Effects of Kernel Processing at Harvest of Brown Midrib Corn Silage on Finishing Performance of Steers

Lauren A. Ovinge
F. Henry Hilscher
Curtis J. Bittner
Bradley M. Boyd
John N. Anderson
Galen E. Erickson

Summary with Implications

A 2 × 3 factorial finishing study evaluated kernel processing in three corn silage hybrids on finishing performance of yearling steers fed 40% silage. The three hybrids included a control corn silage (CON), a brown midrib (bm3), and a brown midrib with a softer endosperm (bm3-EXP). No interactions were observed between hybrids and kernel processing (P > 0.45). Feeding both bm3 hybrids increased dry matter intake and average daily gain over CON (P < 0.01). Cattle fed bm3-EXP and bm3 had lower feed to gain than CON (P = 0.04), with no differences between the two brown midrib hybrids. Feeding silage that has undergone kernel processing decreased dry matter intake with similar average daily gain, which decreased feed to gain by 2.6% at 40% inclusion compared to non-processed silage (P = 0.10). The improvement in silage is calculated to be 6.5% (2.6/40) when kernel processing was utilized as compared to not kernel processing the corn silage hybrids.

Introduction

Corn silage is utilized in the beef and dairy industry as a roughage source, and increasing nutrient availability of the corn silage through new hybrids and processing methods can improve feed quality for cattle. Brown midrib hybrids of silage have a lower lignin concentration resulting in improvement of fiber digestibility (*2018 Nebraska Beef Cattle Report, pp.49–51*). Feeding brown midrib corn silage at 45% in finishing diets resulted in greater ADG and HCW compared to silage hybrids without a brown midrib trait *(2018 Nebraska Beef Cattle Report pp.85–87)*. Some research indicates utilizing kernel processing at harvest may improve corn silage starch digestibility, presumably by reducing kernel size and increasing surface area for ruminal microbes. While starch digestibility is improved, a decrease in fiber digestibility has been observed, negating the positive effects of the kernel processing, resulting in no change in DM digestibility. Kernel processing also adds an extra cost to silage production, increasing equipment requirements due to the processor. The objectives of this experiment were to determine whether kernel processing is beneficial in finishing feedlot diets containing 40% of corn silage hybrids with brown midrib traits or brown midrib with a softer endosperm.

Table 1. Diet composition (DM Basis) for beef cattle fed three different corn silage hybrids[1] that had been kernel processed (+KP) or not (-KP).

	CON		*bm3*		*bm3*-EXP	
Item	-KP	+KP	-KP	+KP	-KP	+KP
CON Corn Silage	40.0	40.0				
bm3 Corn Silage			40.0	40.0		
bm3-EXP Corn Silage					40.0	40.0
Modified distillers grains	30.0	30.0	30.0	30.0	30.0	30.0
Dry-rolled corn	25.0	25.0	25.0	25.0	25.0	25.0
Supplement[2]	5.0	5.0	5.0	5.0	5.0	5.0

[1] Treatments were control (CON; hybrid-TMF2H708), a *bm3* hybrid (*bm3*; hybrid-F15579S2), and an experimental *bm3* hybrid (*bm3*-EXP; hybrid-F15578XT) with a softer endosperm

[2] Supplement formulated to be fed at 5% of diet DM, Supplement consisted of 2.98% fine ground corn, 1.50% limestone, 0.125% tallow, 0.30% salt, 0.05% trace mineral package, 0.015% Vitamin A-D-E package as a percentage of the final diet. It was also formulated for 30 g/ton Rumensin®(Elanco Animal Health, DM Basis) and 8.8 g/ton Tylan® (Elanco Animal Health, DM basis).

Procedure

Corn silage was harvested at the Eastern Nebraska Research and Education Center (ENREC) near Mead, Nebraska, between September 2 and 12, 2016. Corn silage harvest was initiated when the field was approximately ¾ milkline and 37% DM. The three hybrids (Mycogen® seeds) utilized were a control (CON; hybrid TMF2H708), a brown midrib hybrid (*bm3*; hybrid F15579S2), and an experimental brown midrib hybrid (*bm3*-EXP; hybrid-F15578XT) that has a softer endosperm. Dry matter samples were taken from each truckload of corn silage and dried in a 60°C forced-air oven for 48 h to determine DM of the silage at harvest. Each corn silage hybrid was split into two within the field, one being chopped to 19-mm chop length with 2-mm kernel processing, and the other chopped at 19-mm chop length, with no kernel processing. Silages were stored in sealed AgBags® and opened after 21 d, silage was sampled for fermentation analysis and DM (forced air oven at 60°C). All feeds were sampled weekly for DM, and monthly composites were analyzed for nutrient composition.

