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Evaluation of Corn Silage Hybrids with the Brown Midrib Trait and Silage Inclusion for Finishing Cattle

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Summary with Implications

A finishing study evaluated three corn silage hybrids fed at either 15 or 45% of diet DM for finishing steers. The three hybrids were a standard corn silage hybrid which served as the control, a brown midrib hybrid and an experimental brown midrib hybrid with a softer endosperm. An interaction was observed between hybrid and silage inclusion. Gain and HCW were greater for steers fed the experimental brown midrib compared to other two hybrids when fed at 15%. Feeding brown midrib hybrids at 45% of the diet DM resulted in greater ADG and HCW when compared to a control corn silage without the brown midrib trait. Feeding brown midrib varieties of corn silage at 45% of the diet DM improved feedlot performance and carcass characteristics compared to control corn silage.

Introduction

Increased corn silage inclusion during times of increased corn prices can be an economical alternative compared to corn, although ADG and F:G are not as favorable (2015 Nebraska Beef Cattle Report, pp. 66–67). Feeding corn silage allows cattle feeders to take advantage of the entire corn plant at a time of maximum quality and tonnage as well as secure substantial quantities of roughage/grain inventory (*2013 Nebraska Beef Cattle Report,* pp. 74–75). Inclusion of distillers grains with elevated concentrations of corn silage has been shown to be an economical alternative compared to corn in times of high prices, with less depression in performance compared to adding greater concentrations of silage without distillers grains (2014 Nebraska Beef Cattle Report, pp. 88–89). The brown midrib (*bm3*) mutation has been shown in previous research to lower lignin concentrations and improve fiber digestibility. However, little research has been done in beef finishing diets for corn silage incorporating the *bm3* trait. Feeding *bm3* silage may enhance finishing performance, and offset the negative effects of feeding greater inclusions compared to traditional inclusions as a roughage source (i.e., 15% of the diet DM or less). Therefore, the objective of this experiment was to determine the effect of feeding two corn silage hybrids containing the *bm3* trait compared to a control silage at either 15 or 45% of diet DM on calf fed steer performance and carcass characteristics.

Table 1. Diet composition (DM basis) of 3 different hybrids fed at 15 or 45% corn silage to finishing steers.

	Treatments[1]					
	15% corn silage			45% corn silage		
Ingredient	CON	BM3	BM3-EXP	CON	BM3	BM3-EXP
Control corn silage	15.0	-	-	45.0	-	-
BM3 corn silage	-	15.0	-	-	45.0	-
BM3-EXP corn silage	-	-	15.0	-	-	45.0
MDGS	20.0	20.0	20.0	20.0	20.0	20.0
Dry rolled corn	30.5	30.5	30.5	15.5	15.5	15.5
High moisture corn	30.5	30.5	30.5	15.5	15.5	15.5
Supplement[2]						
Fine ground corn		1.333			1.083	
Limestone		1.675			1.675	
Salt		0.300			0.300	
Urea		0.500			0.750	
Tallow		0.100			0.100	
Beef Trace Mineral[3]		0.050			0.050	
Vitamin A-D-E[4]		0.015			0.015	
Rumensin-90[5]		0.0165			0.0165	
Tylan-40[5]		0.0102			0.0102	

[1] Treatments were control (CON; hybrid-TMR2R720), a *bm3* hybrid (BM3; hybrid-F15579S2), and an experimental *bm3* hybrid (BM3-EXP; hybrid-F15578XT) with a softer endosperm
[2] Supplement was fed at 4.0% of diet DM
[3] Beef trace mineral (10% Mg, 6% Zn, 4.5% Fe, 2% Mn, 0.05% Cu, 0.3% I, and 0.05 Co), 0.015%
[4] Vitamin A-D-E package (1,500 IU of vit A, 3,000 IU of vit D, 3.7 IU of vit E).
[5] Formulated to provide 30 g/ton of Rumensin and 90 mg/hd/d of Tylan

