing method; WDGS = main effect of dietary WDGS inclusion; Interaction = interaction of corn processing method and dietary WDGS inclusion.
[2]Corn processing method; SFC = steam-flaked corn; DRC = dry rolled corn.
[3]Final individual BW measured live and shrunk 4%.
[4]Analyzed as gain:feed.
[5]Final individual BW calculated as individual HCW / 63% (common dressing percent).

Table 3. Carcass characteristics of heifers consuming steam-flaked or dry-rolled corn based diets with or without corn wet distiller's grains.

	0% WDGS		20% WDGS			Probability[1]		
Item	SFC[2]	DRC	SFC	DRC	SE	Corn	WDGS	Interaction
HCW, lb	759	761	770	771	10	0.83	0.16	0.87
Dressing percent[3]	64.1	64.9	64.5	64.5	0.3	0.27	0.95	0.29
Fat thickness, in	0.52	0.48	0.52	0.52	0.03	0.57	0.54	0.63
Marbling score[4]	545	544	527	529	11	0.97	0.19	0.90
LM area, sq. in	14.4	14.5	14.8	14.5	0.3	0.68	0.48	0.40
USDA yield grade	2.46	2.33	2.39	2.49	0.14	0.92	0.77	0.43

[1]Overall treatment F-test; Corn = main effect of corn processing method; WDGS = main effect of dietary WDGS inclusion; Interaction = interaction of corn processing method and dietary WDGS inclusion.
[2]Corn processing method; SFC = steam-flaked corn; DRC = dry rolled corn.
[3]HCW/Final live BW shrunk 4%.
[4]400 = Slight^{00}, 500 = Small^{00}, 600 = Modest^{00}, etc.

Table 4. Energy density (Mcals NEg/lb) of dry rolled corn (DRC), steam-flaked corn (SFC) and wet distiller's grains plus solubles (WDGS)[1].

Ingredient	DRC	DRC/WDGS[2]	SFC[3]	SFC/WDGS[4]
DRC	0.700	----	----	----
SFC	----	----	0.774	----
WDGS	----	0.746		0.773

[1]Energy densities of ingredients calculated from animal performance relative to the DRC control using the replacement method.
[2]Energy density of WDGS is 107% value of DRC in DRC-based diets.
[3]Energy density of SFC is 110% value of DRC.
[4]Energy density of WDGS is 100% value of SFC in SFC-based diets.

Table 5. Daily accumulation of nutrients of pen scrapings from heifers fed dry rolled or steam-flaked corn based diets with or without corn wet distiller's grains.

	0% WDGS		20% WDGS			Probability[1]		
Item	SFC[2]	DRC	SFC	DRC	SE	Corn	WDGS	Interaction
DM, $lb \cdot hd^{-1} \cdot d^{-1}$	3.82	5.44	4.59	6.16	0.36	<0.01	0.08	0.94
OM, $lb \cdot hd^{-1} \cdot d^{-1}$	2.83	4.18	3.26	4.50	0.26	<0.01	0.16	0.83
N, $lb \cdot hd^{-1} \cdot d^{-1}$	0.126	0.187	0.147	0.217	0.013	<0.01	0.09	0.72
P, $lb \cdot hd^{-1} \cdot d^{-1}$	0.0390	0.0487	0.0479	0.0562	0.0029	0.02	0.03	0.81
K, $lb \cdot hd^{-1} \cdot d^{-1}$	0.091	0.115	0.118	0.139	0.009	0.04	0.02	0.89

[1]Overall treatment F-test; Corn = main effect of corn processing method; WDGS = main effect of dietary WDGS inclusion; Interaction = interaction of corn processing method and dietary WDGS inclusion.

[2]Corn processing method; SFC = steam-flaked corn; DRC = dry rolled corn.