Syngenta Enogen Corn Fed as Corn Grain and Corn Silage in Diets Containing Corn Coproducts Did Not Enhance Diet Digestibility in Growing Heifers

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Syngenta Enogen Corn Fed as Corn Grain and Corn Silage in Diets Containing Corn Coproducts Did Not Enhance Diet Digestibility in Growing Heifers

Abstract

Objective: Evaluate the effect of feeding corn grain and corn silage from Enogen corn (EC; Syngenta Seeds, LLC., Downers Grove, IL) or conventional corn (CON) in diets containing either wet distillers grain (WDG; ICM Biofuels, St. Joseph, MO) or Sweet Bran [proprietary wet corn gluten feed (WCGF); Cargill Animal Nutrition, Blair, NE] on intake and digestibility in growing cattle.

Study Description: Eight ruminally cannulated crossbred heifers (initial body weight = 816 ± 94 lb) were used in an intake and digestibility study designed as a replicated 4 × 4 Latin square. Four consecutive, 15-day periods consisted of 10 days for diet adaptation, 4 days of fecal sampling, and 1 day of ruminal sampling. Heifers were fed once daily at 10:00 a.m. Chromic oxide (Cr_2O_3) was used as an external digestion marker to calculate apparent total-tract diet digestibility.

Results: Heifers eating EC tended to have greater starch digestibility (P = 0.07) than heifers eating CON. No differences (P > 0.34) in dry matter or fiber digestibilities were observed between corn sources. There were coproduct × hour interactions for concentration of ruminal ammonia (P < 0.01) and two branched chain fatty acids, isobutyrate (P < 0.01) and isovalerate (P < 0.01). In heifers fed WCGF, isobutyrate and isovalerate concentrations reached a peak at 2 hours after feeding, then declined between 2 and 24 hours after feeding. Heifers fed WDG isobutyrate and isovalerate concentrations were greatest at 0 hours after feeding. Differences between concentrations of isobutyrate and isovalerate can be explained by differences in protein digestibility of WCGF and WDG.

The Bottom Line: Enogen corn hybrids fed as dry rolled corn and corn silage in diets containing corn coproducts did not result in better diet digestibility compared to conventional corn hybrids, but diets containing WDG may offer better growth performance (Scilacci et al., 2022) for growing cattle due to more ruminally undegradable protein compared to diets containing WCGF.

Keywords

Enogen corn hybrids, corn coproducts, diet digestibility

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Cover Page Footnote

Syngenta Seeds, LLC, Downers Grove, IL

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Abstract

Eight ruminally cannulated crossbred heifers [initial body weight (BW) = 816 ± 94 lb] were used in an intake and digestibility study designed as a replicated 4 × 4 Latin square. The objective was to evaluate the effect of feeding corn grain and corn silage from Enogen corn hybrids (EC; Syngenta Seeds, LLC., Downers Grove, IL) or conventional corn hybrids (CON) in diets containing either wet distillers grain (WDG; ICM Biofuels, St. Joseph, MO) or Sweet Bran [proprietary wet corn gluten feed (WCGF); Cargill Animal Nutrition, Blair, NE]. Four consecutive, 15-day periods consisted of 10 days for diet adaptation, 4 days of fecal sampling, and 1 day of ruminal sampling. Experimental unit was animal within period. Corn source × coproduct interactions were not observed ($P > 0.16$) in this study. A main effect ($P < 0.05$) of coproduct occurred for molar percentage of isobutyrate, and there was a tendency ($P < 0.07$) for greater digestibility of starch in EC diets than CON diets, but neither dry matter nor fiber digestibility were affected ($P > 0.34$) by corn source or coproduct. There were coproduct × hour interactions detected for concentration of ruminal ammonia ($P < 0.01$) and two branched chain fatty acids, isobutyrate ($P < 0.01$) and isovalerate ($P < 0.01$). Although diets containing EC hybrids tended to have better starch digestibility, Enogen corn hybrids fed as dry rolled corn and corn silage in diets containing corn coproducts did not result in better diet digestibility compared to conventional corn hybrids.

