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Summary

Dry-rolled corn (DRC), high-moisture corn (HMC), or steam-flaked corn (SFC) was replaced with increasing levels of wet distillers grains with solubles (WDGS; 0, 15, 27.5, 40% DM) to determine if an interaction exists between corn processing method and WDGS level in finishing steer diets. Optimal feedlot performance was observed with 40%, 27.5%, and 15% WDGS in DRC, HMC, and SFC based diets, respectively. Fat thickness, DMI, and marbling score responded quadratically to WDGS level and incidence of liver abscess decreased linearly with increasing WDGS levels. In conclusion, a greater response to WDGS level was observed with less intensely processed corn.

Introduction

Wet distillers grains with solubles (WDGS), has been shown to have an energy value that is superior to a 1:1 ratio of high-moisture and dry-rolled corn when included in finishing cattle diets (Vander Pol et al., 2006 *Nebraska Beef Report*, pp. 51-53). There is some evidence however of an interaction between corn processing method and optimum WDGS inclusion level. Results from literature indicate high-moisture ensiled corn and steam-flaked corn have 104 and 113% the energy value of dry-rolled corn, respectively. Vander Pol et al. (2006 *Nebraska Beef Report*, pp. 48-50) fed diets based on corn processed by various methods that contained 30% WDGS (DM basis) and found F:G was superior in steers fed high-moisture corn and similar in steers fed dry-rolled corn compared to steers fed steam-flaked corn. Generally

the cost of corn processing increases with the intensity of the processing method, so a greater response to WDGS inclusion in diets based on less intensely processed grain may render them an economically attractive alternative to diets based on more intensely processed grain. Therefore, the objective of this trial was to determine if an interaction exists between the effects of corn processing method and WDGS inclusion level on finishing steer performance measurements.

Procedure

In this trial, 480 crossbred steer calves (BW = 692 ± 39 lb) were used. Upon arrival at the feedlot, steers were individually identified, vaccinated with Bovi-Shield Gold 5 and Somubac (Pfizer Animal Health), and injected with Dectomax Injectable (Pfizer Animal Health). Steers were revaccinated approximately 16 days following initial

processing with Bovi-Shield Gold 5, Somubac, and Ultrachoice 7 (Pfizer Animal Health). Seven days prior to initiation of the experiment, steers were limit fed (2% BW) a diet containing 33% dry-rolled corn, 33% wet corn gluten feed, 33% alfalfa hay, and 1% supplement (DM basis). Steers were weighed on day 0 and 1 of the experiment and the average was used as initial BW. Steers were blocked by weight and randomly assigned to one of 48 feedlot pens (10 steers/pen). Pens were then assigned randomly to one of 12 treatments. A randomized complete block design was used with a 3 x 4 factorial treatment structure. The first factor was corn processing method (dry-rolled - DRC, high-moisture ensiled - HMC, or steam-flaked - SFC) and the second factor was WDGS dietary inclusion level (0, 15, 27.5, and 40% DM).

Experimental diets (Table 1) contained 7.5% alfalfa hay, 5% dry meal
(Continued on next page)

Table 1. Experimental diets (DM basis).

	0%WDGS	15%WDGS	27.5%WDGS	40%WDGS
DRC, HMC, or SFC ^a	82.5	72.5	60.0	47.5
WDGS ^b	—	15.0	27.5	40.0
Alfalfa hay	7.5	7.5	7.5	7.5
Molasses	5.0	—	—	—
Dry supplement ^c				
Fine ground corn	1.570	2.460	2.988	2.988
Urea	1.36	0.5	-	-
Limestone	1.29	1.50	1.47	1.47
Salt	0.30	0.30	0.30	0.30
Potassium chloride	0.08	—	—	—
Calcium sulfate	0.16	—	—	—
Tallow	0.13	0.13	0.13	0.13
Trace mineral premix ^d	0.05	0.05	0.05	0.05
Rumensin-80 premix ^e	0.021	0.021	0.023	0.023
Thiamine premix ^f	0.015	0.015	0.015	0.015
Vitamin premix ^g	0.015	0.015	0.015	0.015
Tylan-40 premix ^h	0.009	0.009	0.009	0.009
Formulated Nutrient Composition				
CP	13.0 %	14.2 %	15.7 %	18.6 %
Ca	0.70 %	0.70 %	0.70 %	0.71 %
P	0.33 %	0.36 %	0.41 %	0.46 %
K	0.65 %	0.66 %	0.85 %	1.03 %
S	0.20 %	0.25 %	0.33 %	0.41 %

^aDRC = dry-rolled corn, HMC = high-moisture corn, and SFC = steam-flaked corn.

^bWDGS = wet distillers grains with solubles.

^cFormulated to be fed at 5% of diet DM.

^dPremix contained 10% Mg, 6% Zn, 4.5% Fe, 2% Mn, 0.5% Cu, 0.3% I, and 0.05% Co.

^ePremix contained 80 g/lb monensin, fed at 0.018% of diet DM for the first 92 days of experiment and then adjusted to due to differences in intakes between treatments.

