TMR Fine-Tuning

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Presentation Outline

- Goals for a good TMR
- Tracer auditing methods
- My summer project
- Results and Conclusions
TMR 101

• TMR = Total Mixed Ration

• Allows greater control and accuracy over the ingredients and nutrients fed

• Improves rumen fermentation

• Increases milk production
Rumen Functions & TMR

- Ideal particle size for digestion
- Maintain normal rumen pH
- Microbial protein production
- Maintain consistent fermentation conditions
TMR Ration Sorting
Importance of Monitoring

- Hard to manage without measuring.
  - Need data to know what has been occurring
  - Need data to monitor management changes
  - Need to be able to effectively monitor how the feeding plan was implemented
  - Information has to be readily available for effective monitoring
There are Different Rations

- We’ve all heard that there are three rations
  1. What’s on paper
  2. What’s mixed
  3. What’s consumed

But how do we know when those are different, how do we test for it and what do we do when we know the results?
Variation in Feeding

• TMR testing--is it useful?
  1-2-3 Rule:

  Rule of Thumb for TMRs

  \[
  \begin{array}{ccc}
  CP & \pm 1 & ADF \pm 2 & DM \pm 3 \\
  \end{array}
  \]

• Count marker feeds
• Particle size along length of bunk
• Check for over-mixing (e.g. new TMR feeders or after maintenance)
Making an Ideal TMR

• Avoid under-mixing
  – less effective utilization of the feed

• Avoid over-mixing
  – Grind or pulverize feed
  – Cause ingredients to separate
  – Forage particle size reduced which reduces amount of fibre available for digestion
  – Can cause digestive upset, displaced abomasums, laminitis, acidosis, low cud chewing
What is a TMR Audit?

- Evaluates methods of feed storage, preparation and delivery
- Penn State particle size separator
  - Four-tier screen system to help determine if particle size recommendations are being met
Tracer Methods

• Sodium Analysis
  – Samples taken from bunk are sent to lab to determine whether sodium is distributed evenly through the feed (submit 10 samples, total analytical cost approx. $100)

• Visible tracers: Addition of marker feeds are another form of tracer, e.g. white beans, as was done in this study

• Tracers are used to assess variation in samples of the TMR. Reported as the coefficient of variation (CV)
  – Lower CV is better, as that indicates better consistency
• My project involved 13 farms and a total of 16 TMR audits

• We added white beans to the TMR during mixing to compare the results with the Penn State box and sodium tracer
My Days on Farm...

• Arrive on farm before mixing (often VERY early)

• Ask some general questions about the mixing
  – Type of mixer and its age
  – What regular maintenance is done on the mixer
  – How many cows are being fed
  – What is the mixing sequence and how long is the feed being mixed

• Add 7.5g of beans per kilogram of mix
  – Usually added at the same time as supplements
• Immediately after feeding, 10 samples were taken and shaken through the Penn State box

• Number of beans were counted and weight of sample per tray was taken

• 10 more samples taken weighed three hours later
  – To determine extent of feed sorting by cows

• Coefficient of variation was calculated, samples also taken for sodium analysis
### White Bean Example Results

<table>
<thead>
<tr>
<th></th>
<th>Av. Tray 1</th>
<th>Av. Tray 2</th>
<th>Av. Tray 3</th>
<th>Av. Tray 4</th>
<th>CoVar Tray 1</th>
<th>CoVar Tray 2</th>
<th>CoVar Tray 3</th>
<th>CoVar Tray 4</th>
<th>Av CoVar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round 1</td>
<td>34.6</td>
<td>28.2</td>
<td>30.2</td>
<td>6.9</td>
<td>11.9</td>
<td>10.1</td>
<td>4.6</td>
<td>8.3</td>
<td>8.7</td>
</tr>
<tr>
<td>Round 2</td>
<td>36.5</td>
<td>28.8</td>
<td>30.4</td>
<td>4.1</td>
<td>18.5</td>
<td>16.9</td>
<td>7.3</td>
<td>18.1</td>
<td>15.2</td>
</tr>
</tbody>
</table>

#### Number of Beans Per Kilogram at Farm #1

![Bar Chart for Number of Beans Per Kilogram at Farm #1](chart.png)
Effects of Feed Sorting on Tray Percentages at Farm #1

- **Av. Tray 1**: Round 1 > Round 2
- **Av. Tray 2**: Round 1 ≈ Round 2
- **Av. Tray 3**: Round 1 > Round 2
- **Av. Tray 4**: Round 1 > Round 2

