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DIETS OBTAINED FROM ESOPHAGEALLY FISTULATED HEIFERS AND STEERS SIMULTANEOUSLY GRAZING SEMIDESERT TOBOSA RANGELAND[1]

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INTRODUCTION

In the past the most popular technique employed to quantify botanical and chemical composition of the grazing animal's diet has been esophageally fistulated animals (Theurer et al. 1976). Studies involving both wildlife (Skjenneberg et al. 1975) and domestic livestock (Theurer et al. 1976) have used esophageally fistulated animals. Animal diets have been studied to determine plant species preference, seasonal influences and topography influences on the grazing animal's diet (Van Dyne et al. 1980). Specific studies to evaluate grazing strategies (Taylor et al. 1980), diurnal selectivity patterns (Kirby and Stuth 1982) and the influence of herbage mass on diets (Hodgson and Jamieson 1981) have also employed esophageally fistulated animals.

Often one class of animal is used to obtain diet information, while the results are extrapolated to another class of animal within the same species (Anderson 1977). Langlands (1969) indicated that age, breed and sex differences of sheep do not appear to be important sources of variation in extrusa composition; however, similar information for cattle appears to be unavailable. In a study to compare the in vitro organic matter digestibility of ingesta from esophageally fistulated 7-month-old calves, 10-month-old steers and mature lactating dairy cows, Le Du and Baker (1981) found the average quality of the forage selected to be similar. Walker et al. (1981) using microhistological analysis of fecal material showed small but significant differences between cow and calf diets.

The purpose of this study was to compare and contrast diets obtained from esophageally fistulated growing heifers and mature steers grazing simultaneously on a semidesert tobosa (Hilaria mutica) range during active growth. Botanical and chemical composition of the diets were evaluated.

MATERIALS AND METHODS

The study was conducted on a semidesert tobosa grassland located on the Jornada Experimental Range (106°45'W, 32°29'N) in Dona Ana County, New Mexico at an elevation of 1,309 m above sea level. The vegetation on this relatively level clayey bottomland site is essentially a pure stand of tobosa, interspersed with patches of burrograss (Scleropogon brevifolius) with a scattered overstory of soaptree yucca (Yucca elata) and tarbush (Flourensia cernua), considered a woody invader. A total of 75 mm of precipitation was received before July 1, 1979, which represented 29% of the 261 mm of precipitation received in 1979. Total precipitation in 1979 was 31 mm more than the long-term average of 230 mm recorded at ranch headquarters (Paulsen and Ares 1969). Mean maximum and minimum ambient air temperatures during the 11-day study in June were 36 and 11°C, respectively. Mean wind speed during this time averaged 2 kmph while a mean evaporation of 11 mmpd was recorded.

Between June 19 to 29, a total of 117 diet collections were scheduled between 0700 and 1135 hours (Mountain Daylight Time) using four mature steers and five growing heifers, all esophageally fistulated. During 4 of the 11 days, diets were sampled on two similar areas. Diets collected on all days except June 27 formed the data base. The cattle were of mixed Hereford and Angus breeding. Only 67% of the diet collections resulted in analyzable data. Rumen contamination, animals that would not graze and lost samples were responsible for the 33% reduction from the proposed number.

Animals were not fasted overnight, but were gathered from a mesa dropseed (Sporobolus flexuosus) range each morning before active grazing began, except for the day and night of June 19 when the animals were kept in a corral and fed alfalfa (Medicago sativa) hay. After the animals were gathered from the pasture, they were loaded into a stock trailer and moved to the collection site where esophageal fistula plugs or cannulae were removed, leaving an unobstructed esophagus. Screen-bottom diet collection bags were put in place and animals representing both sexes were released to freely graze the tobosa range for about 30 minutes. No apparent differences in grazing behavior were noted between sexes. Observers on horseback recorded the plant species grazed and representative plants of the same species were clipped and taken to the laboratory and pressed. These pressed specimens were used during botanical analysis of the diets. Once the diets were collected, the plugs or cannulae were replaced and the animals were trailered back to the holding pasture and released. The same areas were grazed again the following day. The diet collections were thoroughly mixed and samples $\leq$ 1,200 ml in volume were placed in plastic bags. The plastic bags were identified by date, animal and location before being placed in a deep freeze and frozen to a temperature of -20°C until they were lyophilized. The dried diet samples were then ground through a Wiley mill to pass a 40-mesh (0.5 mm) screen. The ground material was stored in plastic bottles before botanical and chemical analyses.

