Strategies to Improve Economic Efficiency of the Dairy

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Considering nutritional grouping

Take home messages

Opportunity to improve economic efficiency
Considering additional nutritional groups

Diets closer to requirements
Saves feed costs and increases income over feed costs

Improved profitability
IOFC gains far exceed additional expenses or losses

Additional benefits
• ↓ environmental concerns
• ↑ health conditions
Feeding all lactating cows equally
A larger number of cows are overfed

Same ration (TMR) to all cows (groups)
All lactating cows receive same nutrient density diet

Preferred “high” rations
Low producing animals receive more nutrients than required

One diet for all
Would never optimize production and efficiency

VandeHaar, 2011
Improve feed efficiency + feeding groups

Improved nutrient use efficiency
Diet closer to cow requirements

Less nutrient excretion
Decreased environmental concerns

Less overfed animals
Decreased over conditioned cows

Lower feeding costs
Higher milk income over feed cost

Wang et al., 2000
Why farmers do not group more?

Trying to find most important constraints

2-page mailed survey

Results (responses)
• 196 WI farms
• 211 MI farms

Constraints to feeding more ration groups
1. Milk drops when cows are moved
2. Desire to keep management simple
3. Conflicts with grouping for reproduction
4. Farm facilities do not allow it
5. Not enough labor or personnel to handle it

Contreras-Govea et al., 2013
A simulation study...
Strategies for grouping cows
Depend on farm and herd characteristics

Individual cow nutrient requirements
• Energy
• Protein (RUP, RDP, MP)

Number of lactating cows on the herd
States

Farm characteristics
Capacity to handle lactating feeding groups

Adapted from McGilliard et al., 1983; St-Pierre and Thraen, 1999
Milk (and components)
Cow-specific lactation curves

Milk based on
• Herd ME305
• Cow PPA or ME305
• Stochasticity

Components
• Herd
• Stochasticity

Base function
• Woods
• Adjusted Woods

De Vries, 2001
1. Available from farm records, or
2. Stochastic distribution

Initial individual cow BW
Cow-specific BW

Daily BW and BCS change according to:
- Lactation
- DIM
- Stochasticity

<table>
<thead>
<tr>
<th>Body weight, kg</th>
<th>Days after calving</th>
</tr>
</thead>
<tbody>
<tr>
<td>565</td>
<td>0</td>
</tr>
<tr>
<td>580</td>
<td>200</td>
</tr>
<tr>
<td>595</td>
<td>400</td>
</tr>
<tr>
<td>610</td>
<td>600</td>
</tr>
<tr>
<td>625</td>
<td>800</td>
</tr>
</tbody>
</table>
Criteria for nutritional grouping

Several criteria exist

Days after calving (DIM)
Based on stage of lactation

Fat (protein) corrected milk
Based on level of production measured as F(P)CM

Dairy merit
Function of both F(P)CM and BW

Cluster
Seems to be MOST efficient criterion

McGilliard et al., 1983
St-Pierre and Thraen, 1999
Nutritional grouping
Two main types of groups

Obligated groups
• Fresh (< 22 DIM)
• Dry (=> 220 DCC)
• Daily assigned

Optional groups
• Actual additional groups
• Daily assigned
• Monthly re-grouped
Cow and herd simulation
Monte Carlo approach

Next event scheduling
• Pregnancy
• Abortion
• Dry-off
• Parturition
• Involuntary culling
• Death

Two-step
• 1. Binary outcome of event:
  • Happens or not
  • E.g., uniform distribution

• 2. DIM of the occurrence
  • When it happens
  • E.g., Weibull distribution

Immediate replacement
• After a cow leaves the herd

Replicates
• 1,000 replicates for each cow within specific herd
## Cow simulation

