

## Seasonal variation in the selective behaviour of dairy goats on the Sierra area of Spain

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### ABSTRACT

Seasonal variation in the preference of a herd of dairy goats when grazing grass, trees and shrubs or acorns was studied. Grass accounted for 70% (1478 mouthfuls), 76% (4221 mouthfuls) and 65% (2228 mouthfuls) of the selections made in the autumn-winter, spring and summer seasons, respectively, which showed a close relationship between palatability and degree of maturing of available grass. Ligneous species (trees and shrubs) were consumed to variable extents during the year, their consumption gradually increasing between autumn-winter, spring and summer, and accounting for 19% (395 mouthfuls), 24% (1303 mouthfuls) and 35% (1219 mouthfuls) in the three seasons, respectively. This increase was also a result of the decreasing availability of grass in the natural course of the seasons. Despite availability in autumn-winter period, holm and cork oak acorns only accounted for a small percentage in the overall ration (11%, 221 mouthfuls). The results revealed the importance of the herbaceous components within the total goat ration, goats using woody browse only when there was grass shortage.

**KEY WORDS:** palatability, caprine, shrubs, trees, grazing, browsing

### INTRODUCTION

Herbivores, which feed on feedstuffs of widely variable quality, must match their nutritive needs and intake rates to the varying conditions of pasture (Pfister and Malecheck, 1986). The diet they choose is dictated by a number of factors among which those features of plants which determine their palatability, play a major role (Ramírez et al., 1991).

Along with grass in goat diets, brush plants can constitute an important source of feed in semiarid regions (Wilson, 1977; Morrical, 1984; Pfister and Malecheck, 1986; Schacht and Malecheck, 1989), supplying essential proteins (Mangan, 1988), although Le Houérou (1980) maintains that the energy supplied from brush is scant, does not fill cattle needs, but can be important for goat production.

The west and southwest of Spain has a grazing area around 5700000 ha, but there are few reports on the grazing behaviour of goats, and none dealing with the mountain areas north of Córdoba, Seville and Huelva, where typical Mediterranean vegetation grows at different stages and with a variable degree of human participation.

This work aimed to determine the basic spectrum of goat diets throughout a grazing cycle on areas of the Northern Sierra of Seville.

#### MATERIAL AND METHODS

A herd of 220 Florida dairy goats, of 60 kg live weight, was used. Goats were farmed semiextensively, and received a feed supplement of 0.66 kg barley/day/goat in summer, autumn and winter. Milk production was 432 kg (3.22% protein and 4.84% fat) in 216 days of lactation, and one kid was produced per litter. Goats were 4 to 8 years old. Since there were three kidding periods (March, September, December), the herd comprised animals at different stages of milk production. Florida is a hypermetric, longilineal and cyrtoid dairy breed native to the Guadalquivir Valley, located in the province of Seville, where there is an estimated population of 30000 breeding goats, used primarily for milk and cheese production. One of the main characteristics of this breed is its ability to utilise natural resources and agricultural residues in grazing (Sánchez et al., 1990).

Feeding behaviour was monitored on one day per week over the whole grazing season, using six adult females previously selected as representative of their herd (Meuret et al., 1985). Each animal was observed for a ten-minute period. Monitoring began each day with the animal nearest the observer, and continued with the remaining animals at ten-minute intervals (the time necessary to locate and approach the animals). When all experimental animals had been monitored once, the process was repeated in two more monitoring shifts, always beginning with the same animal. In this way, monitoring covered 50% of grazing time with three observation periods per animal. The species used, and the number of mouthfuls taken, were recorded.

The study area was located in the Sierra Norte in the province of Seville (Spain), at 500 — 700 m above sea level (lat. 37° 56' N; long. 5° 28' W). Mean annual rainfall is 800 mm; the mean winter temperature 7.5° C (minimum -9° C) and the mean summer temperature 22.9° C (maximum 38° C). The area consists of mixed holm oak-cork oak ranges with areas of shrub cover containing abundant *Cistus* spp. Weight per bite was recorded for all grassy species and for the following woody species. *Quercus rotundifolia* Lam., *Q. suber* L., *Olea europaea* L., *Cistus salvifolius* L., *C. albidus* L., *C. ladanifer* L., *Pistacia lentiscus* L. and *P. terebinthus* L. However, we did

not control others such as *Q. faginea* Lam., *Arbutus unedo* L., *Phyllirea angustifolia* L., *C. monspeliensis* L., *C. populifolium* L. or *Ulex europaeus* L. which, though palatable, accounted for rather a small proportion of the goats' diet (less than 0.1%), consistent with earlier findings by Harrington (1978) and Rios and Riley (1985), who pointed out that, although goats may consume a large variety of species, most of their diet consists of the 3–8 most common species in the grazing area.