Bars represent the percentage of sample present in each tray.
Percentages of Mass of Total Sample in Each Tray for Farm #1

Sample Number

1
2
3
4
5
6
7
8
9
10

Percentage of Sample Present

% tray 1
% tray 2
% tray 3
% tray 4
# Example Sodium Tracer Lab Results:

<table>
<thead>
<tr>
<th>Sample #</th>
<th>Farm A AM</th>
<th>Farm A PM</th>
<th>Farm D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.329</td>
<td>0.247</td>
<td>0.485</td>
</tr>
<tr>
<td>2</td>
<td>0.329</td>
<td>0.257</td>
<td>0.500</td>
</tr>
<tr>
<td>3</td>
<td>0.314</td>
<td>0.277</td>
<td>0.483</td>
</tr>
<tr>
<td>4</td>
<td>0.266</td>
<td>0.296</td>
<td>0.483</td>
</tr>
<tr>
<td>5</td>
<td>0.269</td>
<td>0.271</td>
<td>0.424</td>
</tr>
<tr>
<td>6</td>
<td>0.274</td>
<td>0.283</td>
<td>0.519</td>
</tr>
<tr>
<td>7</td>
<td>0.275</td>
<td>0.265</td>
<td>0.503</td>
</tr>
<tr>
<td>8</td>
<td>0.252</td>
<td>0.278</td>
<td>0.553</td>
</tr>
<tr>
<td>9</td>
<td>0.271</td>
<td>0.271</td>
<td>0.491</td>
</tr>
<tr>
<td>10</td>
<td>0.259</td>
<td>0.253</td>
<td>0.531</td>
</tr>
<tr>
<td>Mean</td>
<td>0.284</td>
<td>0.27</td>
<td>0.498</td>
</tr>
</tbody>
</table>

| Coeff. Of Variation (%) | 10.1 | 5.5 | 6.5 |
TMR Goal: Precise Feeding

• Feed cost is a huge expense to a dairy farm and we expect this to continue in the long run

• The are many different feed management areas to focus on, cannot focus just on the ration to optimize feeding program

• “Variety may be the spice of life, but consistency pays the bills.”
Conclusions

• Using the beans was good in that it provides same day results

• It was time consuming

• Particle size gave a good overview of whether large and medium particles are mixed consistently – useful check after making changes to feeding

• Sodium analysis ended up being more accurate at determining consistency high value ingredients
Acknowledgements

- John Osborne, Floradale Feed Mill Limited
- University of Guelph/OMAFRA KTT Funding
- Participating Farmers
Investigation of Nutritional Practices on Robotic Dairy Farms in Ontario

Tom Wright, OMAFRA
Vern Osborne, John Cant, Michelle Linington, and Vanja Djukic, University of Guelph
The Study

- 33 farms surveyed

  Feed samples
  Water sample
  Survey – management, nutrition, barn layout
  Production data from robot
Participants
Automatic Milking

- Partial mixed ration (PMR) is fed in the feedbunk plus feed (usually pellets) provided in the robot

- Two feeds are distinct but both can affect
  - Milk production
  - Cow health
  - Milking behaviour (e.g. # of visits)

- Different Barn Designs for Cow Traffic flow:
  - Free-traffic
  - Milk-first
  - Feed-first
Milk Production

Average Milk Yield (kg/cow/day)

Farm Number

1  3  5  7  9  11  13  15  17  19  21  23  25  27  29  31
Milk Composition

![Milk Composition Chart]

- **Farm Number**
- **Protein Content**
- **Fat Content**

The chart illustrates the protein and fat content across various farms, with Farm Number 26 showing a notably higher fat content compared to other farms.
## Particle Size of the PMR

<table>
<thead>
<tr>
<th></th>
<th>% Long Particles</th>
<th>% Medium Particles</th>
<th>% Short Particles</th>
<th>% Fine Particles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penn State</td>
<td>2-8</td>
<td>30-50</td>
<td>30-50</td>
<td>20 or less</td>
</tr>
<tr>
<td>Past Ontario TMR Research</td>
<td>19.8±6.5</td>
<td>34.3±6.6</td>
<td>35.5±3.3</td>
<td>10.5±2.9</td>
</tr>
<tr>
<td>Robot PMR results</td>
<td>13.1±6.7</td>
<td>47.1±8.0</td>
<td>32.2±7.0</td>
<td>7.6±3.9</td>
</tr>
</tbody>
</table>
PMR: Energy and CP