Follows actual COW card

<table>
<thead>
<tr>
<th>Variable</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow ID</td>
<td>#</td>
<td>Cow identification</td>
</tr>
<tr>
<td>Parity</td>
<td>#</td>
<td>Lactation</td>
</tr>
<tr>
<td>DIM</td>
<td>d</td>
<td>Days in milk, days after calving</td>
</tr>
<tr>
<td>DCC</td>
<td>d</td>
<td>Days in pregnancy (DIP)</td>
</tr>
<tr>
<td>Fat</td>
<td>%</td>
<td>Fat component on milk</td>
</tr>
<tr>
<td>Protein</td>
<td>%</td>
<td>Protein component on milk (%)</td>
</tr>
<tr>
<td>PPA*</td>
<td>%</td>
<td>Predicted producing ability</td>
</tr>
<tr>
<td>ME 305*</td>
<td>kg/305 d</td>
<td>Mature equivalent milk production</td>
</tr>
<tr>
<td>BW</td>
<td>kg</td>
<td>Live body weight</td>
</tr>
</tbody>
</table>

*Either PPA or ME305 used to assess cow’s milk class. PPA preferred if available*
# Studied herds

All data collected at the **cow-level**

<table>
<thead>
<tr>
<th>Herd (size)</th>
<th>570</th>
<th>787</th>
<th>727</th>
<th>331</th>
<th>1460</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herd ME 305, kg</td>
<td>16,140</td>
<td>12,884</td>
<td>13,897</td>
<td>13,348</td>
<td>14,188</td>
</tr>
<tr>
<td>1</td>
<td>43</td>
<td>39</td>
<td>39</td>
<td>38</td>
<td>45</td>
</tr>
<tr>
<td>Average DIM</td>
<td>187</td>
<td>178</td>
<td>201</td>
<td>208</td>
<td>189</td>
</tr>
<tr>
<td>21-d PR, %</td>
<td>18</td>
<td>19</td>
<td>19</td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td>Culling risk, %</td>
<td>32</td>
<td>37</td>
<td>36</td>
<td>35</td>
<td>40</td>
</tr>
<tr>
<td>Abortion, %</td>
<td>7</td>
<td>11</td>
<td>11</td>
<td>16</td>
<td>7</td>
</tr>
<tr>
<td>BW available</td>
<td>✗</td>
<td>✗</td>
<td>✓</td>
<td>✓</td>
<td>✗</td>
</tr>
</tbody>
</table>
...And we are finding
Herd 331, nutritional diets

Crude protein, % DM

1 group

2 groups

3 groups

Months after starting simulation
Cow 6338(727) = 78% milk, 1 yr

3rd Lactation

Milk

DMI

-$23$ milk, -$200$ feed, +$177$ IOFC

Group-pen availability
State of cow

-846 Mcal

-137 kg CP
Cow10020(727) = 92% milk, 1 yr

1st Lactation

- $18 milk, -$43 feed, +$25 IOFC

-165 Mcal

-32 kg CP
Economic efficiency

Income over feed cost ($/cow per yr)

Nutritional groups

1. $2,375
2. $2,425
3. $2,475
4. $2,525
5. $2,575

Nutritional groups
331
570
727
787
1460

+$19
+$20
+$45
+$47
+$55
+$57
+$61
+$63
+$66
+$70
+$73
Energy efficiency

Mcal/Mcal consumed (%)

Nutritional groups

- +0.69%
- +0.38%
- +0.58%
- +0.26%
- +0.75%
- +1.02%
- +0.93%
- +0.96%
- +0.73%
- +0.63%
- +0.73%
- +0.63%

Nutritional groups:

- 331
- 570
- 727
- 787
- 1460
Nitrogen efficiency

Milk N produced/Feed N consumed (%) vs. Nutritional groups

Nutritional groups:
- 331
- 570
- 727
- 787
- 1460

Changes in nitrogen efficiency:
- +0.41%
- +0.61%
- +0.25%
- +0.69%
- +0.84%
- +0.91%
- +0.93%
- +0.75%
- +0.71%
- +0.94%

Graph shows the relationship between milk nitrogen production and feed nitrogen consumption across different nutritional groups.
Impact of milk depression

