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A note on the chemical composition and tannin content of some Mediterranean shrubs browsed by Sarda goats

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SUMMARY – Hand-plucked samples of herbage and shrubs (N = 78) browsed by Sarda goats during two years, in spring and summer, were analysed to assess their chemical features. Moreover, on the basis of bite-counting method results, the whole botanical diet and chemical compositions were calculated. The chemical composition of herbaceous species, mostly annuals, changed markedly between spring and summer: an increase in dry matter (DM) and neutral detergent fibre (NDF) was concurrent with a decrease in crude protein (CP). Condensed tannin content (CT), measured by the Folin-Ciocalteau method, was low (<1.5%) in herbaceous species, and steady from spring to summer. On average, relatively small changes in DM and CP were recorded for ligneous species, whereas CT tended to increase from spring to summer. As a result, the chemical composition of the diet showed an increase of condensed tannin content (from 6% to 8%) and a reduction in CP (from 11% to 9%). As conclusion, the results accumulated so far highlight that the CP availability in the diet of lactating goats browsing on a semi-arid Mediterranean shrubland is rather low throughout spring and summer, decreasing from the former to the latter season.

Key words: ADI-CP, condensed tannins, diet composition, goats, Mediterranean shrubland.

RESUME – *"Composition chimique et contenu en tannins du maquis méditerranéen pâturé par des chèvres Sardes". Pendant deux années consécutives au printemps et en été, des échantillons (N = 78) d'herbe et de maquis ont été prélevés et analysés pour en déterminer la composition chimique. La composition botanique et chimique de la ration ingérée par des chèvres a été aussi déterminée avec la méthode des coups de dents. Les taux de MS et NDF de l'herbe ont été plus élevés en été par rapport au printemps tandis que la teneur en MAT tendait à diminuer ; le taux de tannins condensés a été bas (<1,5% MS) et il n'a pas changé pendant les deux saisons. Par contre dans les espèces ligneuses, le taux de MS et de MAT demeurait presque constant et celui des tannins condensés tendait à augmenter en été. Par la suite, la ration ingérée a montré un taux plus haut en tannins (6% vs 8%) et plus bas en MAT (11% vs 9%) pendant l'été. Le pourcentage en MAT de la ration ingérée par des chèvres au pâturage dans le maquis méditerranéen est plutôt réduit et il diminue pendant la période estivale. En outre, les taux élevés de tannins réduisent la digestibilité de la MAT.*

Mots-clés : *ADI-MAT, tannin condensé, composition de la ration, chèvre, parcours méditerranéen*.

Introduction

The Mediterranean shrubland is an important feeding resource for ruminants. According to Guerin quoted by Saflétou (1995) the main ruminant species can be ranked for the browsing attitude as follows: goat > sheep > cattle. Even if it is already known that woody species can represent above 50% of goats' dry matter intake (Landau *et al.,* 1995; Decandia *et al*., 1997), the assessment of their contribution in terms of nutrients is far to be achieved. This shortage of scientific knowledge stems mainly from:

(i) The difficulty of an accurate sampling of the plant portions that are actually consumed by the browsing goats (Nastis 1993).

(ii) The high concentration in these plants of anti-nutritive substances that often limit, besides the intake, the digestion, uptake and utilization of the nutrients. Among these substances, the most important by far are the polyphenols, and in particular, the condensed tannins (McLeod, 1974).

The objectives of this study were: (i) to measure, in spring and summer, the chemical composition, including tannins, of the browsed portions of Mediterranean woody and herbaceous species; and (ii) to evaluate their contribution, in terms of nutrients, to the diet of lactating goats.

Materials and methods

The botanical composition of the pasture on offer and selected by the goats is reported by Decandia *et al.* (1997 and this volume). Seventy-eight samples of different Mediterranean ligneous and herbaceous species were collected in spring and summer during the years 1996 and 1997. The samples, that represented the plant fractions eaten by lactating Sarda goats, were hand-plucked according to the method of direct observation of biting (Meuret *et al.*, 1985) and immediately frozen at –20°C. The samples were then freeze-dried and analysed to determine: dry matter (DM), crude protein (CP), ether extract (EE), neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL) according to Martillotti *et al*. (1987), and acid detergent insoluble proteins (ADI-CP) (Van Soest, 1991).

