Supplementation of Cattle Browsing Tagasaste (Chamaecytisus proliferus) During Autumn Improves Liveweight Gain

J. T. B. Milton¹, N. Mackintosh², J. Engelke³, M. K. Seymour³, K. Kenny³, T. J. Wiley³, G. T. Tudor³, W. R. Standing⁴, N. J. Edwards⁵, E. G. Taylor⁶, R. H. Davidson¹ and N. D. Costa⁶

¹ Faculty of Agriculture, The University of Western Australia, Nedlands, WA, 6907,
² ‘Cantabilling Springs’, Jurien Bay, WA 6516,
³ Agriculture WA, Moora, WA, 6510,
⁴ Meat Program, Agriculture WA, South Perth, WA, 6151,
⁵ CSIRO Division of Animal Production, Private Bag, Wembley, WA 6014,
⁶ Division of Veterinary and Biomedical Sciences, Murdoch University, WA Australia 6150.

ABSTRACT: A study was conducted to determine the response of yearling steers browsing tagasaste in the autumn of 1998 to being fed a daily supplement of either 2 kg lupin grain, 1 kg lupins + 4.5 kg silage or 9.0 kg silage to supply 25% of their metabolisable energy requirement to support a liveweight gain of 1 kg per head.day⁻¹. The twenty steers on each treatment were run on similar five-hectare plots contained within a 4-year-old stand of tagasaste on a commercial farm, ‘Cantabilling Springs’. The steers browsing tagasaste without a supplement lost an average of 12.8 ± 3.7 kg whereas steers supplemented with lupins gained an average of 38.0 ± 7.7 kg. Steers supplemented with lupins plus silage gained an average of 29.1 ± 5.8 kg and steers supplemented with silage gained 5.1 ± 2.7 kg during the period 4 February to 29 May. The liveweight change of the steers supplemented with lupins was not different (p>0.05) to those supplemented with lupins plus silage and the steers in both of these groups gained significantly more weight (p<0.05) than those supplemented with silage or those browsing tagasaste with no supplement. Ammonia and the profile of volatile fatty acids were determined in rumen fluid collected via a stomach tube. Supplementation with lupins significantly increased the concentrations of ruminal ammonia, and decreased the ratio of acetic acid:propionic acid and the ratio of total volatile fatty acids:branched-chain volatile fatty acids in ruminal fluid. The concentration of metabolites and the activity of enzymes in plasma were within the normal range for each parameter assayed. Steers supplemented with lupins alone had higher (p<0.05) concentrations of urea in plasma than the steers on the other three treatments. The concentration of plasma creatinine for the steers consuming tagasaste without a supplement was higher (p<0.05) than steers browsing tagasaste with a supplement. This study shows the benefit in liveweight gain and rumen function when steers browsing tagasaste during autumn are supplemented with lupins. Feeding silage with lupins can be more cost-effective, and reduce the variability in lupin intake.

Key words: Tagasaste, Cattle growth, Supplements, Rumen and plasma metabolites

INTRODUCTION

Establishment of over 100,000 hectares of the perennial, leguminous browse-fodder, tagasaste on the deep, infertile sands in Western Australia has increased carrying capacity from one or two, to approximately 12 DSE per hectare (Oldham et al., 1994). Most of this increase in production occurs during the active growing season from June until late October, which mirrors the pattern of animal growth on annual pastures. In fact, cattle browsing tagasaste over late summer and autumn only maintain live weight despite crude protein content being rarely less than 15%, and the in vitro dry matter digestibility (DMD) generally greater than 70%.

The underlying factors influencing this lack of production, and the potential response to supplements have not been well-documented. This paper reports the results of a study to determine the response to supplementation of yearling steers browsing tagasaste over autumn. The supplements used were lupin grain to provide a readily fermentable source of energy and rumen degradable protein-nitrogen and/or silage as a source of roughage with moderate levels of energy and protein.

MATERIALS AND METHODS

Twenty hectares, representative of a 4-year-old stand of 100 ha of tagasaste was subdivided with electric fencing into 4 plots each of five hectares that had a similar slope and depth to the water table. At the start of the study, the edible tagasaste available was approximately 3,000 kg DM per hectare in each of the four plots. Water was supplied to each plot from a common source. Eighty European-infused Brahman cross steers aged 16 months and weighing 320 – 380 kg (average 346 kg) were stratified on live weight and 20 were allocated to each plot on 4 February, 1998. The steers on each plot were fed a daily supplement of either 2 kg lupins, 4.5 kg silage + 1 kg lupins or 9.0 kg silage to supply 25% of the steer’s metabolisable energy requirement to support a liveweight gain of 1 kg per head.day⁻¹. All animals were drenched with Ivomec and implanted with Ralgro, and had access to a complete macro- and trace-mineral lick designed to alleviate mineral deficiencies in cattle browsing tagasaste. Steers were weighed one month after the start of supplementation and every two to three weeks thereafter. There was no rainfall during February, then 67mm was recorded at the site from March to 26 May, and a further 34mm on the three days prior to and including 29 May when supplementation ceased. The edible tagasaste available was 800 kg DM per hectare in each of the 4 plots at this time. All steers were then removed from the tagasaste plots and grazed a
clover/ryegrass paddock at a stocking rate of one steer per hectare.