Crossbred yearling steers (n=360; initial BW 882 ± 16.6 lb) were sorted into 2 BW blocks and assigned randomly to one of 36 pens (10 steers/pen) 17 days after harvest of the silage. The light block included 3 replications, and the heavy block included 3 replications. All steers were limit-fed a common diet of 50% alfalfa hay and 50% SweetBran® at 2% of BW for 5 days prior to the initiation of the trial to minimize gut fill. Initial BW was measured on two consecutive days and averaged. Adaptation diets included 30% MDGS, 25% and DRC, 5% supplement with silage increasing

Table 2. Nutrient and fermentation analysis of silage hybrids[1]

	CON		*bm3*		*bm3*-EXP	
Item	-KP	+KP	-KP	+KP	-KP	+KP
DM[2]	39.3	36.7	38.2	35.6	38.5	36.4
CP	8.10	8.09	9.28	8.76	9.07	8.31
NDF, %	43.4	44.3	45.6	44.9	46.2	47.3
ADF, %	33.5	33.1	32.2	30.3	32.7	30.4
Starch, %	33.1	34.1	30.2	32.1	29.8	31.4
pH	3.9	3.9	4.2	4.0	3.9	3.9
Lactic acid, %	6.37	5.28	2.51	5.46	5.52	5.48
Acetic acid, %	1.12	1.46	5.00	2.95	2.07	1.63
Propionic acid, %	0.02	0.01	0.21	0.23	0.08	0.00
Butyric acid, %	0.00	0.00	0.00	0.00	0.00	0.00
Total Acids, %	7.51	6.76	7.71	8.64	7.67	7.12

[1] Treatments were control (CON; hybrid-TMF2H708), a *bm3* hybrid (*bm3*; hybrid-FI5579S2), and an experimental *bm3* hybrid (*bm3*-EXP; hybrid-FI5578XT) with a softer endosperm, and not kernel processed (-KP) and kernel processed (+KP)
[2]DM was calculated using weekly samples and oven dried for 48 h at 60°C.
Note: Fermentation analysis was conducted only on d 21 silage samples. All other analyses (DM, CP, NDF, ADF, starch) are based on composites of weekly samples taken during the finishing trial, and analyzed at Dairyland Labs (St. Cloud, MN).

Table 3. Main effect of corn silage hybrid on cattle performance and carcass characteristics.

	Treatment[1]				
Item	Control	*bm3*	*bm3*-EXP	SEM	*P*-Value[2]
Pens	12	12	12		
Performance					
Initial BW, lb	882	882	882	11.8	1.00
Final BW, lb[3]	1310[a]	1347[ab]	1354[b]	13.7	0.07
DMI, lb/day	31.3[a]	32.4[b]	32.8[b]	0.33	0.01
ADG, lb[3]	4.12[a]	4.47[b]	4.54[b]	0.058	0.01
Feed:Gain[3]	7.58[a]	7.24[b]	7.22[b]	-	0.04
	883	**882**	**882**	**11.7**	**1.00**
Carcass Characteristics					
HCW, lb	826[a]	849[ab]	853[b]	8.7	0.07
LM Area, in[2]	12.5	12.5	12.5	0.09	0.99
Marbling Score[4]	476[a]	516[b]	511[b]	7.1	0.01
Backfat Thickness, in	0.54	0.58	0.56	0.015	0.20
Liver Abscesses, %	9.09	4.73	6.46	2.86	0.56

[a,b]Means with different superscripts differ ($P < 0.05$).
[1] Treatments were control (CON; hybrid-TMF2H708), a *bm3* hybrid (*bm3*; hybrid-FI5579S2), and an experimental *bm3* hybrid (*bm3*-EXP; hybrid-FI5578XT) with a softer endosperm
[2]*P*-value for the main effect of corn silage hybrid
[3]Calculated from hot carcass weight, adjusted to a common 63% dressing percentage
[4]Marbling Score 400-Small[00], 500 = Modest[00]

from 0 to 40% inclusion in replacement of alfalfa hay in the diet, over a period of 21 days and 4 steps. Treatment silage was included in diets at 21-d post-harvest at the initiation of the second adaptation period. Treatments were arranged as a 2×3 factorial, that consisted of kernel processing (kernel processed or not), and three corn silage hybrids (CON, *bm3*, *bm3*-EXP; Table 1). Corn silage was included at 40% in the final diets and modified distillers grains plus solubles included at 30%. All steers were fed Rumensin® (Elanco Animal Health) at 30 g/ton of DM and Tylan® (Elanco Animal Health) was included at 8.8 g/ton of DM. Steers were implanted with Component 200® (Elanco Animal Health) on d 1. Steers were fed for 104 days prior to harvest. Steers were shipped in the evening and harvested the following morning. The day of harvest, HCW were recorded, and carcass-adjusted final BW was calculated from a common 63% dressing percentage. The carcass adjusted final body weight was used to determine ADG and F:G. Carcass characteristics included marbling score, 12th rib fat thickness, and LM area, which were recorded after a 48-h chill.