^fPremix contained 40 g/lb thiamine.

^gPremix contained 1500 IU vitamin A, 3000 IU vitamin D, 3.7 IU vitamin E per g.

^hPremix contained 80 g/lb tylosin.

Table 2. Effect of corn processing method (CPM) and wet distillers gains with solubles (WDGS) inclusion level on performance and carcass characteristics in finishing steer diets.

WDGS level:	Dry-Rolled Corn				High-Moisture Corn				Steam-Flaked Corn				P-value		
	0	15	27.5	40	0	15	27.5	40	0	15	27.5	40	CPM	WDGS	CxW ¹
<i>Performance</i>															
Initial BW, lb	702	702	700	702	700	701	703	705	703	701	702	704	0.32	0.01	0.02
Final BW, lb ^{2ab}	1311	1333	1347	1359	1316	1365	1367	1351	1318	1328	1305	1280	< 0.01	0.02	< 0.01
DMI, lb/day ^c	22.3	22.2	21.4	21.3	20.1	21.0	20.2	20.0	20.2	20.2	19.8	18.8	< 0.01	< 0.01	0.10
ADG, lb/day ^{abd}	3.64	3.77	3.87	3.92	3.68	3.96	3.97	3.86	3.67	3.74	3.60	3.44	< 0.01	0.01	< 0.01
Feed:gain ^{ae}	6.12	5.89	5.52	5.42	5.46	5.29	5.08	5.16	5.50	5.39	5.49	5.46	< 0.01	< 0.01	< 0.01
<i>Carcass Characteristics</i>															
HCW, lb ^{ab}	826	840	849	856	829	860	861	851	830	836	822	806	< 0.01	0.02	< 0.01
12th rib fat, in. ^f	0.53	0.55	0.62	0.58	0.53	0.62	0.54	0.61	0.47	0.57	0.51	0.47	< 0.01	0.05	0.08
LM area, in. sq.	12.5	13.0	12.6	13.1	12.9	13.0	12.8	12.8	13.2	12.8	12.8	12.9	0.66	0.59	0.36
Marbling score ^{3c}	521	557	551	528	529	542	524	516	500	531	539	482	0.04	< 0.01	0.59
KPH fat, %	1.96	2.01	2.10	2.01	2.00	2.00	1.96	2.04	1.96	2.06	1.95	1.93	0.31	0.44	0.05
Yield grade ^{4c}	3.33	3.28	3.67	3.42	3.20	3.54	3.43	3.55	3.01	3.39	3.19	2.98	< 0.01	< 0.05	0.07
Liver abscess, % ^g	2.5	5.0	2.5	2.5	11.0	10.0	0	13.1	21.1	5.0	2.5	2.5	0.14	0.04	0.07

¹P-value for the effect of corn processing method x WDGS.

²Calculated from hot carcass weight, adjusted to a common dressing percentage of 63.

³400 = Slight 0, 500 = Small 0.

⁴Where yield grade = $2.5 + 2.5(\text{Fat thickness, in}) - 0.32(\text{LM area, in}^2) + 0.2(\text{KPH fat, \%}) + 0.0038(\text{hot carcass weight, lb})$.

^aLinear effect of WDGS within DRC ($P < 0.01$).

^bQuadratic effect of WDGS within SFC ($P < 0.05$).

^cQuadratic effect of WDGS across all treatments ($P < 0.01$).

^dQuadratic effect of WDGS within HMC ($P < 0.05$).

^eLinear effect of WDGS within HMC ($P < 0.05$).

^fQuadratic effect of WDGS across all treatments ($P < 0.05$).

^gLinear effect of WDGS across all treatments ($P < 0.05$).

supplement, and varying proportions of corn and WDGS. Molasses was included in diets containing 0% WDGS to prevent any problems associated with the low moisture content of those diets. Gluten meal was also included in the 0% WDGS diets until day 120 of the experiment. From day 1 to 42 of the experiment, gluten meal replaced 4.3% (DM) of corn to meet the metabolizable protein (MP) requirement of those calves. The level of gluten meal was decreased every 3 weeks after that, until the MP requirement was met with the basal diet. Rumensin-80 premix inclusion levels were increased to reflect differences in expected and actual DMI as well as differences in DMI between diets. The amount fed per head was also increased from 345 mg of rumensin per head daily to 360 mg/head daily.

On day 1 of the experiment, steers were implanted with Synovex-S (Fort Dodge Animal Health). On day 50 of the experiment, steers were re-implanted with Synovex-Choice (Fort Dodge Animal Health) and poured with Durasect II (Pfizer Animal Health).

