STEAM-FLAKED CORN DIETS CONTAINING COMBINATIONS OF WET CORN GLUTEN FEED AND ALFALFA HAY: EFFECTS ON DIET DIGESTIBILITY AND RUMINAL CHARACTERISTICS

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Summary

Twelve ruminally cannulated Jersey steers were used to measure digestibility and ruminal characteristics of steam-flaked corn based diets containing combinations of wet corn gluten feed (WCGF) and alfalfa hay (AH). Starch intake was lower ($P<0.05$), but neutral detergent fiber intake was higher ($P<0.05$) as AH and WCGF increased in the diet. Ruminal pH was increased by AH (linear, $P<0.05$) and tended ($P<0.07$) to increase with WCGF. Feeding higher levels of WCGF tended to increase passage rate ($P=0.17$) and decreased ($P<0.05$) total tract organic matter digestibility. Flaked corn diets containing at least 25% WCGF may contribute enough roughage to allow reduction of alfalfa hay levels.

(Key Words: Wet Corn Gluten Feed, Steam-Flaked Corn, Digestibility.)

Introduction

Roughage in modern cattle finishing diets is typically provided in small amounts (0 to 10% of dry matter). Roughages are often expensive due to their predisposition to shrink and their high cost per unit of energy. Due to its inherent fibrous characteristics, wet corn gluten feed (WCGF) has been used as a source of roughage in corn-based finishing diets. WCGF is also a good source of energy and is thought to lessen the propensity for acidosis when added to high-grain finishing diets. Our objective was to evaluate the effects on ruminal characteristics and diet digestibility when WCGF was used as a source of energy and as a replacement for alfalfa hay (AH) in steam-flaked corn (SFC) finishing diets.

Experimental Procedures

Twelve ruminally cannulated, mature Jersey steers (1290 lbs) were fed SFC-based diets containing 25 or 45% WCGF and 0, 2, or 6% AH in a 2 × 3 factorial design (Table 1). There were three 14-day periods. Each period consisted of 10 days for adaptation and 4 days for sampling. Steers were allowed *ad libitum* access to feed provided once daily. Chromic oxide (15 g) was hand mixed daily into individual diets on days 4 through 13 as a marker for diet digestibility. On day 11, a solution containing 3 g of cobalt-EDTA was pulse dosed through the ruminal cannula at 8:00 a.m. to estimate liquid passage and ruminal volume.

Fecal grab samples were collected three times daily on days 11 through 14 to estimate fecal output. Samples of ruminal fluid were collected beginning at 8:00 a.m. on day 11 and subsequently at 2, 4, 6, 8, 12, 18, and 24 hours after feeding.

Results and Discussion

Replacement of SFC with WCGF and AH caused starch intake to decrease ($P<0.05$), but neutral detergent fiber intake to increase ($P<0.05$; Table 2). The digestibilities of starch and fiber were similar among diets, but feeding 45% WCGF de-

creased (P<0.01) organic matter digestibility, which was due to higher fiber and lower starch content of these diets (Table 1). Although additional WCGF decreased digestibility, it potentially created a more stable rumen environment, as it tended to lower the concentration of ruminal VFA (P=0.13) and increase pH (P=0.08; Table 3). Increasing dietary AH yielded quadratic responses (P<0.05) in concentrations of NH_3, total volatile fatty acids, and propionate (Table 3). These quadratic effects may be attributed to lower intakes for steers fed diets containing 25% WCGF and 2% alfalfa hay. Like WCGF, additional AH increased (linear, P<0.05) ruminal pH. Smaller additions of AH raised pH to a greater extent than larger additions of WCGF, implying that quantitatively AH, is the more effective roughage source. Furthermore, acetate:propionate ratio increased with levels of AH to a greater extent for cattle fed 25% WCGF than with cattle fed 45% WCGF, and this provided a WCGF × AH interaction (P<0.05). Liquid passage rate tended to be faster (P=0.17) when 45% WCGF was fed (Table 2). This faster rate of passage may partially explain the reduced digestibility of diets containing 45% WCGF.

Both WCGF and AH contribute value as roughage sources. Compared with AH, larger quantities of WCGF may be needed to provide equivalent roughage value, but digestibility may be reduced in diets containing high levels of WCGF. Feeding additional WCGF and AH may create a more favorable rumen environment. However, feeding at least 25% WCGF regardless of AH level appeared to provide adequate roughage to limit acidosis.