Moreover the samples were submitted for condensed tannin assay (Martillotti *et al.*, 1987). Briefly the samples were incubated in a solution of acidified methanol and then filtered. The filtrate was added with a solution including Folin Ciocalteau reagent and sodium carbonate. After two hours, the samples were assayed for total polyphenols by a spectrophotometer (765 nm) using cathechin as standard. To measure non-tannic polyphenols the same procedure was used but the filtrate was pre-treated with methyl-cellulose and ammonium sulphate before adding the Folin Ciocalteau reagent. Condensed tannins (CT) were measured as the difference between total and non-tannic polyphenols. The non structural carbohydrates (NSC) were also calculated according to Van Soest (1991).

The botanical composition of the diet was assessed using the direct observation of animals as described by Decandia *et al.* (1997 and this volume).

On the basis of diet botanical composition and chemical analysis of each species, the chemical composition (NDF, ADF, ADL CP, and CT) of the diet was inferred.

The effects of the season (spring, SP, and summer, SU) within species was assessed by ANOVA using the General Linear Procedure (GLM) of SAS package (SAS, 1987).

Results and discussion

The chemical composition of herbaceous species (HE), mostly annuals, changed markedly between the seasons (Table 1). DM and NDF ranged from 25% and 44% in spring to 57% and 58% in summer respectively (NS), while CP decreased ($P = 0.06$) from 14% (spring) to 7% (summer). Condensed tannin content of the herbage was low (<1.5%) and steady from spring to summer.

Ligneous species as expected, had, on average, higher ADL and CT contents than HE (Table 1). Unlike HE, ligneous species generally showed smaller changes in DM and CP with the exception of *Lonicera implexa* Aiton (LO) and *Rhamnus alaternus* L. (RH). Crude protein ranged between 9% in *Myrtus communis* L. (MY) and 14% DM (RH) in spring and between 7% (LO) and 12% DM *Rubus ulmifolius* Schott (RU) in summer. No difference was found in the percentage of CP bound to the fibre (ADI-CP) from spring to summer. The maximum ADI-CP level was shown by *Pistacia lentiscus* (PL) while the minimum by RH in both seasons.

Most of the woody species showed slight changes in NDF and ADF passing from spring to summer. The highest levels were found in the oak samples *Quercus ilex* L. (QI) and *Quercus suber* L. (QS) as well as in *Smilax aspera* L. (SM) while RH was on the low of the rank. The content of lignin (ADL) tended to parell that of NDF therefore QI, QS and SM have probably the less digestible fibre.

Non structural carbohydrates ranged between the high levels of RH (>50% DM) to the low levels of QI, QS and SM (<35% DM) without any significant change along with the season.

On the contrary CT tended to increase from spring to summer. In particular in PL condensed tannin concentration grew from 18 to 22% DM (NS) and in QI from 4 to 8% DM ($P < 0.05$). Even in low-tannin woody species, like LO, a significant accretion of condensed tannins was found. On average, the top CT concentration was detected in PL, the bottom in LO. Intermediate values were shown by QS, RU,

and MY. Condensed tannin content in woody species is similar to that reported by Silanikove *et al.* (1996), in Israel. The chemical composition of goat diets is shown in Fig. 1. It is noteworthy that CP tended to decrease (from 11 to 9%) whereas CT grew from 6 to 8% passing from spring to summer. On the contrary NDF, ADF and ADL levels were practically unchanged through the study period. Landau *et al.* (1995) found a quite similar diet composition in Damascus and Mamber goats browsing a Mediterranean shrubland. The levels of NDF and ADL were on average higher in the Israeli than in the present study.

Table 1. Mean chemical composition of samples hand plucked in spring (SP) and summer (SU) which represented the fractions grazed or browsed