Procedure

Three hybrids of corn silage were grown and harvested at the Eastern Nebraska Research and Extension Center (ENREC) near Mead, NE. The three hybrids (Mycogen® seeds) were a standard corn silage hybrid which served as the control (CON; hybrid-TMR2R720), a *bm3* hybrid (BM3; hybrid-F15579S2), and an experimental *bm3* hybrid (BM3-EXP; hybrid-F15578XT) with a softer endosperm. Silage was harvested from 9/11/15 through 9/16/15 and stored in concrete wall bunkers until the initiation of the trial. Bunker samples were sampled for DM and fermentation analysis 28 d after harvesting to ensure proper ensiling. All feeds were sampled weekly for DM, and monthly composites analyzed for nutrients.

Table 2. Nutrient and fermentation analysis of silage hybrids[1] (DM basis)

	CON		BM3		BM3-EXP	
Nutrient[2]	Mean	CV[3]	Mean	CV[3]	Mean	CV[3]
DM, %	33.3	6.2	33.2	5.4	34.1	5.7
CP, %	8.6	3.4	9.6	7.8	9.1	3.9
NDF, %	40.9	4.3	41.0	4.4	39.0	3.6
ADF, %	27.1	2.5	26.7	2.2	23.6	3.0
Lignin, %	4.3	27.5	3.7	24.2	2.81	34.6
Starch, %	31.0	8.8	32.0	8.9	30.8	6.7
Sugar, %	2.3	28.1	2.4	37.8	2.8	22.4
pH	3.89	2.5	3.86	1.9	3.81	6.3
Lactic Acid, %	5.6	17.1	6.2	16.6	6.0	15.6
Acetic acid, %	1.4	31.2	1.6	30.9	1.5	34.4
Propionic acid, %	0.34	40.5	0.43	48.7	0.46	54.0
Butyric acid, %	< 0.01	0.0	< 0.01	0.0	< 0.01	0.0
Total acids, %	7.3	10.4	8.2	11.0	7.9	10.8

[1] Treatments were control (CON; hybrid-TMR2R720), a *bm3* hybrid (BM3; hybrid-F15579S2), and an experimental *bm3* hybrid (BM3-EXP; hybrid-F15578XT) with a softer endosperm
[2] DM was calculated using weekly samples and oven dried for 48 h at 60^0 C. All other samples are based on monthly composites of weekly samples taken during the finishing trial, and analyzed at Dairy One Labs (Ithaca, NY).
[3] C.V. = coefficient of variation and is calculated by dividing the standard deviation by the mean and is expressed as a percentage.

Crossbred steers were received as calves and following a 28 day receiving process, steers (n = 360; initial BW = 736; S.D. = 54 lb) were sorted into 3 BW blocks and assigned randomly to one of 36 pens (10 steers / pen). The light block contained 3 replications, middle BW block contained 2 replications, and the heaviest BW block contained 1 replication. All steers were fed limit-fed a common diet consisting of 50% alfalfa hay and 50% SweetBran® at 2% of BW for five days prior to trial initiation to minimize gut fill, prior to weighing two consecutive days. Initial BW was calculated by averaging the two-day weights. Treatments were designed as a 2 × 3 factorial arrangement that consisted of inclusion of corn silage in the finishing diet (15% or 45% silage on a DM basis) and silage hybrid (CON, BM3, or BM3-EXP;). Corn silage fed at 45% of diet DM in the finishing diet replaced a 50:50 blend of dry-rolled and high-moisture corn compared to 15% silage treatments. All steers were fed a supplement formulated for 30 g / ton of Rumensin® (Elanco Animal Health, DM basis) and a targeted intake of 90 mg / steer daily of Tylan® (Elanco Animal Health). Steers were implanted with Component TE-IS® (Elanco Animal Health) on d 1, and re-implanted with Component TE-200® (Elanco Animal Health) on d 91. Steers were fed for 173 d before harvest. Prior to shipping to a commercial abattoir, pens of steers were weighed on a platform scale for live final BW measurements. A 4% pencil shrink was applied to this weight for final live BW, and calculation of dressing percentage (HCW / shrunk live final BW). Steers were weighed the afternoon prior to evening shipping, and harvested the following morning. The day of harvest, HCW were recorded, and carcass adjusted final BW was calculated from HCW adjusted to the overall common dressing percentage (63.8%). Carcass-adjusted final BW was used to calculate ADG and F:G. Marbling score, 12th rib fat thickness, and LM area were recorded after a 48-h chill.

