Dairy cow welfare in new farm feeding systems

Andrew Fisher

Anoma Hetti Arachchige & Joanne Coombe

Ellen Jongman, Bill Wales, Martin Auldist, Michael Pyman and Peter Mansell
Background:

Then

Now

RESEARCH FOCUS: Integration of mixed rations with grazed pasture (PMR)
Background:

Then

Now

RESEARCH FOCUS: Integration of mixed rations with grazed pasture (PMR)
Potential consequences of increased grain feeding

Grain feeding (especially as a “slug”) → Rumen pH → Risk of SARA (Sub-acute ruminal acidosis)
Aims

To investigate the health and welfare of dairy cows in flexible feeding systems by

1. Evaluation of methods of measuring rumen pH
2. Comparing rumen pH and markers of inflammation between feeding systems
3. Evaluation of hoof health
4. Evaluation of changes in rumen epithelium
DEPI Ellinbank “parent” experiment

160-210 cows

Control
50% pasture
Grain in bail
Pasture silage in paddock

PMR
50% pasture
PMR on feedpad
Pasture silage in paddock
The effects on claw health of supplement feeding grazing dairy cows on feed pads

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d Maffra Veterinary Centre, Maffra, Victoria 3860, Australia
Summary

- Most prevalent lesions
  - White line disease, Paint brush haemorrhage, Bruises

- No effect of feeding system or supplement level on PBH, bruise or WLD

- High risk of lesion at 2nd assessment if it was present at 1st

**Importance of hoof care in early lactation**
Rumen pH profile
Rumen pH profile
Rumen pH profile
## Results

<table>
<thead>
<tr>
<th>Method of feeding</th>
<th>Mean pH</th>
<th>Time pH &lt;6.0 (%)</th>
<th>Area (time*pH 6.0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (n=8)</td>
<td>6.16 ± 0.06</td>
<td>37.4 ± 4.0</td>
<td>2978 ± 309</td>
</tr>
<tr>
<td>PMR (n=7)</td>
<td>6.14 ± 0.06</td>
<td>39.6 ± 4.3</td>
<td>3110 ± 330</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grain supplement</th>
<th>Slope (per kg supplement)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.014 ± 0.019</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td>-0.34 ± 1.28</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>-30.4 ± 98.4</td>
<td>0.77</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>P value</th>
<th>Method</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.84</td>
<td>0.48</td>
</tr>
<tr>
<td></td>
<td>0.72</td>
<td>0.80</td>
</tr>
<tr>
<td></td>
<td>0.77</td>
<td>0.76</td>
</tr>
</tbody>
</table>
Summary

- No significant effect of system (slug feeding vs PMR) on rumen pH parameters commonly associated with SARA.
The relationship between feeding method, levels of supplement, rumen pH and pathological changes in the ruminal epithelium of grazing dairy cows
Steele et al (2011)

Damage to rumen papillae

Grade 1-3 = nil-minor lesions
Grade 3-5 = minor lesions with corneum sloughing
Grade 5-9 = severe deep lesions with large amounts of corneum sloughing
No correlation between change in parakeratosis score and % time rumen pH below pH 6.0 ($r_s = -0.27$, $P = 0.33$)
Overall conclusions

**No effect** of feeding system
(PMR on feedpad vs grain fed in dairy) for:

1. Rumen pH parameters
2. Hoof health
3. Pathological changes in the rumen epithelium
1. Dairy Farmer Practice Survey
System 1: Low bail system
(grazed pasture + other forages + up to 1.0 t grain /conc. in bail)

System 2: Moderate- high bail system
(grazed pasture + other forages + > 1.0 t grain / conc. in bail)

System 3: PMR system
(grazed pasture for most of year + PMR on feed-pad ± grain / conc. in bail)

System 4: Hybrid system
(grazed pasture for < 9 mths per year + PMR fed on feed-pad ± grain / conc. in bail)

