

Forage Sources with Whole Corn in Receiving Diets for Cattle

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Story in Brief

Six different forages were fed in 50 percent roughage rations to 24 Hereford-Angus steers (800 lb). The diets of 50 percent forage, 42 percent whole shelled corn and 8 percent supplement were fed at a level equal to 2 percent of body weight daily. The six forages examined were cottonseed hulls (CSH), prairie hay (PH), alfalfa hay (AH), sorghum plant silage (SS) and two varieties of corn plant silage (FCS and GCS). Organic matter digestibility was greater with the corn silage diets. Some forage diets (CSH, PH and two of the three silages) were more digestible (+18, +4, +5 percent) than expected while alfalfa hay diets were 14 percent less digestible than expected. Results suggest that although forage digestibility is important in selecting a roughage for receiving cattle diets, forages may interact differently with whole shelled corn and have considerably more or less value in mixed diets than expected. Starch digestion was greatest with the cottonseed hull-supplemented diet.

Introduction

Upon arrival in commercial feedlots yearling feeder calves are fed diets containing 40 to 60 percent forage. Such high forage diets may be fed for 5 to 120 days depending on cattle size and economic conditions. Source of forage may influence energy availability from grain (Teeter and Owens, 1981). The purpose of this research was to evaluate the influence various types of forages have on efficiency of nutrient utilization with high roughage diets.

Experimental Procedures

Procedures used in this study are presented elsewhere in this publication (Rust and Owens, 1982). The level of forage was 50 percent in this study whereas in the other study, diets contained 10 percent forage. Diets and supplement composition are shown in Tables 1 and 2. The forage sources were cottonseed hulls (CSH), prairie hay (PH), alfalfa hay (AH), sorghum plant silage (SS) and two varieties of corn plant silage (GCS and FCS).

Table 1 Diet composition (DM basis)

Item	%
Whole shelled corn	42
Forage	50
Supplement	8

Table 2. Supplement composition^a (DM basis)

Item	Supplement		
	CSH & PH	AH	Silages
	-----%		
SBM	72.3		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		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

^aVitamin A and D were added to supply NRC requirements.

Results and Discussion

Organic matter digestion was greatest for the corn silage diets and lowest for the alfalfa hay-supplemented diet (Table 3). CSH, PH and two of the three silage-supplemented diets yielded greater than expected digestibilities based on TDN values from the NRC for dairy cattle while the alfalfa hay-supplemented diet produced lower than expected values. When digestibilities were higher than expected, starch digestibilities were also high and vice versa. Results suggest that certain forages may enhance the digestibility of whole corn while others, such as alfalfa, may reduce starch digestion from whole shelled corn. The selection of a forage for mixed diets to be used in receiving rations should be based not only on digestibility and nutrient content of the forage, but also on the influence the forage has on digestibility of the grain in the ration.

Starch digestion tended to be lower for the SS and PH-supplemented diets. Starch digestion was greatest (96.3 percent) for the cottonseed hull-supplemented diet, which agrees with previous studies (Rust and Owens, 1982; Teeter and Owens, 1981). A trend for greater fiber digestion was seen with the PH and silage diets.

Table 3. Effect of forage source on nutrient digestibility

Item	Forage Source					
	CSH	PH	AH	SS	GCS	FCS
Digestibility, % organic matter						
Determined	68.0 ^{def}	65.9 ^{de}	61.3 ^d	65.2 ^{de}	76.6 ^f	71.6 ^{ef}
Predicted ^a	57.7	63.1	65.8	64.4	71.9	71.9
Starch	96.3 ^c	78.7 ^b	83.7 ^{bc}	76.7 ^b	90.4 ^{bc}	88.5 ^{bc}
ADF	43.6 ^g	56.3 ^h	40.4 ^g	46.5 ^{gh}	56.0 ^h	46.5 ^{gh}
Nitrogen	54.4	57.0	57.1	60.4	69.7	64.4

^aCalculated from TDN of ingredients listed in NRC for dairy cattle.

^{bc}Means in a row with different superscripts differ statistically ($P < .06$).

^{def}Means in a row with different superscripts differ statistically ($P < .10$).

^{gh}Means in a row with different superscripts differ statistically ($P < .15$).

Effects of forage source on composition of feces is shown in Table 4. Fecal pH increased as fecal ash content increased ($P < .0005$). Some researchers have suggested that indigestible fiber or minerals bound to the indigestible fiber buffer intestinal and fecal pH. The relationship between fecal starch or fecal fiber with pH was poor in this study. Fecal starch content was lowest for the CSH-supplemented ration. Ruminal pH and ammonia levels were not significantly different for diets containing the six roughage sources (Table 5). Results conflict with the suggestion that certain forages produce higher ruminal pH than other forages. Volatile fatty acid concentrations were similar except for isobutyrate and valerate. These are branch chain fatty acids derived primarily from protein degradation. With lower protein forages, one might expect lower levels of these acids.

