Effect of Finishing Cattle with Blends of High Moisture and Steam-Flaked Corn with and without Distillers Grains

Braden C. Troyer
Zac C. Carlson
Levi J. McPhillips
Mitchell M. Norman
Andrea K. Watson
James C. MacDonald
Galen E. Erickson

Summary with Implications

The objective of this study was to determine the impacts of feeding different ratios of high-moisture corn and steam-flaked corn in diets with or without distillers grains and test for an associative effect between grain processing methods. Steers (n=120; BW=775 ± 15.6 lb) were assigned randomly to one of 8 diets. Diets tested included 100:0, 75:25, 50:50, 25:75, and 0:100 of high-moisture corn:steam-flaked corn in diets with 20% modified distillers grains or 100:0, 50:50, and 0:100 in diets without distillers grains. There was an interaction observed for average daily gain as gain improved in 50:50 blends of HMC:SFC in diets without distillers grains and was not different as grain type changed when distillers grains was in the diet. Feeding modified distillers grains plus solubles increased carcass weight, average daily gain, intake, and fat thickness compared to control diets. Also feeding greater inclusions of steam-flaked corn resulted in an improvement in feed conversion. In conclusion, a possible positive associative effect was observed for a 50:50 blend of high-moisture corn and steam-flaked corn when no byproduct was included in the diet. Including modified distillers grains plus solubles in these finishing diets improved gain when compared to diets without byproducts. Additionally, feeding steam-flaked corn improved conversion compared to high-moisture corn.

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Introduction

Steam-flaking is a corn processing method widely used by feedlots located in the southern United States. Higher priced corn can make steam-flaking more economical due to improved feed conversion (F:G) by maximizing starch digestibility. Likewise, access to distillers grains (DGS) and benefits from harvesting and storing corn early in the fall has led to Midwestern feedlots basing their rations around high-moisture corn (HMC) and distillers grains, which also improves F:G compared to dry-rolled corn based diets. Use of steam-flaked corn (SFC) in Midwest finishing rations is increasing. Some producers recognize the benefits of having corn inventory and price secured in the fall and continue to store and feed HMC in their operations. While both SFC and HMC are rapidly fermented in the rumen, it is possible that rates of fermentation differ so that a positive associative effect may be observed when fed in combination.

Distillers grains, a byproduct of the ethanol industry, continues to be an economical source of both protein and energy in Midwestern finishing rations. Steam-flaked corn has improved F:G compared to HMC when fed without distillers (*2007 Nebraska Beef Cattle Report*, pp. 33–35). Similarly, SFC has improved F:G compared to DRC when fed without byproducts, but when both corn types are fed with 35% wet DGS, performance is similar (*2012 Nebraska Beef Cattle Report*, pp. 70–72). When distillers grains is included in HMC diets and SFC diets, F:G has been variable depending on the study (*2007 Nebraska Beef Cattle Report*, pp. 33–35; *2021 Nebraska Beef Cattle Report*, pp. 44–45). Therefore, the objective of this experiment was to determine the implications of feeding different inclusions of HMC and SFC with and without 20% modified DGS (MDGS) in the diet on a DM basis. Additionally, this study was designed to determine if positive associative effects are observed when HMC and SFC are fed together in diets with or without MDGS.

