

Figure 2. *In vitro* gas production of control and fertilized grain sorghums. (Means with different superscripts are significantly different,  $P < .05$ ).

plant. Specifically, the decrease in tannin content noted for the Darset variety may be particularly beneficial. Additional fertilizer, however, did not have a consistent effect on digestibility (IVDMD). Because protein shielding of starch appears to be a major factor affecting the digestibility of grain sorghum, additional nitrogen fertilizer could theoretically increase protein content and subsequently decrease digestibility. Since no detrimental effects were observed, the addition of extra nitrogen to growing grain sorghum should not present a nutritional problem.

## Roughage - Concentrate Associative Effects

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### Story in Brief

Twelve growing steers (657 lb) were fed whole shelled corn rations at two levels of feed intake. Cottonseed hulls or chopped alfalfa hay was added to the corn to form 10- and 40-percent roughage-supplemented rations for each roughage. Increasing ration

intake from a maintenance level to 1.8 times maintenance decreased dry matter digestibility from 87.1 to 83.3 percent. Roughage addition reduced fecal starch at high (10.1 vs. 6.6 percent) but not low ration intakes.

Starch digestibility at the maintenance level of intake decreased with addition of either roughage (.8 percent decrease for each percentage of added alfalfa and .07 percent for cottonseed hulls). Starch digestibility at the higher intake level increased with .10 percent added roughage (.10 percent for each percentage of added alfalfa and .26 percent for cottonseed hulls) and decreased with further addition of roughage (.06 percent for each 1 percent addition of alfalfa and .03 percent for cottonseed hulls). Whole corn kernels appearing in feces accounted for 22 percent of the total fecal starch with 40 percent cottonseed hulls in the ration in contrast to 69 percent for other treatments, indicating that whole kernels represent a large portion of the total fecal starch with these rations. Cottonseed hulls at a high level appear to increase starch digestion by increasing rumination and reducing the amount of whole corn passing through the tract.

## 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 effects on animal performance. These studies usually have replaced grain with forage and thereby decreased concentrate intake while increasing dry-matter intake. Recent results have shown a marked positive effect of cottonseed hulls and a negative effect of chopped alfalfa hay on starch digestibility of whole shelled corn when a constant amount of corn was fed (Teeter, 1980). The objective of this study was to further examine starch digestibility of a whole shelled corn ration with added cottonseed hulls or chopped alfalfa hay.

## Materials and Methods

Twelve growing hereford steers were allotted to five rations (Table 1) and fed at intake levels of maintenance or 1.8 times maintenance. The five rations were: 1) whole shelled corn (WSC), 2) WSC + 10 percent cottonseed hulls, 3) WSC + 40 percent cottonseed hulls, 4) WSC + 10 percent chopped alfalfa hay and 5) WSC + 40 percent chopped alfalfa hay. Steers were rotated among rations for four periods.

To examine the influence of roughages on particle size of starch in feces, fecal samples were sieved through .31-inch mesh screens and analyzed for starch.

## Results and Discussion

Increasing feed intake from 1 to 1.8 times maintenance reduced dry-matter digestibility a mean of 4.4 percent (Table 2). This indicated that digestibility estimates

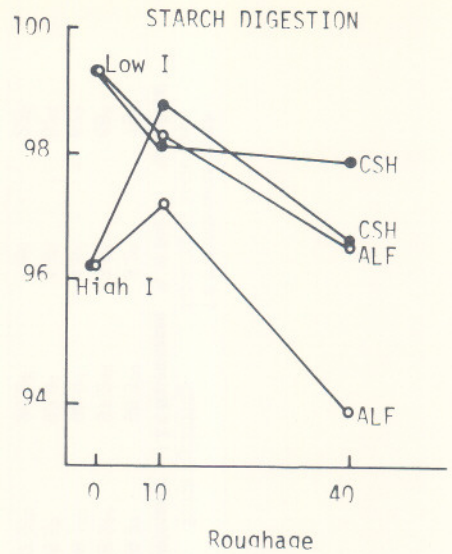
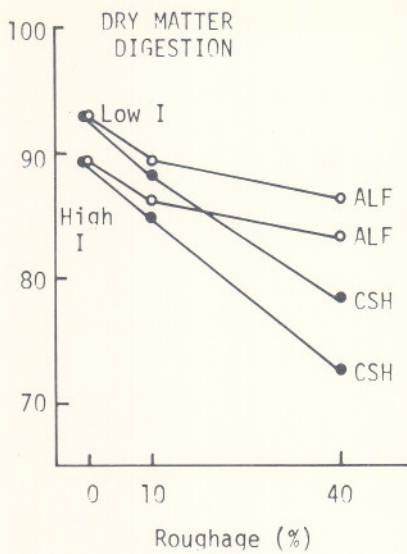
**Table 1. Supplemented composition (pelleted)**