The dry matter, crude protein (CP) and metabolisable energy (ME) content of the lupins and silage were:

- lupins: 92.8%, 36.5% in DM and 13.7 MJ/kg DM;
- silage: 29.7%, 10.8% in DM and 9.4 MJ/kg DM. A composite sample of edible tagasaste (leaf and stem <5mm) taken from all plots in April had a CP content of 16.2% in DM, a DMD of 74.8% and a calculated ME content (SCA, 1990) of 10.7 MJ/kg DM.

Ruminal fluid was collected via stomach tube from about half the steers on each plot on 1 April. At the same time, a sample of jugular blood was collected into lithium heparin for plasma metabolites and enzymes except for glucose that was collected into tubes containing oxalate/fluoride. The concentration of ammonia in the rumen fluid was determined using a Boehringer ammonia kit. Plasma metabolites and enzymes were measured by standard, quality-assured methods on a Cobas-mira autoanalyser. Volatile fatty acids were determined using capillary-GC columns on a Shimadzu gas chromatograph.

All results were tabulated and analysed using Microsoft Excel and Prism statistical software.

RESULTS AND DISCUSSION

Over the 90 days from 4 February to 5 May, the cattle supplemented with lupins, and lupins + silage gained 0.59 ± 0.06 and 0.58 ± 0.05 kg per head. day⁻¹, respectively. These growth rates were significantly (p<0.05) greater than the steers supplemented with silage (0.37 ± 0.03 kg per head. day⁻¹) or those steers just browsing tagasaste (0.23 ± 0.04 kg per head.day⁻¹). It is important to note that the edible tagasaste available to the steers was similar for the four plots at the start (3,000 kg DM per hectare) and the finish (800 kg DM per hectare) of the supplementary period.

Lupin supplementation increased the total liveweight gain of the cattle browsing tagasaste over the autumn period, despite the tagasaste containing sufficient crude protein for growth. Even at a stocking rate of 4 steers per hectare, the average daily gains approaching 0.6 kg per head. day⁻¹ represent very good total liveweight gains of just under 2.5 kg per hectare.day⁻¹ during the period of supplementation. In contrast, those steers consuming tagasaste alone achieved only a modest total liveweight gain of less than 1 kg per hectare. day⁻¹. It is noteworthy that an individual liveweight gain of 0.6 kg per day is considered a suitable background growth regimen for cattle to enter a feedlot. Although supplementation with silage did result in significantly (p<0.05) higher growth rates than on tagasaste alone, the magnitude of the increase was significantly less than supplementation with lupins.

As there were similar amounts of edible tagasaste available to the steers in each of the plots throughout the period of supplementation, the differences in average daily gain and total liveweight gain per hectare are attributable to the supplements of lupins and/or silage. Thus feeding a supplement of lupins and/or silage during the summer and autumn significantly increases the productivity of steers browsing tagasaste.

In contrast, Wiese et al. (1994) reported no significant improvement in the liveweight gain of cattle fed a supplement of oaten grain when browsing tagasaste but their study was conducted during winter and spring and their cattle were already growing at 0.86 kg per head.day⁻¹ on tagasaste alone.

In addition to significantly improved rates of growth, the steers receiving supplements of lupins also had improved indicators of rumen function and microbial efficiency as shown by the ruminal ammonia concentrations, and lower ratios of acetic

Figure 1. Average live weights (+/- SEM) of cattle browsing tagasaste and supplemented with lupins, lupins + silage, and silage during autumn at ‘Cantabilling Springs’.

Supplementation ceased on 29 May.
acid:propionic acid and total volatile fatty acids:branched chain volatile fatty acids (Table 1).

Factors that underlay the reduction in ruminal efficiency may include a low intake of tagasaste, low degradability of tagasaste protein, and low rate of fermentation of the carbohydrates in tagasaste. Notwithstanding this, the steers on all treatments maintained homeostasis of glucose, calcium, phosphorus and magnesium (Table 2). The plasma protein concentrations were also within the normal range (Table 2). However, the concentration of creatinine in plasma from the steers browsing tagasaste alone was significantly (p<0.05) higher than for steers on the other three treatments. This suggests that the steers browsing tagasaste alone were breaking down muscle protein.

