Timing of initiation and duration of feeding ruminally-protected choline (RPC) affects performance of lactating Holstein cows


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Change in Yield of Milk or FCM From Supplementation With Various RP-Choline Sources During the Transition Period

Mean increase of 2.0 kg/d

* choline effect, $P < 0.10$
Change in Yield of Milk or FCM From Supplementation With Various RP-Choline Sources After the Transition Period

- Mean increase of 3.2 kg/d

* choline effect, $P < 0.10$

- Intake of Choline ions
  - Davidson et al., 2008 (40 g/d)
  - Erdman & Sharma, 1991 (43 g/d)
  - Moshen et al., 2011 (22 g/d)
  - Erdman & Sharma, 1991 (33 g/d)
Supplementation of ruminally-protected choline (RPC)\textsuperscript{1} to multiparous Holstein cows will increase milk yield regardless of whether that supplementation is initiated prepartum or post-transition; however, milk yield response should be greatest when supplementation is initiated prepartum.

Objective

To evaluate the timing of initiation and duration of feeding ruminally-protected choline (RPC)\textsuperscript{1} on dairy cow performance.

\textsuperscript{1} ReaShure, Balchem Corp., New Hampton, NY
Materials and Methods

• 99 Pregnant\textsuperscript{1}, nonlactating multiparous Holstein cows from the University of Florida research herd were enrolled in the experiment at 241 d of gestation.

• Cows trained to Calan gates were supplemented once daily with 0 or 12.9 g/d of choline ion (0 or 60 g/d of ReaShure) as a top-dressing mixed with ground corn and dried molasses for the last 21 d before calving (255 d of gestation).

\textsuperscript{1} One cows was removed due to calving issues.
Dietary Treatment Arrangement

No choline
-21 days 0 21 105
Control (No RPC) Control (No RPC)

Post-transition
-21 days 0 21 105
Control (No RPC) Choline (60 g of RPC; ReaShure)

Transition
-21 days 0 21 105
Choline (60 g of RPC; ReaShure) Control (No RPC)

Continuous
-21 days 0 21 105
Choline (60 g of RPC; ReaShure) Choline (60 g of RPC; ReaShure)

Days relative to calving
<table>
<thead>
<tr>
<th>Item, DM basis</th>
<th>Prepartum diet</th>
<th>Lactation diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEL, Mcal/kg¥</td>
<td>1.48(^1)</td>
<td>1.71(^2)</td>
</tr>
<tr>
<td>Crude protein, %</td>
<td>15.8</td>
<td>16.6</td>
</tr>
<tr>
<td>Metabolizable protein, g/d¥</td>
<td>1,055(^1)</td>
<td>2,435(^2)</td>
</tr>
<tr>
<td>Methionine, % of MP¥</td>
<td>2.9</td>
<td>2.4</td>
</tr>
<tr>
<td>Lysine : Methionine¥</td>
<td>2.6:1</td>
<td>3.0:1</td>
</tr>
<tr>
<td>aNDF, %</td>
<td>41.7</td>
<td>29.9</td>
</tr>
<tr>
<td>ADF, %</td>
<td>23.9</td>
<td>19.9</td>
</tr>
<tr>
<td>Starch, %</td>
<td>18.2</td>
<td>26.7</td>
</tr>
<tr>
<td>Ca, %</td>
<td>0.58</td>
<td>0.79</td>
</tr>
<tr>
<td>P, %</td>
<td>0.33</td>
<td>0.36</td>
</tr>
<tr>
<td>DCAD, mEq/100 g</td>
<td>-10.2</td>
<td>34.3</td>
</tr>
</tbody>
</table>

\(¥\) Based on NDS Professional  
\(^1\) Based on DMI of 11.7 kg/d  
\(^2\) Based on DMI of 22.0 kg/d
Statistical Analysis

• Analyses was divided into the following 2 periods of time:
  • Transition;
    • Control vs. RP-choline during the transition period
  • Post-transition; 2 by 2 factorial design
    • Control, post-transition, transition, continuous
1) Control vs. RP-choline during the transition period

