

Roughage— Concentrate Associative Effects

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Story in Brief

Seven mature ruminally cannulated steers (1220 lb) were limit fed whole shelled corn at about 1.2 percent of body weight. Cottonseed hulls or chopped alfalfa hay was added to the corn to form 40 percent roughage supplemented rations. Cottonseed hull addition reduced fecal starch by 85 percent, starch output in feces per day 54 percent and increased starch digestibility from 91.7 to 96.2 percent over the 0 roughage treatment. Alfalfa hay addition reduced fecal starch 20 percent but increased starch output per day by 219 percent. Added alfalfa hay lowered starch digestibility to 82.4 percent. Starch disappearance from nylon bags suspended in the rumen of steers fed the various rations was 150 percent faster for steers fed alfalfa hay than those fed corn alone and 128 percent faster than the cottonseed hull-fed steers. Results suggest that roughages differ in their effects upon rate and extent of starch digestion.

Introduction

Roughages are included in feedlot rations to supply bulk to aid in prevention of acidosis and to enhance palatability. Many workers have examined roughage to concentrate ratio effects on animal performance. These studies usually have replaced grain by forage and decreased concentrate intake. The objective of this study was to determine if starch digestibility of a whole shelled corn ration is altered by either cottonseed hulls or chopped alfalfa hay addition while corn intake is held constant.

Materials and Methods

Seven mature mixed cross steers were allotted to three treatments: 1) whole shelled corn (WSC), 2) WSC plus 40 percent cottonseed hulls and 3) WSC plus 40 percent chopped alfalfa hay. Each steer was assigned an intake of WSC and supplement (Table 1) at approximately 1.2 percent of body weight. WSC intake remained constant with roughage addition. Steers were rotated among rations for the three periods.

To examine digestion in the rumen alone, four particle sizes of corn were placed in nylon bags and suspended in the rumen of steers fed the three diets to digest. Particles consisted of whole corn grain, scratched whole kernel grain, corn grain ground through 6-mm screen or ground through 3-mm screen. Nylon bags were removed at 1.5, 3, 6, 12, 24 and 48 hours of digestion in the rumen to estimate rate of starch digestion. The starch digestion rate was calculated using the linear portion of the digestion curve after correction for undigested material washing through the bag.

Results and Discussion

Results demonstrate a large effect of added roughage (Table 2). Fecal starch was reduced by 84.7 percent with addition of cottonseed hulls and 20.0 percent by added alfalfa. Part of this is due to increased fecal output. Total loss of starch in feces was higher with the alfalfa supplemented than the whole shelled corn ration alone. Cottonseed hull addition reduced starch loss in the feces. Starch digestibility with cottonseed hulls was over 96 percent, compared with 82 percent for the alfalfa supplemented ration.

Nylon bags containing whole corn, scratched corn or corn ground through a 6- or 3-mm screen were ruminally incubated (Table 3). Results suggest that roughage source at the 6- and 3-mm screen sizes and corn grinding effect rate of starch disap-

Table 1. Ration composition.

	Basal ration, %
Corn grain	96.6
Urea	0.74
Dicalcium phosphate	2.03
KC1	0.61
Vitamin D	+
Vitamin A	+

Table 2. Fecal and starch digestibility.

	Roughage		
	Basal	Basal + 40% CSH	Basal + 40% alfalfa
Fecal dry matter, %	32.6 ^a	28.8 ^a	25.5 ^a
Fecal dry matter, kg/day	1.2 ^a	3.7 ^b	3.5 ^b
Fecal starch, %	25.5 ^a	3.9 ^b	20.4 ^a
Starch output, kg/day	0.36 ^a	0.17 ^b	0.79 ^c
Starch digestibility, %	91.7 ^a	96.2 ^b	82.4 ^c

^{abc}Means in a row with different superscripts differ significantly ($P < .05$).

Table 3. Starch disappearance, %/hr.

	Ration		
	Basal	Basal + 40% CSH	Basal + 40% alfalfa
Whole	0.06	0.06	0.06
Scratched	0.09	0.08	0.07
6 mm	0.93	1.21	1.74
3 mm	1.42	1.67	2.14

peared. Rate of starch disappearance did not differ between whole or scratched kernels and appeared to be independent of roughage source. Grinding corn through the 6- or 3-mm screens increased rate of starch disappearance markedly. Roughage addition to the ration increased starch disappearance with the greatest effect from alfalfa hay. This is opposite what might have been expected from the digestion study. Therefore, roughage must have effects beyond that on rate of digestion in the rumen. These may include effects on rumination (chewing and extent and rate of particle size reduction) and on time for digestion in the rumen or intestines. Although the reasons why roughages differ in their effect on starch digestion are unclear, results suggest that the type of roughage chosen with whole shelled corn rations may drastically alter digestibility of starch by mature cattle.