Introduction

Recent research conducted at the Kansas State University Beef Stocker Unit suggested dietary dry matter (DM) digestibility was better for diets containing Enogen corn hybrids compared to conventional corn hybrids. Growing cattle eating Enogen corn as dry rolled or whole shelled corn had lower fecal starch concentrations than cattle fed similarly processed conventional corn hybrids. Corn coproducts are widely used in the cattle feeding industry, but the impacts to nutrient intake and digestion by feeding

Enogen corn hybrids as dry rolled corn and corn silage in diets containing corn coproducts to growing cattle have not been determined.

Experimental Procedures

Eight ruminally cannulated crossbred Angus heifers [initial body weight (BW) = 816 ± 94 lb] were used in a replicated 4 × 4 Latin square design with four consecutive 15-day periods. Experimental unit was animal within period. Heifers were housed in 8 soil-surfaced 20 × 40 ft pens in a large outdoor holding facility. Each heifer had access to a manually filled water tank, and cattle were fed once daily at 10:00 a.m. Heifers were fed (Table 1) corn grain and corn silage from Enogen corn hybrids (EC; Syngenta Seeds, LLC., Downers Grove, IL) or conventional corn hybrids (CON) in diets containing either wet distillers grain (WDG; ICM Biofuels, St. Joseph, MO) or Sweet Bran [proprietary wet corn gluten feed (WCGF); Cargill Animal Nutrition, Blair, NE]. Each 15-day period included 10 days for diet adaption, 4 days for fecal sampling, and 1 day for ruminal sampling. Feed refusals were collected each morning and weighed using a portable scale (model iGB; Ishida, Kyoto, Japan). Additionally, feed refusals were targeted at 4 lb/day during diet adaptation and sampling to ensure *ad libitum* consumption of diets. On days 4 to 14, chromic oxide (Cr_2O_3) as an external digestion marker was top dressed and hand mixed into each daily ration to allow calculation of apparent total-tract diet digestibility. Feed samples were collected, and fecal samples were collected from the rectum of each animal on days 11 to 14 at 8-hour intervals after feeding. Fecal sampling time advanced by 2 hours each day, thus, 2-hour intervals were represented for 24 hours after feeding. Following collection, feed and fecal samples were frozen at -4°F. Following study completion, feed and fecal samples were thawed, subsampled, and composited by animal within period, then refrozen and taken to a commercial laboratory for nutrient analysis (SDK Laboratories, Hutchinson, KS).

On day 15 of each period, four locations in the rumen were sampled prior to feeding, and at 2, 4, 6, 8, 12, 18, and 24 hours after feeding to determine ruminal volatile fatty acid profile and ammonia concentration. The pH of each sample was measured using a calibrated pH meter (Pinpoint; American Marine Inc., Ridgefield, CT). Approximately 100 cc of ruminal contents were strained through 8 layers of cheesecloth. One cc of strained ruminal fluid was transferred into each of four 2-cc microcentrifuge tubes containing 250 μL of 25 % (wt/vol) *m*-phosphoric acid. Following collection of 0-hour samples, cobalt-ethylenediamine tetraacetic acid (Co-EDTA) dissolved into 200 cc of distilled water was immediately dosed through the ruminal cannula. At 2, 4, 6, 8, 12, 18, and 24-hour sampling times, 15 cc of ruminal fluid was transferred into 20-cc scintillation vials for use in measuring concentration of cobalt and calculating liquid passage rate and ruminal liquid volume. Immediately after collection, all ruminal fluid samples were frozen at -4°F pending analysis.

Results and Discussion

Experimental diet composition and nutrient analysis are presented in Table 1. Intake and nutrient digestibilities are presented in Table 2. No significant ($P \leq 0.16$) corn source × coproduct interactions were observed in this study, thus only main effects are discussed. No main effect differences ($P \geq 0.21$) between corn sources were observed for DM intake, fiber intake, or starch intake. The EC heifers tended to have greater ($P = 0.07$) starch digestibility than those fed CON. No other detectable differences ($P > 0.34$) in DM or fiber digestibilities were observed between corn sources.

