INTRODUCTION
- Feeding lower dietary protein (CP < 16% of DM) increased N efficiency and maintained production in field studies.
- Dairy cows experience negative protein balance during early lactation.
- High producing cows mobilize up to 1000 g/d of tissue protein to support milk protein or for gluconeogenesis during first 7 to 10 days in milk (DIM).

OBJECTIVE
- Investigate transcriptional adaptation and proteolytic activity of skeletal muscle of high producing cows in response to plane of dietary and metabolizable protein during early lactation.

MATERIALS AND METHODS

Completed Randomized Design
- Thirty-one multiparous Holstein cows (a subset of a larger study)
  - Treatments:
    - LL: a low CP (15% DM) diet (1 to 91 DIM, n = 9)
    - HL: a high CP (17.5% DM) diet (1 to 21 DIM), and a low CP diet (22 to 91 DIM, n = 11)
    - HM: a high CP diet (1 to 21 DIM), and a medium CP (16.2% DM) diet (22 to 91 DIM, n = 11)

Data Collection
- Milk yield and DMI (daily), and milk composition (weekly)
- Plasma 3-methylhistidine (3-MH) and serum creatinine (CRE) (1, 7, 13, 19, 26, 40, 54, 68, and 82 DIM)
- Semitendinosus muscle biopsy (2, 11, and 62 DIM)
- Gene expression:
  - RNA extraction: 100 mg tissue, QIAzol + miRNeasy Micro Kit (QIAGEN)
  - Primer design: Primer Express 3.0
  - RT-qPCR: standard curve method for relative mRNA expression
  - Normalization with geometric mean of 3 internal control genes

Statistical Analysis
- ANOVA with MIXED procedure of SAS
- Repeated measures for unequally spaced interval of sampling
- Fixed effect: treatment, DIM
- Random effect: cow within treatment
- Natural logarithmic transformation for gene expression as needed

RESULTS

Table 1. Nutrient composition of diets.

<table>
<thead>
<tr>
<th>Item</th>
<th>Low CP diet</th>
<th>Moderate CP diet</th>
<th>High CP diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP, % DM</td>
<td>15.3 ± 0.1</td>
<td>17.0 ± 0.2</td>
<td>17.7 ± 0.1</td>
</tr>
<tr>
<td>Neutral detergent fiber, % DM</td>
<td>35.6 ± 0.3</td>
<td>34.4 ± 0.2</td>
<td>33.3 ± 0.3</td>
</tr>
<tr>
<td>Starch, % DM</td>
<td>24.2 ± 0.2</td>
<td>24.5 ± 0.2</td>
<td>24.6 ± 0.3</td>
</tr>
<tr>
<td>NEL, Mcal/kg DM</td>
<td>1.64 ± 0.01</td>
<td>1.64 ± 0.01</td>
<td>1.65 ± 0.01</td>
</tr>
</tbody>
</table>

Table 2. Intake and production performance from calving to wk 9 of lactation.

<table>
<thead>
<tr>
<th>Item</th>
<th>LL</th>
<th>HL</th>
<th>HM</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMI, kg/d</td>
<td>25.9</td>
<td>26.0</td>
<td>25.1</td>
<td>0.98</td>
</tr>
<tr>
<td>CP intake, kg/d</td>
<td>3.79</td>
<td>3.95</td>
<td>4.02</td>
<td>0.12</td>
</tr>
<tr>
<td>NE intake, Mcal/d</td>
<td>41.6</td>
<td>41.9</td>
<td>40.3</td>
<td>0.12</td>
</tr>
<tr>
<td>Milk yield, kg/d</td>
<td>48.3</td>
<td>49.9</td>
<td>51.4</td>
<td>2.66</td>
</tr>
<tr>
<td>Fat, kg/d</td>
<td>1.87</td>
<td>1.91</td>
<td>1.91</td>
<td>0.00</td>
</tr>
<tr>
<td>Fat, %</td>
<td>3.70</td>
<td>3.74</td>
<td>3.69</td>
<td>0.87</td>
</tr>
<tr>
<td>True protein, kg/d</td>
<td>1.48</td>
<td>1.97</td>
<td>1.97</td>
<td>0.00</td>
</tr>
<tr>
<td>True protein, %</td>
<td>2.93</td>
<td>2.91</td>
<td>2.91</td>
<td>0.51</td>
</tr>
<tr>
<td>MUN, mg/dL</td>
<td>8.47</td>
<td>8.99</td>
<td>11.66</td>
<td>0.43</td>
</tr>
</tbody>
</table>

Statistical Analysis
- ANOVA with MIXED procedure of SAS
  - Repeated measures for unequally spaced interval of sampling
  - Fixed effect: treatment, DIM
  - Random effect: cow within treatment
  - Natural logarithmic transformation for gene expression as needed

CONCLUSIONS
- Feed intake and lactation performance were not affected by plane of dietary protein in early lactation.
- Moderate reduction of dietary protein (by 1% of DM) did not amplify the breakdown of skeletal muscle during early lactation.
- The physiology of early lactation rather than dietary protein level coordinated transcriptional adaptation of genes in skeletal muscle, which may facilitate proteolysis, sparing glucose, and using fatty acid as energy substrates.

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