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## Foraging behaviour and nutrition of goats grazing on shrublands of Greece

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**SUMMARY** - Goats have increasing economic importance for Mediterranean countries. Goats in this area depend for their survival primarily on the forage produced in shrublands. Goats grazing in shrublands of Greece select about 60% shrubs, 16% grass, and 24% forbs on a yearly basis. However, the herbaceous component can contribute 50% or more of the goat's diet when their availability is high. Diet quality of goats grazing in kermes oak shrubland (*Quercus coccifera* L.) depend on the percent of plant species available and may be influenced by the management scheme used. Management such as reducing shrubby cover or introducing other more nutritious species than kermes oak can affect animal performance.

**Key words:** Goats, shrublands, pasture, behaviour, Greece.

**RESUME** - "Comportement au pâturage et nutrition des chèvres dans des maquis de Grèce". Les caprins ont pris une importance économique grandissante dans les pays méditerranéens. Dans ces régions, les caprins dépendent en premier lieu, pour leur survie, du fourrage produit par les arbustes. Les caprins, dans les zones arbustives de Grèce, sélectionnent environ 60% d'arbustes, 16% de graminées et 24% d'autres herbes annuellement. Cependant, la partie herbacée peut représenter 50% ou plus du régime des caprins lorsque cette végétation est très disponible. La qualité du régime des caprins s'alimentant d'arbustes de chênes Kermès (*Quercus coccifera* L.) dépend du pourcentage des espèces végétales disponibles et peut être influencé par le type de gestion. Si celle-ci vise à réduire le couvert d'arbustes ou à introduire d'autres espèces plus nutritives que le chêne Kermès, les performances des animaux peuvent en être modifiées.

**Mots-clés :** Caprins, arbustes, pâturage, comportement, Grèce.

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### Introduction

The goat was one of the first animals to be domesticated by man. Today the majority of their world population live and graze on rangelands. It is felt that goats have to play an important role in future agricultural systems since they have the ability to convert the vegetation of marginal ecosystems to useful products. In Mediterranean countries, goat husbandry is the most productive use of areas dominated by woody species, known as shrublands (Le Houerou, 1972; Mill *et al.*, 1985; Papachristou, 1990).

Shrublands in the Mediterranean region cover more than 2 million hectares (Le Houerou, 1980), and include evergreen or deciduous (broadleaved) woody species. The most common evergreen species in the shrublands of Greece is Kermes oak (*Quercus coccifera* L.) which is an important component of the goats' diet throughout the year (Nastis, 1985). It is well established that dense shrublands provide limited amounts of usable forage due to their impermeability. Thus sparse shrublands are preferred for grazing. On the other hand absence of the shrub component in the semi-arid regions results in very poor forage quality, when herbaceous species mature. Because goats can survive and make high returns for their owners under grazing in shrublands whereas other ruminants have difficulty surviving (Merril and Taylor, 1976; Lu, 1988), they are considered of great importance in these areas of Greece. For this reason, several studies have been conducted to study the productivity, improvement of forage quality, and management of shrublands in Greece (Tsiouvaras, 1987), especially those dominated by kermes oak.

Lately, there has been a development of studies of the grazing behaviour of goats in relation to forage availability within shrublands of Greece under different management schemes with the goal of increasing forage and livestock production. These management schemes had in view to change vegetation structure and plant species composition of shrublands for the animal welfare. The purpose of this paper is to summarize the results of these studies.

## Foraging behaviour of goats

Goats are described in the literature as grazers or opportunistic feeders, since they adapt their selectivity in relation to seasonal changes of forage availability (Malechek and Provenza, 1983; Papachristou, 1990). However, they are very active animals, highly selective and are primarily browsers. In order to reach browse goats often adopt a bipedal stance to reach up to 2 m. It has also been reported that goats can climb trees when tree structure permits this (Garcia and Gall, 1981), indicating that the animal can utilize all kinds of forage resources.

## Dietary selection of goats in shrublands of Greece

Over the past few years considerable information has appeared in the literature on the goats' dietary habits (Malechek and Provenza, 1983; Lu, 1988). Recently, in Mediterranean countries where the goat population is more than 10 percent of the world population, more and more studies are carried on dietary selection of goats (Papachristou and Nastis, 1988).

In Greece, Papachristou and Nastis (1992a) used oesophageal fistulated goats grazing in shrublands and determined the botanical composition of their diets. The vegetation of study area was dominated by Kermes oak. Other woody species present were *Cistus incanus* Rchb., *Rubus idaeus* L., etc. The dominant grass species were *Festuca ovina* L. and *Dactylis glomerata* L., while *Trifolium* spp., *Medicago* spp. and

*Vicia* spp. comprised the majority of forbs. Details of forage availability, animals and grazing scheme are given in a previous work (Papachristou and Nastis, 1992a).