	%
Dehydrated alfalfa meal	1.04
Soybean meal	60.0
Cottonseed meal	22.7
Calcium carbonate	10.5
Potassium chloride	2.5
Salt	2.7
Rumensin (60 gram)	0.17
Tylan 40	0.09
Vitamin A 10m/lb	0.15
Trace mineral	0.15

**Table 2. Fecal and starch digestibility**

	Dry matter digestibility		Fecal starch		Starch digestibility		1.8 X maintenance starch appearing as whole corn	
	Maintenance	1.8 X Maintenance	Maintenance	1.8 X Maintenance	Maintenance	1.8 X Maintenance	% of Fed	% of Fecal
Basal	93.1 <sup>a</sup>	89.5 <sup>a</sup>	6.2 <sup>ab</sup>	19.0 <sup>a</sup>	99.2 <sup>a</sup>	96.3 <sup>bc</sup>	3.2 <sup>a</sup>	75 <sup>a</sup>
10% alfalfa	89.4 <sup>b</sup>	86.3 <sup>ab</sup>	7.6 <sup>ab</sup>	10.3 <sup>bc</sup>	98.3 <sup>ab</sup>	97.3 <sup>ab</sup>	3.8 <sup>a</sup>	68 <sup>a</sup>
10% CSH	88.5 <sup>b</sup>	84.7 <sup>b</sup>	8.5 <sup>a</sup>	5.0 <sup>bc</sup>	98.1 <sup>ab</sup>	98.9 <sup>a</sup>	4.5 <sup>a</sup>	67 <sup>a</sup>
40% alfalfa	86.3 <sup>c</sup>	83.3 <sup>b</sup>	7.0 <sup>ab</sup>	11.4 <sup>b</sup>	96.5 <sup>b</sup>	93.9 <sup>c</sup>	4.6 <sup>a</sup>	67 <sup>a</sup>
40% CSH	78.4 <sup>d</sup>	72.8 <sup>c</sup>	3.7 <sup>b</sup>	4.9 <sup>c</sup>	97.9 <sup>ab</sup>	96.6 <sup>ab</sup>	.8 <sup>b</sup>	22 <sup>b</sup>

<sup>abcd</sup>Means in a column with different superscripts differ significantly (P<.05).



**Figure 1. Effect of roughage addition on ration dry matter digestibility**

**Figure 2. Effect of roughage addition on starch digestibility**

determined at low levels of intake may overestimate digestibility at higher, more practical feed intake levels. Fecal starch was low when rations were fed at maintenance levels of intake but increased with feed intake. Percent fecal starch was negatively related with starch digestibility though the relationship was not close. Fecal starch values without fecal output estimates appear to be a poor predictor of starch digestibility across levels of roughage.

Ration dry-matter digestibility (Figure 1) was reduced with roughage addition. These results indicate that roughages have a lower digestibility than corn grain. Roughage effects varied with level of intake, level of roughage and source of roughage (Figure 1). At maintenance intakes, addition of 10 percent roughage lowered starch digestibility while at 1.8 maintenance, 10 percent roughage addition enhanced starch digestibility. Adding 40-percent alfalfa hay reduced starch digestibility at both levels of intake while cottonseed hulls only had a depressing effect at the maintenance level of intake. With whole corn rations fed at a low level of feed intake, including a low level of roughage appears undesirable while adding roughage at a higher level of feed intake seems desirable. When higher roughage levels are fed, cottonseed hulls cause less depression in starch digestion than chopped alfalfa hay. From 22 to 75 percent of the starch in feces was found in particles caught by a .3-inch screen. These were primarily intact corn kernels. With 40-percent cottonseed hulls and the higher level of feed intake, the proportion of starch appearing as whole corn kernels in the feces of steers was much lower than with other rations fed. This may reflect increased chewing or rumination with cottonseed hulls in the ration. Further study of the effects of specific roughage sources and levels on starch digestion is needed.

### Literature Cited

Teeter, R. G. and F. N. Owens. 1980. Okla. Ag. Exp. Sta. Res. Rep. 156.