CP = 13-18%
Energy = 1.4-1.8 Mcal/kg
PMR – Nutrient Variation
Source of Total Dietary Energy

![Bar chart showing net energy required and provided by PMR and pellet for each farm number. The chart illustrates the dietary energy distribution across different farms, with a clear indication of net energy provided by PMR and pellet for each farm.](chart.png)
Net Energy Provided by Pellet

6.9 to 35%, Avg. 21.7%
Pellet Nutrient Composition

![Bar chart showing CP (%DM) and NEL (Mcal/kg) across different farms. The x-axis represents Farm Number from 1 to 31, and the y-axis represents CP (%DM) and NEL (Mcal/kg). The chart compares Protein Content (blue) with NEL (red) for each farm.](image)
Frequency of Pellet CP% Surveyed

Number of Farms

CP (%DM)

18% 19% 20% 21% 22% 23% 24% 25% 27% 30% 35% 42% 46%
Pellet Variation by Farm

- **CP**: Minimum (15), Average (25), Maximum (35)
- **NDF**: Minimum (10), Average (20), Maximum (30)
- **ADF**: Minimum (5), Average (10), Maximum (15)
High Moisture Corn

- Dispensed separately from pellet
  - Some difficulty with flow
High Moisture Corn

- Premixed in fixed fraction with pellet and dispensed together
Pellet Calcium Content

![Bar chart showing the calcium content of pellets from different farms. The x-axis represents the farm number, and the y-axis represents the percentage of dry matter (%DM). The bars indicate the calcium content for each farm.]
Water Quality

Water Parameters

Iron (ppm) vs. Farm Number

Sulphate (ppm)

Iron Content

Sulphate

Farm Number

1 3 5 7 9 11 13 15 17 19 21 23 25 27 29
% of Cows Fetched

% of Milking Cows

Farm Number
Grouping Strategies

# Feeding Groups

Farm Number
Feed Comparison

Example Herd
Herd milking average 32 L/d, Butterfat 3.8%

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>$/tonne</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn Silage</td>
<td>55</td>
</tr>
<tr>
<td>Haylage</td>
<td>80</td>
</tr>
<tr>
<td>HM corn</td>
<td>200</td>
</tr>
<tr>
<td>Protein supplement</td>
<td>470</td>
</tr>
<tr>
<td>Premix</td>
<td>1,000</td>
</tr>
<tr>
<td>Chopped straw</td>
<td>90</td>
</tr>
<tr>
<td>Robot pellets</td>
<td>450</td>
</tr>
</tbody>
</table>

(Keunen, 2014)
## Example Feed Costs

<table>
<thead>
<tr>
<th></th>
<th>1-Group TMR</th>
<th>Milk-First</th>
<th>Feed-First</th>
<th>Free-Traffic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TMR or PMR Balance Point</strong></td>
<td>35</td>
<td>33</td>
<td>30</td>
<td>25</td>
</tr>
<tr>
<td><strong>Robot Pellet Quantity</strong></td>
<td>N/A</td>
<td>1-3, avg 1.5</td>
<td>2-5, avg 2.3</td>
<td>2-7, avg. 3.4</td>
</tr>
<tr>
<td><strong>Pellet Cost $/cow/day</strong></td>
<td>0</td>
<td>0.68</td>
<td>1.03</td>
<td>1.53</td>
</tr>
<tr>
<td><strong>Protein and Premix $/cow/d</strong></td>
<td>1.86</td>
<td>1.78</td>
<td>1.62</td>
<td>1.45</td>
</tr>
<tr>
<td><strong>Subtotal ($/cow/d)</strong></td>
<td>1.86</td>
<td>2.46</td>
<td>2.65</td>
<td>2.98</td>
</tr>
<tr>
<td><strong>Total Ration Cost ($/cow/d)</strong></td>
<td>5.99</td>
<td>6.13</td>
<td>6.21</td>
<td>6.39</td>
</tr>
<tr>
<td><strong>Yearly purchased feed cost ($/yr)</strong></td>
<td>67,890</td>
<td>89,790</td>
<td>96,725</td>
<td>108,770</td>
</tr>
</tbody>
</table>
Acknowledgements

- University of Guelph/OMAFRA KTT Program
- Robyn Walsh - Post Farm Structures
- Dean Miller – Norwell Dairy Systems
- Ron Piett – A&L Labs
- CanWest DHI
- Progressive Dairy Operators
- Participating farmers
Thanks and Questions

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