Nutritional Grouping Strategies for Dairy Lactating Cows

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Rationale
Opportunity to fine-tune nutrient use

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

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

One diet for all
Would never optimize production and efficiency
**Improve feed efficiency**

+ feeding groups (precision feeding)

**Improved nutrient use efficiency**
Diet closer to cow requirements

**Less nutrient excretion**
Decreased environmental concerns

Wang et al., 2000

**Less overfed animals**
Decreased overweighted cows

**Lower feeding costs**
Higher milk income over feed cost
Why farmers do not group more?
Trying to find most important constraints

2-page mailed survey

25% feeding same ration to all lactating

<table>
<thead>
<tr>
<th>Reported constraint</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Perception of milk drops</td>
</tr>
<tr>
<td>2  Keep mgt. simple</td>
</tr>
<tr>
<td>3  Conflicts w/repro group</td>
</tr>
<tr>
<td>4  Facilities do not allow</td>
</tr>
<tr>
<td>5  Don’t believe are needed</td>
</tr>
<tr>
<td>6  Nutritionist don’t want</td>
</tr>
<tr>
<td>7  Labor or personnel</td>
</tr>
</tbody>
</table>

Results (responses)
~200 WI
~59 MI

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

Individual cow nutrient requirements
• Energy
• Protein

Farm characteristics
Capacity to handle lactating feeding groups

Number of lactating cows on the herd

Adapted from McGilliard et al., 1983; St-Pierre and Thraen, 1999
Cow-level estimates
Internally performed

Nutrient requirement
• NEL (NRC, 2001)
• CP (McGilliard et al., 1983)

Feed requirement
• DMI (NRC, 2011)

Live body weight
• Farm records (if available)
• Calculated (Korver et al., 1985)

Nutrient per unit DM
• NEL/DMI
• CP/DMI

![Graph showing body weight vs. days after calving for lactation 1 and lactation > 1](image)
Nutrient requirement for a group
Energy and protein

Lead factor
Multiplicative factor to adjust nutrient requirements of a group

Stallings and McGilliard, 1984
St-Pierre and Thraen, 1999

$$NE_{group} \ (Mcal) = 83^{rd} \ Percentile \ of \ (NE_{group\_cows})$$

$$CP_{group} \ (%) = 83^{rd} \ Percentile \ (CP_{group\_cows})$$
Criteria for nutritional grouping

Several criteria exist

Days after calving (DIM)
Based on stage of lactation

Fat corrected milk
Based on level of production measured as FCM

Dairy merit
Function of both FCM and BW

Cluster
Seems to be MOST efficient criterion

McGilliard et al., 1983
St-Pierre and Thraen, 1999
Value of NE, CP, and milk
Determine diets’ cost (August 2013)

Using referee feeds
Petersen method

St-Pierre and Giamocic, 2000

Corn:  9% CP + 2 Mcal/kg  = $0.267/kg

SBM: 54% CP + 2.2 Mcal/kg = $0.587/kg

Price NE and CP
NE ($/Mcal) = 0.116
CP ($/kg) = 0.748

Price of milk
$0.42/kg

http://future.aae.wisc.edu/

http://dairymgt.info/tools/feedval_12/index.php
Optimize cows to a feeding group
Maximize the income over feed cost

Non-linear optimization
• Iterative process (all permutations)
• Search for global maxima IOFC

\[ \text{Max}(\text{IOFC}) = \text{SUM}(\text{IOFC}_{\text{group}}) \]

\[ \text{IOFC}_{\text{group}} = \text{Milk Value} - \text{Feed Cost} \]

Cabrera, 2012
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
• Diet changes
Overall net return
Bottom line grouping strategies

Net return
+ Max (IOFC)
- Extra management
- Milk depression
+ Savings
Grouping strategies for feeding
Online user-friendly decision support tool
Video demonstration
Available at DairyMGT.info