Differences between corn sources were also not detected for ruminal pH, ammonia concentration, total volatile fatty acid concentration, liquid passage rate, and ruminal liquid volume. Heifers fed CON had a greater ($P < 0.01$) molar percentage of acetate compared to EC heifers. Conversely, heifers fed EC had a greater molar percentage of butyrate ($P < 0.05$) than those fed CON. Heifers fed EC also tended to have greater molar percentages of propionate and isovalerate ($P < 0.10$) than heifers fed CON.

Heifers consuming WCGF had lower ($P < 0.05$) intake of neutral detergent fiber and acid detergent fiber than those fed WDG, and this was associated with a tendency ($P = 0.07$) for lower DM intake for heifers fed WCGF. No main effects ($P = 0.30$) between coproducts were detected for starch intake. No other detectable differences ($P > 0.29$) in DM, fiber, or starch digestibilities were observed for main effect of coproduct. Main effect differences between coproducts were also not observed for ruminal pH, ammonia concentration, total volatile fatty acid concentration, liquid passage rate, and ruminal liquid volume, but heifers fed WCGF had numerically greater ruminal liquid volume than those fed WDG. Heifers fed WDG had a greater ($P < 0.05$) molar proportion of isobutyrate than heifers fed WCGF, whereas heifers fed WCGF had a greater ($P < 0.01$) molar percentage of valerate than those fed WDG. Heifers fed WDG had a greater ($P < 0.05$) molar percentage of butyrate than those fed WCGF. No main effect between coproducts was observed for molar proportions of acetate ($P < 0.19$), propionate ($P > 0.75$), or isovalerate ($P > 0.35$).

There were no corn source × coproduct × hour interactions for any ruminal parameters, and no corn source × hour interactions were observed ($P > 0.05$). However, there were coproduct × hour interactions for concentration of ruminal ammonia ($P < 0.01$) and two branched chain fatty acids, isobutyrate ($P < 0.01$) and isovalerate ($P < 0.01$). In heifers fed WCGF, isobutyrate and isovalerate concentrations reached a peak at 2 hours after feeding, then declined between 2 and 24 hours after feeding. Heifers fed WDG isobutyrate and isovalerate concentrations were greatest at 0 hours after feeding, then declined between 0 hours through 24 hours after feeding. Concentration of isobutyrate and isovalerate in heifers fed WDG increased above concentrations of isobutyrate and isovalerate in heifers fed WCGF between 12 hours and 24 hours after feeding.

Differences between concentrations of isobutyrate, isovalerate, and ammonia can be explained by differences in protein digestibility of WCGF and WDG. Rumen undegradable protein comprises a greater proportion of crude protein in WDG compared to WCGF or Sweet Bran (National Academies of Science, 2016). Thus, protein in WCGF is more extensively catabolized in the rumen. More degradable protein in WCGF diets can explain a more rapid response in ruminal ammonia production post-feeding, compared to WDG diets.

Implications

Although diets containing Enogen corn hybrids tended to have better starch digestibility, Enogen corn hybrids fed as dry rolled corn and corn silage in diets containing corn coproducts did not result in better diet digestibility compared to conventional corn hybrids. However, diets containing WDG may offer better growth performance (Scilacci et al., 2022) for growing cattle due to more ruminally undegradable protein than diets containing WCGF.

Acknowledgments

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Table 1. Composition and nutrient analysis of study diets

Ingredient, % of total DM[3]	Corn source[1]			
	CON		EC	
	Coproduct[2]			
	WCGF	WDG	WCGF	WDG
Conventional corn hybrids	21.0	19.0	0.0	0.0
Enogen corn hybrids	0.0	0.0	21.0	19.0
Conventional corn silage	20.0	20.0	0.0	0.0
Enogen corn silage	0.0	0.0	20.0	20.0
WCGF	30.0	0.0	30.0	0.0
WDG	0.0	30.0	0.0	30.0
Long-stem alfalfa hay	12.0	13.0	12.0	13.0
Chopped prairie hay	12.0	13.0	12.0	13.0
Supplement[4]	5.0	5.0	5.0	5.0
Nutrient composition				
DM, % as fed	56.45	50.78	52.93	48.24
Crude protein	14.31	15.47	14.28	15.87
Starch	24.93	23.23	25.00	22.88
Neutral detergent fiber	29.31	29.64	30.94	31.88
Acid detergent fiber	14.02	14.32	15.24	15.75
Calcium	0.69	0.73	0.76	0.85
Phosphorus	0.41	0.46	0.39	0.46

