THE PHYSICAL AND CHEMICAL COMPOSITION AND DIGESTIBILITY OF PODS FROM THREE DIFFERENT MEDIC CULTIVARS

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SUMMARY
The physical characteristics of 3 medic cultivars (Paraggio, Circle Valley and Serena) varied substantially. Paraggio had the heaviest pods (46.4 g/1000 pods compared with 29.4 for Circle Valley and 14.6 for Serena) and a greater number of seeds per pod (6.7, 4.3 and 3.8 respectively). Circle Valley had heavier \( P < 0.05 \) seeds than either Paraggio or Serena.

A higher \( P < 0.05 \) percentage of Circle Valley seed was recovered in faeces (23%) compared to Paraggio (5%). The in vivo dry matter digestibility (DMD) of chaff + Circle Valley (57%) was higher \( P < 0.05 \) than chaff + Paraggio (53%), while the DMD of chaff alone was 56%. Apparent N retention did not differ \( P > 0.05 \) between diets (0.6-1.5 g N/day), but apparent S retention was higher \( P < 0.05 \) in the diets containing medic pod (0.10-0.22 compared with 0.04 g S/day). Sheep rejected Serena pod material for unknown reasons.

The relatively low percentage of Paraggio seed recovered in faeces could affect pasture regeneration as well as nutrition of sheep grazing medic based pastures. This needs to be investigated further.

Keywords: medic, seed, husk, seed recovery.

INTRODUCTION
The seeds of most medics are highly digestible, with only about 2% surviving passage through the digestive system of sheep. However, Denney et al. (1978, 1979) found that barrel medic (\textit{M. truncatula} cv. Jemalong) pods, containing seeds that were 91-95% digestible (Carter 1980; Thomson et al. 1990), provided only small amounts of nutrients to sheep. Use of the nitrogen and long-chain fatty acids available from the seed was inhibited by high levels (77% of organic matter) of acid detergent fibre in the husk (Denney et al. 1978, 1979). If medic pod material is to be useful as feed, then selection for pod material containing less fibrous husk may be advantageous.

The percent of ingested seed recovered from faeces can be expected to have a bearing on both animal production and regeneration of medics in annual pastures. The depletion of the seed bank due to ingestion of medic pods by grazing sheep can be a major cause of deterioration of medic stands (Carter 1980, 1987). Seeds of a few medic cultivars have been shown to have relatively high recovery after ingestion. Carter (1980) reported that the seeds of 1 medic line (\textit{M. polymorpha} SA 4231) were recovered in the faeces at a level of 20% of those ingested. Selection of medic lines such as SA 4231 may lead to improved persistence of medic cultivars in mixed swards. A more versatile pasture cultivar might be developed if selection for the 2 traits, low fibre in the husk and higher seed recovery in the faeces, could be combined.

The experiment reported here was designed to examine 3 types of medic pod material anticipated to be different in both physical composition and the proportion of ingested seed recovered.

MATERIALS AND METHODS
Twenty-four adult merino wethers with a mean liveweight of 43 (± 2.1) kg (± s.e.m.) and stratified into groups according to liveweight were randomly allocated to 4 treatments (diets). They were housed indoors in metabolism crates (16 wethers, 4/treatment) to allow separate collection of urine and faeces, or in single pens (8 wethers with attached faecal collection harnesses, 2/treatment). About 100 kg of pod material from each of 3 medic cultivars; 2 burr medics (\textit{M. polymorpha} var. brevispina), Circle Valley and Serena and 1 barrel medic (\textit{M. truncatula}), Paraggio, were collected and cleaned. Circle Valley pod material was purchased from a private farm where medic was grown for production of registered seed. In this case the harvester used for collection of the Circle Valley pod material had been previously used in an oat crop and contained residual oat grain. Paraggio and Serena pod material was harvested from a grazing experiment (Casson et al. unpublished data), where pure stands of each cultivar had been sown and maintained. No contamination of pod material resulted from residues in the equipment, however as the site of collection had been grazed for 3 years, a large amount of faeces was harvested along with the pod material. Even after cleaning, some extraneous material, amounting to 6% of Circle Valley, 17% of Serena and 19% of Paraggio remained. This medic pod material was then mixed with wheaten chaff.
(55.5% DMD, 1.07% N and 0.11% S) to prepare the 4 diets, chaff + Circle Valley (chaff/CV), chaff + Paraggio (chaff/Par), chaff + Serena and chaff only.

