STUDIES ON THE VOLUNTARY CONSUMPTION OF MATURE HERBAGE BY WEANER SHEEP IN RELATION TO OAT GRAIN, GLUTEN MEAL AND MINERAL SUPPLEMENTATION

I. N. SOUTHEY* and H. LLOYD DAVIES†

Summary

The voluntary consumption of mature herbage from the agricultural areas of south Western Australia by medium Peppin Merino weaner sheep (mean liveweight 23.0 kg) was measured in a pen experiment. When supplemented with oat grain the mean daily intake of herbage was reduced from 368 g to 121 g. Gluten meal increased the voluntary feed consumption of the herbage. There was also a response in liveweight gain and wool length to the highest level of protein supplementation.

I. INTRODUCTION

The deficiencies of matured herbage during the summer drought as feed for sheep—particularly weaner sheep—in the winter rainfall areas of southern Australia have been documented (Allden 1959; Donald and Allden 1959; Davies, Boundy and Southey 1968; McLaughlin and Bishop 1969).

These deficiencies are sometimes overcome by offering grain or hay supplements to the sheep. Some reports indicate that the intake of herbage may be reduced when supplements are offered (Holder 1960; Allden and Jennings 1962; Allden 1969). The authors cited carried out their work with grazing animals and estimated the intake of herbage by various indirect techniques which preclude an accurate estimate of intake.

In addition to the well documented evidence for nitrogen and energy deficiencies in the mature herbage (Allden 1959), there is some evidence, particularly from chemical analysis, that the dry herbage may also be deficient in many minerals (Davies, Greenwood and Watson 1966). These mineral deficiencies could possibly depress the intake of low quality roughage (Hemsley 1964).

In order to investigate further the relationship between supplement and herbage consumed, an experiment was conducted to determine the effect of energy, protein and mineral supplementation on herbage intake by weaner sheep in pens.

* C.S.I.R.O., Division of Plant Industry, Western Australian Laboratories, Wembley, Western Australia.
† Present address: M. C. Franklin Laboratory, University of Sydney Farms, Camden, New South Wales.
II. MATERIALS AND METHODS

(a) Treatments

There were 7 treatments, and 4 medium Peppin Merino wether weaner sheep of mean bodyweight of 23.0 kg were allocated by restricted stratified randomisation to each treatment. Sheep on all treatments were offered matured grass-dominant herbage (containing at least 75 per cent Bromus rigidus, the remainder consisting of Trifolium subterraneum and Arctotheca calendula) ad libitum (chemical composition: 0.77 per cent N, 2.2 per cent silica-free ash, 42.4 per cent acid-detergent fibre, 5.9 per cent lignin, 0.10 per cent sulphur). This was collected from an ungrazed paddock at the C.S.I.R.O. Yalanbee Research Station, Bakers Hill, Western Australia. This paddock had been sown to subterranean clover at least 10 years previously and had been top-dressed annually with at least 200 kg/ha of superphosphate. The herbage was coarsely hammer-milled. The supplements were offered daily in separate bins as follows:

Group 1  Controls — no supplement
Group 2  409 g of coarsely crushed oat grain
Group 3  200 g of coarsely crushed oat grain + 100 g of gluten meal
Group 4  200 g of coarsely crushed oat grain + 215 g of gluten meal
Group 5  60 g mineral mixture*
Group 6  60 g mineral mixture + 409 g of coarsely crushed oat grain
Group 7  60 g mineral mixture + 200 g of coarsely crushed oat grain + 215 g of gluten meal.

The experiment ran from February 6 to March 10, 1968 in the animal house at the Yalanbee Research Station, Bakers Hill, Western Australia.

(b) Measurements

(i) Daily dry matter intake
Feed residues were collected and weighed daily at 0830 h. Fresh feed was offered at 0900 h daily.

(ii) Weighing
The sheep were weighed weekly.

(iii) Wool production
The dye-banding technique of Williams and Chapman (1966) was used to measure the effect of treatment on increase in wool length.

(iv) Haematology
The sheep were sampled by jugular venipuncture fortnightly, samples were centrifuged and the plasma analysed for urea (Chaney and Marbach 1962), glucose (Huggett and Nixon 1957), inorganic phosphate (A.O.A.C. 1965), non-esterified fatty acids (Annison 1960) and haemoglobin (King and Wootton 1959).

