THE EFFECT OF ADVANCING SEASON ON FORAGE DIGESTION AND RUMINAL FERMENTATION IN CATTLE GRAZING ON TALLGRASS PRAIRIE

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Story in Brief

Fistulated beef steers grazing native tallgrass prairie were used to monitor diet quality and ruminal digestion during four trials in the 1986 grazing season (May-September). Diet crude protein decreased from 12.23% in mid-May to 7.53% in late September. Acid detergent fiber and neutral detergent fiber ranged from 42.92 to 47.6% and from 74.48 to 81.22%, respectively. Potential dry matter disappearance and nitrogen disappearance decreased from 74.5 and 57.6% in mid-May to 72.6 and 39.1% in late September. The combined effects of reduced dietary protein and reduced nitrogen disappearance lowered ruminally digestible protein from 8.10% in mid-May to 2.74% in September. Ruminal ammonia concentration (mg/100ml) ranged from 7.09 in mid May to 2.18 in late September. However, cotton string digestibility did not vary significantly among trials suggesting that the decline in ruminal digestibility of grazed forage associated with advancing season is due to indigestible forage constituents rather than ammonia deficiencies in the rumen.
(Keywords: forage quality, digestion, fermentation, rangeland)

Introduction

The influence of advancing season on growth and nutritive value of range plants in relation to daily requirements of grazing animals is well noted. However, information concerning the relationship between diet quality, ruminal environment and nutrient utilization in grazing cattle is limited. A more complete understanding of these relationships will aid the development of nutrition and grazing management programs that will improve the efficiency of livestock production from these areas.

In 1986, a two year study was initiated to investigate the seasonal changes in diet quality, forage intake and nutrient utilization that occur on tallgrass prairie in central Oklahoma. A portion of this study is discussed in this report.

Methods and Procedures

Cattle were grazed on moderately-stocked native range located 12 miles WSW of Stillwater. Range condition on the area was high fair-low excellent and the vegetation was dominated by big bluestem, little bluestem and switchgrass.

Four 7-day trials were conducted: mid-May(May), late June(LJune), mid-August (MAug) and late September (LSept) of 1986. Diet samples were obtained from esophageally fistulated steers the first two days of each trial and during two interim periods: early June (EJune) and early September (ESept). Masticate samples were dried in a forced air oven at 50C, ground through a 2mm screen and stored for analysis of crude

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protein (CP), neutral detergent fiber (NDF) and acid detergent fiber (ADF).

Six ruminally cannulated beef steers composed of Angus X Hereford and Limousin X Hereford breeding were used to monitor ruminal fermentation. Ruminal fluid was collected at 0800, 1400 and 2000 hours on day 6, and 0200 hours on day 7 of each trial. Fluid was strained through cheesecloth, acidified and immediately frozen in plastic whirlpaks.

Ruminal dry matter (DMD) and nitrogen disappearance was estimated by suspending duplicate dacron bags containing 2g (as-is) esophageal masticate in the rumen for intervals of 72, 48, 36, 24 and 12 hours. Duplicate bags containing .5g of cotton string were also incubated for 72, 48, 36 and 24 hour to monitor ruminal cellulose disappearance. All bags were removed from the rumen simultaneously, washed with water until effluent ran clear and were dried at 55C for 48 hours. Residual forage was removed from the bags and analyzed for dry matter and kjeldahl nitrogen (N). Strings were removed from bags, washed clean, placed in foil pans, dried at 105C and weighed to determine disappearance.

Results and Discussion

Diet protein declined from 12.24% in MMay to 8.47% in LJune and stabilized around 7.6% throughout the remainder of the grazing season (Table 1). Cell wall constituents in the diets increased from MMay to EJune and again from LJune to MAug.

In situ dry matter disappearance reflected changes in the less digestible fiber fraction, acid detergent fiber, that occurred during the summer (Tables 1 and 2). The primary differences occurred at incubation times greater than 36 hours. May and June diets were more digestible at 48 and 72 hours than either August or September diets. Assuming that digestibility approximates TDN content, energy availability in diets dropped approximately 20% from MMay to LSept.

TABLE 1. Diet components.

	TRIAL					
Component	Mid May*	Early June**	Late June*	Mid Aug*	Early Sept**	Late Sept*
Crude Protein	12.24[a]	9.86[b]	8.47[c]	7.63[c]	7.79[c]	7.53[c]
Acid Detergent	42.92	45.81	43.81	44.91	47.01	47.60
Neutral Detergent	76.23[a]	78.34[b]	78.59[b]	81.21[c]	81.22[c]	74.48[a]

[a,b,c]Means within row with different subscripts differ significantly ($P<.05$).