### Table 1. Ruminal ammonia and ratios of acetate:propionate and total volatile fatty acids:branched-chain fatty acids from cattle browsing tagasaste and supplemented with lupins, lupins + silage and silage during autumn at ‘Cantabilling Springs’

<table>
<thead>
<tr>
<th></th>
<th>Tagasaste</th>
<th>Tagasaste + Lupins</th>
<th>Tagasaste + Lupins + Silage</th>
<th>Tagasaste + Silage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ruminal ammonia (mM)</td>
<td>5.1 ± 0.6 (10)</td>
<td>7.5 ± 1.0 (9)</td>
<td>6.9 ± 0.7 (9)</td>
<td>4.9 ± 0.7 (10)</td>
</tr>
<tr>
<td>Acetate:propionate ratio</td>
<td>4.5 ± 0.1 (10)</td>
<td>4.0 ± 0.1 (9)</td>
<td>4.8 ± 0.1 (10)</td>
<td>4.5 ± 0.1 (11)</td>
</tr>
<tr>
<td>Total VFA:BCVFA ratio</td>
<td>62.4 ± 3.0 (10)</td>
<td>44.2 ± 5.5 (9)</td>
<td>53.5 ± 4.0 (8)</td>
<td>53.6 ± 3.6 (9)</td>
</tr>
</tbody>
</table>

Values are means ± SEM with the number of animals in parenthesis. Values within a row with different superscripts are different p<0.05.

### Table 2. Plasma metabolites from cattle browsing tagasaste and supplemented with lupins, lupins plus silage and silage during autumn at ‘Cantabilling Springs’

<table>
<thead>
<tr>
<th>Number of animals</th>
<th>Tagasaste</th>
<th>Tagasaste + Lupins</th>
<th>Tagasaste + Lupins + Silage</th>
<th>Tagasaste + Silage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose (mM)</td>
<td>4.3 ± 0.24</td>
<td>4.2 ± 0.18</td>
<td>4.7 ± 0.54</td>
<td>3.8 ± 0.19</td>
</tr>
<tr>
<td>Urea (mM)</td>
<td>4.3 ± 0.32a</td>
<td>6.6 ± 0.81b</td>
<td>3.8 ± 0.44c</td>
<td>2.4 ± 0.16c</td>
</tr>
<tr>
<td>Creatinine (μM)</td>
<td>200 ± 4.8a</td>
<td>178 ± 10.1b</td>
<td>188 ± 5.1b</td>
<td>173 ± 4.3b</td>
</tr>
<tr>
<td>Protein (g/L)</td>
<td>79 ± 1.3</td>
<td>79 ± 2.2</td>
<td>81 ± 0.9</td>
<td>78 ± 1.3</td>
</tr>
<tr>
<td>Calcium (mM)</td>
<td>2.44 ± 0.04</td>
<td>2.44 ± 0.04</td>
<td>2.56 ± 0.02</td>
<td>2.54 ± 0.03</td>
</tr>
<tr>
<td>Phosphorus (mM)</td>
<td>2.45 ± 0.07a</td>
<td>2.45 ± 0.08a</td>
<td>2.18 ± 0.07ab</td>
<td>2.08 ± 0.11b</td>
</tr>
<tr>
<td>Magnesium (mM)</td>
<td>0.96 ± 0.02</td>
<td>0.98 ± 0.02</td>
<td>0.92 ± 0.02</td>
<td>0.91 ± 0.02</td>
</tr>
</tbody>
</table>

Values are means ± SEM. Values within a row with different superscripts are different p<0.05.

Growth rates and rumen function can be significantly improved in cattle browsing tagasaste during autumn by feeding supplements, especially those containing lupins. The profitability of providing supplements to cattle browsing tagasaste over autumn will depend on their cost-effectiveness for the cattle to achieve market targets.

The steers in the study at ‘Cantabilling Springs’ were sold for live export to the Middle East and the minimum liveweight for this market was 425 kg. Of the steers supplemented with the lupins and lupins plus silage, 18 in each group (90%) exceeded this liveweight with an average liveweight of 465 kg when sold for 125 c/kg liveweight on 1 September. In contrast, only 67% of the unsupplemented steers and those that had been supplemented with silage could be sold at this time. The unsold steers had to be held on farm until November and then were sold for 120 c/kg at an average liveweight of approximately 480 kg.

The management of ‘Cantabilling Springs’ now know it is possible to achieve a growth rate of around 0.6 kg/day for steers grazing tagasaste at a high stocking rate when supplemented with modest levels of either lupins or silage plus lupins during late summer and autumn. This is the most difficult period in the feed year to achieve growth of cattle on ‘Cantabilling Springs’. Thus it is now possible for the manager to exploit opportunities for backgrounding cattle for lotfeeding for the domestic market or to grow-out cattle for live export.

With the silage valued at $73.50/tonne DM fed-out and the lupins valued at $200/tonne fed-out, the cost to feed 2 kg per head.day⁻¹ of lupins or 1 kg lupins + 4.5 kg silage per head.day⁻¹ for 114 days was $45.60 and $34.00 per head. In addition to being cheaper, the supplement of lupins plus silage has a number of practical advantages over feeding 2 kg of lupins alone. When lupins are fed with silage to a large mob of cattle there is a better chance that all cattle will get their fair share of both supplements. Also the potential for problems from engorgement when lupins are fed alone would be greater if the lupins were fed only 2 or 3
times per week as is normal practice, rather than daily as in this study.

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REFERENCES


Email: jmilton@agric.uwa.edu.au