COMPARISON OF LIVEWEIGHT GAIN AND MINERAL METABOLISM OF SHEEP FED PASTURE OR TAGASASTE

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SUMMARY

Twelve sheep were individually fed either green cocksfoot pasture or tagasaste in metabolism cages. Liveweight gain, dry matter digestibility, mineral content of the feeds, apparent uptake from the gut and levels of retention of P, S, K, Ca, Mg and Na were measured over a period of ten days. Despite 20% higher dry matter intake and 10% higher digestibility and 40% higher N content in the feed, the sheep fed tagasaste performed no better than the sheep fed pasture. Levels of all minerals were lower in the tagasaste than in the pasture. Apparent efficiency of absorption of N, Mg and Na was greater with the tagasaste, while that for K, P and S was less; retention of S and Na was greater and that for P, K and Ca was less. The performance of sheep fed tagasaste may be restricted by retention of P, S, or Ca, but is less likely to be restricted by low retention of K, Mg or Na.

Keywords: Tagasaste, digestibility, nutritive value, liveweight gain, minerals.

INTRODUCTION

Tagasaste (Cytisus proliferus) is a tree legume capable of producing large amounts of readily edible forage (Radcliffe 1983). Several experiments (Borens and Poggi 1986; Roberts 1986; Hemsley et al. 1987) have shown that its nutritive value is comparable to that of mixed pasture but inferior to that of lucerne. One experiment (Hemsley and Downes 1986) has shown, however, that when a diet of tagasaste was supplemented with minerals (P, S, K, Ca and Mg) the liveweight gain and wool growth of sheep fed tagasaste were substantially increased. That experiment did not report the mineral content of the tagasaste and did not measure the absorption or retention of the various minerals added. The experiment described here was designed to measure the levels of the major minerals in the tagasaste, their apparent absorption from the gut and their retention or loss from the animal.

MATERIALS AND METHODS

Animals A total of 12 sheep, approximately 9 months old and an average liveweight of 30 kg, was fed in metabolism cages a diet of either pasture (4 sheep) or tagasaste (8 sheep).

Diets The pasture was predominantly cocksfoot (Dactylis glomerata) and was harvested with a rotary mower. The tagasaste was harvested at a height of 1 m from a two year old hedge which had been harvested six months earlier. In order to provide a uniform diet and to improve palatability only leaves and stems less than 5 mm diameter were offered to the sheep.
Feeding. From February 5-17 1987, the sheep were fed twice daily. The "pasture" sheep were fed ad libitum and the "tagasaste" sheep fed at a restricted level designed to achieve a comparable intake to the "pasture" sheep. Feeding continued for 13 days and measurements were made over the last ten days.

Measurements. The weight of all feed offered and refused, and outputs of faeces and urine were recorded for each sheep. Samples of feed, refusals, faeces and urine were collected for dry matter determinations and mineral analyses (N, P, S, K, Ca, Mg and Na) (Anon 1986). Liveweights were recorded at the start and end of the experiment.

RESULTS AND DISCUSSION

Digestibility and liveweight gain

The dry matter digestibility (DMD) of the tagasaste was significantly higher than that of the pasture (Table 1). Difficulty was experienced in regulating the intake of the stemmy tagasaste so that the "tagasaste" sheep had 20% higher DM intake and 34% higher ME intake than the "pasture" sheep (Table 1). According to ARC (1980) ME intake for maintenance of these sheep should have been about 4.7 MJ/d. The "pasture" sheep would therefore have been expected to maintain weight and the "tagasaste" sheep to gain about 50 g/d. In fact the "pasture" sheep had a small loss of 66 g/d while the "tagasaste" sheep had a larger loss of 124 g/d. These liveweight changes were however, not significantly different from each other.

Table 1 Dietary details and liveweight gains of "pasture" and "tagasaste" sheep

<table>
<thead>
<tr>
<th>Diet</th>
<th>Dry matter g/kg</th>
<th>Digestibility g/kg</th>
<th>Intake g/d</th>
<th>ME intake MJ ME/d* g/d</th>
<th>Faeces g/d</th>
<th>Urine ml/d</th>
<th>LWG g/d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasture</td>
<td>310</td>
<td>542</td>
<td>578</td>
<td>4.58</td>
<td>259</td>
<td>548</td>
<td>-66</td>
</tr>
<tr>
<td>Tagasaste</td>
<td>280</td>
<td>602</td>
<td>695</td>
<td>6.15</td>
<td>277</td>
<td>588</td>
<td>-124</td>
</tr>
<tr>
<td>LSD (P=0.05)</td>
<td>-</td>
<td>26</td>
<td>117</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>163</td>
</tr>
</tbody>
</table>

* Intake (g) x ((0.01925 x DMD) - 0.661) x 0.81 (Moir 1961, ARC 1980)

Mineral metabolism

Details of the fate of ingested minerals are shown in Table 2.

Nitrogen. The high N content in the tagasaste diet was associated with a substantially higher output of N in the urine. (As N analyses of the faeces were not available, 'no assessment of apparent absorption or retention was possible).
Phosphorus The P content of both diets, but particularly that of the tagasaste, was low. The low dietary intake of P and the inevitable loss of endogenous P in the faeces, resulted in a negative P balance. This low apparent uptake of P could also have been associated with the comparatively high levels of Ca in the diet (Grace 1983).