The experiment was conducted over 30 days, with a 14 day introductory period and 3 sequential measurement periods of 5, 5 and 6 days (periods 1, 2 and 3). For the first 4 days of the introductory period, the treatment groups were offered either 1200 gair dry wheaten chaff/day, or 1200 g/day of 1 of 3 air dry diets containing 50% of 1 of the medic pod samples and 50% wheaten chaff. Sheep selected against pod material from Paraggio and Serena when offered at 50% of the diet. Subsequently the amount of pod material in all diets was reduced to 20% and sheep were offered 900 g/day of their respective diets for the remainder of the introductory period. Even at this lower percentage of pod material sheep refused Serena pod and this treatment was excluded from the experiment.

During periods 1 to 3, the sheep were offered about 800 g/day of their respective diets (chaff or chaff + 20% medic pod). This amount was equivalent to the mean intake during the introductory period. During these periods faeces from each sheep were collected daily, weighed, and a 10% subsample taken and dried in a forced draft oven at 75°C. A further 100 g subsample was retained for measurement of seed recovery. Urine from the sheep in metabolism crates was collected into polythene bottles, containing 20 mL of concentrated hydrochloric acid to maintain pH below 2. Feed residues were collected daily, dried, pooled within sheep and treatment period and retained for analysis. Apparent dry matter digestibility (DMD) was estimated from feed intake and faecal output for all sheep. In addition, apparent nitrogen (N) and sulfur (S) balances were calculated for the sheep in metabolism crates.

The amount of seed in the faeces of each sheep was determined daily by serially washing the 100 g subsamples of wet faeces through 2 sieves (4 and 1 mm). No seed was observed to pass through the 1 mm sieve. The washed samples were then dried in an oven at 50°C, aspirated to remove large pieces of fibre and hand cleaned. Clean samples were weighed and tested for hardseed percentage. The amount of seed in feed residues was estimated by taking 50 g subsamples from the pooled residues, manually sorting out pod material, weighing this fraction and calculating the weight of seed in daily residues from the known weight of seed in pod (g/kg).

Physical characteristics of the pod material were determined by hand dissecting 5 samples of 100 pods of each medic cultivar into husk and seed and weighing each component. The percentage of hardseed was measured using International Seed Testing Association methods (WA Department of Agriculture Seed Testing Laboratory, Perth). Analysis for dry matter (DM), N, S, acid detergent fibre (ADF), lignin and ash were by standard techniques.

Differences between pod characteristics or treatments in the experiment were tested for significance using analyses of variance. Results are reported as means with s.e.m.

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Pod weight (g/1000)</th>
<th>Seed weight (g/1000)</th>
<th>Seeds/pod</th>
<th>Seed/pod (g/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circle Valley</td>
<td>29.4b</td>
<td>3.9a</td>
<td>4.3b</td>
<td>56b</td>
</tr>
<tr>
<td>Serena</td>
<td>14.6c</td>
<td>2.5c</td>
<td>3.8c</td>
<td>45a</td>
</tr>
<tr>
<td>Paraggio</td>
<td>46.4a</td>
<td>3.4b</td>
<td>6.7a</td>
<td>49c</td>
</tr>
<tr>
<td>s.e.m.</td>
<td>1.04</td>
<td>0.09</td>
<td>0.19</td>
<td>26.4</td>
</tr>
</tbody>
</table>

RESULTS
There were differences ($P < 0.05$) between all varieties in the physical characteristics of pod material (Table 1). Pod weight and number of seeds per pod were greatest ($P < 0.05$) for Paraggio and lowest for Serena, while the relationship was reversed for the weight of seed per kg of pod.

Husk material from Circle Valley, Serena and Paraggio pods contained respectively 43, 49 and 52% ADF, 11.0, 13.8 and 13.3% lignin, 4.9, 5.6 and 4.3% ash, 1.6, 2.6 and 1.9% N and around 0.09% S. There was only a small range of these chemical components in the seeds. However, the percentage of ADF (14.7, 14.8 and 14.6%), lignin (4.0, 5.1 and 7.1%) and ash (3.6, 3.6 and 3.5%) was less in the seed than the husk, while N (5.8, 6.0 and 7.0%) and S (0.22, 0.25 and 0.29%) were higher.
For each diet (chaff/CV, chaff/Par and chaff), sheep always consumed over 90% of the feed offered (730–799 g/day). Analysis of residues indicated that the animals selected against contaminating faeces in the mixed diets. Nearly all (99.7%) of the chaff/CV diet was ingested, with the small residue of 3 ± 1.1 g air dry feed/day entirely comprised of chaff. Sheep offered chaff/Par refused 42 ± 12.6 g air dry feed/day of which only 11 ± 1.5% was pod material, the rest being faeces.