System 5: TMR system
(zero grazing for the whole year. Cows housed and fed a TMR)
## Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>FS 1</th>
<th>FS 2</th>
<th>FS 3</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of cows/ herd</td>
<td>215(^{a})</td>
<td>244(^{a})</td>
<td>339(^{b})</td>
<td>0.007</td>
</tr>
<tr>
<td>Grazing land (ha)</td>
<td>114.9(^{a})</td>
<td>115.8(^{a})</td>
<td>178.0(^{b})</td>
<td>0.009</td>
</tr>
<tr>
<td>Distance walked (km)</td>
<td>1.6</td>
<td>1.5</td>
<td>1.7</td>
<td>0.818</td>
</tr>
<tr>
<td>Milk yield (kg)/ cow/ lactation</td>
<td>5514.2(^{a})</td>
<td>6744.4(^{b})</td>
<td>6924.7(^{b})</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total milk solids (kg)/ cow/ lactation</td>
<td>410(^{a})</td>
<td>509(^{b})</td>
<td>544(^{b})</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Lactation length (days)</td>
<td>298(^{a})</td>
<td>306(^{a, b})</td>
<td>314(^{b})</td>
<td>0.039</td>
</tr>
<tr>
<td>Lame cows %</td>
<td>5.7</td>
<td>7.2</td>
<td>5.9</td>
<td>0.294</td>
</tr>
<tr>
<td>Mastitis cases %</td>
<td>7.5(^{a})</td>
<td>12.3(^{b})</td>
<td>9.6(^{a, b})</td>
<td>0.018</td>
</tr>
</tbody>
</table>
Results

- 68% of farmers allowed cows to stand on the feed-pad >3 h/day
- Trough space allowance on the feed-pad = 0.6 ± 0.37 m/cow
- 53% of farmers provided feed-barriers on the feed-pad
2. Time budget of dairy cows in feeding systems based on total mixed ration fed in conjunction with reduced grazed pasture
Research aim

To quantify the daily behavioural time budget; (lying, ruminating, grazing behaviours)

of cows fed on different levels of PMR & control diet
Research focus

1. How do PMR cows adjust for the extra standing time on a feed pad?

2. How does it change the pattern of post feeding lying behaviour?

3. Do they sacrifice some lying time for grazing?

4. How does it change the ruminating behaviour?

“Time Budget Analysis”
The Animal Welfare Science Centre

Traditional diet (64 cows)

PMR (64 cows)

<table>
<thead>
<tr>
<th>DM/cow/day</th>
<th>8 kg</th>
<th>10 kg</th>
<th>12 kg</th>
<th>13.5 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behaviour (hours)</td>
<td>PMR</td>
<td>Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>-----</td>
<td>---------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lying</td>
<td>10.6</td>
<td>10.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grazing</td>
<td>4.0</td>
<td>5.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ruminating</td>
<td>8.5</td>
<td>8.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not chewing</td>
<td>10.1</td>
<td>10.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lying ruminating/ total ruminating</td>
<td>78 %</td>
<td>73 %</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*a, b - Values within rows with different letters are significantly different at P < 0.05*
## Results – Supplement level

<table>
<thead>
<tr>
<th>Behaviour (hours)</th>
<th>8 kg</th>
<th>10 kg</th>
<th>12 kg</th>
<th>13.5 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lying</td>
<td>10.4</td>
<td>10.7</td>
<td>10.2</td>
<td>10.8</td>
</tr>
<tr>
<td>Grazing</td>
<td>5.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.5&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.1&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Ruminating</td>
<td>7.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.7&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>8.9&lt;sup&gt;cb&lt;/sup&gt;</td>
<td>8.9&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Lying ruminating time / total ruminating time %</td>
<td>77</td>
<td>78</td>
<td>72</td>
<td>76</td>
</tr>
</tbody>
</table>

<sup>a,b,c</sup> - values within rows with different letters are significantly different at P < 0.05
Integrating grazed pasture with supplements fed as a PMR on a feed-pad for approximately 1.5 h a day slightly changed the time budget of pasture-based dairy cows with no indication of negative consequences for cow welfare.
Effects of different systems of feeding supplements on time budgets of cows grazing restricted pasture allowances

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3. Space allowance and barriers influence cow competition for mixed rations fed on a feed-pad between bouts of grazing
To reduce competition:

✓ More feeding space per head
✓ Feed barriers
RESEARCH AIM

to evaluate how space allowance and use of feed barriers interact to affect feeding and social behaviour of dairy cows fed a PMR on a feed-pad
The Animal Welfare Science Centre