Milk depression

No milk depression

-0.05% Δgroup

9.1 kg

Income over feed cost ($/cow per yr, bars)

Nutritional groups

Herd 787
Decision support tool…

http://DairyMGT.info
A simplified online tool
Herd-specific assessments (DairyMGT.info)
Additional costs and benefits
Impacts grouping feeding strategies

Management cost
• Additional labor
• Extra management

Avoid costs
• Additives and supplements savings

Milk depression
• Cow social interactions
Grouping Strategies

Farm/herd possibilities and decision-making

Current Groups

NO

How many can?

Current diet

Group sizes

Added Cost & Benefits

YES

How many does?

How many can?

Current diet

Group sizes

Added Cost & Benefits
Tool demonstration
# Grouping Illustration

## Economic impact of nutritional grouping

### Current Situation

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactating Cows</td>
<td>470</td>
</tr>
<tr>
<td>Current Groups</td>
<td>None</td>
</tr>
<tr>
<td>NEL Mcal/lb</td>
<td>0.80</td>
</tr>
<tr>
<td>CP, %</td>
<td>17</td>
</tr>
</tbody>
</table>

### Possible Situation

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
<td>3</td>
</tr>
<tr>
<td>Group Sizes</td>
<td>100, 100, 270</td>
</tr>
<tr>
<td>Milk loss</td>
<td>2.27 kg/d x 4 d</td>
</tr>
<tr>
<td>Added Costs</td>
<td>$1,000/month</td>
</tr>
<tr>
<td>Saved costs</td>
<td>None</td>
</tr>
</tbody>
</table>
### Possible Situation

<table>
<thead>
<tr>
<th>Group</th>
<th>Cows</th>
<th>NEL</th>
<th>CP</th>
<th>IOFC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td>0.62</td>
<td>13.07</td>
<td>4.7</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
<td>0.65</td>
<td>14.18</td>
<td>7.2</td>
</tr>
<tr>
<td>3</td>
<td>270</td>
<td>0.71</td>
<td>16.05</td>
<td>9.3</td>
</tr>
<tr>
<td>All</td>
<td>470</td>
<td>0.68</td>
<td>15.02</td>
<td>7.9</td>
</tr>
</tbody>
</table>

### Current Situation

<table>
<thead>
<tr>
<th>Group</th>
<th>Cows</th>
<th>NEL</th>
<th>CP</th>
<th>IOFC</th>
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<tbody>
<tr>
<td>All</td>
<td>470</td>
<td>0.80</td>
<td>17.00</td>
<td>6.9</td>
</tr>
</tbody>
</table>

**Annual value of grouping $135,000/ herd**
Wisconsin herds analysis
Analysis from dairy farm records
30 Wisconsin dairy farms

No grouping vs. 3 groups
- Same size groups

Same prices for all
- $0.35/kg milk
- $0.315/kg CP
- $0.1174/Mcal NEI

Grouping criterion
- Cluster

Projected body weight
- 500 kg primiparous
- 600 kg multiparous
Analysis from dairy farm records
30 Wisconsin dairy farms

<table>
<thead>
<tr>
<th>Lactating cows (n=30)</th>
<th>No grouping</th>
<th>3 Groups</th>
<th>Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>&lt;200</td>
<td>697</td>
<td>1,059</td>
</tr>
<tr>
<td>Mean</td>
<td>788</td>
<td>2,311</td>
<td>2,707</td>
</tr>
<tr>
<td>Maximum</td>
<td>&gt;1,000</td>
<td>2,967</td>
<td>3,285</td>
</tr>
</tbody>
</table>

Increase of IOFC ($/cow per year)
• Between 7 and 52%
• Mean = $396
• Range = $161 to $580
Acknowledgements

This project is supported by Agriculture and Food Research Initiative Competitive Grant No. 2011-68004-30340 from the USDA National Institute of Food and Agriculture
Thanks