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Nutritive value of white oak (*Quercus pubescens* Wild.) browsed by goats

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SUMMARY – An *in vivo* trial was conducted in order to evaluate the nutritive value of white oak (*Quercus pubescens* Wild.) browse, during summer. Four indigenous goats (5-6 months, 24 ±0.9 kg BW) were placed in metabolic cages for a 20-d period. Fresh oak branches were offered to the goats and replaced, from 8 a.m. to 8 p.m., every two hours. The oak browse composition was: 124 g/ kg DM, 478 g/ kg DM and 118 g/ kg DM for CP, NDF and ADL, respectively. Average daily intake was 111 g DM/kg $BW^{0.75}$. *In vivo* apparent digestibility of DM and CP of oak browse was 52% and 53%, respectively. Apparent digested nitrogen (N) was 12.2 g/day while apparent retention of N was 7.5 g/day. White oak can be considered as a valuable feed supplement for goats during summer, since it has a relatively high DM digestibility for this period and N retention was in excess of their maintenance requirements.

Keywords: *In vivo* digestibility, intake, foliage, small ruminants.

RESUME – *"Valeur nutritive de* Quercus pubescens *brouté par les chèvres". La valeur nutritive de* Q. pubescens *brouté par les chèvres a été étudiée pendant l'été. Quatre chèvres autochtones (5-6 mois, 24 kg) ont été mises en cage métabolique pendant 20 jours. Des rameaux frais ont été offerts aux chèvres, remplacés toutes les deux heures à partir de 8.00 h jusqu'à 20.00 h. La composition chimique trouvée était : PB 124g/kg MS, NDF 478 g/MS et ADL 118 g/MS. La consommation moyenne journalière était de 111g MS /kg PB. La digestibilité apparente in vivo de* Q. pubescens *brouté était de 52% MS et 53% PB. L'azote digéré apparent était de 1,2g/jour et l'azote apparent retenu était de 7,5 g/jour. Les résultats rencontrés suggèrent que* Q. pubescens *pourrait être considéré comme une pâture complémentaire de grande valeur pour les chèvres pendant l'été pour deux raisons : premièrement parce que la valeur de la digestibilité a été relativement élevée dans cette période et deuxièmement parce que l'azote retenu dépassait les besoins d'entretien.*

Mots-clés : *Digestibilité in vivo, consommation, fourrage, petits ruminants.*

Introduction

Formations of woody species used predominately for grazing in the Mediterranean region, cover more than 60 million hectares (Le Houerou, 1980) including evergreen and deciduous species. In Greece, these species occupied 3.15 million ha (Ministry of Agriculture of Greece, 1992) and represent the 60% of goats' diet (Papachristou and Nastis, 1996).

White oak (*Quercus pubescens* Wild.) is a deciduous tree, mainly in a shrubby form throughout the Mediterranean zone and Greece. It is a palatable species with foliage of relative high nutritive value grazed during spring and summer (Papachristou and Papanastasis, 1994). *Q. pubescens* with other woody species as *Fraxinus ornus* and *Carpinus orientalis* could be used as reserves stands for supplementary feeding during the critical nutritional period of summer (Papachristou and Nastis, 1996). The objective of this study was to evaluate dry matter intake and apparent *in vivo* digestibility of white oak (*Quercus pubescens)* as summer browse when fed alone to goats.

Materials and methods

A digestibility trial was conducted at the Chrysopigi Forest Experimental Station (41° 15' E, 23° 27' N) at 600 m altitude near Serres, Macedonia, Greece. The mean annual temperature and precipitation were 13°C and 630 mm, respectively.

Quercus pubescens browse was tested in goats during summer period (20/7-15/8). Four local breed male goats weighing from 21.5 kg - 25.6 kg initially were selected for the experiment. The goats were born and reared into the experimental area. All animals were placed individually in cages similar to those described by Nastis (1982) and had access to fresh water and salt *ad libitum*. Branches of *Q. pubescens* were harvested daily and offered fresh to the animals from 8.00 a.m. to 20.00 p.m. every two hours. Total feed presented was more than three times the maximum intake of the animals to favour selection. Browse samples similar to those grazed by goats were collected daily for the chemical analyses.

