Effects of Corn Processing and Silage Inclusion in Feedlot Diets on Steer Performance

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Summary with Implications

A feedlot study compared the effects of corn silage inclusion on steer performance and carcass characteristics within dry-rolled corn diets and steam-flaked corn diets. Treatments included four corn silage inclusions as 0, 15, 30, or 45% of dry matter in both steam-flaked corn and dry-rolled corn base diets. Feeding a steam-flaked based corn diet increased average daily gain by 7.8% and improved feed conversion by 6.8% when compared to steers fed a dry-rolled corn diet. As corn silage inclusion increased, feed conversion increased linearly. When fed to the same days on feed carcass adjusted final body weight, hot carcass weight, and average daily gain responded quadratically: steers fed 15% and 30% corn silage gained faster and were heavier than steers fed 0% or 45% corn silage. Feeding steam-flaked corn improved gain and feed conversion compared to dry-rolled corn. Regardless of corn processing method, including corn silage in the diet at 15 or 30% of dry matter maximized gain but as expected, feed conversion was lowest with no roughage.

Introduction

Corn silage is an abundant and cost-effective roughage source within the Midwest.

Increasing corn silage inclusion from 15% to 45% while replacing dry rolled corn in finishing rations resulted in poorer feed conversion and slower average daily gain (*2013 Nebraska Beef Cattle Report*, pp. 74–75). Previous studies have shown that when feeding corn silage at 12–15% of diet dry matter (DM), cattle perform similarly to steers fed alfalfa hay at 7.5–8% of diet DM (*2019 Nebraska Beef Cattle Report*, pp. 63–65; *2007 Nebraska Beef Cattle Report*, pp. 29–32). Consequently, as corn grain price increases it may become more economically efficient to reduce ration price by increasing corn silage inclusion (*2021 Nebraska Beef Cattle Report*, pp. 69–71). The objective of this study was to determine optimal corn silage inclusion in dry-rolled corn and steam-flaked corn finishing diets on finishing performance and carcass traits.

Table 1. Diet composition on a DM basis fed to finishing steers

Corn Processing Method	DRC				SFC			
Corn Silage Inclusion, %	0	15	30	45	0	15	30	45
Dry-Rolled Corn	79	64	49	34	-	-	-	-
Steam Flaked Corn	-	-	-	-	79	64	49	34
Corn Silage	0	15	30	45	0	15	30	45
Modified Distillers Grains	15	15	15	15	15	15	15	15
Supplement[2]	6	6	6	6	6	6	6	6

[1] Diets were formulated to include Rumensin (Elanco Animal Health) at 30 g/ton of DM and Tylan (Elanco Animal Health) at 8.8 g/ton of DM

[2]Supplement included urea at 1% of diet DM, trace mineral and vitamins

Procedure

A randomized block design finishing study was conducted at the University of Nebraska Panhandle Research and Extension Center (PREEC) in Scottsbluff, NE. Crossbred steers (n = 480; initial BW = 856± 37 lb) were utilized in 2 × 4 factorial arrangement of treatments with 6 replications per simple effect treatment. Treatments consisted of four inclusions of corn silage (0%, 15%, 30%, or 45%) within a dry-rolled corn (DRC) or steam-flaked corn (SFC) diet. Steers were limit-fed at 2% of BW for five days prior to initial weighing to equalize gut fill. The limit-fed diet was comprised of 40% corn silage, 40% alfalfa hay, 14% modified distillers grains, and 6% supplement. Cattle weights were collected on two consecutive days, following limit feeding, and averaged to determine initial body weight (BW). Steers were stratified by first day weights and sorted into 4 weight blocks. Cattle were assigned randomly to pens within weight block. Pens were assigned randomly to one of eight treatments. Each pen contained 10 steers for a total of 48 pens with pen serving as the experimental unit. Cattle were implanted with Revalor XS (Merk Animal Health) on day 0. The adaptation period included 5 steps over 28 days. On day 1, all steers received 19% corn, 15% modified distillers grains, and 20% alfalfa hay for the first step lasting 7 days. The second step increased corn silage to 45% for only the 45% corn silage inclusion treatment diets, with 10% alfalfa hay, 24% corn, and 15% modified distillers grains. In the second step all other treatment diets consisted of 30% corn silage, 10% alfalfa hay, 39% corn, and 15% modified distillers grains. Cattle on the 30% and 40% corn silage treatments started the finishing ration (Table 1) in the third step. The rest of the treatment diets reduced corn silage inclusion over the last 2 steps while increasing corn until reaching their respective corn silage inclusion levels (0 and 15%).

