CHEMICAL COMPOSITION OF THE DIET, INTAKE AND GAIN OF YEARLING CATTLE ON DIFFERENT GRAZING INTENSITIES [1]

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Summary

ESOPHAGEAL fistulated yearling cattle were used to collect diet samples and to measure intake during the summers of 1969 and 1970. Samples were taken from 128 hectare pastures grazed at heavy and light intensities.

No great differences were observed between pastures for crude protein, gross energy, acid detergent fiber, lignin and cellulose levels in the diets. Heavy grazing resulted in somewhat lower values for dry matter digestibility and intake. The differences in intake were greater later in the season when total forage available may have become limited on the heavy grazed pasture.

Individual livestock gains reflected the greater digestibility and intake observed on the light use pasture. Gain per animal was greatest on the light use pasture. However, more gain per hectare was produced on the heavy use pasture.

Introduction

Grazing intensity has been reported to affect animal responses. As grazing intensity increases, livestock have less chance to graze selectively due to an increased removal of preferred species of plants and plant parts.

Bement (1969) reported daily gains of cattle on blue grama (*Bouteloua gracilis* (HBK) *Lag. ex. steud.*). As grazing intensity increased, total kilograms of beef produced per hectare increased, but individual animal gains decreased.

Bryant *et al.* (1970) summarized the results of increased grazing pressure on animal and plant responses. The yield of herbage and weight gain per animal and per hectare were affected by grazing pressure. When grazing pressure was intense enough so that a low availability of herbage resulted, the quality of grazed diets decreased. This was attributed to a reduction in oppportunity for selective grazing. The coarser, more mature portions of plants were eaten resulting in lower digestibility and nutrient content of the diet.

This study was undertaken to determine the effects of long term heavy and light grazing intensities on dietary quality and animal performance. Changes that occur in these parameters through the summer grazing season were also studied.

Materials and Methods

The study area was located on the Pawnee Intensive Site of the International Biological Programs Study for Analysis of Structure and Function of Grassland Ecosystems. The Pawnee Site is part of the Central Plains Experimental Range operated by the Agricultural Research Service of the U.S.D.A. The site is located 34 miles north of Greeley, Colorado near the town of Nunn. The area is shortgrass prairie dominated by blue grama.

Two pastures of 128 ha each that had been grazed at heavy and light intensities from May through September for the past 32 years comprised the study area. In 1969, 38 and 15 head of yearling heifers grazed the heavy and light use pastures, respectively. The numbers were reduced to 35 and 12 head on the pastures in 1970 because of low precipitation.

Diet samples were collected with esophageal fistulated yearling steers in 1969. In 1970 fistulated heifers were utilized as sampling agents because of animal management problems resulting from mixing steers and heifers.

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Four fistulated animals were allocated per pasture during June, July and August of 1969 and 1970. This number of sampling agents was considered adequate for sampling for chemical composition of the diet with 95% confidence (Van Dyne, 1968). Fistula samples were collected during the first week of June, July and August in 1969. A more intensive sampling program was initiated during the summer of 1970. Samples were collected twice weekly during June, July and August.

Total fecal collections were made using fecal collection bags and harnesses similar to those described by Lesperance and Bohman (1961). Feces were collected at 12-hr. intervals for a 5-day period during June, July and August of 1969. Morning and evening samples were then pooled to obtain a 24-hr. sample. During the summer of 1970, one 24-hr. sample was taken each week of the summer. Because heifers were used in 1970, urine deflectors (VanEs and Vogt, 1959) were used to deflect urine from the fecal bags. Four animals per pasture were used as fecal collectors.

The animals were weighed every 28 days following a 24-hr. stand without feed or water. Weight changes of fistulated cattle were not included in the pasture gains.

Esophageal samples were dried in a forced-air oven at 60 C for 48 hr. and then ground through a 40-mesh screen. Nitrogen and gross energy were determined by the procedures set forth by the A.O.A.C. (1960). Acid detergent fiber (ADF), lignin and cellulose were determined by the permanganate lignin technique of Van Soest and Wine (1968). Dry matter digestibility was determined by a modification of the *in vitro* digestion technique of Tilly and Terry (1963). Instead of centrifuging the samples at the termination of pepsin digestion as the original technique directs, the samples were filtered through tared, fritted glass crucibles and the final weight determined. Intake was calculated as:

$$\text{Intake} = \frac{100 \times \text{feces weight}}{100 - \%\ \text{digestibility}}$$

The least squares analysis of variance was used for data analysis (Steel and Torrie, 1960).

