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Evaluation of Feedlot and Carcass Performance of Steers Fed Different Levels of E-Corn, a Potential New Feed Product from Ethanol Plants

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Summary

A pre-process fractionation produces a feed product called E-corn, which is low in fat and contains heat-treated starch. E-corn replaced dry rolled corn at 0, 20, 40, or 60% (DM basis) in finishing diets containing either 30% wet distillers grains plus solubles (WDGS) or 30% wet corn gluten feed (WCGF). E-corn level x byproduct type interactions were not observed. Dry matter intake increased quadratically to E-corn inclusion level (P = 0.04), while F:G responded cubically with 20% and 60% E-corn inclusion having the lowest F:G (P = 0.02). However, when E-corn level increased from 0 to 60% of diet DM, linear decreases in marbling, fat depth, and calculated yield grade were observed (P < 0.01). Steers fed WDGS had lower DMI (P < 0.01) and F:G (P = 0.02) compared to steers fed WCGF. It appears that optimal inclusion of E-corn is 20% of diet DM.

Introduction

Improving the efficiency of ethanol production has included refined milling processes by ethanol companies. One such refinement has led to either partial or complete fractionation of the germ, endosperm, and bran. In addition to increasing ethanol production efficiency, opportunities may arise to develop "novel" byproducts intended for livestock feed use. Specifically, the product E-corn was created as the remaining meal from the fractionation of corn into the endosperm used for ethanol, and the germ, from which corn oil is extracted and sold as food-grade corn oil. Previous research on the use of E-corn in swine diets has shown a feeding value equal to that of corn. Therefore, it is hypothesized the use of E-corn in beef cattle finishing diets will yield similar cattle performance and carcass characteristics compared to corn-based diets.

Procedure

A 153-day finishing trial was conducted utilizing 120 crossbred yearling steers (BW = 821 ± 14 lb) in a randomized complete block design. Steers were fed individually using Calan electronic gates. Five days prior to 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 -1, 0, and 1 to determine initial BW. Animals were blocked by BW, stratified within block, and assigned randomly to one of eight treatments in one of four barns. Animal served as the experimental unit, and there were a total of 15 replications per treatment.

Dietary treatments were designed as a 2 x 4 factorial arrangement (Table 1), with the first factor being type of

(Continued on next page)

Table 1. Dietary treatments for individually fed finishing steers to evaluate E-corn in diets containing either WCGF or WDGS.

	E-corn Level[1]			
Ingredient	0	20	40	60
WCGF diets				
Dry rolled corn	60.0	40.0	20.0	0.0
WCGF	30.0	30.0	30.0	30.0
E-corn	0.0	20.0	40.0	60.0
Stalks	5.0	5.0	5.0	5.0
Supplement[2]	5.0	5.0	5.0	5.0
Nutrient composition[3]				
Crude protein	*14.5*	*14.6*	*14.8*	*15.0*
Fat	*3.7*	*3.1*	*2.6*	*2.1*
Sulfur	*0.26*	*0.26*	*0.26*	*0.27*
NDF	*25.6*	*25.8*	*26.0*	*26.1*
WDGS diets				
Dry rolled corn	60.0	40.0	20.0	0.0
WDGS	30.0	30.0	30.0	30.0
E-corn	0.0	20.0	40.0	60.0
Stalks	5.0	5.0	5.0	5.0
Supplement[2]	5.0	5.0	5.0	5.0
Nutrient composition[3]				
Crude protein	*17.2*	*17.4*	*17.6*	*17.7*
Fat	*6.3*	*5.8*	*5.3*	*4.7*
Sulfur	*0.37*	*0.38*	*0.38*	*0.38*
NDF	*25.6*	*25.7*	*25.9*	*26.0*

[1]E-corn inclusion level represented as a percentage of diet DM.
[2]Formulated to contain 59.1% fine ground corn, 41.0% limestone, 6.0% salt, 1.0% beef trace mineral (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), 320 mg/hd/d monensin, 40g/lb thiamine, and 90 mg/hd/d tylosin.