[1]CON = Conventional corn hybrids, dry rolled. EC = Enogen corn hybrids, dry rolled (Syngenta Seeds, LLC, Downers Grove, IL).

[2]WCGF = wet corn gluten feed (Sweet Bran, Cargill Animal Nutrition, Blair, NE). WDG = wet distillers grain (ICM Biofuels, St. Joseph, MO).

[3]DM = dry matter.

[4]Supplement pellet (Cargill Animal Nutrition, Minneapolis, MN) was formulated to contain (DM basis) 9.2% crude protein, 1.53% crude fat, 17.0% crude fiber, 7.4% calcium, 0.22% phosphorus, 4.62% salt, 0.50% potassium, 331 mg/kg monensin, and 60.10 mg/kg diflubenzuron.

Table 2. Effect of Enogen corn hybrids or conventional hybrids in diets containing corn coproducts on intake and digestibility

Item	Corn source[1]				SE[3]	P-value[4]		
	CON		EC					
	Coproduct[2]							
	WCGF	WDG	WCGF	WDG		S	CP	S × CP
Number of observations	8	8	8	8				
Intake, lb/day								
Dry matter	26.54	27.54	27.09	28.90	1.23	0.21	0.07	0.58
Neutral detergent fiber	8.20	8.80	7.94	8.58	0.42	0.40	0.05	0.90
Acid detergent fiber	4.01	4.34	3.79	4.14	0.20	0.22	0.04	0.95
Starch	6.64	6.35	6.79	6.75	0.35	0.30	0.53	0.66
Ruminal[5]								
pH	6.11	6.10	6.04	6.16	0.07	0.99	0.34	0.28
Ammonia, mM	3.48	3.26	3.25	3.33	0.31	0.77	0.80	0.58
Total volatile fatty acid, mM	79.83	77.59	78.04	76.88	1.82	0.39	0.25	0.71
Ruminal,[6] molar %								
Acetate	62.77	62.08	61.25	60.81	0.47	< 0.01	0.19	0.76
Propionate	20.66	21.05	21.63	21.50	0.46	0.09	0.75	0.53
Butyrate	12.10	12.56	12.57	13.01	0.31	0.05	0.05	0.96
Valerate	1.81	1.65	1.86	1.69	0.05	0.28	< 0.01	0.95
Isobutyrate	0.86	0.90	0.87	0.93	0.03	0.45	0.04	0.82
Isovalerate	1.79	1.75	1.82	2.06	0.12	0.09	0.35	0.16
Liquid passage rate,[7] %/hour	10.5	10.5	10.8	11.0	0.01	0.44	0.80	0.79
Ruminal liquid volume,[7] gal	17.0	15.3	16.7	15.9	1.20	0.88	0.16	0.61

[1] CON = Conventional corn hybrids, dry-rolled. EC = Enogen corn hybrids, dry-rolled (Syngenta Seeds, LLC., Downers Grove, IL).

[2] WCGF = wet corn gluten feed (Sweet Bran, Cargill Animal Nutrition, Blair, NE). WDG = wet distillers grain (ICM Biofuels, St. Joseph, MO).

[3] Largest standard error of least square mean is reported.

[4] S = Corn source. CP = coproduct.

[5] Average of values collected at 0, 2, 4, 6, 8, 12, 18, and 24 hours after feeding.

[6] Individual volatile fatty acid expressed as a molar percentage of total ruminal volatile fatty acid concentration.

[7] Calculated from samples collected at 0, 2, 4, 6, 8, 12, and 18 hours after dosing of Co-EDTA at time of feeding.