TABLE 1. PERCENT CRUDE PROTEIN IN IN DIET SAMPLES [a]

Sampling period	Grazing intensity		
	Heavy	Light	F value
1969 June	12.7 (1.6)	13.6 (2.2)	0.86
July	11.8 (0.3)	11.5 (2.3)	3.16
August	11.4 (1.7)	10.1 (1.4)	0.69
1970 June	12.3 (3.5)	13.1 (3.0)	0.01
July	10.1 (3.3)	10.7 (3.2)	0.67
August	9.6 (1.7)	8.7 (3.6)	0.01

[a] Numbers within parentheses are standard errors.

TABLE 2. GROSS ENERGY OF DIET SAMPLES (kcal/g) [a]

Sampling period	Grazing intensity		
	Heavy	Light	F value
1969 June	4.2 (0.1)	4.1 (0.1)	3.21
July	4.2 (0.5)	3.9 (0.5)	0.36
August	3.6 (0.0) [b]	4.0 (0.1)	....
1970 June	3.9 (0.3)	3.8 (0.3)	0.34
July	3.8 (0.5)	4.1 (0.3)	4.34
August	3.9 (0.3)	4.0 (0.2)	1.62

[a] Numbers within parentheses are standard errors.
[b] Only one sample analyzed so no statistical analysis was run.

Results and Discussion

Percent crude protein of dietary samples was not different due to grazing intensity for any sampling period (table 1). During both summers, percent dietary protein was slightly higher in June, 13.6% and 13.1% in 1969 and 1970, respectively, but the differences were not significant.

Dietary gross energy values (table 2) were not different due to grazing intensity. Percent ADF (table 3) was significantly lower in diets ($P<.01$) from the light grazing treatment in July of 1970. A similar trend was observed in 1969 but the differences were nonsignificant due to the large variation among samples. A similar trend was noted in August of 1969. Grazing intensity did not affect dietary ADF in August of 1970. There was an increase in ADF as the season advanced in both years.

TABLE 3. PERCENT ACID DETERGENT FIBER IN DIET SAMPLES [a]

Sampling period	Grazing intensity		
	Heavy	Light	F value
1969 June	40.3 (2.9)	40.3 (3.3)	0.01
July	42.7 (6.2)	36.1 (6.3)	2.75
August	51.3 (4.1)	42.6 (7.3)	2.11
1970 June	38.2 (4.4)	39.1 (2.3)	0.17
July	43.4 (5.1)	34.2 (2.4)	8.52 ($P<.01$)
August	41.3 (3.5)	40.3 (2.8)	0.59

[a] Numbers within parentheses are standard errors.

TABLE 4. PERCENT LIGNIN IN DIET SAMPLES [a]

Sampling period	Grazing intensity		
	Heavy	Light	F value
1969 June	8.6 (1.1)	9.2 (1.1)	0.27
July	9.4 (1.2)	8.9 (1.9)	0.75
August	9.8 (2.3)	11.5 (4.2)	0.27
1970 June	7.8 (1.5)	7.5 (1.7)	0.15
July	9.1 (2.1)	8.0 (1.9)	2.53
August	10.6 (3.1)	9.2 (2.0)	1.41

[a] Numbers within parentheses are standard errors.

Generally, dietary lignin (table 4) increased in both pastures as the summer progressed. A A slight decrease in lignin content was observed from June through July on the light use pasture in 1969. The increase was probably related to forage maturation. Grazing intensity did not affect dietary lignin in any sampling period. Dietary cellculose (table 5) was slightly lower for samples from the heavily grazed pasture than from the lightly grazed pasture in June and August of both years. Diet samples from the light use pasture in July of 1969 contained less cellulose than those from the heavy grazed pasture. However, this was not observed in 1970. None of these differences in dietary cellulose levels were significant.

Differences between pastures were not great during either year for the chemical constituents measured. Other workers have reported results to the contrary. Cook, Stoddart and Harris (1951); Pieper, Cook and Harris (1959); and Bryant *et al.* (1970) have reported that higher grazing intensities resulted in a lower quality diet in terms of nutrient content. The deviation from other findings may be explained in part by the type of vegetation being grazed. Bement (1969) has reported that blue grama does not have a smooth growth pattern and reacts to precipitation with spurts of growth. Blue grama was the principal species found in cattle diets from both pastures. Regrowth in the heavy use pasture may have been sufficient to keep forage quality at similar levels as those in the light use pasture.

