Impact of concentrate supplementation on two Holstein cow strains in a pasture-based feeding system

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Introduction

Is it necessary to feed concentrate to ruminants in a pasture-based feeding system?

Reasons against:

→ Ethical (feed no food)
→ Physiological (fibre digestion)
→ Economical (high costs)

Reasons for:

→ Meet nutritional demand (avoid strong negative energy balances)
→ Higher milk yield (use genetic potential)
→ Independent from pasture offer

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Introduction

Using the best fitting cow strain

- New Zealand Holstein cows are bred for efficient use of pasture.

- They differ in body condition score and body weight (BW) compared to other Holstein-Friesian cow strains. (McCarthy et al., 2007)

- Cows with different BW may differ in grazing efficiency. (HOLMES et al., 1999)
Material and methods

• Place: Organic farm in Switzerland (824 m.a.s.l.)
• Experimental design: Crossover study
• Animals:
  • 12 Swiss Holstein cows (HCH)
  • 12 Holstein cows of New Zealand origin (HNZ)
  • BW: HCH, 621 ± 100 kg
      HNZ, 567 ± 83 kg
  • 91 ± 18 d in milk
• Feed:
  • Pasture (6.5 MJ NEL/kg DM, 173 g CP/kg DM)
  • 0 kg or 6 kg of cereal grain mix concentrate (Conc) offered in 2 meals

NEL = netto energy lactation  CP = crude protein (N * 6.25)
Material and methods

- Measurements:
  - Milk yield and milk composition
  - Feed intake $\rightarrow$ n-alkane double indicator technique (MAYES et al., 1986)
  - Eating behaviour $\rightarrow$ chewing recorders (NYDEGGGER et al., 2011)
  - Blood parameters
- Statistic: Mixed-model analyses concerning cow strain and concentrate
Results: Milk yield

Milk yield:

- $P_{(\text{Conc})} < 0.001$; $P_{(\text{Cow})} < 0.05$
- $P_{(\text{Cow} \times \text{Conc})} < 0.05$

- HCH produced more ($P < 0.05$) milk per kg concentrate than HNZ (0.8 vs. 0.5 kg/kg)

Energy corrected milk yield (ECM):

- $P_{(\text{Conc})} < 0.001$; $P_{(\text{Cow})} = 0.41$
- $P_{(\text{Cow} \times \text{Conc})} = 0.16$

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Results: Milk composition

Milk protein

![Bar chart showing milk protein percentage for 0kg and 6kg concentrate supplementation.]

Milk fat

![Bar chart showing milk fat percentage for 0kg and 6kg concentrate supplementation.]

Milk protein:
- HCH = Red bar
- HNZ = Yellow bar

P (Conc) = 0.13
P (Cow) < 0.01

Milk fat:
- HCH = Red bar
- HNZ = Yellow bar

P (Conc) < 0.001
P (Cow) = 0.08

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Results: Feed intake

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Feed intake

- Grass: 12 kg DM/d
- Grass + 6kg Concentrate: 18 kg DM/d
- Concentrate: 6 kg DM/d

<table>
<thead>
<tr>
<th>Items</th>
<th>Conc 0kg</th>
<th>Conc 6kg</th>
<th>P-Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intake / BW^{0.75} (kg DM / 100 kg)</td>
<td>10.4</td>
<td>12.5</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>ECM / intake (kg / kg)</td>
<td>1.84</td>
<td>1.69</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>
Results: Eating behaviour

Rumination

Eating

Rumination: $P\ (\text{Conc}) = 0.15$
$P\ (\text{Cow}) < 0.05$

HCH =
HNZ =

Eating: $P\ (\text{Conc}) < 0.001$
$P\ (\text{Cow}) = 0.20$

No differences in bites per bolus (n/d): $P\ (\text{Conc}) = 0.26$; $P\ (\text{Cow}) = 0.83$
# Results: Blood parameters

<table>
<thead>
<tr>
<th>Items</th>
<th>Conc 0kg</th>
<th>Conc 6kg</th>
<th>SD</th>
<th>P-Values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HCH</td>
<td>HNZ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glucose (mmol / l)</td>
<td>3.15</td>
<td>3.31</td>
<td>0.18</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td></td>
<td>3.25</td>
<td>3.46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urea (mmol / l)</td>
<td>4.86</td>
<td>4.77</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.68</td>
<td>3.73</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BHB (mmol / l)</td>
<td>0.91</td>
<td>0.82</td>
<td>0.17</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.68</td>
<td>0.69</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEFA (mmol / l)</td>
<td>0.12</td>
<td>0.14</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.08</td>
<td>0.09</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BHB = $^2$-hydroxybutyrate  
NEFA = non-esterified fatty acids
Conclusion

• HCH were better able to use concentrate for extra milk production → no differences without concentrate supplementation between HCH and HNZ

• HNZ had longer rumination time → better fibre digestibility? → no effect on feed conversion efficiency

• With supplementation:
  • Low milk fat content → changes in ruminal fermentation, but no difference in bites per bolus → indicate adequate fibre content in diet or inadequate indicator?
  • Less time spent eating, but total DM intake increased → more energy for milk production, but extra milk production less than 1 kg milk per kg concentrate → economical aspect
  • Without supplementation: blood parameters indicate a small energy deficit
Thank you for your attention!
Results: Physical activity

Standing

Moving

Lying

Standing:

P (Conc) = 0.39
P (Cow) = 0.31

Moving:

P (Conc) < 0.001
P (Cow) = 0.74

Lying:

P (Conc) < 0.001
P (Cow) = 0.053
## Results: Eating behaviour

<table>
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<th>Conc 6kg</th>
<th>P-Values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HCH</td>
<td>HNZ</td>
<td>HCH</td>
</tr>
<tr>
<td>Bites per boli (n / d)</td>
<td>51.5</td>
<td>53.8</td>
<td>54.9</td>
</tr>
<tr>
<td>Bites eating (n / d)</td>
<td>41’232</td>
<td>42’102</td>
<td>32’070</td>
</tr>
<tr>
<td>Ruminating mastication (n / d)</td>
<td>27’661</td>
<td>29’796</td>
<td>28’888</td>
</tr>
</tbody>
</table>