Table 1. Composition of Experimental Diets for Steers Fed Steam-Flaked Corn Diets Containing Combinations of Wet Corn Gluten Feed (WCGF) and Alfalfa Hay (AH; % of Dry Matter)

	25% WCGF			45% WCGF		
Item	0% AH	2% AH	6% AH	0% AH	2% AH	6% AH
Ingredient						
Flaked corn	65.3	63.6	60.4	48.3	46.3	42.4
Wet corn gluten feed	23.5	23.5	23.6	43.1	43.1	43.2
Alfalfa hay	-	1.9	5.8	-	2.0	5.9
Tallow	3.0	3.0	3.0	3.0	3.0	3.0
Premix[1]	2.5	2.6	2.6	2.5	2.5	2.6
Soybean meal	2.2	2.0	1.4	-	-	-
Urea	1.0	1.0	1.0	0.8	0.8	0.8
Limestone	1.7	1.6	1.5	1.7	1.6	1.5
Sodium chloride	0.3	0.3	0.3	0.3	0.3	0.3
Potassium chloride	0.4	0.4	0.3	0.3	0.3	0.2
Premix[2]	0.1	0.1	0.1	0.1	0.1	0.1
Dry matter, %	69.3	69.3	69.2	59.4	59.3	59.3
Organic matter, %	96.2	96.0	95.3	95.7	95.5	95.1
Starch, %	53.6	52.2	45.6	44.6	41.2	36.6
NDF, %	21.5	22.9	23.7	27.3	28.0	30.2
Crude protein, %	14.6	14.7	14.7	15.1	15.2	15.3
Calcium, %	0.68	0.65	0.63	0.72	0.71	0.65
Phosphorus, %	0.31	0.30	0.30	0.37	0.38	0.38

[1]Formulated to provide: 300 mg Rumensin and 90 mg Tylan daily.
[2]Formulated to provide: 1180 IU/lb vitamin A, and 0.1 ppm Co, 0.6 ppm I, 60 ppm Mn, 0.3 ppm Se, 60 ppm Zn, 10 ppm Cu, and 10 ppm thiamin.

Table 2. Intake, Total Tract Apparent Digestibility, Ruminal Passage Rate, and Ruminal Volume of Steers Fed Steam-Flaked Corn Diets Containing Combinations of Wet Corn Gluten Feed (WCGF) and Alfalfa Hay (AH; % of Dry Matter)

	25% WCGF			45% WCGF			
Item	0% AH	2% AH	6% AH	0% AH	2% AH	6% AH	SEM
Intake, lb							
Dry matter	18.7	17.4	18.5	18.5	18.2	19.0	1.7
Organic matter	18.1	16.8	17.6	17.2	17.4	18.1	1.6
Starch[ab]	9.9	9.0	8.4	7.9	7.5	7.1	1.1
Neutral detergent fiber[ab]	4.2	4.2	4.4	5.1	5.3	5.7	0.42
Digestibility, %							
Organic matter[a]	87.5	87.2	87.5	84.7	85.5	87.0	0.73
Starch	98.3	98.1	98.1	98.4	97.6	97.5	0.72
Neutral detergent fiber	69.1	69.9	69.8	67.5	70.2	71.5	3.2
Fluid							
Passage rate, %/h	3.5	3.9	3.6	3.9	3.8	4.7	0.77

[a]Effect of level of WCGF (P<0.01).
[b]Linear effect of AH (P<0.05).

Table 3. Ruminal Fermentation Profiles of Steers Fed Steam-Flaked Corn Diets Containing Combinations of Wet Corn Gluten Feed (WCGF) and Alfalfa Hay (AH; % of Dry Matter)

	25% WCGF			45% WCGF			
Item	0% AH	2% AH	6% AH	0% AH	2% AH	6% AH	SEM
pH[a]	5.82	5.90	5.93	5.95	5.88	6.08	0.072
Acetate:propionate[b]	1.22	1.44	2.02	1.46	1.64	1.74	0.19
	---------- mM ----------						
NH_3[c]	6.5	8.4	7.9	6.5	9.9	4.3	2.2
Lactate	0.3	0.3	0.2	0.2	0.2	0.1	0.15
Total VFA[c]	110.7	95.8	118.3	105.7	100.1	100.0	8.1
Acetate	50.3	44.4	64.5	48.9	48.2	51.7	4.0
Propionate[c]	44.3	33.2	36.5	41.2	31.9	35.3	4.7
Butyrate	10.7	12.8	11.9	10.1	13.0	9.7	1.5

[a]Linear effect of AH (P<0.05).
[b]Linear effect of AH × WCGF (P<0.05).
[c]Quadratic effect of AH (P<0.05).