Procedure

The relationship between HMC and SFC in diets with and without MDGS was explored at the Eastern Nebraska Research and Extension Center (ENREC) to compare finishing cattle performance. This study utilized 120 crossbred yearling steers (775 ± 15.6 lbs) individually fed from the end of June to mid-November using the Calan gate system. Treatments included (Table 1) 100% HMC, 50:50 blend HMC:SFC, or 100% SFC fed with and without distillers. Additionally, a 25:75 blend and a 75:25 blend of HMC:SFC was fed with MDGS only for a total of 8 treatments (DM basis; corn grain was included at 60% of the diet when MDGS was included and 80% of the diet when MDGS was not included). All cattle were stepped up to their respective diet over 22 d with corn replacing silage and wheat straw. Initial diets included 40% corn silage and 20% or 25% wheat straw for the control diets and MDGS diets, respectively. Control diets included 30% corn in step one and increased by an average of 12.5 units over 4 steps to reach a finishing diet containing 80% corn. Similarly, MDGS diets contained 15% corn in step one and increased by an average of 11.3 units over 4 steps to reach a finishing diet containing 60% corn. Distillers inclusion remained constant across all steps at 20% DM. Steam-flaked corn averaged 29.9 lb/bu and was delivered three times per week from Raikes Feedlot near Memphis, Nebraska. High moisture corn (70% DM) was harvested, rolled in a roller mill, and stored in bunkers before initiation of this trial. All diets contained 15% corn silage and 5% supplement, which was formulated with 1% urea and 0.5% Empyreal (Cargill corn milling, Blair NE) in diets without MDGS and 0.5% urea in diets with MDGS to ensure metabolizable protein requirements were met. All supplements were formulated to provide 30 g/ton of DM Rumensin (Elanco Animal Health) and to provide 90 mg/steer daily Tylan (Elanco Animal Health).

Cattle were implanted on day 1 with

Table 1. Composition of steam-flaked corn and high-moisture corn based finishing diets with or without modified distillers gains plus solubles

	Control			20% MDGS				
	HMC	50:50 HMC:SFC[5]	SFC	HMC	75:25 HMC:SFC	50:50 HMC:SFC	25:75 HMC:SFC	SFC
SFC[1]	-	40.0	80.0	-	15.0	30.0	45.0	60.0
HMC[2]	80.0	40.0	-	60.0	45.0	30.0	15.0	-
MDGS[3]	-	-	-	20.0	20.0	20.0	20.0	20.0
Corn Silage	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
Supplement[4]	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Urea	1.0	1.0	1.0	0.5	0.5	0.5	0.5	0.5
Empyreal	0.5	0.5	0.5	-	-	-	-	-

[1]SFC—Steam-flaked corn average (29.9 lb/bu.)

[2]HMC—High-moisture corn (70% DM rolled and stored in bunker).

[3]MDGS—modified distillers grains plus solubles. (51.2% DM)

[4]Supplement—formulated to contain 30 g/ton monensin (Rumensin, Elanco Animal Health) diet DM, and provide 90 mg/hd/d tylosin (Tylan, Elanco Animal Health). Suppment contained limestone, vitamins ADE, and trace mineral package to meet all mineral and vitamin requirements.

[5]HMC:SFC—ratio of high-moisture corn to steam-flaked corn in each diet

Revalor IS (Merck Animal Health) and re-implanted on day 51 with Revalor 200 (Merck Animal Health). Cattle were on feed 140 days. Initial body weight (BW) was determined based on an average 3-day BW following 5 days of limit feeding to equalize gut fill. Before slaughter, a 1-day final BW was collected and animals were slaughtered at a commercial abattoir. During harvest, hot carcass weight (HCW) was recorded and carcass adjusted final BW was calculated based on a common 63% dressing percentage. Carcass characteristics including marbling, 12th rib fat thickness, and *Longissimus* muscle (LM) area were collected following a 48-hour chill.

Data were analyzed using the PROC MIXED procedure of SAS (SAS Institute Inc., Cary, N.C.) as a completely randomized design with cattle stratified by initial BW and animal was the experimental unit. This resulted in 15 replications per diet. The model included the proportion of SFC and HMC, distillers inclusion, and interaction for those 3 ratios balanced across both distillers inclusions. Linear and quadratic contrasts were developed to evaluate corn ratio in diets with 20% MDGS. For the 3 ratios balanced with 0 or 20% MDGS, corn processing ratio within distillers inclusion was tested for linear and quadratic responses. Main effects of distillers inclusion and corn ratio (100:0, 50:50, and 0:100) are presented if an interaction was not detected. A *P*-value of less than 0.10 was considered significant.

