Concentrate supplementation during the four weeks prepartum: dairy cow production and immune function

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The Transition Period – 3 weeks before and 3 weeks after calving is the most traumatic period in the dairy cow production cycle.
The Transition Period – 3 weeks before and 3 weeks after calving is the most traumatic period in the dairy cow production cycle. Many changes/challenges during this time include:

- Social, routine and hormonal changes
- Dietary quality changes
- Metabolic challenge - **negative energy balance**
- Immune dysfunction - **normal occurrence**, contributory metabolic effects
- Increased risk of infectious and metabolic diseases
The Transition Period is associated with a peak disease incidence

- Negative energy balance can result in:
  - Increased number of infectious diseases
  - Decreased milk production
  - Decreased reproductive success

Background (iii)

- Need to identify nutritional strategies to help cows ‘transition better’
- Reduce negative energy balance and its immunosuppressive effects
- Work from the USA and New Zealand suggest restricting energy intake before calving
- However:
  - AFBI work has shown that 88% of cows in Northern Ireland had a BCS $\leq 2.5$ at dry-off (target 2.75)
  - Thin cows (BCS $\leq 2.25$ at dry off) offered concentrates during the dry period had lower culling rates in early lactation
Previous AFBI research has shown that supplementing additional concentrates throughout the dry period improved immune function during the week after calving¹

However, concentrates are expensive

Can this beneficial effect on immune function be achieved by supplementing concentrates for a shorter period?

Methodology

- 28 multiparous and 22 primiparous Holstein-Friesian dairy cows
- 2 treatments imposed during the 4 weeks before calving
- **Silage**: Grass silage only
- **Silage plus concentrates**: Grass silage + concentrates (60:40 DM ratio) in a complete diet
  4.5 kg DM concentrates/cow/day
- All cows offered a common diet for 70 days post calving
- Grass silage + concentrates in a complete diet (40:60 DM basis) and concentrates in parlour
Statistical Analysis

- Data were analysed using Genstat Version 16.2 (VSN International, Oxford, UK).

- Continuous data (e.g. dry matter intake, milk yield, milk composition, liveweight, BCS, postpartum serum NEFA and BHBA) were analyzed using REML repeated measures analysis.

- Mean weekly data for neutrophil activity, prepartum serum NEFA and BHBA were analysed by ANOVA.
Results

1. Cow performance
2. Body tissue changes
3. Immune measures
Effects of offering additional concentrates for 4 weeks prepartum on total DMI

![Graph showing the effects of offering additional concentrates for 4 weeks prepartum on total DMI. The graph compares the consumption of silage only and silage plus concentrates. The y-axis represents total DMI (kg/day) and the x-axis represents the week (relative to calving). The graph includes error bars representing SEM. The statistical analysis shows that the difference between the two treatments is significant with a SED of 0.56, P < 0.001 for silage plus concentrates and a SED of 0.46, P = 0.370 for silage only.](image-url)
Effects of offering additional concentrates for 4 weeks prepartum on milk production

<table>
<thead>
<tr>
<th></th>
<th>Silage</th>
<th>Silage plus concentrates</th>
<th>SED</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk yield (kg/d)</td>
<td>33.2</td>
<td>33.5</td>
<td>1.00</td>
<td>0.785</td>
</tr>
<tr>
<td>Milk fat (g/kg)</td>
<td>44.6</td>
<td>44.2</td>
<td>1.30</td>
<td>0.696</td>
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<tr>
<td>Milk protein (g/kg)</td>
<td>32.8</td>
<td>33.1</td>
<td>0.51</td>
<td>0.541</td>
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<tr>
<td>Milk fat + protein yield (kg/day)</td>
<td>2.54</td>
<td>2.57</td>
<td>0.085</td>
<td>0.729</td>
</tr>
</tbody>
</table>
Results

1. Cow performance
2. Body tissue changes
3. Immune measures
Effects of offering additional concentrates for 4 weeks prepartum on bodyweight

- **Silage only**
- **Silage plus concentrates**

**Bodyweight (kg)**

- Treatment, $\text{SED} = 3.3$, $P = 0.027$
- Treatment, $\text{SED} = 6.513$, $P = 0.054$

Error bars represent SEM
Effects of offering additional concentrates for 4 weeks prepartum on body condition score

![Graph showing body condition score over weeks for silage only and silage plus concentrates.](image)

- Silage only: Treatment, SED = 0.023, P = 0.060
- Silage plus concentrates: Treatment, SED = 0.038, P = 0.076

Error bars represent SEM.
Effects of offering additional concentrates for 4 weeks prepartum on serum NEFA concentration

Silage only

Silage plus concentrates

Treatment, SED = 0.032, P = 0.023

Treatment, SED = 0.05, P = 0.137

Error bars represent SEM
Results

1. Cow performance
2. Body tissue changes
3. Immune measures
Effects of offering additional concentrates for 4 weeks prepartum on Neutrophil activity

![Graph showing Phagocytic Index (×100) over different days relative to calving. The x-axis represents days, ranging from -14 to 21. The y-axis represents Phagocytic Index. The graph compares Silage plus concentrates and Silage only conditions. Error bars represent SEM.](image)
Effects of offering additional concentrates for 4 weeks prepartum on Neutrophil activity

![Graph showing oxidative burst index over days relative to calving. The x-axis represents day (relative to calving), with values at -14, 3, 7, 14, and 21. The y-axis represents oxidative burst index, ranging from 0 to 450. Two bars are shown for each day: one for silage plus concentrates and another for silage only. The error bars represent SEM. The statistical significance is indicated as P = 0.078.]
Conclusions

- Supplementing a grass silage diet with additional concentrates for 4 weeks before calving resulted in:
  - Larger bodyweight and BCS gain prepartum but no effect in bodyweight and BCS loss postpartum
  - No effect on postpartum dry matter intake, milk yield or milk composition
  - No significant effect on measures of neutrophil activity
Implications

Unlike supplementing a grass silage diet with additional concentrates for the entire dry period, supplementing for the close-up period only did not have any beneficial effects on immune function.

Further studies are needed to examine the effects of body condition on immune measures.
Acknowledgements

AFBI Dairy Unit Staff