Technical note
The effect of water availability on feed intake and digestion in sheep

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Abstract
Six castrated male Karagouniko sheep, offered three levels of water, were used in a $3 \times 3$ Latin Square design to study the effects of mild water restriction on roughage intake and digestion. The three treatments were offered water ad libitum throughout the day (A), made available to the animals for 1 h daily (B) or 65\% of the water consumed ad libitum (C). Sheep in Treatment A consumed more water (181.9 g/kg BW\textsuperscript{0.75}) than the two water restriction regimes, which did not differ significantly (B: 128.8, C: 117.5 g/kg BW\textsuperscript{0.75}) between them. Roughage dry matter intake and digestibility of nutrients did not differ significantly between treatments. Non-significant differences ($p>0.05$) were also observed in the rate of passage of undigested residues between treatments (A: 48.7, B: 56.9 and C: 54.5 \%/h). It was concluded that the water restrictions usually applied during the dry season did not have any significant effect on the nutrition of a local breed of sheep in Greece.

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1. Introduction
Drinking water is often a limiting factor for livestock farming in rough grazing areas of the semi-arid Mediterranean zone. During the dry season, in particular, animals consume forage of low moisture content and they have irregular and limited access to drinking water. Drinking may either be limited to once a day when the animals visit a water point, or to the quantities the shepherd can carry to his animals. Moreover, low water availability is characteristic of most sheep producing areas of Greece, and occurs in summer when sheep are in their first half of pregnancy and not lactating. Since a close relationship exists between water intake and the consumption of roughages (Forbes, 1967; Benjamin et al., 1977; More et al., 1983; Silanikove, 1992), restrictions in water availability may result in poor animal nutrition, though a small degree of restriction does not appear to be harmful in practice. However, differences between breeds have been recorded in the efficiency of water usage (Schoeman and Visser, 1995). The present study was undertaken to determine the effects of watering once daily or restricted water consumption, as compared to ad libitum water intake, on dry forage intake and digestion of an indigenous breed of Greek sheep.
2. Materials and methods

Six mature male castrated sheep of the Karagouniko breed were used to evaluate the effects of water availability on feed intake and digestion, under mild air temperature conditions (average temperature 18, 20 and 22°C for the 1st, 2nd and 3rd 16-day period, respectively). Three treatments were imposed in a 3×3 Latin Square design where each animal received all three treatments in three experimental periods. The three treatments were: Treatment A, fresh water was continuously available to the animals; Treatment B, fresh water was provided once daily for 1 h after feeding and Treatment C, fresh water was restricted to 65% of the ad libitum consumed quantity.

The animals were fed lucerne hay (92% DM, 12.82% CP, 92.4% OM, 1.61% EE, 40% NDF, 28.3% ADF) that was chopped through a 5 cm screen. The hay offered was adjusted to allow a 10% residues margin. To determine the apparent digestibility of the offered forage, the animals were confined in standard metabolism cages housed in naturally ventilated animal shed. The lucerne hay was fed at 9:00 hours daily for 16 days in each period. Days 1–10 were the adaptation sub-period whereas Days 11–16 were the measurement sub-period. During the latter, forage offered and residues were weighed daily, while 40 g samples were collected and stored at −20°C for subsequent analyses.

The mean retention time (MRT) of undigested residues in the alimentary tract of the animals, was estimated using C36-alkane as marker (Dove and Mayes, 1991). Grab faecal samples were collected at 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 24, 30, 36, 42, 54, 66, 80, 104 and 128 h after dosing. To calculate the MRT of the undigested residue in the alimentary tract, the multicomartmental model of Dhanoa et al. (1985) was employed to describe the patterns of C36-alkane excretion in the faeces. Data were analysed statistically using the REML procedure of the Genstat statistical package (Genstat 5 Committee, 1994 Release 3.1).

3. Results and discussion

The ad libitum provision of water (Table 1) resulted in higher water intake (p<0.001) compared with the other two treatments, but there was no difference in water consumption (p>0.05) between the two options of restriction. The voluntary intake of DM (Table 1) was not different between treatments. Nevertheless the ratios of water consumed per kg DM intake were significantly different (p<0.001) between treatments (Table 1).

Similarly to the DM intake, the in vivo apparent digestibility of the analyzed feed components (Table 2) assessed through the respective digestibility coefficients, was not significantly different (p>0.05) between the three treatments. Furthermore, the intake of digestible dry matter (Table 1) and the MRT of the undigested residues (Table 2) were not significantly different (p>0.05) between treatments. The residence time for Treatment A was calculated at 48.7 h and those for Treatments B and C was 56.9 and 54.5 h, respectively (Table 2).

In line with the data of Silanikove (1985) restriction of water did not have any significant effect on DMI or the digestibility of nutrients. The WI:DMI ratio in treatment A (ad libitum WI and DMI) of this experi-

<table>
<thead>
<tr>
<th>Access to water</th>
<th>Water intake (g/day)</th>
<th>Feed intake (g DM/day)</th>
<th>Digestible dry matter intake (g/day)</th>
<th>Water/feed (g/g DM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ad libitum</td>
<td>3758&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1451</td>
<td>797</td>
<td>2.59&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>−1 h per day</td>
<td>2660&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1340</td>
<td>755</td>
<td>1.98&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Restricted to 65%</td>
<td>2761&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1383</td>
<td>757</td>
<td>2.0&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>SED</td>
<td>327</td>
<td>52</td>
<td>76</td>
<td>0.15</td>
</tr>
<tr>
<td>Degrees of freedom</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Level of significance</td>
<td>**</td>
<td>NS</td>
<td>NS</td>
<td>***</td>
</tr>
</tbody>
</table>

<sup>** p < 0.01, *** p < 0.001; NS : not significant.</sup>
<sup>a Figures with a different superscript denote sign difference.</sup>
ment agrees with those reported by Forbes (1967) for non-pregnant ewes. Reduction of water intake by 29 and 26.5% in the sheep of our experiment, decreased \((p<0.001)\) the WI:DMI ratio by 23 and 31% for Treatments B and C, respectively (Table 1). A similar reduction of 30% to this ratio was observed by More et al. (1983) in goats when the water intake was restricted by 50%.

The MRT of the undigested residues in this study was higher by 17 and 12% for Treatments B and C, respectively compared with that of Treatment A. Imposing a reduction of up to 40% in voluntary food intake of a forage diet at near maintenance in sheep, goats and cattle, was found to be associated by only small changes in particulate matter MRT in the rumen, and with no appreciable effect on the apparent digestibility (Varga and Prigge, 1982; Robinson et al., 1985; Brun-Bellut et al., 1988). The calculated average MRT of 53.4 h is very close to figures reported in some other studies (Silanikove, 1987; Hadjigeorgiou, 1996).

4. Conclusions

The water availability regimes practiced in this experiment, which are quite similar to those practices exercised by shepherds in Greece during the summer period, did not have a significant effect on the alimentary function of the Karagouniko breed of sheep. However, water economy appears to be important under the studied water limitation regimes, thus allowing the best possible utilization of the available resources.

References


Silanikove, N., 1985. Effect of dehydration on feed intake and dry matter digestibility in desert (Black Bedouin) and non-desert (Swiss Saanen) goats fed on lucerne hay. Comp. Biochem. Physiol. 80A, 449–452.