* Diets samples taken during ruminal digestion trials.

**Diet samples taken during interim periods do not correspond with ruminal digestion trials.

TABLE 2. In situ dry matter disappearance, %.

Hours of Incubation	TRIAL			
	Mid May	Late June	Mid Aug	Late Sept
12	30.22	29.35	33.60	30.66
24	47.97[a]	48.28[a]	44.14[ab]	38.09[b]
36	53.69	59.23	55.27	48.88
48	67.56[a]	66.39[a]	61.93[a]	54.92[b]
72	74.50[a]	75.09[a]	69.37[b]	57.61[c]

[a,b,c]Means within row with different subscripts differ significantly (P<.05).

Nitrogen disappearance followed a trend similar to forage DMD (Table 3). Potentially digestible nitrogen ranged from 72.6% in MMay to 39.1% in LSept. Combining values for diet protein with values for 48 hour nitrogen disappearance (Tables 1 and 3), estimated levels of digestible protein were 8.10% in MMay, 5.11% in LJune, 4.62% in MAug and 2.74% in LSept.

Ruminal ammonia concentrations, when averaged over time of day, were significantly lower in LSept than in earlier periods (Figure 1). Previous research has suggested that ruminal microbes require between 2 and 5 mg NH_3-N/100 ml rumen fluid. Levels in the current study varied across this range but there were no differences in ruminal cotton string disappearance (Table 4). This suggests that ruminal fiber digestion was limited by structural changes in the dietary fiber rather than an ammonia deficiency in the rumen.

Table 3. In situ nitrogen disappearance, %.

Hours of Incubation	TRIAL			
	Mid May	Late June	Mid Aug	Late Sept
12	18.65[a]	24.21[b]	35.11[c]	21.13[ab]
24	42.28[a]	38.79[a]	40.84[a]	17.08[b]
36	48.85[a]	52.71[a]	53.07[a]	31.82[b]
48	66.18[a]	60.29[a]	60.57[a]	36.42[b]
72	72.59[a]	72.12[a]	64.98[b]	39.10[c]

[a,b,c]Means within row with different subscripts differ significantly (P<.05).

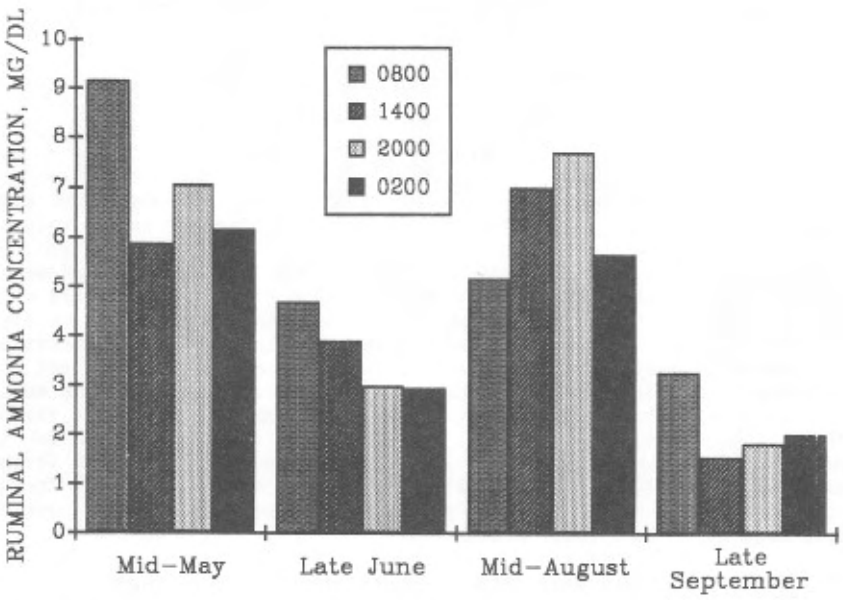

Figure 1. Ruminal ammonia concentration, mm/100 ml.

TABLE 4. In situ cellulose disappearance, %.

Hours of Incubation	TRIAL			
	Mid May	Late June	Mid Aug	Late Sept
24	17.70	20.19	18.71	19.34
36	32.14	37.27	39.73	38.67
48	52.05	53.14	49.43	62.49
72	84.27	81.84	76.13	85.28

In previous OSU studies, feeding high protein supplement in July, August and September improved weight gain .3-.4 lb/day. Our preliminary results suggest that improved gains result from correcting a protein deficiency for the steers rather than correcting a ruminal ammonia deficiency. Further analysis will evaluate a second year of data including the relationship between nitrogen intake and protein available in the small intestine.