Steers were fed for 125 days and slaughtered at Greater Omaha. Hot carcass weight (HCW) and liver abscess scores were collected on the day of slaughter. After a 48-hour chill, USDA marbling score, longissimus muscle (LM) area, and 12th rib

Table 2. Simple effect of silage inclusion within corn processing method on steer performance and carcass characteristics

	DRC				SFC					*P*-value
	0	15	30	45	0	15	30	45	SEM	Interaction
Pens	6	6	6	6	6	6	6	6		
Performance										
Initial BW, lb	855	859	858	856	859	858	855	859	1.7	0.15
Final BW[1], lb	1297	1311	1331	1298	1331	1367	1351	1338	9.1	0.27
DMI, lb/d	22.6	23.5	25.7	26.3	22.2	24.7	25.7	26.7	0.28	0.04
ADG[1], lb/d	3.55	3.62	3.79	3.54	3.77	4.06	3.97	3.83	0.070	0.26
Feed:Gain[1 2]	6.37	6.49	6.80	7.44	5.90	6.08	6.48	6.96	-	0.80
Carcass Characteristics										
HCW, lb	817	826	839	818	838	861	851	843	5.7	0.26
LM Area, in^2	13.3	13.0	13.3	12.9	13.4	13.3	13.0	13.1	0.14	0.15
Marbling[3]	512	552	559	499	529	570	558	531	17.1	0.82
Fat Thickness, in	0.55	0.61	0.56	0.56	0.56	0.65	0.66	0.59	0.019	0.17
Liver Abscess[4], %	11.7	5.0	10.0	3.3	20.0	6.7	5.0	8.3	-	-

[1] Calculated using hot carcass weight with a 63% dressing percentage adjustment

[2]Analyzed as Gain:Feed, reciprocal of Feed:Gain

[3] Marbling Score 500=Modest00, 600=Moderate00

[4] Liver abscess scores were analyzed in SAS as a binomial distribution, corn silage inclusion x corn processing interaction was not significant (P = 0.38)

Table 3. Main effects of corn processing method on steer performance and carcass characteristics

	Corn Processing Method			
	DRC	SFC	SEM	*P*-value
Pens	24	24		
Performance				
Initial BW, lb	857	858	0.9	0.40
Final BW[1], lb	1310	1347	4.6	<0.01
DMI, lb/d	24.5	24.8	0.14	0.14
ADG[1], lb/d	3.62	3.91	0.036	<0.01
Feed:Gain[1 2]	6.77	6.35	-	<0.01
Carcass Characteristics				
HCW, lb	825	848	2.9	<0.01
LM Area, in.	13.1	13.2	0.75	0.33
Marbling[3]	530	547	8.7	0.18
Fat Thickness, in.	0.57	0.62	0.010	<0.01
Liver Abscess[4], %	7.5	10.0	-	-

[1] Calculated using hot carcass weight with a 63% dressing percentage adjustment

[2] Analyzed as Gain:Feed, reciprocal of Feed:Gain

[3] Marbling Score 500=Modest00, 600=Moderate00

[4] Liver abscess scores were analyzed in SAS as a binomial distribution, effect of corn processing method was not significant (P = 0.42)

fat depth were recorded. Carcass adjusted final body weight (BW), average daily gain (ADG), and feed efficiency were calculated from final BW based on HCW adjusted to a 63% dress. Feed efficiency (G:F) were analyzed, but data are reported as feed conversion (F:G).