Nitrogen was calculated on an oven-dry (105°C) organic matter basis and expressed as crude protein according to the Kjeldahl procedure outlined by the AOAC (1970). In vitro organic matter digestibility was estimated using the Tilley and Terry (1963) technique. Rumen fluid was obtained from cattle maintained on alfalfa hay. Botanical analysis followed the Sparks and Malechek (1968) microhistological technique as modified by Holechek and Gross

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(1982). Analysis of the data, expressed as a decimal percent, was carried out in a completely random design. The Statistical Analysis System (SAS) General Linear Models (GLM) procedure was used to generate the least square means (SAS 1979). If F values were significant ($P < 0.05$), least square means were separated according to the Proc GLM and SAS procedures at $P < 0.05$. If F values were not significant ($P > 0.05$), raw means plus and minus standard deviations were reported.

RESULTS

Botanical analysis indicated the diets were composed of 19 different plant genera represented by 5 grasses, 11 forbs and 3 shrubs (Table 1). Heifer and steer diets did not differ ($P > 0.05$) in grass, forb and shrub components, but averaged 35 ± 10, 51 ± 9 and 14 ± 7%, respectively. The predominant grass, forb and shrub found in the diet was Hilaria mutica, Sphaeralcea subhastata and Flourensia cernua. Each contributed 14 ± 7, 16 ± 8 and 12 ± 7%, respectively. If Stephanomeria pauciflora, which contributed 15 ± 6% to the diet, is included, these four plants contributed 57% to the botanical composition of the diets. The remaining 15 plants each contributed < 8% to the diets. Unidentifiable fragments, assumed to be of forb origin, composed 1 ± 2% of the material to be identified in the diets. However, steer diets had a slightly (0.5%) larger unidentifiable fragment category compared to the heifer diets ($P < 0.10$).

Heifer and steer diets were not similar ($P < 0.05$) in all 19 plant genera. Heifer diets contained 2% more ($P < 0.05$) Chenopodium sp. and 5% more ($P < 0.05$) Sphaeralcea subhastata when compared to steer diets. Steer diets, on the other hand, contained 3% more ($P < 0.05$) Mentzelia multiflora compared to heifer diets. Table 2 gives the exact contribution of these three genera to the diets. Even though Verbena sp. contributed < 1% to the diets, it was only found in heifer diets ($P < 0.10$). The remaining 15 plant genera were similar ($P > 0.05$) in the diets between sexes.

Plant preference among animals varied and approached significance ($P < 0.10$) for the grass and forb diet components, while variability among animals in preference for the two grass genera, Hilaria and Scleropogon, were significant ($P < 0.05$) (Table 3). Only one heifer selected a higher percentage of forbs when compared to the remaining four heifers and four steers.

Chemical analysis of diet samples indicated crude protein content of heifer diets averaged 17%, 3% higher ($P < 0.05$) than the mean diet selected by the steers, although standard errors were 0.3% for both sexes. In vitro organic matter digestibility (IVOMD) did not differ ($P > 0.05$) between the sexes and averaged 62 ± 6%. Among animal variability was apparent ($P < 0.05$) for crude protein, but not for IVOMD (Table 3).