Results

A tendency for an interaction ($P = 0.11$; Table 2) was observed for ADG between distillers inclusion and ratio of HMC:SFC. Cattle fed diets with no distillers grains exhibited a quadratic response (P = 0.07) with ADG increasing when diets changed from 100% HMC to 50:50 blend, which was similar to cattle fed 100% SFC. Based on ADG, a positive associative effect was observed for the 50:50 blend of HMC:SFC in diets without MDGS, but ADG was not positively impacted for the 50:50 treatment compared to either 100% SFC or 100% HMC in diets with 20% MDGS. Gain was not impacted ($P > 0.59$) as SFC replaced HMC in diets with 20% MDGS.

Additionally, a tendency for an interaction was detected for backfat ($P = 0.13$). Diets without MDGS had a tendency for a linear increase ($P = 0.13$) from 0.42 inches to 0.49 inches as diets increased in SFC inclusion from 0 to 100%. Diets containing MDGS had no difference in backfat ($P = 0.66$; Table 2) and averaged 0.54 inches.

There were no interactions for any other parameters measured so main effects of corn blends and distillers inclusion will be discussed. There was a tendency for live final BW, carcass adjusted final BW, and HCW to linearly increase ($P \leq 0.15$) as SFC inclusion increased in the diet. Also F:G improved significantly ($P = 0.03$) as SFC increased in the diet due to DMI remaining constant ($P = 0.67$). Marbling also linearly increased ($P = 0.08$) as SFC inclusion increased in the diet. Modified distillers grains inclusion resulted in improved ($P \leq 0.04$) carcass adjusted final BW, HCW, DMI, and fat thickness compared to diets without MDGS. No differences ($P \geq 0.19$) in F:G, *longissimus* muscle area, or marbling were detected for diets with or without MDGS.

For the different ratios of HMC:SFC within diets containing 20% MDGS, there was little impact on final BW, HCW, DMI, or ADG ($P > 0.26$; Table 3). Based on changes in DMI and ADG, although not significant, there was an impact on F:G due to ratio of HMC:SFC. As SFC replaced HMC in diets containing 20% MDGS, F:G improved linearly ($P = 0.09$). Carcass characteristics were not impacted ($P > 0.44$) as ratio of HMC:SFC changed in diets with 20% MDGS.

Conclusion

These data demonstrate a positive associative effect at a 50:50 HMC:SFC blend when fed without MDGS, shown by similar ADG and F:G for the 50:50 blend and 0:100 blend of HMC:SFC which were both improved compared to 100:0 blend. These

Table 2. Effect of steam-flaked corn and high-moisture corn inclusion in finishing diets with or without modified distillers grains

	HMC	50:50 HMC:SFC[5]	SFC	SEM	C x D Lin[6]	C x D Quad	Lin	Quad	DGS[7]
Initial BW, lb				15.6	0.80	0.74	0.66	0.67	0.86
0% MDGS[8]	773	776	776	-	-	-	0.89	0.94	-
20% MDGS[9]	768	784	779	-	-	-	0.43	0.8	-
Live FBW, lb				25.4	0.87	0.71	0.15	0.68	0.32
0% MDGS	1318	1356	1359	-	-	-	0.25	0.58	-
20% MDGS	1349	1366	1381	-	-	-	0.28	0.71	-
Adj. FBW[1], lb				28.0	0.59	0.27	0.11	0.38	0.04
0% MDGS	1280	1357	1339	-	-	-	0.13	0.16	-
20% MDGS	1360	1369	1389	-	-	-	0.26	0.99	-
ADG, lb				0.149	0.23	0.11	0.14	0.32	0.02
0% MDGS	3.63	4.15	4.02	-	-	-	0.06	0.07	-
20% MDGS	4.23	4.18	4.27	-	-	-	0.59	0.91	-
DMI, lb				0.73	0.27	0.21	0.67	0.86	<0.01
0% MDGS	22.1	23.2	22.6	-	-	-	0.63	0.32	-
20% MDGS	25.3	24.1	24.2	-	-	-	0.31	0.99	-
F:G[2]				-	0.78	0.46	0.03	0.42	0.92
0% MDGS	6.22	5.68	5.67	-	-	-	0.09	0.28	-
20% MDGS	6.02	5.79	5.70	-	-	-	0.09	0.93	-
HCW[3], lb				17.6	0.59	0.27	0.11	0.38	0.04
0% MDGS	807	855	844	-	-	-	0.13	0.16	-
20% MDGS	857	863	875	-	-	-	0.26	0.99	-
LM Area, in^2				0.38	0.81	0.26	0.20	0.72	0.19
0% MDGS	13.9	14.6	14.5	-	-	-	0.28	0.29	-
20% MDGS	14.6	14.6	15	-	-	-	0.66	0.76	-
Fat, in				0.036	0.13	0.80	0.55	0.92	<0.01
0% MDGS	0.42	0.45	0.49	-	-	-	0.13	0.92	-
20% MDGS	0.55	0.54	0.51	-	-	-	0.66	0.73	-
Marbling[4]				26.8	0.77	0.28	0.08	0.72	0.58
0% MDGS	439	482	492	-	-	-	0.15	0.61	-
20% MDGS	451	438	489	-	-	-	0.44	0.68	-