The MIXED procedure of SAS was used to analyze animal performance and carcass characteristics with pen as the experimental unit. Liver abscess scores were analyzed as a binomial distribution using PROC GLIMMIX procedure of SAS. Block was treated as a fixed effect. Assessing interactions between corn processing and corn silage inclusion, data were analyzed as a 2×4 factorial. In cases where no interaction was detected, the main effects of corn processing or corn silage inclusion were evaluated. Orthogonal contrasts were utilized to evaluate linear, quadratic, and cubic effects of corn silage inclusion.

Results

A significant interaction between corn silage inclusion and corn processing was observed for DMI ($P = 0.04$). As corn silage inclusion increased in the diet, DMI also increased linearly ($P < 0.01$; Table 2) for both corn processing methods. Dry matter intake was not significantly different between SFC and DRC fed cattle at 0% ($P = 0.33$), 30% ($P = 0.90$), or 45% ($P = 0.31$) corn silage inclusion. The interaction ($P = 0.04$) is likely due to DMI of cattle fed 15% silage, as cattle fed DRC consumed less than cattle on the SFC diet ($P < 0.01$). No significant corn silage inclusion by corn processing method interactions were observed for any other performance or carcass traits ($P > 0.15$), thus, only main effects will be presented.

Feeding SFC increased final BW and HCW when compared to steers in the DRC treatment ($P < 0.01$) (Table 3). Cattle fed SFC gained 7.8% more ($P < 0.01$) and feed conversion was improved by 6.8% ($P < 0.01$) compared to steers fed DRC. As a

Table 4. Main effects of corn silage inclusion on steer performance and carcass characteristics

	Corn Silage Inclusion, %					*P*-value		
	0	15	30	45	SEM	Linear	Quad.	Cubic
Pens	12	12	12	12				
Performance								
Initial BW, lb	857	859	857	857	1.2	0.98	0.67	0.24
Final BW[1], lb	1314	1339	1341	1318	6.4	0.61	<0.01	0.90
DMI, lb/d	22.4	24.1	25.7	26.5	0.20	<0.01	0.02	0.39
ADG[1], lb/d	3.66	3.84	3.88	3.69	0.050	0.59	<0.01	0.74
Feed:Gain[1 2]	6.13	6.28	6.64	7.20	-	<0.01	<0.01	0.97
Carcass Characteristics								
HCW, lb	828	843	845	831	4.1	0.61	<0.01	0.91
LM Area, in.	13.3	13.2	13.1	13.0	0.10	0.02	0.63	0.85
Marbling[3]	520	560	558	515	17.1	0.73	<0.01	0.99
Fat Thickness, in.	0.56	0.63	0.61	0.58	0.014	0.53	<0.01	0.28
Liver Abscess[4], %	15.8	5.8	7.5	5.8	-	-	-	-

[1] Calculated using hot carcass weight with a 63% dressing percentage adjustment

[2] Analyzed as Gain:Feed, reciprocal of Feed:Gain

[3] Marbling Score 500=Modest00, 600=Moderate00

[4] Liver abscess scores were analyzed in SAS as a binomial distribution, effect of corn silage inclusion was significant (P = 0.03)

result of greater gain, fat depth ($P < 0.01$) was greater for cattle fed SFC compared to DRC treatments.

Feed conversion responded quadratically as silage inclusion in the diet increased with feed conversion being similar for cattle in the 0% and 15% silage inclusion treatments and increasing as silage inclusion increased in the 30% and 45% silage inclusion treatments ($P < 0.01$) (Table 4). Quadratic trends were observed for final BW, HCW, ADG, marbling, and fat depth ($P < 0.01$). Steers fed 15% or 30% corn silage gained faster and were heavier than those fed 0% or 45% corn silage. Corn processing method had no impact on liver abscess scores (P = 0.42). The incidence of liver abscesses increased in cattle fed 0% corn silage when compared to cattle fed 15, 30, or 45% corn silage (P = 0.03).

Conclusion

Feeding SFC resulted in a 7.8% increase in ADG and a 6.8% improvement in F:G. Corn silage inclusion had similar effects on performance in both DRC diets and SFC diets. In diets containing either DRC or SFC, corn silage can be included at up to 30% of the ration without negative impacts on steer performance.

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