TABLE 5. PERCENT CELLULOSE IN DIET SAMPLES [a]

Sampling period	Grazing intensity		
	Heavy	Light	F value
1969 June	24.4 (1.1)	26.0 (1.1)	1.76
July	27.9 (5.0)	22.2 (3.3)	2.71
August	24.6 (2.5)	26.0 (1.4)	0.67
1970 June	24.4 (3.5)	26.0 (2.2)	0.71
July	26.8 (2.1)	26.6 (2.2)	0.06
August	24.5 (3.7)	26.8 (2.1)	2.89

[a] Numbers within parentheses are standard errors.

TABLE 6. PERCENT *IN VITRO* DRY MATTER DIGESTIBILITY OF DIET SAMPLES [a]

Sampling period	Grazing intensity		
	Heavy	Light	F value
1969 June	41.4 (10.3)	50.5 (10.9)	1.97
July	48.4 (6.7)	50.6 (17.0)	0.04
August	50.4 (2.8)	57.3 (5.5)	4.63
1970 June	62.1 (7.4)	58.8 (10.7)	0.54
July	55.5 (10.7)	61.9 (6.8)	4.07
August	53.8 (6.4)	60.0 (5.3)	4.99 ($P<.05$)

[a] Numbers within parentheses are standard errors.

Percent dry matter digestibilities (DMD) of diet samples are listed in table 6. Higher DMD was observed on the light use pasture during the summer of 1969. However, a limited number of samples were analyzed and differences were not significant. The same trend was evident in 1970 except for June. Apparently cattle in the light use pasture were able to select a more digestible diet. Differences in digestibility should be reflected in the chemical constituents measured (tables 1 to 5). Why this did not occur is not readily explainable. Cattle diets from the light use pasture were significantly ($P<.05$) more digestible than those from the heavy use pasture during August in 1970.

Daily intake was nonsignificantly higher on the light use pasture during the summer of 1969 (table 7). In 1970, cattle in the heavy use pasture consumed slightly more during June. However, during July and August cattle on the light use pasture consumed significantly more ($P<.01$ and $P<.05$, respectively) forage. Due to the heavy stocking rate, less forage may have been available for consumption on the heavy use pasture later in the season. Forage in the light use pasture was more di-

TABLE 7. DRY MATTER INTAKE OF FISTULATED CATTLE [a] (kg/day)

Sampling period	Grazing intensity		
	Heavy	Light	F value
1969 June	3.1 (0.7)	4.2 (0.8)	2.04
July	4.2 (0.6)	4.9 (2.5)	0.22
August	5.7 (0.5)	6.4 (0.9)	1.27
1970 June	2.7 (1.1)	2.4 (0.4)	0.53
July	2.7 (0.9)	3.9 (0.6)	19.30 ($P<.01$)
August	3.6 (0.7)	4.5 (0.9)	5.46 ($P<.05$)

[a] Numbers within parentheses are standard errors.

TABLE 8. AVERAGE MONTHLY GAIN PER HEAD AND PER PASTURE AND TOTAL GAIN (KG) FOR CATTLE ON THE HEAVY AND LIGHT GRAZED PASTURES

Grazing intensity	Month			
	June	July	August	Total
1969 Heavy				
Per head	14	8	16	38[a]
Per pasture	540	322	608	1470[b]
Light				
Per head	20	11	24	55[a]
Per pasture	300	169	355	824[b]
1970 Heavy				
Per head	21	11	20	52[a]
Per pasture	737	395	698	1830[b]
Light				
Per head	19	14	26	59[a]
Per pasture	224	167	317	708[b]

[a] Cattle on heavy use pasture gained significantly less ($P<.05$) per head than those on light use pasture.
[b] Cattle on heavy use pasture gained significantly more ($P<.05$) total weight per pasture than those on light use pasture.

gestible which might also contribute to increased intake.

Individual livestock gains were greater on the light use pasture while total gain per pasture was higher on the heavy use pasture (table 8). Bement (1969) has reported similar effects of grazing intensity with cattle on blue grama range. The response in animal performance to intensity of grazing was largely through differences in intake and digestibility of the forage. Higher individual gains ($P<.05$) on the light use pasture were probably due to a greater intake of a more digestible forage. On the heavy use pasture individual gains were greater in 1970 even though intake was less than in 1969. However, when the differences in gain were greatest, the differences in digestibility were also greatest. During June and July of 1970 forage digestibility was much greater than in 1969.

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