Palatability of *Psolarea* spp. Accessions Offered as Micro-Swards to Dairy Sheep

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Introduction

Psoralea bituminosa C.H. Stirton (syn. *Bituminaria bituminosa* L.) is a perennial legume usually considered of low palatability because of the strong smell that can be emitted by oil glands located on its foliage. However the nutritive value of P. *bituminosa* in terms of forage composition and digestibility was proven similar to or even better than that of other legumes. The aerial part of this species may contain a high concentration of furano-coumarins, out of which psoralen and angelicin are the most abundant (Pecetti *et al.* 2007). These substances could be harmful to animals, being responsible for contact photodermatitis, in addition to possibly limiting forage intake. Nevertheless there are some examples of the utilisation of *P. bituminosa* either as green or dry forage. In the Canary Islands, it is grazed all year and also is collected from late spring to mid-summer to make hay used to feed goats (Ventura *et al.* 2009). In Israel P. *bituminosa* is grazed by cattle in particular in mid-spring, when the principal grasses become less palatable. In late spring, when the herbaceous species dry up, P. *bituminosa* becomes the only species with green leaves and cattle graze the whole plant intensively (Sternberg *et al.* 2006).

The potentiality of Psoralea as forage species for dairy sheep is less known. For that reason an experiment was carried out to evaluate the propensity of Sarda dairy sheep towards different accessions of *Psoralea* spp. using the micro-swards method (Orr *et al.* 2005).

Materials and Methods

A short-term test was carried out to measure sheep propensity for 4 accessions of *Psoralea*. The accessions studied were: P. *bituminosa crassiuscula* Vilaflor; *P. bituminosa bituminosa* Llano del Beal; *P. bituminosa bituminosa* Monte Rosello; *P. morisiana* Punta Giglio. The forages were sown separately in thirty replicate plastic boxes (46.5 cm, 28.5 cm, 14 cm) per accession (120 boxes in total) to establish micro-swards (Orr *et al.* 2005). The seeds were sown on average at a rate of 20 g/m^2. The boxes were hand-watered when the soil surface was deemed dry. Each accessions was offered in a 4 x 4 Latin-Square design with 3 replicates to a total of twelve Sarda dairy sheep, with milk yield of 1.310±0.04 kg/head/day (mean±SE) and live weight of 42.0±1.0 kg. In a 10-day pre-experimental period the ewes were adapted to individual boxes with concrete floor and fed with ryegrass hay and a commercial concentrate. Since then they were familiarized to the propensity test routine using micro-swards sown with *Hordeum vulgaris* L. (training period, 4 days). After this they were submitted to the experimental treatments (experimental period, 4 days). During this period, between 10 and 12 a.m., the ewes were daily exposed in a random sequence to one of the treatments (two paired boxes of one accession) for about 5 min. During the test the behaviour of the ewes was video-recorded. The micro-sward boxes were weighed before and after each test in order to determine the biomass removed, corrected for evapotranspiration losses (ET), measured using micro-swards of the same accession. Every day the sward surface height (SSH) of each micro-sward was measured by a sward stick before and after grazing.

On 2 occasions during the experiment one micro-sward per accession not offered to the animals, was cut at the root-shoot interface after SSH measurement. The samples were freeze-dried and submitted for DM, CP, EE, NDF, ADF, ADL, N fractions, water soluble carbohydrates (WSC) determinations (AOAC 1990). In vitro DM digestibility (IVDMD) was measured by pepsine-cellulase method. Total (Tot. Ph.) and tannic phenols (Tan. Ph.), using Folin Ciocalteu's reagent, and condensed tannins (CT), using the butanol–HCl method and expressing the concentration as leucocyanidin, were also determined. On the basis of weight and chemical measurements and video analysis, the following behavioural parameters were calculated with reference to each 5 min propensity test: intake on fresh (FMI) and on dry matter (DMI) basis (g/head); eating time (ET, min); number of bites (NB, n.); bite mass (BM, g); bite frequency (BF, n/min) and intake rate (IR, g/min). Chemical parameters were analysed with GLM procedure using forage treatment as fixed effect. SSH and behavioural data were analysed with mixed procedure, using forage treatment as fixed effect and animal, day and replicate as random effects.

Treatment means were separated by Tukey test (P<0.05). Regression analyses were also performed to explore relationships between behavioural data and chemical parameters using daily accession values averaged across replicates (SAS 2001).

Results

The chemical composition of the different accessions was

Table 1. Behavioral responses of ewes fed with different accessions of Psoralea (Lsmeans ± SE).

	Llano del Beal	Monte Rosello	Punta Giglio	Vilaflor	*P*<
Eating time (min)	1.57±0.4ab	1.81±0.4a	0.72±0.4b	1.47±0.4ab	0.05
FM Bite Mass (g)	0.72±0.1b	1.13±0.1a	0.94±0.1ab	0.95±0.1ab	0.05
DM Bite Mass (g)	0.11±0.02	0.15±0.02	0.14±0.02	0.16±0.06	0.06
Bite Rate (n/min)	25.6±6.1	29.2±6.3	16.5±6.1	29.5±6.1	0.23
FM Intake Rate (g/min)	17.2±5.4ab	33.9±5.6a	14.6±5.4b	24.6±5.4ab	0.05
DM Intake Rate (g/min)	2.65±0.8	4.36±0.8	2.20±0.8	4.33±0.8	0.12

Values in the same row with different letters differ significantly (P<0.05).

characterised by a variable CP content ranging, between 15.2 of *Vilaflor* and 20.1% DM of *Monte Rosello* (P>0.1). In all accessions almost 0.25 of total protein is putatively unavailable to animal digestion (fraction C, *i.e.* ADIN). Total and tannic phenols were undifferentiated among accessions while IVDMD was higher (P<0.05) in *Punta Giglio* and *Llano del Beal* (83.1 %) than *Monte Rosello* (81%) and *Vilaflo*r (78%). The highest pre- and post-grazing sward height was found in *Monte Rosello* (23.1±0.6 and 15.9±0.9 cm respectively) whereas the lowest in Llano del Beal (14.2±0.6 and 12.1±0.9), being *Punta Giglio* (17.0±0.6 and 15.9±0.9) and *Vilaflor* (16.8±0.6 and 14.2±0.9) intermediates (P<0.001).

Overall feeding behaviour variables (Table 1) showed very low values as compared to those found in a similar experiment by Giovanetti *et al.* (2011) who offered to dairy sheep other Mediterranean forages. The intake rate, often regarded as a gauge of forage immediate palatability showed higher level on FM basis in *P. bituminosa bituminosa* Monte Rosello than *P. morisiana* Punta Giglio (P<0.05) although these were about half of those recorded by Giovanetti *et al.* (2011) for lucerne and one third for sulla. This result confirmed what already found with naïve lambs exposed to the same *Psoralea* spp. accessions (Decandia *et al.* 2012). Using daily mean accession values, a negative relationship was detected between FMIR and total phenols (FMIR (g/min) = 60.9±10.4 - 24.5±11.7 Tot.Ph (% DM); R^2=0.26, P<0.05, RMSE=10.57, CV=45.9) indicating the probable role of these compounds in reducing *Psolarea* palatability.

Conclusion

Results accumulated so far show that *P. bituminosa* has overall a lower palatability than other Mediterranean legume forages such as lucerne or sulla with a variability among accessions that warrants further analysis and possibly follow-up studies.

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