#### GRASS

Grass intake per bite was quantified by grouping all herbaceous species in a single class according to Hoppe et al. (1977), Bourbouze (1980) and Bryant et al. (1979, 1980). Weight per mouthful was estimated by manual simulation of grazing using the hand clipping method as described by Meuret et al. (1985) by dividing the weight of samples collected at five different places into the number of bites (500). Samplings were carried out with a variable frequency depending on the vegetative status of the grass and the evolution of animal behaviour. A single sample was considered to be representative of November, December and January, and another of July and August. The greater dynamism of the herbaceous stratum and animal grazing compelled us to carry out monthly samplings between January and July. Data were subjected to variance analysis at the Computer Centre of the Institute of Zootecnia.

#### TWIGS

Amounts of arboreal and shrubby species ingested by goats were estimated individually as, unlike herbaceous species, their browsing depends on the vegetative status of the plants. A method was developed based on the marked correlation between twig weight and diameter, which was investigated in our department by Tovar Andrada (1978) and Martinez Teruel (1984).

Regression equations were fitted for each control on the basis of about 200 weight and diameter measurements by using material of each species collected at the grazing spots. Potential relation was used, because this type was the most accurate in accounting for weight-diameter relations in all species and control dates, consistent with findings by Rumble (1987).

Stem diameter at the biting point (DBP) as an independent variable in the fitted regression equations for each ligneous species and sampling season were used to calculate the weight of a bite. DBPs were obtained for each control by a group of observers who followed the herd and measured diameters of the browsed stems according to directions given by Tovar Andrada (1978). In both cases, diameters were measured to within 0.05 mm with a slide calliper and weights to

within 0.01 g on an electronic balance. Data were subjected to variance analysis at the Computer Center of the Institute of Zootecnicos.

## RESULTS AND DISCUSSION

Table 1 reflects the variation in preferences by goats for each of the main feed groups making up their diet. All of these variations are significant ( $P \leq 0.05$ ) except for the ligneous-acorn comparison, which did not differ in the autumn-winter period. As far as seasons are concerned, the significance for grass was  $P \leq 0.01$ , except for comparing the autumn-winter period with summer ( $P \leq 0.005$ ). The ligneous species had the same significant differences, except between spring and summer ( $P > 0.005$ ). The significance of acorns was  $P \leq 0.001$ . Goats chose grass preferentially over ligneous species throughout the periods (Tables 1 and 2), consistent with findings of Schwartz and Said (1981) while Arnold and Dudzinski (1966) found that the most abundant species are also those consumed preferentially.

The relationship between the selection of grass and its seasonal production was virtually linear throughout the winter-spring period, it decreased over the

TABLE 1  
Average number of mouthfuls and statistical differences between the different strata and seasons

Season	Grass	Trees and shrubs	Acorns	Total
Autumn-winter	<sup>a</sup> 1478.1 ± 103.4 <sup>a</sup>	<sup>a</sup> 394.5 ± 48.1 <sup>b</sup>	<sup>a</sup> 220.6 ± 27.3 <sup>b</sup>	<sup>a</sup> 697.7 ± 105.3
Spring	<sup>b</sup> 4221.1 ± 363.2 <sup>a</sup>	<sup>b</sup> 1302.9 ± 138.7 <sup>b</sup>	<sup>b</sup> 15.0 ± 4.5 <sup>c</sup>	<sup>b</sup> 1846.3 ± 132.5
Summer	<sup>a</sup> 2228.7 ± 358.7 <sup>a</sup>	<sup>b</sup> 1219.5 ± 275.7 <sup>b</sup>	—	<sup>b</sup> 1724.1 ± 112.3
Total	2642.6 ± 258.3 <sup>a</sup>	972.3 ± 122.6 <sup>b</sup>	117.8 ± 25.3 <sup>c</sup>	

The superscripts on the right and left of the figures denote the different strata and seasons, respectively. Different superscripts on the same figure denote a statistical significance of at least  $P < 0.05$

TABLE 2  
Average per cent of number of mouthfuls and statistical differences between the different strata and seasons

Season	Grass	Trees and shrubs	Acorns	Total
Autumn-winter	<sup>a</sup> 70.6 ± 2.1 <sup>a</sup>	<sup>a</sup> 18.9 ± 2.5 <sup>b</sup>	<sup>a</sup> 10.5 ± 1.3 <sup>c</sup>	<sup>a</sup> 18.9 ± 1.9
Spring	<sup>ab</sup> 76.2 ± 2.9 <sup>a</sup>	<sup>a</sup> 23.5 ± 2.9 <sup>b</sup>	<sup>b</sup> 0.3 ± 0.1 <sup>c</sup>	<sup>b</sup> 50.0 ± 3.2
Summer	<sup>b</sup> 64.6 ± 2.5 <sup>a</sup>	<sup>b</sup> 35.4 ± 2.2 <sup>b</sup>	—	<sup>c</sup> 31.1 ± 2.1
Total	71.5 ± 1.6 <sup>a</sup>	26.3 ± 2.2 <sup>b</sup>	2.2 ± 1.2 <sup>c</sup>	