There was no difference between periods in the percentage (23 ± 1.8%) of Circle Valley seed recovered in the faeces. For Paraggio, the percentage of seed recovered differed (P < 0.05) between periods 1 and 2 (2 ± 0.1% and 7 ± 0.7% respectively), however, the mean recovery was lower (P < 0.05) at 5 ± 0.6% than for Circle Valley.

The percentage of hardseed in hand dissected samples of pod was 97% for Circle Valley and 85% for Paraggio. Passage through the digestive tract tended to lower by 6 to 8% the hardseed percentage of Circle Valley (91 ± 0.8% after recovery), but had little effect on the hardseed percentage of Paraggio (87 ± 0.6%).

There were no differences in DM intake or faecal output of individual sheep on the 3 diets during the last 2 periods of the experiment and the data for these 2 periods were combined to calculate DMD and apparent N and S retention to be higher for Paraggio seed, although the daily intake of Circle Valley seed (65 ± 0.5%) was not different to the chaff/CV (57 ± 0.6%) or chaff/Par (53 ± 0.5%). The DMD of the chaff/Par diet was lower (P < 0.05) than that of the chaff/CV.

There were no differences (P > 0.05) between diets in apparent N retention, the values being 0.6 (± 0.13) g N/day for chaff, 1.5 (± 0.30) g/day for chaff/CV and 1.2 (± 0.43) g N/day for chaff/Par. Apparent S retention differed (P < 0.05) between all 3 treatments with 0.04 (± 0.014), 0.22 (± 0.018) and 0.10 (± 0.012) g/day being retained from chaff, chaff/CV and chaff/Par respectively.

DISCUSSION

Seed mass and seed numbers are 2 factors that have been highlighted as being important in accounting for variation in the recovery of seeds after ingestion (Thomson et al., 1990), with larger seeds generally having lower faecal recovery. We found that Circle Valley seeds, although slightly heavier, had a higher recovery in faeces than seeds of Paraggio. The lower percentage of hardseed (85% compared with 97%) for Paraggio than Circle Valley may have had a positive effect on the digestibility of these seeds. It is apparent, however, that other characteristics such as specific gravity and the size and shape of seeds may be important in determining recovery in faeces (Thomson et al., 1990).

The digestibility of the chaff/CV diet was 4% higher than that for the chaff/Par diet. This was unexpected given that Paraggio seed was more digestible (less seed recovered in the faeces) than the seed of Circle Valley, although the daily intake of Circle Valley seed (85 g) was slightly higher than the intake of Paraggio seed (65 g). Differences in the fibre content of the husk material and its digestibility will influence DMD of pod material and this may have been the reason for the higher DMD of chaff/CV, particularly as Circle Valley husk had a lower ADF content than Paraggio husk.

The similarity of apparent N retention of sheep on all diets is also difficult to explain given the higher N content of medic seed (6%) than chaff (1%). The relatively low DMD of all diets may have meant that energy was limiting the efficient use of dietary N and there was a trend for apparent N retention to be higher for chaff/CV than chaff/Par, which is consistent with the higher digestibility. This suggests that, although only about 20% of medic seed N is available for absorption from the small intestine (Denney et al., 1979), N may not be the primary limitation to sheep performance when grazing dry medic pastures. The N:S ratios of the diets and medic seed were > 20:1, well outside the optimum range (10-12:1) for efficient microbial activity in the rumen (Moir et al., 1967–68).

Performance of sheep grazing medic based pastures may depend upon the amount of pod available, the seed/pod weight ratio, the amount of pod ingested by sheep and the proportion of this material in the diet. Additionally, Brownlee and Denney (1985) found that the amount of medic pod consumed was influenced by the availability of other pasture components. It increased to 70% of the diet by late autumn. More information is needed on rates of ingestion of pod material and effects on regeneration of pastures with different medic cultivars under different grazing conditions.

ACKNOWLEDGMENTS

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REFERENCES