Summer Diet of Spanish Goats Grazing Chaparral

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Abstract

The browsing preference and feed intake of Spanish goats was studied on a 0.2-ha chaparral field in which a wild fire had occurred 5 years earlier. The dominant shrub speices were chamise *(Adenostoma fasciculatum),* scrub oak *(Quercus dumosa),* eastwood manzanita *(Arctostaphylos glandulosa),* and ceanothus *(Ceanothus greggii).* Four goats with esophageal fistulae were used to sample the forage. The browsing preference of Spanish goats was highly directed (about 80%) towards scrub oak and chamise. The remainder of the diet was mostly grasses and forbs, while eastwood manzanita and cupleaf ceanothus made a negligible contribution. Shrub preference was not related to availability as manzanita and ceanothus had the highest volume and were the most abundant species. Regression models to estimate IVDMD from the diet's chemical and botanical contents were derived. IVDMD of esophageal samples was positively correlated with the content of grass and forbs and negatively correlated with the sum of the percentages of scrub oak and chamise.

Browse intake by grazing ruminants is reported to vary widely with season, alternative vegetation, and type of animal (Wilson 1969). Several studies in the United States (Merrill 1975 and Davis et al. 1974), Australia (Wilson et al. 1975), Africa (Griego and Malechek 1975 and Du Toit 1972), and Malaysia (Davendra 1978) indicate that goats may consume large amounts of browse. Wilson et al. (1975) reported that young feral goats grazing alone had 50% browse in their diets and consumed 70% to 90% browse when they grazed plots following sheep. Malecheck and Leinweber (1972 a,b) reported that goats grazing on ranges in the Edwards Plateau of Texas showed a distinct preference for grass from June to October, while browse was an important food item in winter and early spring. They showed that the botanical and chemical composition of the diet of goats was responsive to range condition and to the stocking rate. Similarly, earlier studies by Fraps and Cory (1940) indicated that goats had a greater tendency than cattle or sheep to vary their diet with changing seasons. The ability of goats to utilize browse is probably an important factor contributing to their survival in marginal areas where the feed quality is poor and does not provide minimal nutrition to support cattle and sheep (Davendra 1978, Huston 1978, and Wilson 1969). Comparative studies between angora and Spanish goats by Merrill (1975) and Davis et al. (1974) indicate that Spanish goats eat less grass and forbs than angora goats. Also, Taylor (1975) and Merrill and Taylor (1976) found that Spanish goats are more effective than angora goats as a brush control agent, particularly under poor range conditions. Under more favorable range conditions, angora goats were more efficient.

The purpose of this study was to assess summer diet selection and feed intake by Spanish goats browsing chaparral. Regression coefficients and other statistical parameters relating the dietary chemical and botanical composition (X's) to the in vitro dry matter digestibility (Y) were also computed.

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Materials and Methods

Field-Procedure—Plants

The study took place during the summer of 1977 on a 0.2-ha chaparral brush field in the Discanso Ranger District, Cleveland National Forest, San Diego County, in which a wild fire had occurred 5 years earlier. The elevation was approximately 1,200 meters, and the dominant shrub species were chamise *(Adenostoma fasciculatum),* scrub oak *(Quercus dumosa),* eastwood manzanita *(Arctostaphylos glandulosa),* and cupleaf ceanothus *(Ceanothus greggii).* Less than 2 weeks before sampling, an unseasonal early and heavy rain contributed to the growth of herbaceous vegetation (grasses and forbs).

Animals

Nine 1- to 2-year-old (24–38 kg body weight) Spanish goat wethers were used. Permanent esophageal fistulae were established and closed with removable plugs in four goats to collect diet samples (VanDyne and Torell 1964). Fresh cuts of the dominant shrub species were pen fed to the goats for four days before sampling. Goats were confined overnight in a coyote-proof pen (supplied with drinking water and salt) to protect them from predator attack. Our previous work (Sidahmed et al. 1977) indicated that moderate fasting (12 to 24 hr.) did not have a pronounced effect on the composition of samples collected by sheep. Diet samples were collected after a 1 to 2 hour period of grazing each morning, and fecal bags were emptied at 0800 hr daily. After both diet and fecal samples were collected, the animals were left to forage freely until sunset. Diet samples were frozen immediately with dry ice and kept frozen until analyzed.

Analytical Procedures

Botanical identification (Harker et al. 1964) was performed on all esophageal samples after freeze drying. The freeze-dried samples were spread on an aluminum tray (24× 15 cm). The fragments occurring under the crosshair of a binocular microscope were identified at 16× magnification where 200 points were selected in an ordered 1-cm^2 grid. The percentage botanical composition of a species was calculated as:

$$\frac{\text{No. of points on a species}}{\text{Total no. of identifiable points}} \times 100$$

Samples were ground in a Wiley Mill (1-mm screen) for proximate analysis and in vitro dry matter digestibility (IVDMD) (Tilley and Terry 1963) using rumen liquor from a goat fed alfalfa hay. The mean daily dry matter intake ($g/W\ kg^{3/4}$) was calculated from the mean daily weight of fecal dry matter output and IVDMD of the esophageal samples.

