Roughage Source in Feedlot Diets

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Story in Brief

The influence of roughage source on digestion of a high grain diet was measured with 24 Hereford-Angus steers. The six roughages tested were cottonseed hulls, prairie hay, alfalfa hay, sorghum plant silage and two varieties of corn plant silage. The diet consisted of 82 percent whole shelled corn, 10 percent roughage and 8 percent supplement. Daily feed intake was restricted to 2 percent of body weight. Digestion of organic matter, starch, ADF and nitrogen were not significantly different for the diets containing the six roughages. Total diet organic matter and starch digestibilities tended to be higher for cottonseed hulls and prairie hay diets than the diets containing silage. The more completely digested roughages were not necessarily associated with the more digestible grain diets. Results indicate that cattle feeders may ignore forage digestibility and energy content in selection of roughages for whole corn finishing diets and be more concerned with roughage availability, palatability, ration handling characteristics and cost. Traditional roughages such as corn silage and alfalfa hay, which are often preferred by cattle feeders, appeared to have little advantage in this study.

Introduction

Corn is usually processed to increase its energy availability. Feeding corn in the whole shelled form eliminates one processing step and some costs. Cattlemen often prefer alfalfa hay or corn silage as a roughage source in feedlot diets. One possible reason for this preference may be the presence of unidentified growth factors. The purpose of this research was to examine the influence different types of forages have on digestion of whole shelled corn in typical feedlot finishing diets.

Experimental Procedures

Twenty-four Hereford-Angus steers (800 lb) were utilized to examine the effects of six different roughage sources on digestion of a high concentrate diet. The six roughages (Table 1) were cottonseed hulls (CSH), prairie hay (PH), alfalfa (AH), sorghum plant silage (SS) and two corn plant silages (FCS = forage corn silage and GCS = grain corn silage). Four steers were randomly allocated to each of the six roughages. Animals were housed in individual pens on slatted concrete floors. Steers were fed the assigned diets for 21 days. The last 5 days of this period, fecal grab samples were collected at 0600 hr, pH was determined and samples were frozen for laboratory analysis. Chromic oxide was added at .2 percent of the diet as an indigestible marker to calculate digestibility. Steers were fed twice daily. Diets contained whole shelled corn (WSC) plus supplement and roughage (Table 2). Supplement composition is shown in Table 3. Protein was added to obtain a minimum protein level of 10.5 percent with some of the rations being above this level. Feed and fecal samples were analyzed to determine the digestibility of organic matter, nitrogen, starch and fiber. Fiber content was

Table 1. Ingredient analysis (%)

Item	DM	Dry matter basis		
		Starch	ADF	Protein
Cottonseed hulls	88.5	3.9	64.2	7.5
Prairie hay	91.2	3.8	46.2	5.9
Alfalfa hay	90.6	2.0	40.1	18.2
Sorghum silage	27.9	18.5	37.3	7.7
Corn silage (grain)	33.8	21.1	31.3	8.4
Corn silage (forage)	32.8	23.2	30.0	7.6
Whole shelled corn	88.4	73.8	2.4	9.9

Table 2. Diet composition (DM basis)

Ingredient	%
Whole shelled corn	82
Forage	10
Supplement	8

Table 3. Supplement composition[a] (DM basis)

Ingredients	CSH & PH %	AH %	Silages %
SBM	72.3	0	45.3
Ground corn	5.1	50.4	4.9
Dicalcium phosphate	10.7	13.1	13.1
Limestone	2.7	15.1	15.1
Potassium chloride	0	5.6	5.6
Salt	1.6	3.1	3.1
Urea	3.8	7.5	7.5
Sodium sulfate	2.4	2.4	2.4
Trace mineral mix	.2	.3	.3
Chromic oxide	1.3	2.5	2.5

[a]Vitamin A and D were added to supply NRC requirements.

estimated by analyzing the samples for acid detergent fiber (ADF). Rumen samples were obtained using a stomach tube on the final day of the study and analyzed for pH, ammonia concentration and volatile fatty acid concentrations.

