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Contribution of two native fodder trees to sheep nitrogen retention

Thomas G. Papachristou

National Agricultural Research Foundation, Forest Research Institute
570 06 Vassilika, Thessaloniki - Greece

Summary: In vivo digestibility trials were conducted in metabolism cages to evaluate the contribution of immature and mature foliage of oriental hornbeam (*Carpinus orientalis* Mill.) and manna ash (*Fraxinus ornus* L.) on nitrogen retention and digestibility by sheep. Nitrogen retention did not differ ($P \leq .05$) between species (1.9 g/d for oriental hornbeam and 4.1 g/d for manna ash) in mature stage, while sheep fed with immature manna ash foliage had greater (8.6 g/d; $P \leq .05$) nitrogen retention than did those fed with the immature oriental hornbeam 5.6 g/d). Forage dry matter intakes (g/kg body weight^{.75}) averaged 70.6 for immature and 85.8 for mature foliage and did not differ ($P \leq .05$) between species. Nitrogen retention followed the same pattern as dry matter digestibility, digestible nitrogen and dietary crude protein while it did not in the case of forage intake. It was concluded that foliage of both species may be an effective source of nitrogen for sheep during the long dry summer and early autumn.

Key words : fodder trees, sheep, forage, digestibility, Greece

INTRODUCTION

During the last years, an increased interest has been shown on the role of native and introduced browse species in mediterranean grazing systems (Papanastasis, 1993). Oriental hornbeam (*Carpinus orientalis* Mill.) and manna ash (*Fraxinus ornus* L.) are deciduous trees, mainly in shrubby form that occur throughout the mediterranean silvo-pastoral systems. They occupy a large part of native shrublands while they are also considered for creation of artificial woody stands (Papachristou and Nastis, 1990, Platis and Papanastasis, 1993). Both species are of relatively high nutritive value and are preferred by animals during the summer (Papachristou and Papanastasis, 1994). Papachristou and Nastis (1990) found that their in vivo digestibility by goats was higher than 64% during summer while it declined to 54% in the last stage of their maturity in autumn. It is thought that fodder trees can play an important role in the nutrition of grazing animals during periods when grasses and forbs are dormant and low in nutritive value. However, till now emphasis has been given to the use of fodder browse species for goats, because of their ability to utilize this type of forage.

The objectives of this research were to evaluate the effects of oriental hornbeam and manna ash browse on nitrogen balance, intake and digestibility by sheep when fed at two stages of foliage maturity (immature and mature).

MATERIALS AND METHODS

Branches of both species were cut in September 1992 when green leaves were fully expanded but senescent (mature stage) and in June 1993 when growth rates were high (immature stage). This material was harvested daily and offered fresh in metabolism cages to four sheep weighing 28.0 ± 1.6 kg when trials started (September 1992) and which reached 47.9 ± 7.6 kg when the experiment was completed (June 1993). Each trial was preceded by a 10-day preliminary period followed by a 10-day collection period, during which faecal and urinary outputs were measured and samples were collected for analysis (Harris, 1970). Browse samples (grazeable material including leaves and twigs) were collected daily by hand during each collection period.

All samples were analyzed for nitrogen content (A.O.A.C., 1990). Browse samples were also analyzed for neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) (Goering and van Soest, 1970). Results were expressed on a dry matter basis at 105°C. Chemical composition data for diets consumed by sheep in the digestion trial are shown in Table 1.

Table 1. Chemical composition of browse species consumed by sheep in the digestion trials

Chemical constituents	Browse species			
	Oriental hornbeam		Manna ash	
	Immature	Mature	Immature	Mature
N, %	1.9	1.4	1.7	1.3
NDF, %	41.7	44.6	40.0	39.8
ADF, %	24.9	27.6	22.7	23.5
ADL, %	7.3	11.0	6.5	6.9

The experimental design was a completely randomized block design with four (sheep) blocks. Data were subjected to an ANOVA test and significant differences among means were detected at the .05 probability level, using the Duncan's new multiple range test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Intake and Digestibility

Dry matter intake and apparent dry matter digestibility did not differ ($P \leq 0.05$) between browse species in the same stage of their maturity (Table 2). The highest intake was recorded for sheep fed mature manna ash and the lowest for immature oriental hornbeam. Values are lower than those recorded for goats (Papachristou and Nastis, 1990, Papachristou unpublished data) indicating that goats can better utilize this type of forage (browse). Sheep tended to have a lower intake when fed both species in the first stage of maturity than in the last one, although crude protein content and dry matter digestibility were higher (Table 2). It is known (Malechek and Provenza, 1983, Nastis, 1993) that forage consumption is not only related to the digestibility and crude protein content but also to a summation of many parameters and the interactions among them. Thus, forage that contains high levels of nutrients may also contain high levels of tannins, alkaloids, terpenes and numerous other. Such forage may not be consumed as it would be expected because of the astringent taste which is evoked by tannins and alkaloids (Arnold and Hill, 1972). However, Khazaal et al. (1993) reported that total extractable tannins of manna ash was similar in both stages of maturity while for oriental hornbeam it was higher in the mature material. In addition, the intake for goats was higher when fed immature than mature oriental hornbeam and manna ash (Papachristou and Nastis, 1990).

Nitrogen retention

Nitrogen retention differ ($P \leq .05$) between oriental hornbeam and manna ash when they were fed at the immature stage while they did not differ at the mature stage (Table 2). In all cases positive nitrogen retention values were recorded indicating that the dietary crude protein intake of both fodder species was at satisfactory levels. Observations on the partitioning of dietary nitrogen by the animals (Table 2) indicated that N intake and retained didn't follow the same pattern as dry matter intake but they had a similar pattern of digestibility. Thus the primary effect of the chemical components of shrubs studied on sheep nitrogen status was the reduced nitrogen digestibility, rather than forage intake. Results of this study indicated that nitrogen retention by sheep was more a function of nitrogen digestibility than nitrogen intake. However, studies on goats (Nastis and Malechek, 1981, Sidahmed et al., 1981, Nunez-Hernandez et al., 1989, Boutouba et al., 1990) showed that nitrogen retention was rather related to nitrogen intake than nitrogen digestion.

Table 2. Dry matter intake, dry matter digestibility and nitrogen utilization by sheep fed immature and mature browse of oriental hornbeam and manna ash.

Items	DIETS			
	Immature		Mature	
	oriental hornbeam	manna ash	oriental hornbeam	manna ash
DM intake, g/kg BW ^{.75}	66.2a1	75.0a	82.5a	96.6a
DM digestibility, %	56.9a	60.7a	47.4a	54.0a
CP, % of diet	11.8	10.4	8.8	8.0
N intake, g/kgBW ^{.75} /d	1.2a	1.3a	1.1a	1.2a
Digestible N, %	45.0a	52.5a	21.2a	37.5a
Retained N, g/d	5.6b	8.6a	1.9a	4.1a

1 Row means with same letter within stage of maturity do not differ ($P \leq .05$)

CONCLUSIONS

Our data indicate that the chemical components of both browses declined with maturity. The effect that maturity had on the crude protein was to reduce it by 23-25% which affected the digestibility, digestible N, and retained N. However, intake didn't follow the same trend with maturity and sheep consumed large amounts of mature browses for unknown reasons.

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