A general multiple regression analysis (GMRA) computer program was used to develop the regression equations (Huszar 1973),

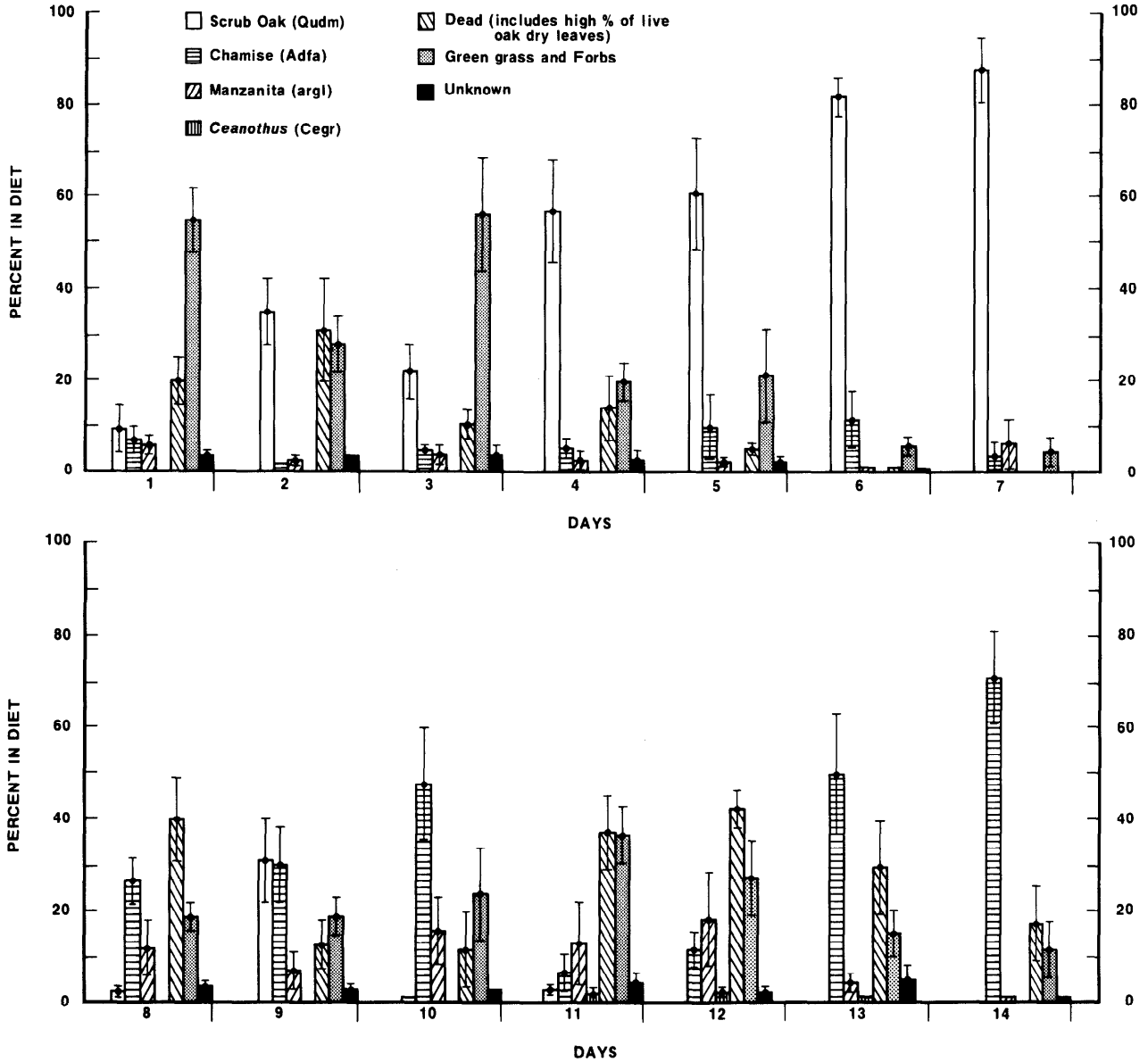

Fig. 1. *Botanical composition of the diet samples in respect to time (means of four goats ± SE).*

which were analyzed according to methods described by Steel and Torrie (1968).