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corn byproduct utilized (WDGS or WCGF) and the second factor being level of E-corn inclusion (0, 20, 40 or 60% diet DM). E-corn replaced DRC in all diets (on equal DM basis), and all diets contained 5% cornstalks and 5% dry supplement. On day 28 of the experiment, calves were implanted with Revalor-S (Intervet, Millsboro, Del.). Throughout the course of the experiment, feed refusals were collected twice weekly, weighed and analyzed for DM content to determine accurate DMI. Feed ingredients were collected weekly, frozen, and stored until the conclusion of the trial and then composited by month and analyzed for DM, CP, fat, sulfur, and NDF content to determine nutrient composition of the diets. All steers were slaughtered on day 153 at Greater Omaha (Omaha, Neb.). On the day of slaughter, hot carcass weight (HCW) and liver abscess data were recorded. Following a 48-hour chill, USDA marbling score, 12th rib fat thickness, and LM area data were collected. Hot carcass weights were used to calculate adjusted final BW by dividing HCW by a common dressing percentage (63%). Average daily gain and F:G were calculated from adjusted final BW. 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).

Steer performance and carcass data were analyzed using the MIXED procedures of SAS (SAS Institute, Cary, N.C.). The model was designed to include corn byproduct type, E-corn inclusion level, and byproduct type x E-corn inclusion level interaction. Orthogonal contrasts were used to determine linear and quadratic effects of E-corn inclusion level. If a significant interaction existed, effects of E-corn were evaluated within byproduct type. When no interaction was observed, only the main effect of E-corn level was evaluated.

Table 2. Steer performance when individually fed varying levels of E-corn for 153 days.

	E-corn Level[1]							
Ingredient	0	20	40	60	Lin[2]	Quad[3]	Cub[4]	Int[5]
Live Performance								
Initial BW, lb	819	821	822	821	0.81	0.82	0.97	0.99
Final BW[6], lb	1280	1305	1270	1272	0.46	0.51	0.23	0.41
DMI, lb/d	21.6	22.0	22.3	21.0	0.37	0.04	0.35	0.93
ADG, lb	3.01	3.16	2.93	2.94	0.36	0.53	0.21	0.36
G:F	0.139	0.144	0.131	0.140	0.59	0.53	0.02	0.30
F:G[7]	7.19	6.94	7.63	7.14				
Carcass Performance								
HCW, lb	806	822	800	801	0.45	0.50	0.23	0.41
Marbling score[8]	528	484	485	444	<0.01	0.94	0.25	0.92
12th rib fat, in	0.46	0.45	0.40	0.37	<0.01	0.72	0.61	0.64
LM area, in^2	12.4	13.2	12.5	13.3	0.05	0.89	<0.01	0.07
Calculated YG[9]	3.25	3.03	3.04	2.70	<0.01	0.49	0.11	0.43

[abc]Within a row means without a common superscript letter differ ($P < 0.10$).
[1]E-corn inclusion level represented on a % of diet DM basis.
[2]Contrast for the linear effect of E-corn level *P*-value.
[3]Contrast for the quadratic effect of E-corn level *P*-value.
[4]Contrast for the cubic effect of E-corn level *P*-value.
[5]Interaction between E-corn inclusion level and corn byproduct type *P*-value.
[6]Calculated from hot carcass weight, adjusted to a 63% yield.
[7]Calculated as 1/G:F .
[8]400 = Slight, 450 = Slight 50, 500 = Small 0, etc.
[9]Yield grade = 2.5 + 2.5(12th rib fat, in) – 0.32(LM area, in^2) + 0.2(KPH fat, %) + 0.0038(HCW, lb).

Table 3. Steer performance when individually fed either 30% wet distiller grains plus solubles (WDGS) or wet corn gluten feed (WCGF) for 153 days.

	TYPE			
Ingredient	WCGF	WDGS	SEM	*P*-Value[1]
Initial BW, lb	823	818	20	.54
Final BW[2], lb	1284	1279	6	0.75
DMI, lb/d	22.4	21.0	0.1	<0.01
ADG, lb	3.02	3.01	0.03	0.95
G:F	0.134	0.143	0.001	0.02
F:G[3]	7.46	6.99		
HCW, lb	809	806	4	0.76
Marbling score[4]	488	483	12	0.76
12th rib fat, in	0.41	0.43	0.38	0.37
LM area, in^2	13.0	12.7	1.0	0.29
Calculated YG[5]	2.95	3.06	0.06	0.17

[1]F-test statistic for the effect of byproduct type.
[2]Calculated from hot carcass weight, adjusted to a 63% yield.
[3]Calculated as 1/G:F.
[4]400 = Slight, 450 = Slight 50, 500 = Small 0, etc.
[5]Yield grade = 2.5 + 2.5(12th rib fat, in) – 0.32(LM area, in^2) + 0.2(KPH fat, %) + 0.0038(HCW, lb).