A summary of the findings of this study is given in Fig. 1. The herbaceous component contributed more than 50% in the goat diets during spring (April through May), although browse was of high quality during this period. On the other hand *Vicia* species, although of high availability did not contribute significant amounts. In the remaining grazing periods goats selected higher quantities of browse. Browse contribution ranged from 48% to 80% depending on herbage availability and season of grazing (Papachristou and Nastis, 1992a). Leaves of all forage species contributed more than 70% during all test periods, while twigs from shrubs and stems from herbaceous species were low but constant during all test periods. (Papachristou and Nastis, 1992a).

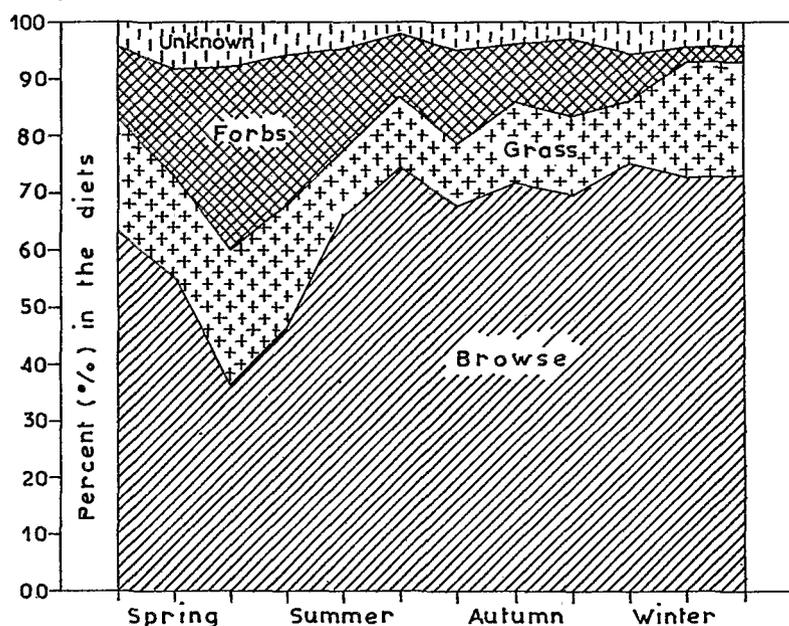


Fig. 1. Botanical composition of diets of goats grazing in shrublands of Greece during the year (adapted from Papachristou, 1990).

In general, goats appear to be adaptive in their dietary habits. They browse more than graze whilst they can graze and utilize considerable quantities of grass and forbs during spring when their availability and quality is high.

## Nutritive value of diets consumed by goats on shrublands of Greece

### Crude protein in the diet

Nutritional information for free grazing goats in shrublands is generally limited (Pfister and Malechek, 1986) particularly in Greece. Liacos and Mouloupoulos (1967) reported that crude protein levels of kermes oak foliage varied from 6% in December to 13% in May. Similar results have been reported by Nastis (1985) for all seasons except spring (Fig. 2). This was probably a result of the selective browsing by the goats. It was also found (Nastis, 1985) that goat production was limited due to nutritional stress during summer, autumn and winter, when animals were feeding on Kermes oak foliage. According to previous research findings reduction of Kermes oak cover in the shrublands of Greece resulted in increasing herbage availability (Liacos *et al.*, 1980). These changes in vegetation structure and composition are considered to improve the nutritional status of goats throughout the year.