Data were analyzed using the MIXED procedure of SAS (SAS Institute, Inc., Cary, N.C.) with pen serving as the experimental unit and block as a fixed effect. The treatment design was a 2 × 3 factorial, therefore data were first evaluated for an interaction between hybrid and inclusion. If a significant interaction was observed for performance variables, then simple effects of hybrid within either 15 or 45% inclusion were evaluated.

Results

Corn silage was targeted to be harvested at 35% DM. However, after fermentation, the DM content declined slightly (Table 2). The fermentation analysis of the three corn silage hybrids indicated that proper fermentation did occur as pH was below 3.9, as well as having total acids greater than 7.3%. The starch percentage and the sugar (water soluble carbohydrates) percentage remained consistent across all three silage hybrids. The ADF and lignin concentrations were numerically lower in both the BM3 and BM3-EXP compared to the CON, as expected.

There was a silage inclusion by hybrid interaction for final live BW, ADG, F:G, dressing percentage, and HCW ($P \leq 0.05$); therefore, simple effects will be presented (Table 3). No interaction was observed between hybrid and inclusion for DMI. Cattle fed 45% silage averaged across hybrids had greater DMI ($P < 0.01$) compared to steers fed 15% silage. Corn silage hybrid did not significantly affect ($P = 0.11$) DMI. Cattle fed BM3-EXP had greater ADG than CON or BM3 when silage was included at 15% of the diet. When silage was fed at 45% of the diet DM, cattle fed BM3 and BM3-EXP gained similarly, but both were greater than CON ($P < 0.05$). Interestingly, steers fed BM3 and BM3-EXP at 45% of the diet had similar ADG to steers fed either 15% CON or 15% BM3 suggesting the *bm3* trait dramatically improved digestibility and gain allowing for more silage to be fed without compromising ADG if the silage contains the *bm3* trait. All treatments with 15% corn silage inclusion had lower ($P \leq 0.04$) F:G compared to 45% corn silage inclusion, but F:G response due to hybrid was different depending on inclusion. For steers fed 15% silage, F:G was lowest for BM3-EXP, greatest for BM3, and intermediate for CON. The range in F:G across the hybrids was 5.63 to 5.92. For steers fed 45% silage, F:G was lowest for cattle fed BM3 while CON and BM3-EXP were not different. The range in F:G was 6.09 to 6.38.

At 15% corn silage inclusion, HCW was greater ($P < 0.01$) for BM3-EXP compared to CON and BM3, but similar between BM3 and CON. At 45% corn silage inclusion, steers fed BM3-EXP and BM3 had similar HCW, but were both heavier ($P < 0.01$) compared to CON. Steers fed 15% silage

Table 3. The effects of silage inclusion and silage hybrid on feedlot performance and carcass characteristics in calf fed steers.

