EXTENSION
BEEF CATTLE RESEARCH UPDATE
Britt Hicks, Ph.D., PAS
Area Extension Livestock Specialist
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Effects of Corn Stalk Inclusion Rate on Rumination and Ruminal pH in Finishing Beef Steers

Coarse-textured roughages, such as corn stalks, are high in neutral detergent fiber (NDF) and function to create a fibrous mat in the rumen that aids in stimulating rumination, buffering ruminal pH, and increasing muscle tone of the rumen. However, increased roughage dilutes available energy in finishing diets. A 2016 survey of consulting feedlot nutritionists showed that for finishing cattle diets, the majority of the nutritionists' clients (37.5%) used corn silage as the primary roughage source followed by the use of corn stalks (29.2%).[1] In a 2007 survey, the primary roughage source used in finishing was corn silage.[2] However, in the earlier survey, none of the clients used corn stalks.

Optimization of roughage levels in high-concentrate diets is necessary to maximize animal performance. However, the effect of dietary roughage level on feedlot performance is a balance between energy consumed and the status of ruminal health. Texas A&M University and West Texas A&M University researchers conducted an experiment to (1) evaluate feedlot performance, rumination, and ruminal pH of cattle consuming a finishing diet with increasing corn stalks inclusion rates and (2) determine the appropriate corn stalk level that contributes to optimal performance while maintaining rumination and ruminal pH.[3]

In this experiment 50 cross-bred steers (initial weight = 666 lb) were randomly allocated to 1 of 3 dietary treatments as well as 1 of 9 Calan head gates (measure individual feed intakes) within 6 pens (3 steers/treatment per pen). Dietary treatments were diets based on steam-flaked corn, with varying concentrations of corn stalks (ground through a 3-inch screen): 5% corn stalks, 10% corn stalks, and 15% corn stalks on a dry matter (DM) basis. As the corn stalks inclusion rate decreased in the diet, it was replaced with wet corn gluten feed (Sweet Bran; Cargill Inc., Minneapolis, MN) so that the portion of fiber that was removed with corn stalks remained in the diet (fiber concentrations remained consistent across experimental diets). Each animal was fitted with a sensory accelerometer that recorded swallowing and regurgitation of a feed bolus. Data were recorded continuously 24 hours a day in 2-hour increments throughout the study to quantify steer rumination behavior (minutes/day). In addition, half of the steers from each dietary treatment received an indwelling rumen bolus to monitor pH. Ruminal pH data were recorded in 15-minute intervals to quantify changes in ruminal pH relative to dietary treatments.

These researchers reported that neither initial nor final shrunk body weight (BW) differed (Table 1). As corn stalks inclusion rate increased, average daily gain (ADG) and gain efficiency (Gain:Feed ratio) decreased linearly ($P \leq 0.02$), whereas dry matter intake (DMI) of cattle consuming 10% corn stalks and 15% corn stalks was greater ($P \leq 0.05$) than those consuming 5% corn stalks. Steers consuming the 5% corn stalks diet outgained those consuming 10% corn stalks by 2.4% and gained 11.5% faster than 15% corn stalks steers. Steers consuming the 5% corn stalks diet had a 13.2% increase in efficiency and consumed 0.9 lb/day less feed compared with 10 or 15% corn stalks steers ($P \leq 0.01$). In addition, increasing dietary corn stalks to 15% linearly decreased ($P \leq 0.04$) fat thickness, Yield Grade, and marbling score and tended to decrease hot carcass weight ($P = 0.10$). Ruminal pH tended ($P < 0.09$) to be greatest in 15% corn stalks steers (6.27), whereas ruminal pH of 10% corn stalks and 5% corn stalks steers were not different (5.98 and 6.05, respectively). Rumination time was greatest ($P \leq 0.01$) for steers consuming the 15% corn stalks diet (362.5 minutes/day) and least with the 5% corn stalks diet ($P = 0.03$).

Table 1. Effects of corn stalk (CS) inclusion rate on feedlot performance, carcass characteristics, ruminal pH, and rumination time.

	Dietary Treatment			P-value	
Item	**5% CS**	**10% CS**	**15% CS**	**CS**	**Linear**
Feedlot Performance					
Days on Feed	230	230	230	--	--
Initial BW, lb	631	644	644	0.44	--
Final BW, lb	1301[a]	1294[a]	1241[b]	0.16	--
ADG, lb/day	3.00[a]	2.93[b]	2.69[c]	0.05	0.02
DMI, lb/day	17.2[b]	18.1[a]	18.1[a]	≤ 0.01	0.16
Gain:Feed	0.176[a]	0.162[b]	0.149[b]	≤ 0.01	≤ 0.01
Carcass Characteristics					
Hot Carcass Weight, lb	827	831	785	0.10	0.07
Fat thickness, in	0.54[a]	0.44[a]	0.41[b]	0.04	0.02
Yield Grade	2.72[a]	2.71[a]	2.21[b]	0.04	0.02
Marbling score	413[a]	413[a]	351[b]	≤ 0.01	≤ 0.01
Rumination					
Ruminal pH	6.05[e]	5.98[e]	6.27[d]	0.09	--
Daily rumination, min/day	298.2[c]	354.9[b]	362.5[a]	≤ 0.01	--

[a-c]Means within a row with unique superscripts differ at P < 0.05.
[d-e]Means within a row with unique superscripts tend to differ at P < 0.10.
Adapted from Jennings et al. 2020.

In conclusion, increasing corn stalk inclusion rate from 5 to 15% in the diet of finishing beef steers increased ruminal pH and rumination which may seem beneficial for rumen health. However, feeding higher corn stalk levels decreased performance. These results indicate that when corn stalks are included at 10% of a finishing diet, there is an increase in hot carcass weight while feedlot performance, ruminal pH, and rumination are maintained.

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[1] Samuelson, K. L., M. E. Hubbert, M. L. Galyean, and C. A. Löest. 2016. Nutritional recommendations of feedlot consulting nutritionists: The 2015 New Mexico State and Texas Tech University survey. J. Anim. Sci. 94: 2648-2663.

[2] Vasconcelos, J. T. and M. L. Galyean. 2007. Nutritional recommendations of feedlot consulting nutritionists: The 2007 Texas Tech University survey. J. Anim. Sci. 85: 2772-2781.

[3] Jennings, J. S., C. L. Lockard, L. O. Tedeschi, and T. E. Lawrence. 2020. Effects of corn stalk inclusion rate on rumination and ruminal pH in finishing beef steers. Appl. Anim. Sci. 36:377-388.