- No choline; n = 50
  - Post-transition
    - Control (No RPC)
    - No choline

- Choline; n = 49
  - Transition
    - Choline (60 g of RPC; ReaShure)
  - Continuous
    - Choline (60 g of RPC; ReaShure)

Days relative to calving
Statistical Analysis

- Analyses was divided into the following 2 periods of time:
  - Transition;
    - Control vs. RP-choline during the transition period
  - Post-transition; 2 by 2 factorial design
    - RPC fed in transition
    - RPC fed post transition
    - The interaction of feeding RPC in transition and post transition
2) RPC fed post transition

No choline; n = 25

Post-transition; n = 25

Transition; n = 25

Continuous; n = 24

Days relative to calving
Effect of Feeding RP-Choline on Colostrum Yield and Composition

Yield, kg:
- Control: 5.2
- Choline: 4.5

Fat, %:
- Control: 4.38
- Choline: 4.38

Protein, %:
- Control: 14.3
- Choline: 14.1

IgG, g/L:
- Control: 117
- Choline: 109

Lactose, %:
- Control: 3.15
- Choline: 3.29

Somatic cell score:
- Control: 7.22
- Choline: 6.50

*P = 0.08

*P = 0.03
# Effect of RP-Choline on first 21 DIM Performance

<table>
<thead>
<tr>
<th>Measure</th>
<th>Control</th>
<th>Choline</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk, kg/d</td>
<td>35.1</td>
<td>36.8</td>
<td>1.1</td>
</tr>
<tr>
<td>Energy-corrected milk, kg/d*</td>
<td><strong>39.0</strong></td>
<td><strong>42.0</strong></td>
<td>1.4</td>
</tr>
<tr>
<td>DM intake, kg/d</td>
<td>16.2</td>
<td>16.4</td>
<td>0.6</td>
</tr>
<tr>
<td>Efficiency (ECM/DMI)*</td>
<td>2.44</td>
<td>2.64</td>
<td>0.07</td>
</tr>
<tr>
<td>Body weight, kg</td>
<td>667</td>
<td>673</td>
<td>7.2</td>
</tr>
<tr>
<td>Body condition score</td>
<td>3.19</td>
<td>3.18</td>
<td>0.05</td>
</tr>
</tbody>
</table>

*Effect of choline, $P < 0.05$
## Effect of RP-Choline on Milk Composition of the first 21 DIM

<table>
<thead>
<tr>
<th>Measure</th>
<th>No Choline in transition</th>
<th>Choline in transition</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk fat, %*</td>
<td><strong>4.41</strong></td>
<td><strong>4.60</strong></td>
<td>0.09</td>
</tr>
<tr>
<td>Milk fat, kg/day*</td>
<td><strong>1.52</strong></td>
<td><strong>1.68</strong></td>
<td>0.06</td>
</tr>
<tr>
<td>True protein, %</td>
<td>3.39</td>
<td>3.35</td>
<td>0.07</td>
</tr>
<tr>
<td>True protein, kg/day</td>
<td>1.16</td>
<td>1.21</td>
<td>0.04</td>
</tr>
<tr>
<td>Somatic cell score</td>
<td>4.28</td>
<td>4.13</td>
<td>0.24</td>
</tr>
</tbody>
</table>

*Effect of choline, $P < 0.05$
Effect of RP-Choline Supplementation on ECM

Week after calving

- Transition, $P = 0.06$
- Post transition, $P = 0.65$
- Transition x Post transition, $P = 0.92$

<table>
<thead>
<tr>
<th>Choline Treatment</th>
<th>kg/d</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Choline</td>
<td>43.5</td>
</tr>
<tr>
<td>Choline in transition</td>
<td>45.8</td>
</tr>
<tr>
<td>Choline post transition</td>
<td>43.2</td>
</tr>
<tr>
<td>Choline continuously</td>
<td>45.2</td>
</tr>
</tbody>
</table>

Transition, $P = 0.06$
Post transition, $P = 0.65$
Transition x Post transition, $P = 0.92$
Effect of Transition Feeding of RP-Choline on Yield of ECM