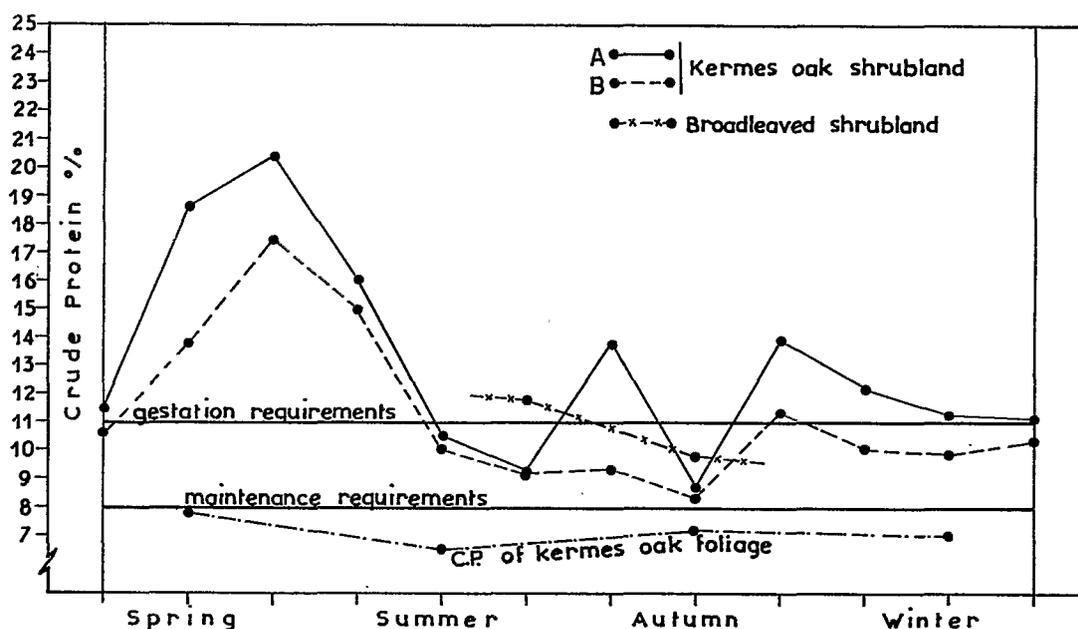


Fig. 2. Crude protein content of kermes oak foliage and of the diets of goats grazing in shrublands with different plant composition. Requirements for dry pregnant goats 30 kg (NRC, 1981) (adapted from Nastis, 1985; Papachristou *et al.*, 1991; Papachristou and Nastis, 1992b).

A study was conducted (Papachristou and Nastis, 1992b) to investigate the implementation of an effective management scheme for kermes oak shrubland aiming at improving the nutritive value of goat diets during the year. In this study 2-year-old, meat-type goats ( $28 \pm 8$  kg) were used. Diet samples were collected

by oesophageal fistulated goats at monthly intervals. In Fig. 2, crude protein content of two kermes oak shrublands with different kermes oak cover proportions is presented. The percentages are as follows: (A) 35% kermes oak, 18% other shrubby species, 31% herbaceous species; and (B) 63%, 4%, 11%, respectively. Crude protein content varied greatly from season to season (Fig. 2). The general pattern was similar for both pastures thus independent of the shrubby and herbaceous vegetation ratio. In general, diet quality declined as herbage matured and availability decreased. Overall, goats selected diets higher in crude protein (14.1%) when grazing took place in shrubland (A) than in shrubland (B) (11.4%). Dietary levels of crude protein approached or exceeded maintenance requirements for goats during all grazing periods. However, in the dry period of the year (August-October) the nutrient content of diets is insufficient to meet gestation requirements, which happens to occur during this period. Thus, it is clear that supplementation is needed during this critical period.

According to recent findings (Papachristou *et al.*, 1991), in this critical period, the nutritional status is elevated when goats graze in shrublands dominated by deciduous broadleaved species such as *Carpinus orientalis* and *Fraxinus ornus*. Diets of goats from broadleaved shrubland, as opposed to kermes oak shrubland, were higher in crude protein content (Fig. 2) in this period.

## Digestibility of diets

Nastis (1985) estimated kermes oak foliage digestibility for goats based on an *in vitro* technique (Tilley and Terry, 1963) as well as *in vivo*. The results indicate that *in vitro* digestibility underestimates *in vivo* digestibility (Fig. 3) by 10 units for mature oak foliage and by 20 for immature. In the grazing studies (Papachristou *et al.*, 1991; Papachristou and Nastis, 1992b), representative dietary samples similar to those consumed by animals were collected and then nutritive composition was determined. The digestibility of animal diets was estimated by *in vitro* technique (Tilley and Terry, 1963), thus the real digestibility of diets must be higher than that estimated (Fig. 3). In Fig. 3, the digestibility values are presented of kermes oak foliage and of shrublands with low kermes oak percent (A), high kermes oak percent (B) and with high broadleaved shrubby species percent (66%) cover. Diets under study were more digestible during spring than the remaining seasons (Fig. 3). Goats selected diets higher in IVOMD (54.9%) when grazing took place in shrubland A than in shrubland B (51.9%). Diets of goats from broadleaved shrubland, as opposed, to kermes oak shrublands, were more digestible (55.3% vs 47.9%), during summer and early autumn (critical period).

## Fibre components in the diet

It is well established that the cell wall fraction of plant tissue is one of the principal factors controlling rates of digestion and intake in animals (McCammon-Feldman, 1980). Papachristou (1990) reported levels of hemicellulose, cellulose and lignin in diets of goats grazing in shrublands throughout the year. Goats selected diets lower in cellulose and lignin and higher in hemicellulose when grazing took place in shrubland with low kermes oak percent cover (A) than in shrubland with high kermes

oak percent (B) (Table 1). The lower values of cellulose and lignin of diets from shrubland A resulted in higher digestibility values (Fig. 3).