	Treatments[1]									
	15% corn silage			45% corn silage						
	CON	BM3	BM3-EXP	CON	BM3	BM3-EXP	SEM	Int.[2]	Concentration[3]	Hybrid[4]
Feedlot performance										
Initial BW, lb	736	735	736	735	736	737	0.7	0.49	0.57	0.36
Final BW[5], lb	1382[b]	1380[b]	1407[a]	1339[c]	1372[b]	1374[b]	6.7	0.04	< 0.01	< 0.01
DMI, lb/d	21.5	22.1	21.8	22.3	22.4	23.0	0.3	0.19	< 0.01	0.11
ADG[5], lb	3.73[b]	3.73[b]	3.88[a]	3.49[c]	3.67[b]	3.68[b]	0.04	0.05	< 0.01	< 0.01
Feed:Gain[6]	5.77[b]	5.92[c]	5.63[a]	6.38[e]	6.09[d]	6.26[e]	-	0.01	< 0.01	0.45
Live Final BW, lb	1377	1373	1389	1361	1370	1372	6.4	0.49	0.03	0.15
Carcass Characteristics										
HCW, lb	882[b]	880[b]	898[a]	855[c]	875[b]	877[b]	4.3	0.04	<0.01	< 0.01
Dress, %	64.05[b]	64.15[a,b]	64.64[a]	62.75[c]	63.89[b]	63.87[b]	0.19	0.03	< 0.01	< 0.01
LM area, in^2	13.5	13.6	13.6	13.8	14.0	13.5	0.1	0.08	0.11	0.29
12th rib fat, in	0.56	0.55	0.59	0.47	0.49	0.52	0.02	0.76	< 0.01	0.23
Marbling score	451	455	475	413	425	443	10.0	0.90	< 0.01	0.03

[a,b,c,d,e] Means with different superscripts differ ($P < 0.05$).
[1] Treatments were control (CON; hybrid-TMR2R720), a *bm3* hybrid (BM3; hybrid-F15579S2), and an experimental *bm3* hybrid (BM3-EXP; hybrid-F15578XT) with a softer endosperm
[2] Silage Concentration × Silage hybrid interaction
[3] Fixed effect of silage concentration
[4] Fixed effect of silage hybrid
[5] Final BW calculated based on HCW / common dressing percent of 63.8%
[6] F:G was analyzed as gain to feed.
[7] Marbling score 400 = small^{00}, 500 = modest^{00}

had heavier ($P < 0.01$) HCW compared to steers fed 45% inclusion across hybrids. No significant interaction was observed for final live BW ($P = 0.49$). When CON silage was fed at 45% of diet DM, live final BW was reduced 16 lb compared to feeding CON at 15% inclusion. However, HCW was reduced by 27 lb when CON silage was fed at 45% compared to 15%. This relative change in HCW compared to final live BW illustrates the negative effect of increasing silage inclusion from 15 to 45% of diet DM on dressing percentage and gut fill. Dressing percentage at 15% inclusion was greatest ($P < 0.03$) for BM3-EXP and lowest for CON, with BM3 being intermediate. However, at 45% silage inclusion, steers fed both BM3-EXP and BM3 had dramatically greater ($P < 0.01$) dressing percentages than CON. All cattle fed 15% silage had greater ($P < 0.01$) dressing percentages compared to cattle fed 45% corn silage. Cattle fed 15% corn silage had greater ($P <0.01$) fat thickness over the 12th rib and marbling score compared to steers fed 45% corn silage in the finishing diet. Fat thickness and marbling generally followed ADG responses.

Conclusions

Feeding BM3-EXP corn silage at 15% of the diet DM resulted in greater final BW, HCW, ADG and lower F:G when compared to the BM3 and CON corn silage. Cattle fed BM3 and CON gained the same, but cattle fed 15% BM3 had poorer F:G than CON. However, both corn silage hybrids with the *bm3* trait fed at 45% of the diet DM resulted in similar, but greater final BW, HCW, and ADG when compared to a control corn silage without the *bm3* trait. Cattle fed BM3 had lower F:G than steers fed BM3-EXP when fed at 45%, which is opposite of 15% inclusion. We conclude that feeding corn silage with the *bm3* trait improved feedlot performance and carcass characteristics compared to non-*bm3* corn silage when fed at 45% but was variable between the *bm3* traits when fed at 15% inclusion.

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