Species†	Season	N	DM	Chemical parameters (% DM)								
				CP	ADI CP††	EE	NDF	ADF	ADL	NSC	Ash	CT
HE	SP	2	25.80	14.31	5.74	2.00	44.11	24.46	4.16	29.00	11.17	1.09
	SU	3	56.73	7.91	7.61	2.00	58.92	31.01	4.72	22.00	11.20	1.00
QI	SP	6	51.97	10.12	19.16	1.60	57.95	37.73	16.25	26.80	4.14	3.64[a]
	SU	3	54.84	8.53	22.93	1.67	56.19	37.49	15.18	29.67	3.96	8.06[b]
QS	SP	4	47.63	9.96	20.47	2.00	53.02	36.14	18.35[b]	29.50	5.66[b]	12.65
	SU	3	47.87	10.73	13.42	2.00	51.63	34.02	14.13[a]	31.50	3.72[a]	14.00
PL	SP	7	44.78	9.57	25.05	2.33	42.17	31.01	20.04	42.33	4.93	18.49
	SU	2	44.09	9.92	27.80	2.00	42.03	34.74	23.24	41.50	4.59	21.74
LO	SP	5	26.84[a]	10.23[b]	6.09	1.06[a]	34.81	22.68	7.70	45.40	7.98[a]	1.76[a]
	SU	3	39.47[b]	7.04[a]	14.48	3.00[b]	29.30	19.47	8.19	50.67	10.35[b]	3.15[b]
MY	SP	5	41.31	9.33	18.04	1.80	36.52	22.75	11.63	46.80	5.52	12.77
	SU	3	39.43	8.02	11.82	2.00	34.43	23.46	9.45	50.50	4.82	14.47
PY	SP	5	33.25[a]	11.66	11.18	3.00	40.89	25.02	10.44	36.20	6.46	4.61
	SU	3	45.52[b]	11.55	12.16	3.33	39.32	22.27	11.19	38.67	7.18	3.80
RH	SP	6	32.80[a]	14.26[b]	3.13	1.60	23.14	14.17	5.59	53.20	8.19	5.64
	SU	3	41.95[b]	11.90[a]	4.15	1.67	21.87	14.67	6.18	55.00	9.27	6.33
RU	SP	4	34.27	13.91	9.40	1.75	35.92	20.44	6.18	42.25	6.37	14.00
	SU	3	39.12	12.25	6.31	2.00	36.72	19.97	6.29	43.00	5.87	13.72
SM	SP	5	38.10	10.49	24.45	2.50	57.90[b]	37.12[b]	19.69	23.50	5.98	4.37
	SU	3	33.58	8.95	24.4	3.00	46.44[a]	31.92[a]	16.21	33.00	7.80	6.96

†He = Herbaceous species, QI = *Quercus ilex*, QS = *Quercus suber*, PL = *Pistacia lentiscus*, LO = *Lonicera implexa*, MY = *Myrtus communis*, PY = *Pyrus amigdaliformis*, RH = *Rhamnus alaternus*, RU = *Rubus ulmifolius*, SM = *Smilax aspera.*

††as % of CP.

[a,b]Means within species and column with different letters are significantly different ($P < 0.05$).

Conclusions

The results accumulated so far, highlight that in the conditions of this study, woody species of Mediterranean shrubland are characterised by high ADL and medium to high level of condensed tannins.

CP content in the diet of lactating goats browsing on a semi-arid Mediterranean shrubland is rather low and tends to decrease from spring to summer. The opposite trend is shown by CT, therefore it is probable that these animals can experience CP and, possibly, energy deficits during the spring-summer period. Further research is needed to better elucidate the nature and the size of these nutrient unbalances.

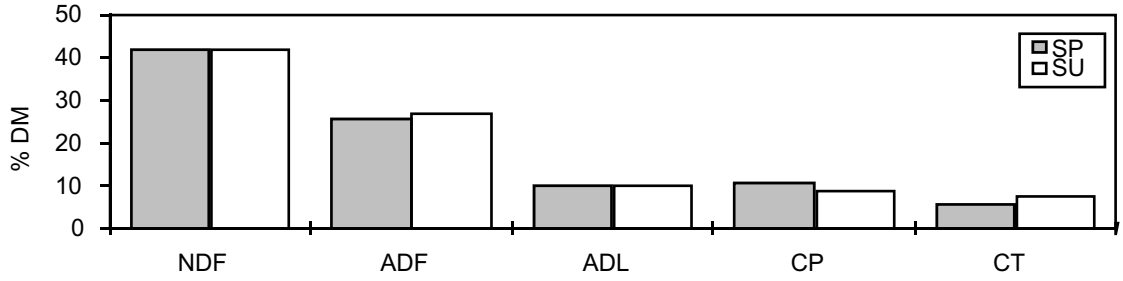

Fig. 1. Chemical composition of the diet of Sarda goats browsing a Mediterranean shrubland in spring (SP) and summer (SU).

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