CONCLUSIONS

Animal diets obtained in this study reveal a high degree of selectivity among plant species. In addition, not all animals select a particular plant species to the same extent; this appeared to be true of the predominant grass Hilaria. Although perennial forbs contributed a higher percentage to the diet than did annual forbs, both growth forms are important. The 4% higher forb content in the heifer diets compared to the steer diets resulted from the perennial forb Sphaeralcea subhastata. It appears the presence of this forb is responsible for higher ($P < 0.05$) crude protein content (17%) of heifer diets compared to steer diets (14%). Nelson et al. (1970) have shown Sphaeralcea subhastata, even in late bloom, has a crude protein content of 18.9%. Our data agrees with Le Du and Baker (1981) who found that IVOMD was not influenced by age or sex of animal. Age and sex were confounded in our experiment as in their study; therefore, these results must be considered as only tentative until further research is conducted to determine the influence of age and sex on the botanical and chemical composition of cattle diets. Heifers selected diets higher in Chenopodium and Sphaeralcea compared to diets selected by steers. This may help explain the higher crude protein in diets collected from the grazing heifers compared to diets collected from the grazing steers. These data support the supposition that forbs contribute to diet quality (Theurer et al. 1976) and that growing animals require diets of higher quality than do mature animals (National Research Council 1976). If this is unconditionally true, care should be used when extrapolating diet data collected from one class of animals to animals of different classes within the same animal species.

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Table 1. Grasses, forbs and shrubs identified in esophageal diets collected from heifers and steers grazing tobosa rangeland during June 1979.

Plant category	Scientific name	Comon name	Life form[1]
Grass	*Aristida* sp.	Threeawn	P
	Bouteloua curtipendula	Sideoats grama	P
	Hilaria mutica	Tobosa	P
	Muhlenbergia porteri	Bush muhly	P
	Scleropogon brevifolius	Burrograss	P
Forbs	*Chenopodium* sp.	Pigweed	A
	Erigeron sp.	Fleabane	A
	Eriogonum abertianum	Orange wildbuckwheat	A
	Eriogonum trichopes	Fineleaved wildbuckwheat	A
	Hymenoxys odorata	Western bitterweed	A
	Lepidium sp.	Pepperweed	P
	Mentzelia multiflora	Desert mentzelia	P
	Perezia nana	Desertholly perezia	P
	Salsola iberica	Russianthistle	A
	Sphaeralcea subhastata	Globemallow	P
	Stephanomeria pauciflora	Wirelettuce	P
	Verbena sp.	Verbena	P
	Verbena wrightii	Wrights verbena	P
Shrubs	*Atripiex canescens*	Fourwing saltbush	P
	Flourensia cernua	Tarbush	P
	Rhus microphylla	Littleleaf sumac	P

[1]A = annual; P = perennial.

Table 2. Percent of major botanical components, three forb genera and their life form in esophageally collected heifer and steer diets expressed as least square means.

Botanical components	Life form[1]	Heifers	Steers
Grass		35[a]	38[a]
Forb		51[a]	47[a]
Chenopodium sp.	A	4[a]	2[b]
Mentzelia multiflora	P	3[a]	6[b]
Sphaeralcea subhastata	P	17[a]	12[b]
Shrub		14[a]	14[a]

[1]A = annual; P = perennial.

[ab]Means in the same row with the same superscript are not different (P>0.05) according to the Proc GLM and SAS procedure.

Table 3. Variability between esophageally fistulated heifers (H) and steers (S) grazing tobosa rangeland expressed as percent composition of least square means, for botanical and chemical components.

Animal Code	Botanical				Chemical[1]	
	Hilaria mutica	*Scleropogon brevifolius*	Total Grasses	Total Forbes	CP	IVOMD
H1	8[a]	10[ab]	29[a]	60[a]	18[a]	61[a]
H2	17[b]	8[bc]	41[cd]	47[b]	15[bc]	61[a]
H3	18[b]	8[bc]	39[bcd]	47[b]	16[b]	62[a]
H4	16[b]	5[c]	34[abc]	50[b]	16[b]	63[a]
H5	9[a]	10[ab]	30[ab]	50[b]	19[a]	58[a]
S6	15[ab]	4[c]	35[abcd]	48[b]	15[bc]	62[a]
S7	17[b]	12[a]	45[d]	43[b]	13[c]	60[a]
S8	18[b]	8[b]	38[abcd]	47[b]	14[c]	63[a]
S9	13[ab]	6[c]	32[abc]	51[b]	16[b]	61[a]

[1]CP = crude protein; IVOMD = *in vitro* organic matter digestibility.

[abcd]Means in the same column with the same superscript are not different (P>0.05) according to the Proc GLM and SAS procedure.