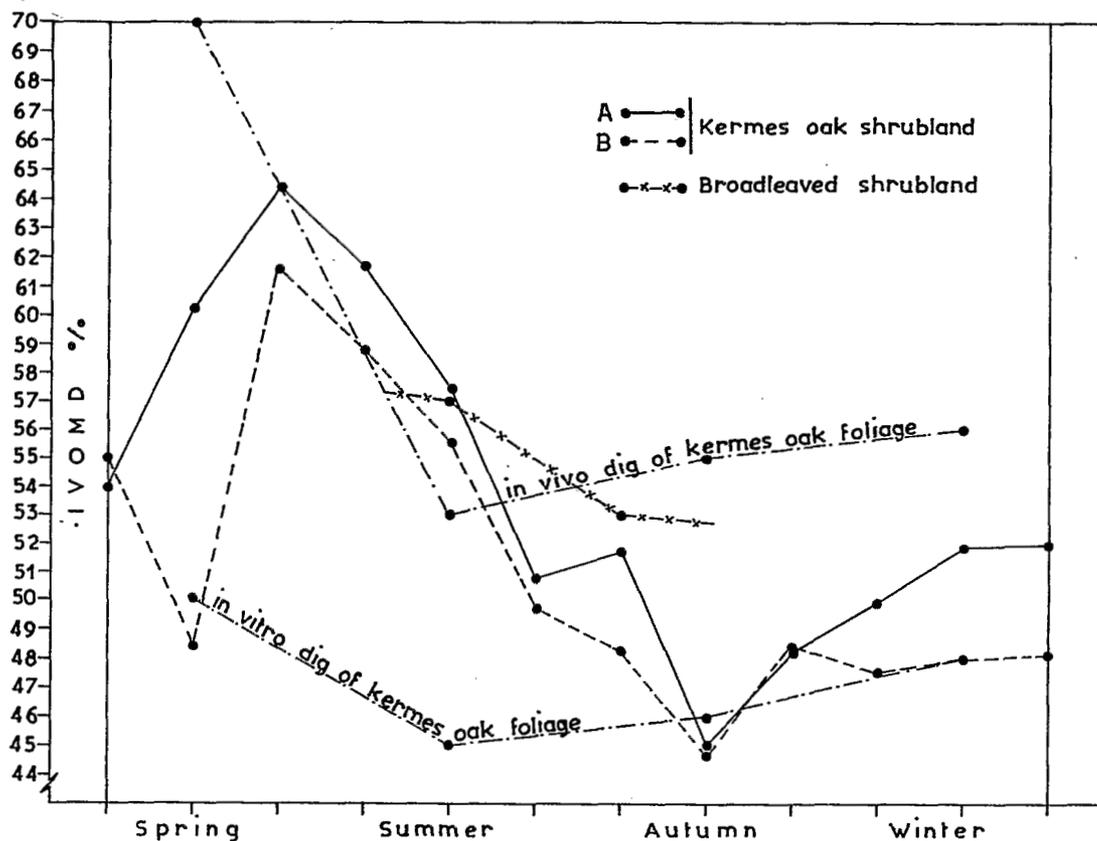


Fig. 3. *In vivo* and *in vitro* digestibility of kermes oak foliage and *in vitro* digestibility of the diets of goats grazing in shrublands with different plant composition (adapted from Nastis, 1985; Papachristou *et al.*, 1991; Papachristou and Nastis, 1992b).

## Conclusions

Our findings suggest that the reduction of the shrubby component down to 53% cover resulted in an increased consumption of herbaceous species, which comprised 50% of the diet during spring. The overall result was an average increase of forage quality all year round. During the critical period of the year a more economical way of meeting gestation demands seems to be the incorporation of deciduous broadleaved plant species wherever this is possible in the mediterranean shrublands.

Table 1. Fibre (%) in the diets of goats grazing on shrublands with low (A) and high (B) kermes oak percent in cover during the year (adapted from Papachristou, 1990)

Grazing periods	Hemicellulose		Cellulose		Lignin	
	A	B	A	B	A	B
Spring	15.6	12.8	12.2	15.2	5.5	7.9 *
Summer	18.9	16.0	15.4	19.8 *	7.1	10.4 *
Autumn	16.8	15.1	15.9	18.7	9.8	11.1 *
Winter	13.2	13.5	16.4	16.6	10.5	13.1 *

\* A<B; P≤0.05

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