Data were analyzed using the PROC MIXED procedures of SAS (SAS Institute, Inc., Cary, N.C.) as a randomized block design with pen as the experimental unit and block as a fixed effect. Liver scores were analyzed as a binomial distribution using PROC GLIMMIX procedures of SAS (SAS Institute, Inc., Cary, N.C.). The treatment design was a 2 × 3 factorial, and data was analyzed first as an interaction to determine whether simple effects of kernel processing within hybrid are compared, or whether main effects of each factor were analyzed. No significant interactions were observed ($P > 0.45$), so main effects of hybrid and kernel processing were evaluated.

Results

Corn silage analysis is shown in Table 2. Fermentation analyses show the 6 silage samples had a pH below 4.2 and total acids were greater than 7.1%. Acid detergent fiber, the cellulose and lignin portion of the plant, was numerically lower for *bm3* and *bm3*-EXP silages compared to the CON, shown in Table 2.

Corn Silage Hybrid

There were no interactions between corn hybrid and kernel processing for any of the growth performance parameters measured ($P > 0.45$). For the main effects of corn hybrid, final BW had a tendency to be greater for *bm3*-EXP hybrid compared to CON silage, with the *bm3* being intermediate ($P = 0.07$). Dry matter intake was similar between *bm3* and *bm3*-EXP hybrids, and were greater than CON-fed steers ($P < 0.01$). Cattle fed *bm3* and *bm3*-EXP had greater ADG compared to CON ($P < 0.01$). Due to increased gain, steers fed *bm3*-EXP had lower F:G at 7.22 compared to CON at 7.60. Steers fed *bm3*

Table 4. Main effect of kernel processing on growth performance and carcass characteristics

	Treatment[1]			
Item	-KP	+KP	SEM	*P*-value[2]
Pens, n	18	18		
Performance				
Initial BW, lb	882	882	9.6	0.99
Final BW, lb[3]	1337	1338	11.2	0.96
DMI, lb/day	32.6	31.8	0.27	0.04
ADG, lb[3]	4.38	4.38	0.047	0.93
Feed:Gain[3]	7.45	7.24	-	0.10
Carcass Characteristics				
HCW, lb	842	843	7.1	0.96
LM Area, in[2]	12.5	12.5	0.07	0.78
Marbling Score[4]	501	501	5.9	0.97
Backfat Thickness, in	0.56	0.56	0.012	0.70
Liver Abscesses, %	4.60	9.23	2.32	0.34

[1]Treatments were not kernel processed (-KP) or kernel processed (+KP)
[2]*P*-Value for the main effect of kernel processing
[3]Calculated from hot carcass weight, adjusted to a common 63% dressing percentage
[4]Marbling Score 400 = Small[00], 500 = Modest[00]

had similar F:G compared to *bm3-EXP* ($P = 0.88$), but lower (7.24) than CON ($P = 0.04$). Likewise, HCW of *bm3*-EXP steers showed a tendency ($P = 0.07$) for them to weigh 44 lb more than CON steers, with *bm3* steers being intermediate. There were no differences in carcass characteristics or liver scores ($P \geq 0.20$), other than marbling scores which were greater for *bm3* and *bm3*-EXP compared to CON fed steers. These results suggest the *bm3* and *bm3*-EXP hybrids improved performance. The *bm3*-EXP with softer endosperm did not have any statistical benefit over *bm3*.

Kernel Processing

For the main effect of kernel processing, steers fed kernel processed silage had lower DMI (0.82 lb/day less) than steers fed silage that was not processed ($P = 0.04$; Table 3). With no difference in ADG ($P = 0.93$), this resulted in a tendency for lower F:G for steers feed kernel processed silage ($P = 0.10$). No differences were observed between steers fed processed silage versus not for HCW, marbling score or rib-eye area ($P \geq 0.78$). Kernel processing of corn silage when fed at 40% of the diet appeared to have a positive effect on F:G of finishing feedlot steers compared to non-kernel processed silages. Feeding kernel processed silage resulted in a 2.6% improvement in efficiency when diets included 40% silage, suggesting the silage was improved by 6.5% (2.6/0.40) compared to not processing silage.

Conclusion

Feeding finishing cattle brown midrib corn silages improved ADG and F:G over the traditional silage when fed at 40% of the diet. Numerically, feeding *bm3*-EXP silage with a softer endosperm had the greatest ADG and lowest F:G, but was not statistically different from *bm3*. Using kernel processing in corn silage did not interact with hybrid, but improved feed efficiency by 2.6% when fed at 40% of diet DM, suggesting a 6.5% improvement in the silage as a feed.

Lauren A. Ovinge, graduate student

F. Henry Hilscher, research technician

Curtis J. Bittner, research technician

Bradley M. Boyd, research technician

John N. Anderson, Mycogen Seeds, Indianapolis Ind.

Galen E. Erickson, professor, Animal Science, University of Nebraska, Lincoln Neb.