The trial was included a 10-d adaptation period followed by a 10-d collection period during which browse offered and refusals, as well as faeces and urine produced were measured and sampled for analysis (Harris, 1970). Volatilisation of ammonia from urine was prevented by adding 50 ml of 25% H_2SO_4 to the plastic receptacles.

Samples of feed, faeces and urine were transferred to the laboratory for chemical analyses. The N content was determined by using a Kjeldahl procedure (AOAC, 1990) and CP content obtained as N*6.25. Browse samples were also analysed for neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) following the procedure of Van Soest *et al.* (1991). The N balance was calculated from the consumed feed and the amount of faeces and urine excreted, and their respective N content.

Results and discussion

Crude protein content (124 g/kg DM) of *Q. pubescens* browse (Table 1) was relatively high during summer. Additionally, Papachristou and Papanastasis (1994) have reported similar CP content (11%) to the same species and have classified it to the medium category according to average relative acceptance index (RAI). *Quercus pubescens* had a higher CP content in comparison to other oak species, as *Quercus coccifera* (65 g/kg DM) (Nastis ,1982), *Quercus cercis* (70.1 g/kg DM), *Quercus libari* (83.5 g/kg DM) *and Quercus branti* (72.1 g/kg DM) (Kamalak *et al.,* 2004) for the same period.

Table 1. Chemical composition (g/ kg DM) of *Quercus pubescens* consumed by goats

DM	927
CP	124
NDF	475
ADF	324
ADL	118

The NDF content (475 g/kg DM) was low for this period. On the contrary, ADL of *Q. pubescens* was relatively high (118 g/kg DM) as the browse consisted of leaves and twigs. It is known that the twigs with maturation have higher concentration of lignin (Papachristou and Nastis, 1993). Similar results have been found for other oak species by Nastis and Malechek (1981).

Voluntary intake for the goats was relatively high (111g/kg $BW^{0.75}$) during the study period (Table 2). This is in agreement with Leouffre and Meuret (1990) findings concerning Q. *pubescens* intake (100±9 g DM/kg $BW^{0.75}$) by goats. Also, Meuret (1988) remarked an intake of *Q. ilex* by goats of 90-100 g/kg $BW^{0.75}$. According to Lu (1988) the dry matter intake of goats varied from 1.5-5.2% of BW. In our trial the intake value of goats was 5.1% and was higher than that of *Fraxinus ornus* and *Carpinus orientalis* (Papachristou, 1996) during summer period.

Apparent dry matter digestibility (52%) (Table 2) was similar to that of the evergreen species *Quercus coccifera* (53%) (Nastis, 1982). It is known that digestibility of woody species browse by goats ranged from 49-54% (Nastis and Malechek, 1981; Papachristou, 1996) as goats can utilize better low quality feed than the other ruminants (Tisserand *et al.,* 1991). Crude protein digestibility of white oak was 53% which can be considered relatively high for this season (Table 3). On the contrary, *Q. coccifera* for the same period had much lower nitrogen digestibility (42%) (Nastis, 1982).

Table 2. Intake and apparent digestibility of dry matter and crude protein of *Q. pubescens* offered to goats

Dry matter intake (g/kg)	1244± 107
Dry matter intake (g kg^{-1} BW $^{0.75}$ day^{-1})	111±5.0
Dry matter digestibility (%)	52±0.02
Crude protein digestibility (%)	53±0.07

Table 3. Nitrogen balance (g/d) for goats consuming *Q. pubescens*

N Intake	Faecal N	Urinary-N	Ap. digested N	Retained N
24.0±2.39	11.8±1.60	4.6±1.40	12.2±1.43	7.6±1.26

The positive nitrogen retention (7.6 g/d) (Table 3) indicated that crude protein intake of *Q. pubescens* was appropriate for goats requirements. It has been reported (Sidahmed *et al.*, 1981) that Spanish goats were in positive N balance when the daily N intake was more than 0.42 g N kg^{-1} BW. In the present study the daily intake was more than 0.42 g N kg^{-1} BW and the digested N was 12.2 g/d. According to the NRC (1981) and Morand-Fehr (1981) foliage of *Q. pubescens* supplies sufficient protein for goat's maintenance during summer period since the recommended maintenance standards for digestible nitrogen are 4.2 g for a 20 kg goat.

Conclusions

Browse of *Q. pubescens* (white oak) seems to be an effective feed for goats and an important component of their diet during the critical summer period.

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