[1]Adjusted final body weight—calculated based on HCW/common 63% dress

[2]F:G—feed conversion calculated based on DMI/ADG

[3]HCW—hot carcass weight

[4]Marbling—400 = small 00, 500 = modest 00, 600 = moderate 00

[5]HMC:SFC—ratio of high-moisture corn to steam-flaked corn in each diet

[6]C x D Lin—p-value testing for linear interactions between corn type and distillers inclusion

[7]DGS—main effect of modified distillers grains

[8]0% MDGS—p-values represent the simple effects in 0% distillers diets

[9]20% MDGS—p-values represent the simple effects in 20% distillers diets

Table 3. Effect of steam-flaked corn and high-moisture corn inclusion in finishing diets fed with 20% MDGS on performance characteristics

	HMC	75:25 HMC:SFC[5]	50:50 HMC:SFC	25:75 HMC:SFC	SFC	SEM	Lin[6]	Quad
Initial BW, lb	768	762	784	779	779	15.6	0.43	0.80
Live FBW, lb	1349	1369	1366	1394	1381	25.4	0.28	0.71
Adj. FBW[1], lb	1360	1359	1369	1401	1389	28.0	0.26	0.99
ADG, lb	4.23	4.27	4.18	4.44	4.27	0.149	0.59	0.91
DMI, lb/d	25.3	25.5	24.1	25.3	24.2	0.73	0.31	0.99
F:G[2]	6.02	6.09	5.79	5.72	5.70	—	0.09	0.93
HCW[3], lb	857	856	863	882	875	17.6	0.26	0.99
LM Area, in^2	14.6	15.0	14.6	14.7	15.0	0.38	0.66	0.76
12th rib Fat, in	0.55	0.53	0.54	0.55	0.51	0.036	0.66	0.73
Marbling[4]	451	489	438	476	489	26.8	0.44	0.68

[1]Adjusted final body weight—calculated based on HCW/common 63% dress

[2]F:G—feed conversion calculated based on DMI/ADG

[3]HCW—hot carcass weight

[4]Marbling—400 = small 00, 500 = modest 00

[5]HMC:SFC—ratio of high-moisture corn to steam-flaked corn in each diet

[6] Lin—p-value testing linear differences between inclusion of grain in diets containing 20% MDGS

data suggest that feeding higher inclusions of SFC in diets that contain MDGS will improve feed conversion. Finally, these data support the idea that replacing HMC, SFC, or a blend of the two grains with MDGS results in increased final BW, HCW, ADG, and DMI, but does not change feed efficiency. In conclusion, replacing HMC with SFC will result in improved feed efficiency and replacing these grains with MDGS will increase final weight and ADG, but feed efficiency will be similar.

Braden C. Troyer, research technician

Zac C. Carlson, research technician

Levi J. McPhillips, feedlot manager

Mitchell M. Norman, feedlot manager

Andrea K. Watson, associate professor

James C. MacDonald, professor, Animal Science, University of Nebraska–Lincoln

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