(v) Dry matter digestibility
The dry matter digestibility (51 per cent) of the herbage was determined in a concurrent digestion trial (18 days pre-feeding, 10 days collections) using four Merino wethers in metabolism cages.

* The mineral mixture was identical to the one used by Moir and Harris (1962).
### TABLE 1
**Mean daily voluntary feed consumption by weaner sheep of mature herbage in relation to supplements**

<table>
<thead>
<tr>
<th>Grain treatment</th>
<th>Mineral Supplement (g)</th>
<th>Dry matter intake of pasture (g)</th>
<th>Intake of concentrate (g/dry matter)</th>
<th>Total intake (g/dry matter)</th>
<th>Digestible dry matter intake (g)</th>
<th>Nitrogen intake (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Control — no supplement</td>
<td>0</td>
<td>361&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0</td>
<td>361</td>
<td>186</td>
<td>2.78</td>
</tr>
<tr>
<td>2. 409 g oat grain</td>
<td>0</td>
<td>121&lt;sup&gt;b&lt;/sup&gt;</td>
<td>304</td>
<td>425</td>
<td>282</td>
<td>0.93</td>
</tr>
<tr>
<td>3. 200 g oat grain + 100 g gluten meal</td>
<td>0</td>
<td>151&lt;sup&gt;b,c,d&lt;/sup&gt;</td>
<td>234</td>
<td>385</td>
<td>262</td>
<td>1.16</td>
</tr>
<tr>
<td>4. 209 g oat grain + 215 g gluten meal</td>
<td>0</td>
<td>251&lt;sup&gt;d&lt;/sup&gt;</td>
<td>285</td>
<td>536</td>
<td>362</td>
<td>2.52</td>
</tr>
<tr>
<td>Mean*</td>
<td></td>
<td>244</td>
<td>441</td>
<td>277</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Nil</td>
<td>60</td>
<td>457&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0</td>
<td>457</td>
<td>235</td>
<td>3.52</td>
</tr>
<tr>
<td>6. 409 g oat grain</td>
<td>60</td>
<td>128&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>340</td>
<td>468</td>
<td>314</td>
<td>0.99</td>
</tr>
<tr>
<td>7. 200 g oat grain + 215 g gluten meal</td>
<td>60</td>
<td>196&lt;sup&gt;b,c,d&lt;/sup&gt;</td>
<td>295</td>
<td>491</td>
<td>342</td>
<td>1.51</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>260</td>
<td>472</td>
<td>297</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Digestibility of herbage = 51.5% (determined)
* Digestibility of oat grain = 73% (estimated from literature)
* Digestibility of gluten meal = 90% (estimated from literature)
* Omitting treatment 3 which has no comparable nitrogen supplement level in the mineral supplemented group.
* Unlike letters indicate means which are different (P<0.05) determined by Duncan's (1955) multiple range test.
III. RESULTS

(a) Voluntary Feed Consumption

The mean voluntary feed consumption of herbage and concentrates is given in Table 1. This table also shows the nitrogen intake and digestible dry matter intake. When a grain supplement was offered, there was an immediate decline in the voluntary consumption of herbage ($P<0.01$ for treatments 2, 3, 6 and 7; $P<0.05$ between treatments 1 and 4). As the nitrogen content of the supplement intake increased, there was an increase in the intake of herbage.

The addition of a mineral supplement did not significantly increase the consumption of herbage. There was no significant interaction between grain and mineral supplementation upon the intake of herbage.

With the exception of treatment 3, there was an increase in total dry matter intake with the addition of a supplement. The addition of each increment of nitrogen to the grain supplement resulted in an increase in intake of dry matter and of digestible dry matter.

There was also an estimated increase (with the exception of treatment 3) in the intake of digestible dry matter with each increment of nitrogen.

(b) Liveweight

Liveweight data (Table 2) are given for day 2-day 30 of the experiment in the pen. Only the high protein groups (4 and 7) gained appreciable weight.