Results

Corn Byproduct Type X E-Corn Inclusion Level

No interaction between corn byproduct type and E-corn inclusion level was observed for steer performance ($P > 0.10$).

E-Corn Inclusion Level

Live steer performance and carcass characteristics for the effect of E-corn inclusion level are presented in Table 2. Regardless of corn byproduct type, steers fed increasing levels of E-corn had similar final carcass adjusted body weights ($P = 0.49$). Intake responded quadratically to increasing

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inclusion of E-corn ($P = 0.04$). Steers that consumed 0 to 40% diet DM of E-corn had similar DMI, while steers consuming 60% diet DM E-corn had lower DMI. Alternatively, as the level of E-corn increased from 0 to 60% of the diet DM, no differences in ADG were observed ($P > 0.10$).

Feed efficiency responded in a cubic manner as the level of E-corn inclusion increased from 0 to 60% of diet DM. Steers fed 20 or 60% E-corn had the numerically lowest F:G and were statistically similar ($P = 0.52$), while steers fed 0 or 40% E-corn had the poorest F:G. This would suggest that replacing DRC with E-corn at 60% of the diet DM in diets containing corn byproducts would result in comparable live steer performance while potentially decreasing average DMI.

Carcass weight was not affected by the increasing inclusion of E-corn ($P = 0.49$). However, as the level of E-corn increased, linear decreases in marbling score, fat depth, and calculated yield grade were observed ($P < 0.01$). When DRC was replaced by E-corn at 20% of the diet DM, decreases of 8.3, 2.2, and 6.8% in marbling score, fat depth, and calculated YG were observed when compared to the DRC-based control. Similarly, when E-corn replaced all of the DRC (60% diet DM E-corn inclusion), decreases of 15.9, 19.6 and 16.9% in marbling score, fat depth, and calculated yield could be expected. Including 40% of the diet DM as E-corn would show intermediate decreases in carcass characteristics, compared to 20% or 60% E-corn inclusion.

Corn Byproduct Type

Live steer performance and carcass characteristics for the effect of corn byproduct type inclusion are presented in Table 3. Final carcass adjusted body weight was not different between steers consuming WDGS or WCGF ($P = 0.75$). Steers consuming WDGS had lower DMI than steers consuming WCGF ($P < 0.01$), while maintaining similar ADG ($P > 0.10$). As a result, steers consuming WDGS had a 6% improvement in feed efficiency versus steers consuming WCGF ($P = 0.02$). Carcass characteristics were unaffected by corn byproduct type ($P > 0.10$).

The feeding value of E-corn was maximized (118% the relative value of corn) at 20% diet DM; total replacement of DRC with E-corn at 60% diet DM showed only a minimal improvement in the feeding value of E-corn versus DRC (101% the relative value of corn). This could be due to the total replacement of corn, which contains more fat and thereby decreases the total energy value of the diet. Furthermore, decreasing the total energy content of the diet appears to have had the greatest impact on carcass characteristics, and reducing the fat content of the diet compromised marbling score, fat depth, and calculated yield grade, indicating a lower degree of finish compared to including DRC only in the diet.

It could be hypothesized that while carcass adjusted final body weight was similar across E-corn inclusion levels, additional days on feed may be required to reach the same degree of finish. Additionally, it appears that inclusion of E-corn with WDGS would reduce DMI but maintain F:G, and optimum performance can be expected at 20% E-corn diet DM inclusion.

It is unclear why the inclusion of E-corn had such profound impacts on carcass finish while not negatively impacting DMI, ADG, or F:G. The fact that there was no difference in ADG and F:G between 0 and 60% E-corn inclusion suggests E-corn may replace corn in diets containing WDGS or WCGF; however, further research is necessary to explain decreases in marbling score, fat depth, and YG (with no effect on HCW).

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