The superscripts on the right and left of the figures denote the different strata and seasons, respectively. Different superscripts on the same figure denote a statistical significance of at least  $P < 0.05$

last third of this period as a result of loss of palatability (Boza López, 1983). Hence preference and availability curves tended to diverge despite availability of pasture. Goats like sheep (Arnold, 1980) tend to be more selective in their consumption and seek only those parts of plants which grow among shrubs or in shady areas and are thus more palatable but reject the more fibrous — and hence less digestible material of already withered species (Morand-Fehr, 1982). According to our results (Table 2), grass accounted for 70%, 76% and 65% of the goats' rations in autumn-winter, spring and summer seasons, respectively ( $P \leq 0.005$ ; Table 1). By the time grass was withered, its selection had fallen to only 60% (last summer control) and consisted basically of inflorescences of composite plants which still retained some moisture (Somlo et al., 1981). These results confirm that goats in Spain consume more grass in the wet seasons (López Palazón, 1953) and during the most intensive period of grass growth (Bryant et al., 1979), which also means a decrease in grass consumption in summer (Morand-Fehr, 1982; Meuret et al., 1985). Such a decrease can be drastic at times (from 74% to 4% in only one month) (Griego, 1977).

Ligneous species, the abundance and availability of which remained virtually constant, were present to a variable extent in the goats' diet selection throughout the year. Their consumption increased gradually from winter, which is indicative of greater selectivity than for herbaceous species (Malecheck and Provenza, 1983), since there are substantial variations in composition, not only in time, but also in space. The particular season therefore did determine their consumption (Damiani and De Simiane, 1980), although the vegetative stages of the plant do not condition its palatability as uniformly as with herbaceous plant (Merrill, 1971). In winter (Table 2), despite scarcity of the herbaceous stratum, trees and shrubs accounted for only 19% of the goats' ration. Consumption of this group increased in spring (24%), which can be attributed to shoots and flowers, the material typically selected in this period. In summer, its consumption rose to 35%, which is consistent with the findings of Harrington (1978), who claims that the proportion of shrubs in goats' diets increases with decreasing availability of grass. This is logical since for lack of any herbaceous growth, shrubs offer forage not only in emergency, but also as quality forage since shrubs preserve their proteins, carotenes and carbohydrates better than grasses (Stodart and Smith, 1955). Although the results in this study are less than those found by other authors, the increase during the summer period was also observed by them (Meuret et al., 1985).

Holm and cork oak acorns are very palatable and actively selected by goats, particularly those fallen from trees. Therefore, periods of greatest intake of this feed group coincide with their ripening. However, despite their availability, they only accounted for a small part of the goats' diet (11% of all mouthfuls in autumn-winter; Table 2). However, their greater unit weight must be considered

when ingested in a single mouthful. Although there are few references to the consumption of acorns by goats, acorn tannins appear to have no adverse effect on their consumption (Morand-Fehr et al., 1983).

In summary, herbaceous components occupy a prominent place in the preferences of goats. When readily available, they can account for virtually the entire selection. Seasonal differences were significant, although variations were not comparable to those found by Dreyer and De Simiane (1980), who claimed that grass is the main component in goats' rations in spring and summer, while two-thirds of the intake time in the dry season are devoted to the consumption of ligneous species. Although shrubs gained increasing significance as the nutritional value of grass drops, they never reached a prominent place in the diet. Finally, the contribution of acorns was minor.

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## STRESZCZENIE

### Sezonowa zmienność w selektywności pobierania roślin przez kozy mleczne w górzystych rejonach Hiszpanii

Badano zmienność sezonową w wyborze roślin (trawa, drzewa i krzewy) przez kozy mleczne podczas wypasu. Trawy stanowiły 70 (1478 kęsów), 76 (4221 kęsów) i 65%

(2228 kęsów) paszy pobranej, odpowiednio w sezonach jesienno-zimowym, wiosennym i letnim, co wskazuje na ścisłą zależność pomiędzy smakowitością i stopniem dojrzałości dostępnej dla zwierząt trawy. Gatunki roślin o dużej zawartości ligniny (drzewa i krzewy) były zjadane w zmiennych ilościach w ciągu roku. Ich pobranie stopniowo wzrastało od okresu jesienno-zimowego poprzez wiosenny do letniego i wynosiło odpowiednio 19 (395 kęsów), 24 (1303 kęsów) i 35% (1219 kęsów). Wzrost ten był także wynikiem zmniejszającej się dostępności trawy na pastwisku podczas naturalnej zmiany pór roku. Mimo możliwości pobierania żołędzi dębu skalnego i korkowego w okresie jesienno-zimowym, ich udział w pobranej dawce wynosił zaledwie 11% (221 kęsów). Wyniki te wskazują na znaczenie paszy trawiastej w składzie paszy pobieranej przez kozy, które zjadały zdrewniałe pędy jedynie w przypadku braku trawy.