Study design

### Pasture Intake
- ≈ 6 kg DM / cow / day

### Supplements
- ≈ 14 kg DM / cow / day

### Number of Cows
- 144

### Characteristics
- Age, BW, BCS, body width, milk yield, DIM

### Acclimatization
- 7 days

### Data Collection
- 21 days
Data collection

Video observation

1. Total feeding time
2. No. of feeding bouts
3. Duration of feeding bouts

Feeding behaviour

4. No. of aggressive behaviours
5. No. of submissive behaviours

Agonistic interactions

Heart rate monitors

6. Heart rate
7. Heart rate variability
## Results

<table>
<thead>
<tr>
<th>Main effects</th>
<th>Feeding time %</th>
<th>Feeding bout frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean</td>
<td>$P$</td>
</tr>
<tr>
<td><strong>Space allowance (m)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.60</td>
<td>92$^a$</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>0.75</td>
<td>95$^b$</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>1.00</td>
<td>96$^c$</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Feed barriers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>94</td>
<td>0.042</td>
</tr>
<tr>
<td>Yes</td>
<td>95</td>
<td></td>
</tr>
<tr>
<td><strong>Social status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dominant</td>
<td>96</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Submissive</td>
<td>91</td>
<td></td>
</tr>
</tbody>
</table>
Conclusions:

Increased feeding space from 0.6 to 0.75 to 1.0 m per cow improved feeding and social behaviours of PMR fed cows.

Use of feed barriers further reduce the competition at the feed trough.

Subordinate cows benefited most from increased feeding space and use of feed barriers.
Space allowance and barriers influence cow competition for mixed rations fed on a feed-pad between bouts of grazing

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‡Department of Environment and Primary Industries, Ellinbank, Victoria 3821, Australia
Overall conclusions

- **No adverse effect** of PMR feeding system on cow time budgets

- Farmers may need to provide more trough space on feedpads to minimise social competition, and incorporate feed barriers
The Animal Welfare Science Centre

Questionnaire

- 20 mins. to complete
- 31 quantitative Q + 3 qualitative Q

1. Herd characteristics and farm information (7 Q)
   Size of herd, size of the farm, distance walked, breeds

2. General production information and health concerns (6 Q)
   Milk yield, Milk solids, lactation length
   Mastitis, Acidosis, Lameness

3. Use of off-pasture areas in the dairy system (4 Q)
   Types, purpose, time spent off-pasture

4. Supplemental feeding (3 Q)
   Types, amounts, buffers

5. Characteristics of feed-out areas / feed-pads (14 Q)
   Size, space allowance, feed barriers, sprinklers, fans, shade
   Purpose, feed delivery, cleaning frequency
## Results

<table>
<thead>
<tr>
<th></th>
<th>PMR</th>
<th>Control</th>
<th>Rate (across whole group)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8kg 16kg Overall 8kg 16kg</td>
<td>8kg 16kg Overall 8kg 16kg</td>
<td>Rate (8kg v 16kg)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group (PMR v Control)</td>
<td></td>
</tr>
<tr>
<td>Change in thickness of</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>stratum corneum ± SD</td>
<td>-3.0 ±5.9</td>
<td>3.0 ±2.0</td>
<td>-0.43 ±5.4</td>
<td>0.50 ±2.1</td>
</tr>
<tr>
<td>(µm)</td>
<td></td>
<td></td>
<td>4.0 ±4.9</td>
<td>2.3 ±4.0</td>
</tr>
<tr>
<td>Change in thickness of</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>living epithelium ± SD</td>
<td>5.5 ±13.9</td>
<td>6.6 ±18.6</td>
<td>6.0 ±14.6</td>
<td>6.6 ±18.0</td>
</tr>
<tr>
<td>(µm)</td>
<td></td>
<td></td>
<td>18.9 ±12.0</td>
<td>12.8 ±15.5</td>
</tr>
<tr>
<td>Change in median</td>
<td>0 (0-1)</td>
<td>0 (0-2)</td>
<td>0.5 (0-1)</td>
<td>1 (0-2)</td>
</tr>
<tr>
<td>parakeratosis (range)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* one cow removed mid-trial