Steers in the heavy (120 head) and

medium (120 head) weight blocks were slaughtered on day 167 and steers in the light (240 head) weight block were slaughtered on day 168 at Greater Omaha Packing Co, Inc., Omaha, Neb. Hot carcass weights and liver abscess data were recorded on the day of slaughter. Marbling score, 12th rib fat thickness, LM area, and kidney, pelvic and heart fat percentage were recorded after a 48-hour chill. Final BW, ADG, and feed efficiency were calculated based on hot carcass weights adjusted to common yield of 63%. Yield grade was calculated using the USDA yield grade equation (yield grade = $2.5 + 2.5(\text{Fat thickness, in.}) - 0.32(\text{LM area, in}^2) + 0.2(\text{KPH fat, \%}) + 0.0038(\text{hot carcass weight, lb})$).

Performance and carcass data were analyzed using the mixed procedure of SAS. Factors included in the model were processing method, WDGS inclusion level, and processing method x WDGS inclusion level. The random variable was weight block and pen was the experimental unit. Orthogonal contrasts were used to detect linear and quadratic effects of WDGS inclusion level across all corn processing treatments when no significant

interaction existed and within corn processing treatment when a significant interaction was present ($P < 0.05$).

Results

Performance and carcass characteristics are presented in Table 2. There were processing method x WDGS level interactions for carcass adjusted final BW, ADG, and F:G ($P < 0.01$). Steers fed DRC experienced linear improvements in final BW, ADG, and F:G ($P < 0.01$), as dietary WDGS level increased. Conversely, final BW and ADG of steers fed SFC responded quadratically ($P < 0.05$) to WDGS level, with steers fed the 15% WDGS having the highest value for both. There was a quadratic ($P < 0.05$) response of ADG and a linear ($P = 0.04$) response of F:G to dietary WDGS level in HMC fed steers. Both corn processing method and WDGS inclusion level affected DMI ($P < 0.01$). Steers fed DRC had higher ($P < 0.01$) DMI than steers fed either HMC or SFC and steers fed HMC had higher ($P < 0.01$) DMI than steers fed SFC. Level of WDGS had a quadratic effect on DMI across

all treatments with steers fed the 40% level having the lowest DMI. In this study, the numerically optimal ADG and F:G were observed with 40% WDGS for DRC, 27.5% WDGS for HMC, and 15% WDGS for SFC thus, there was a greater performance response to WDGS level in diets containing less intensely processed grains.

The only processing method x WDGS level interaction ($P<0.01$) observed for carcass characteristics was for HCW. There tended to be a processing method x WDGS level interaction for 12th rib fat thickness ($P=0.08$), KHP fat percentage ($P=0.05$), yield grade ($P=0.07$) and incidence of liver abscess ($P=0.07$). There was an effect of processing method on 12th rib fat thickness ($P<0.01$), yield grade ($P<0.01$) and marbling score ($P=0.04$). Fat thickness and yield grade were greater ($P<0.01$) for both DRC and HMC fed steers compared with SFC fed steers, while marbling score was greater ($P<0.01$) only for steers fed DRC compared with steers fed SFC. Dietary level of WDGS had a quadratic effect on marbling score ($P<0.01$), yield grade ($P<0.01$), and 12th rib fat thickness ($P<0.05$). Steers fed 40% WDGS had the lowest numeric marbling score, while steers fed 0% WDGS had the lowest numeric yield grade and 12th rib fat thickness. A linear

($P<0.05$) decrease in the percentage of steers with liver abscesses with increasing levels of WDGS was also observed. A linear decrease in the incidence of liver abscesses with increasing WDGS levels indicates an effect on acidosis. This linear trend appears to be strongest in cattle fed SFC with the largest numeric decrease in abscess incidence observed when increasing the WDGS level from 0 to 15%. We have previously observed no effect of WDGS on rumen pH in DRC based diets. However, a severe acidotic insult may help explain why ADG was not higher in steers fed 0% WDGS and SFC compared with steers fed 0% WDGS and either DRC or HMC. The high incidence of liver abscess in the SFC 0% WDGS treatment group (21%) indicates the starch of the SFC used in this trial was highly degraded in the rumen. Assuming this was the case, replacing 15% of this highly degradable SFC with WDGS, which has very little starch and higher fiber content, may have had an impact on rumen pH. Furthermore, it may help explain the relatively poor performance of the SFC 0% WDGS treatment group because one benefit of SFC is thought to be the high digestion of starch reaching the small intestine. This advantage may have been compromised by high ruminal starch digestion, thereby decreasing the amount of starch reaching the

intestine. An interesting observation was that steers fed HMC, which has relatively high ruminal starch digestion, performed very well compared with steers fed SFC or DRC.

In summary, an interaction between corn processing method and WDGS inclusion level occurred. Optimal HCW, final BW, ADG, and F:G were seen with 40% WDGS in DRC based diets, 27.5% WDGS in HMC based diets, and 15% WDGS in SFC based diets. Dry matter intake, fat thickness, and marbling score responded quadratically to WDGS inclusion level. In contrast, incidence of liver abscess responded linearly to WDGS level. It appears that the greatest response of WDGS level on percentage of steers with liver abscesses was seen in the SFC based diet, indicating a high rumen degradability of starch from SFC. In conclusion, a greater performance response to WDGS inclusion in diets based on less intensely processed grain may render them an economically attractive alternative to diets based on more intensely processed grain.

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