When selecting a roughage to supplement whole corn diets used for growing cattle, feeders need to consider not only digestibility of the forage has but also the influence forage has on grain digestibility. Based on expected digestibilities, the cottonseed hull diet was 18 percent more digestible than expected while the

Table 4. Effect of forage source on fecal parameters

Item	Forage source					
	CSH	PH	AH	SS	GCS	FCS
Fecal						
pH	6.04 ⁱ	6.11 ^{ij}	6.32 ^{jk}	6.41 ^k	6.36 ^k	6.27 ^{ijk}
Dry matter, %	25.5 ^h	23.9 ^{gh}	20.8 ^{fg}	22.7 ^{fgh}	24.1 ^h	20.5 ^f
Starch ^a	3.8 ^f	19.5 ^{gh}	13.0 ^{fg}	25.1 ^h	14.7 ^{fgh}	14.5 ^{fgh}
ADF ^a	57.7 ^d	30.0 ^c	33.8 ^c	30.0 ^c	27.9 ^c	28.6 ^c
Nitrogen ^a	2.61 ^k	2.03	2.49 ^{jk}	2.04 ⁱ	2.14 ^{ij}	2.19 ^{ijk}
Ash ^a	6.9 ^e	10.5 ^{de}	10.9 ^{de}	16.4 ^{bc}	21.7 ^b	14.8 ^{cd}

^aPercentage of dry matter.

^{bcd}Means in a row with different superscripts differ statistically ($P < .01$).

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

^{ijk}Means in a row with different superscripts differ statistically ($P < .10$).

Table 5. Effect of forage source on rumen pH, ammonia and volatile fatty acid concentration

Item	Forage source					
	CSH	PH	AH	SS	GCS	FCS
Ruminal						
pH	6.12	6.79	6.34	6.38	6.32	6.33
Ammonia, mg/dl	9.53	5.58	15.22	13.74	15.22	6.25
Volatile fatty acid, moles/100 moles						
Acetate	68.56	66.66	63.44	64.70	63.77	9.63
Propionate	13.78	17.93	15.54	18.26	17.56	16.29
Butyrate	13.88	12.06	13.51	12.81	13.85	10.53
Isobutyrate	.48 ^{cd}	.76 ^{cde}	1.35 ^e	.19 ^c	1.03 ^{de}	.21 ^c
Valerate	1.14 ^a	.85 ^a	2.64 ^b	1.53 ^a	1.49 ^a	.81 ^a
Isovalerate	1.51	1.50	2.78	1.85	1.89	1.10
Caproate	.65	.25	.76	.66	.40	1.43
Total	90.47	95.73	81.78	81.28	72.29	105.57

^{ab}Means in a row with different superscripts differ statistically ($P < .10$).

^{cd}Means in a row with different superscripts differ statistically ($P < .15$).

alfalfa diet was 7 percent less digestible than expected. Prairie hay, sorghum and corn silages were near expected values (+1 to +5 percent). Forage quality and type is more critical in diets containing high levels of roughage than feedlot finishing type diets. Positive and negative effects may be less when the grain in the ration has been more extensively processed. With steam-rolled barley, associative effects of alfalfa were not detected in a California study, but in Colorado, corn silage has consistently reduced digestibility of cracked corn diets. Selection of a forage should be based on the influence that forage has on digestion of the entire diet as well as forage digestibility, palatability, availability, protein content, physical characteristics and cost.

Literature Cited

Teeter, R. G. and F. N. Owens. 1981. Okla. Agr. Exp. Sta. Res. Rep. MP-107:156.
Rust, S. R. and F. N. Owens. 1982. Okla. Agr. Exp. Sta. Res. Rep. MP-112.

Influence of Infrequent Feeding on Ruminal Digestion

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Story in Brief

Four ruminally cannulated Hereford heifers were fed once daily either a high concentrate or high roughage diet. Dacron polyester bags containing either soybean meal (SBM) or cottonseed meal (CSM) were placed in the rumen of these animals for six consecutive four-hour exposure periods to study the influence of time after feeding on ruminal digestion. Disappearance of dry matter (DM) from CSM and SBM was greatest in those animals fed the high concentrate diet. Furthermore, disappearance of these materials from bags was not constant over the entire 24-hr period after feeding. Disappearance tended to be highest immediately after and before feeding. This demonstrates that rumen fermentation is not constant. Feeding protein 4 to 12 hr after feeding energy may increase protein bypass.

Introduction

Studies of rumen fermentation usually assume a steady rate of digestion. Constant conditions may not exist when animals are fed only once or twice daily. Infrequent feeding practices are often utilized in laboratory studies and in dairy parlors.