Results and Discussion

The botanical composition of the diet samples is shown in Figure 1. The contribution of grass and forbs to the diet was reasonably constant at about 20% except for higher intakes on the first and the third day of sampling. For days four to seven, the dietary samples were predominantly scrub oak, and at times this was in excess of 80%. Chamise was also a major component of the diet and attained 70% on the last day of the study when the contribution from scrub oak and grass and forbs decreased. These data are in agreement with those reported by Carrera (as quoted by Davendra 1978) on goats in Mexico in which 83% of the bites were on browse and forbs and 17 % were on grass. Similarly, other studies from Mexico by Huss (1972) and Zertuche (as quoted by Davendra 1978) indicated that Spanish goats preferred browse even when there was an abundance of grass.

Dead material from herbaceous plants and leaves from a fallen liveoak tree in the plot contributed a mean of 19% of the total dry matter intake. During the last week of the study, the greater percentage of grass and forbs in the diet possibly resulted from their increased availability due to growth following the rain before the study commenced. The amount of chamise in the diet was low when scrub oak and grass and forbs were major contributors to the diet. However, browsing on chamise increased when the scrub oak was depleted from the area. Chamise made its greatest contribu-

Table 1: Percentage, crude protein, ether extract, ash and in vitro dry matter digestibility (IVDMD) of four clipped shrub species.

	%			
Species	Crude protein	Ether extract	Ash	IVDMD
Adenostoma fasciculatum (chamise)	10.5	5.4	4.2	28.5
Quercus dumosa (scrub oak)	12.7	2.2	4.7	38.6
Arctostaphylos glandulosa (eastwood manzanita)	6.7	7.5	3.9	28.4
Ceanothus greggii (cupleaf ceanothus)	13.5	3.7	6.5	53.9

Table 2: The regression parameters and (*t*) test analysis of the relationship of the IVDMD (%) of goat diets with their botanical constituents.

Coefficient	The botanical components of the diet sample											
	Scrub oak		Chamise		Oak and chamise		Grass and forbs		Manzanita	Ceanothus	Dead	
a	53.07	52.83	53.31	53.08	57.41	57.40	46.06	46.17	49.1	49.42	50.65	49.13
b	-0.05	-0.001	-0.09	-0.002	-0.12	-0.002	+0.23	+0.004	+0.27	+0.006	+4.14	+0.127
r^2	0.117	0.111	0.139	0.135	0.459	0.442	0.511	0.500	0.084	0.105	0.21	0.123
Sy·x	4.96	0.097	4.90	0.096	3.88	0.077	3.69	0.073	5.05	0.097	4.68	4.94
t test	NS	NS	NS	NS	**	**	**	**	NS	NS	NS	NS
Regression form[1]	L	E	L	E	L	E	L	E	L	E	L	L

**Significant ($P<0.01$)
[1]Form of the regression, L = linear, E = exponential.

tion to the diet when the percentage intake of both dead material and grass and forbs declined. Manzanita and ceanothus were minor components of the diet and were eaten only when the scrub oak crowns were depleted of shoots.

A comparison of the IVDMD of clipped samples from the four browse species (Table 1) and the esophageal fistulae samples (mean 51.6%) shows that the goats always selected a diet with an IVDMD greater than that of the most favored shrub species (scrub oak 38.6% and chamise 28.5%). This indicates that either the goats selected more digestible parts of the shrubs than harvested by clipping or that the herbaceous and dead material in the diet caused an enhancement in the overall digestibility. Ceanothus had the highest in vitro digestibility (53.9 %) and the highest crude protein content (13.5%) but was not preferred by the goats. Goats, therefore, did not select on the basis of protein composition alone.

There was a significant positive association ($P<0.01$) between IVDMD and the percentage of grass and forbs in the esophageal samples (Table 2). Grass and forbs as the independent variable accounted for 50% of the total variation in the IVDMD and so contributed significantly to the digestible energy intake of goats. No significant relationships were found between the IVMD and the percentage of the other dietary constituents. The sum of scrub oak and chamise in the esophageal samples was significant ($P<0.01$), and negatively related to IVDMD and accounted for about 45% of the total variation. The regression coefficients of crude protein (CP), ether extract (EE), and ash on IVDMD were not statisticaly significant. In a step-wise regression analysis of variation in IVDMD using ten independent variables (grass and forbs, ceanothus, chamise, scrub oak, manzanita, crude protein, ash, EE, and sampling days), percentage grasses and forbs in the diet had the highest contribution (IVDMD = 46.07 + 0.23 (percent grasses and forbs), $r^2 = 0.51$, SEE 3.69, $P<0.01$). All other variables caused only a minor reduction in the error sum of squares.

The average dry matter intake of our five Spanish goats (30 kg body weight) was 61 g/ W $kg^{3/4}$ which is comparable to the requirements cited by Huston et al. 1971 and Huston 1978.

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