Grouping Strategies for Feeding Lactating Dairy Cattle

Wisconsin University of Wisconsin-Madison

Extension
Get the farm data

Farm time specific dataset

NE and CP value
• Farm known value
• Calculated from corn and soybean meal

Milk price
• Farm known value

Grouping strategies
• Farm current situation
• Possible situations

Cow information
Table of specific data

<table>
<thead>
<tr>
<th>Cow ID</th>
<th>Parity</th>
<th>DIM</th>
<th>Milk, lb/d</th>
<th>Milk fat, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>6234</td>
<td>1</td>
<td>84</td>
<td>62</td>
<td>4.1</td>
</tr>
<tr>
<td>132</td>
<td>7</td>
<td>118</td>
<td>73</td>
<td>3.8</td>
</tr>
<tr>
<td>6196</td>
<td>1</td>
<td>198</td>
<td>85</td>
<td>3.4</td>
</tr>
<tr>
<td>6149</td>
<td>4</td>
<td>199</td>
<td>114</td>
<td>3.6</td>
</tr>
<tr>
<td>5045</td>
<td>2</td>
<td>280</td>
<td>81</td>
<td>4.3</td>
</tr>
</tbody>
</table>

Additional information
• Cow’s BW, or
• Parity’s average BW
Grouping strategies for feeding
Decision process

Currently grouping?

- How many groups farm can do?
  - How many groups farm does?
  - Current diet formulation
    - Size of possible groups
      - Additional costs and benefits
    - Additional costs and benefits
  - Current diet formulation
    - Size of possible groups
Tool application
Wisconsin farm with 470 lactating cows

<table>
<thead>
<tr>
<th>Current situation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactating cows</td>
<td>470</td>
</tr>
<tr>
<td>Number groups</td>
<td>None</td>
</tr>
<tr>
<td>NE, Mcal/lb</td>
<td>0.80</td>
</tr>
<tr>
<td>CP, %</td>
<td>17%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Possible situation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number groups</td>
<td>3</td>
</tr>
<tr>
<td>Group sizes</td>
<td>100, 100, 270</td>
</tr>
<tr>
<td>Added cost, $</td>
<td>$1,000/month</td>
</tr>
<tr>
<td>Milk loss</td>
<td>5 lb/cow</td>
</tr>
<tr>
<td>Milk loss time</td>
<td>4 days</td>
</tr>
<tr>
<td>Saved cost, $</td>
<td>$0</td>
</tr>
</tbody>
</table>
## Decision support system

### Cluster grouping criteria

<table>
<thead>
<tr>
<th></th>
<th>Cow numbers</th>
<th>NE, Mcal/lb</th>
<th>CP, %</th>
<th>IOFC, $/cow/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>270</td>
<td>0.71</td>
<td>16.05</td>
<td>9.3</td>
</tr>
<tr>
<td>Group 2</td>
<td>100</td>
<td>0.65</td>
<td>14.18</td>
<td>7.2</td>
</tr>
<tr>
<td>Group 3</td>
<td>100</td>
<td>0.62</td>
<td>13.07</td>
<td>4.7</td>
</tr>
</tbody>
</table>

$\times 1,000$

3 groups

$\times 1,000$

3 groups

Annual value of grouping $\times 1,000$

### $147,000$ / 470 cows

Cabrera et al., 2012
Tool application
30 Wisconsin dairy farms

No grouping vs. 3 groups
• Same size groups

Same prices for all
• $15.89/cwt milk
• $0.14337/lb CP
• $0.1174/Mcal NEI

Cluster grouping
• 83rd percentile CP and NEI

Projected body weight
• 1,100 lb primiparous
• 1,300 lb multiparous
### Analysis from dairy farm records

30 Wisconsin dairy farms

<table>
<thead>
<tr>
<th></th>
<th>Number of lactating cows (n=30)</th>
<th>Income over Feed Cost (no grouping)</th>
<th>Income over Feed Cost (3 groups)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$/cow per year</td>
<td>$/cow per year</td>
<td>$/cow per year</td>
</tr>
<tr>
<td>Mean</td>
<td>788</td>
<td>$2,311</td>
<td>$2,707</td>
</tr>
<tr>
<td>Minimum</td>
<td>&lt; 200</td>
<td>$697</td>
<td>$1,059</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

**After reasonable extra costs**

- Still increased net margin of between 5 and 47%
Thanks