Results and Discussions

Total tract digestibility estimates for organic matter, starch, nitrogen and ADF for the six diets are shown in Table 4. At low levels in the diet, source and digestibility of roughage appear less important than in diets composed entirely of roughage. In comparison of predicted vs determined digestibilities, alfalfa and two of the three corn silage diets appeared considerably below expected values. Starch digestion of these diets was also lower with those three roughages. This

Table 4. Effects of forage source on nutrient digestibility

Item	CSH	PH	AH	SS	GCS	FCS
Digestibility, %						
Organic matter						
Determined	73.8	77.1	65.2	69.6	67.8	74.1
Calculated[a]	74.4	75.5	74.5	74.4	75.8	75.8
Starch	90.8	89.2	77.4	79.7	77.4	84.8
ADF	27.1	37.2	25.0	34.2	44.8	47.0
Nitrogen	62.3	66.1	51.6	63.8	55.5	68.3

[a]Calculated from TDN of ingredients listed in NRC for dairy cattle.

suggests that the influence of roughage on corn digestibility in diets containing high levels of whole shelled corn is an important factor when considering value of a roughage. Using roughages which are available and palatable and do not reduce starch digestion may have economic advantages in high-grain diets.

The effect of roughage source on fecal parameters is shown in Table 5. Fecal pH and fecal starch tended to be higher when silages were fed. Fecal fiber was highest and fecal ash lowest with CSH. Fiber digestibility tended to increase as fecal pH increased. This suggests low pH in the large intestine may have reduced fiber digestion with these rations. If fiber digestion in the rumen decreases as grain intake increases, much of the fiber digestion with feedlot diets may be dependent upon fermentation in the large intestine and cecum. Rumen ammonia tended to be higher with the silage diets, and ruminal pH tended to be higher with alfalfa and prairie hay (Table 6). Ruminal volatile fatty acids were similar except for isobutyrate and isovalerate, which are branch chain fatty acids derived primarily from protein degradation. With the low protein roughages, low levels of these acids might be expected.

Although roughage source at 10 percent of the diet did not greatly influence digestion of high concentrate diets in the total digestive tract, the site of digestion may have been altered, which could influence starch digestion. Since forage contributes little energy to the total dietary energy concentration, the energy value or digestibility of a roughage would appear to be of secondary importance to palatability, availability and cost in whole corn finishing diets. Though alfalfa and corn silage are often preferred by cattlemen, no special characteristics or advantages of these roughages could be detected. In fact, the less digestible roughages, cottonseed hulls and prairie hay, seem preferable to improve digestibility of starch in the ration.

Table 5. Effects of forage source on fecal parameters

Item	CSH	PH	AH	SS	GCS	FCS
Fecal						
pH	5.68^{d}	5.75^{d}	5.86^{de}	5.88^{de}	6.12^{e}	6.07^{e}
Dry matter, %	28.2	26.0	29.0	28.9	31.4	28.7
Starch[a]	20.6	26.6	35.2	36.7	37.4	34.2
Nitrogen[a]	2.83	2.76	2.76	2.36	2.61	2.39
ADF[a]	24.7^{c}	18.2^{bc}	14.3^{b}	12.7^{b}	10.5^{b}	11.2^{b}
Ash[a]	7.7^{e}	10.8^{d}	8.2^{de}	11.3^{d}	11.7^{d}	11.5^{d}

[a]Percentage of fecal dry matter.
[bc]Means in a row with different superscripts differ statistically ($P<.01$).
[de]Means in a row with different superscripts differ statistically ($P<.05$).

Table 6. Effect of forage source on rumen pH, ammonia and volatile fatty acid concentration

Item	CSH	PH	AH	SS	GCS	FCS
Ruminal						
pH	5.98	6.20	6.22	5.94	5.91	5.83
Ammonia, mg/dl	4.98[c]	8.77[cd]	9.97[cde]	16.65[e]	15.05[de]	10.65[cde]
Volatile fatty acid, moles/100 moles						
Acetate	59.72	57.03	56.18	57.32	55.89	59.5
Propionate	28.59	30.56	23.03	28.26	21.31	21.9
Butyrate	7.68	9.04	12.24	8.81	12.39	13.57
Isobutyrate	.16	.16	1.02	.48	1.77	.73
Valerate	1.62	1.39	3.55	1.57	3.44	1.69
Isovalerate	1.90[a]	1.82[a]	3.69[ab]	2.47[a]	4.96[b]	2.39[a]
Caproate	.33	0	.29	1.08	.24	.22
Total, μM/ml	81.29	79.36	69.07	110.55	71.80	102.50

[ab]Means in a row with different superscripts differ statistically ($P<.05$).
[cde]Means in a row with different superscripts differ statistically ($P<.01$).