(c) Wool Growth

There was an increase ($P<0.01$) in wool growth between the groups receiving grain supplement compared with the two unsupplemented groups (1 and 5). The high protein and mineral group had significantly superior wool growth to the other groups ($P<0.01$).

<table>
<thead>
<tr>
<th>TABLE 2</th>
<th>Liveweight change and wool growth in relation to treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>Liveweight change (kg) from day 2-day 30 of experiment (Initial wt. 25.2 kg)</td>
</tr>
<tr>
<td>1. Control — no supplement</td>
<td>+0.1</td>
</tr>
<tr>
<td>2. 409 g oat grain</td>
<td>+0.4</td>
</tr>
<tr>
<td>3. 200 g oat grain + 100 g gluten meal</td>
<td>+0.3</td>
</tr>
<tr>
<td>4. 200 g oat grain + 215 g gluten meal</td>
<td>+1.0</td>
</tr>
<tr>
<td>5. 60 g minerals</td>
<td>0.0</td>
</tr>
<tr>
<td>6. 409 g oat grain + 60 g minerals</td>
<td>+0.9</td>
</tr>
<tr>
<td>7. 200 g oat grain + 215 g gluten meal + 60 g minerals</td>
<td>+2.8</td>
</tr>
</tbody>
</table>
(d) Haematology

There were no statistically significant differences in haemoglobin content, non-esterified fatty acids, serum glutamic oxalacetic transaminase or inorganic phosphate levels.

The levels of plasma urea rose with increasing levels of nitrogen in the diet. The high levels (66.7, 95.0 and 67.4 mg/100 ml of plasma on treatments 3, 4 and 7 respectively) suggest that a substantial proportion of the increased protein supplied in the high protein diets was lost as urea due to ammonia formation in the rumen (McDonald 1952).

IV. DISCUSSION

The results given here show that when grain supplements are offered to sheep on an ad libitum intake of dry mature herbage, there is a depression in herbage intake. The level of the supplements offered in this experiment resulted in a lower dry matter intake by the sheep than would be expected on a higher quality diet.

These results differ from those of Blaxter and Wilson (1963) who found in their latest cut hay (the diet closest in quality to the herbage in this study) no increase of any consequence in voluntary consumption of hay above 200 g of concentrate. One important feature in this study is the lower level of nitrogen in the herbage compared with Allden (1959) and Blaxter and Wilson (1963) with the added possibility of a mineral deficiency.

The results also indicate that a mineral deficiency (either a single mineral or several) could be responsible for some of the nutritional inadequacies of typical annual pastures in a Mediterranean environment during the summer drought period. The increase of 96 g in the intake of herbage when given 60 g of minerals, although not statistically significant, suggests that further work on the effect of minerals upon intake of mature herbage is justified. However, correcting the mineral deficiency alone is unlikely to markedly affect either liveweight or wool production.

Although there was a decline in intake of herbage when a grain supplement was offered to the sheep, the response in intake to increasing levels of nitrogen added to the grain indicate that an adequate level of nitrogen for microbial activity in the rumen is an important limiting factor in herbage consumption.

The high levels of blood urea indicate that considerable microbial degradation of the added gluten had occurred and much of the added nitrogen was ineffectively utilized. None of the other blood parameters assisted in interpretation of the nutritional status of these animals.

The overall conclusions from this experiment suggest that the main role of an oaten grain supplement offered to weaner sheep grazing matured herbage is as an alternative feed to the herbage. The addition of nitrogen can, apparently, stimulate increased herbage intake with concomitant increases in liveweight and wool production. The effect of mineral supplementation remains unresolved.
Coop (1949) reported that starvation for three to four days resulted in reduced microbial activity, but that activity appeared to be restored in $18 \pm 6$ h. The rate of intake measured here also suggest that starvation had a deleterious effect on rumen microbial populations for some hours following refeeding and thus it is possible that digestibility of feed eaten was reduced during this time. In fact, Graham (1967) recorded a fall in digestibility resulting from infrequent feeding. Moreover, it is possible that an increased rate of passage due to rapid intake of feed in some treatments resulted in a proportion of fibrous material escaping fermentation in the rumen. Thus, it is likely that infrequent feeding impaired digestion in the rumen.

V. ACKNOWLEDGMENTS

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VI. REFERENCES