![Graph showing the yield of ECM over weeks after calving with and without RP-Choline. The graph indicates a higher yield with RP-Choline compared to no choline. The yield for RP-Choline is 45.5 kg/d, while for no choline it is 42.3 kg/d. The statistical analysis shows Choline, $P = 0.06$, and Choline x Time, $P = 0.92$.](chart.png)
Effect of Timing of Feeding RP-Choline on Milk Composition

<table>
<thead>
<tr>
<th>Measure</th>
<th>No Choline</th>
<th>Choline in transition</th>
<th>Choline post transition</th>
<th>Choline continuously</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk fat, %</td>
<td>3.41</td>
<td>3.51</td>
<td>3.50</td>
<td>3.48</td>
<td>0.12</td>
</tr>
<tr>
<td>Milk fat, kg/day *</td>
<td>1.51</td>
<td>1.65</td>
<td>1.54</td>
<td>1.61</td>
<td>0.07</td>
</tr>
<tr>
<td>True protein, %</td>
<td>2.84</td>
<td>2.85</td>
<td>2.90</td>
<td>2.83</td>
<td>0.05</td>
</tr>
<tr>
<td>True protein, kg/day</td>
<td>1.34</td>
<td>1.33</td>
<td>1.38</td>
<td>1.32</td>
<td>0.03</td>
</tr>
<tr>
<td>Somatic cell score</td>
<td>3.87</td>
<td>4.15</td>
<td>3.47</td>
<td>3.45</td>
<td>0.38</td>
</tr>
</tbody>
</table>

*Effect of choline fed in transition, \( P = 0.06 \).
Effect of Transition Feeding of RP-Choline on DM Intake

Week after calving

| Choline, P = 0.79 | Choline x Time, P = 0.31 |

Choline, P = 0.72
Choline x Time, P = 0.86

23.4 kg/d
23.3 kg/d

+ 0.11 kg of ECM per kg of DM intake

Choline, P = 0.79
Choline x Time, P = 0.31

Choline, P = 0.72
Choline x Time, P = 0.86

1.81
1.92

P = 0.01
Energy-corrected Milk Response to Transition Feeding of RP-Choline is not exclusive of those cows in greater BCS

Choline, $P = 0.04$
Choline x Time, $P = 0.86$

- No choline in transition, $\leq 3.5$ BCS
- Choline in transition, $\leq 3.5$ BCS

Week after calving

ECM, kg/day

44.1 kg/d
40.6 kg/d
3.5 kg/d
Effect of Transition Feeding of RP-Choline on BCS

Choline, P = 0.53
Choline x Time, P = 0.87

Choline, P = 0.03
Choline x Time, P = 0.04

No choline in transition
Choline in transition

LSmeans
3.10 BCS
2.98 BCS

Choline, P = 0.75
Choline x Time, P = 0.28
Transition RP-Choline Reduced Incidence of Subclinical Hypocalcemia (SCH) (< 8.0 mg/dL)

\[ P = 0.03 \]
Effect of Transition Feeding of RP-Choline on Prevalence of Subclinical Hypocalcemia (SCH)

*P < 0.05; +P < 0.10

Choline, *P = 0.19
Choline x Time, *P = 0.09
Transition Feeding of RP-Choline Reduced Plasma Concentration of Haptoglobin at Calving

Choline, $P = 0.45$
Choline x Time, $P = 0.67$

Choline, $P = 0.28$
Choline x Time, $P = 0.08$

* $P < 0.05$
Conclusions

The response (milk yield) to dietary choline by the multiparous Holstein cow is most evident when supplemented during late pregnancy and early lactation.

• Similar results to previous trial at UF were ...
  • The effect of RPC supplementation on milk yield persisted beyond 21 d
  • No effect of RPC on DMI
  • Cows in in BCS ≤ 3.5 are the most responder to RP-Choline
  • Less Subclinical hypocalcemia in CHO-fed cows
  • Less inflammation during the periparturient period in CHO-fed cows (?)

• Different results to previous trial at UF were ...
  • Colostrum IgG concentration was greater in CHO-fed cows in the 2015, but not different in the 2017 trial

What about the in utero effect of choline on heifers performance?