Sulphur The content of S in the tagasaste and the efficiency of S absorption were less than from pasture, yet because the tagasaste sheep excreted less S in urine, their apparent S retention was greater than that of pasture fed sheep. The ratio of S/N in pasture was 0.138 compared with only 0.045 in tagasaste. This latter ratio is much lower than the recommended ratio of 0.067 (ARC 1980) and may partly explain the loss of liveweight by tagasaste fed sheep. The pasture-fed sheep were more likely to be restricted by a lack of energy or N.

Potassium The K content of the tagasaste was less than half that of the pasture. The intake of 6.5 g/d on the tagasaste diet was well above the estimated requirement of 3 g/d for a rapidly growing lamb (ARC 1980), so lack of K should not have restricted liveweight gain. Despite reduced output in the faeces and urine the "tagasaste" sheep had a negative balance compared with a positive balance for the "pasture" sheep. This difference was aggravated by the slightly lower efficiency of absorption of K from the tagasaste diet. Although the sheep fed tagasaste were in slight negative K balance this may have been a result of their loss of weight rather than a cause of it, given the substantial loss of K in the urine.

Calcium As with P, there was a negative uptake from the gut, which was similar for both diets, and this resulted in negative balances. The deficiency was greater with the tagasaste diet, because of a higher loss of Ca in the urine. The low uptake of Ca could be caused by the low level of dietary P (Grace 1983) since the concentration of Ca in both diets was above recommended levels.

Magnesium The level of Mg in the tagasaste was substantially less than in the pasture but this was more than offset by the much higher apparent efficiency of absorption of Mg. Loss of Mg in the urine was greater with the tagasaste so that the net retention was comparable, and negative, for both diets. The large difference in efficiency of absorption between the two diets could be due to the much higher level of K in the pasture (Fontenot et al. 1973).

### Table 2 Metabolism of minerals by sheep fed pasture (Pas) or tagasaste (Tag)

<table>
<thead>
<tr>
<th>Elem.</th>
<th>Conc. in feed</th>
<th>Intake</th>
<th>Output</th>
<th>Apparent absorption</th>
<th>Absorpt. efficiency</th>
<th>Retention</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>g/kg Pas</td>
<td>Tag</td>
<td>g/d</td>
<td>n/l</td>
<td>g/kg</td>
<td>g/kg</td>
</tr>
<tr>
<td>N</td>
<td>20.0</td>
<td>28.0</td>
<td>11.55</td>
<td>19.45</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>P</td>
<td>1.95</td>
<td>1.20</td>
<td>1.13</td>
<td>0.83</td>
<td>1.27</td>
<td>1.28</td>
</tr>
<tr>
<td>S</td>
<td>2.76</td>
<td>1.26</td>
<td>1.50</td>
<td>0.86</td>
<td>1.26</td>
<td>1.14</td>
</tr>
<tr>
<td>K</td>
<td>22.9</td>
<td>9.4</td>
<td>13.23</td>
<td>6.50</td>
<td>3.11</td>
<td>2.07</td>
</tr>
<tr>
<td>Ca</td>
<td>8.85</td>
<td>5.05</td>
<td>5.11</td>
<td>3.51</td>
<td>5.74</td>
<td>1.79</td>
</tr>
<tr>
<td>Mg</td>
<td>2.35</td>
<td>1.65</td>
<td>1.36</td>
<td>1.15</td>
<td>1.13</td>
<td>0.04</td>
</tr>
<tr>
<td>Na</td>
<td>2.30</td>
<td>0.80</td>
<td>1.30</td>
<td>0.56</td>
<td>0.70</td>
<td>0.30</td>
</tr>
</tbody>
</table>

All differences between diets in these columns are significantly different (P<0.05) except those underlined.

n.a. not available.
Sodium. The concentration of Na in the tagasaste was much lower than that in
the pasture. Efficiency of absorption was similar for both diets but because of
the lower loss of Na in the urine of the "tagasaste" sheep, these animals had a
positive Na balance, while the "pasture" sheep were in negative balance.
Despite this difference, the concentration of Na in the urine of the "tagasaste"
sheep was much lower than for the "pasture" sheep; this questions the
usefulness of urine analysis (Morris 1980) for assessing the Na status of
animals.

CONCLUSION

When young sheep were fed a diet of tagasaste with a sufficient energy
content (based on feeding standards) to support a small gain in live weight,
they actually lost weight. The content of P, S, K, Ca, Mg and Na in tagasaste
were all substantially less than in grass dominant pasture. Associated with the
lack of any gain in liveweight by the "tagasaste" sheep, there was a net loss of
P, S, K, Ca and Mg; deficiencies of any of these elements could have been
responsible for the poor growth of the sheep. Prime suspicion is directed
towards P, S and Ca, as appreciable amounts of K and Mg were excreted in
the urine. The pasture fed sheep had lower energy intake but greater retention of
P, K and Ca and better liveweight gain.

Further experiments are planned to obtain more accurate estimates of
liveweight gain and wool growth when sheep are fed these two diets in equal
amounts and ad libitum, and what effect supplementation of each of the major
elements may have on performance.

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