November 9, 2016: Gage County Extension Office
Beatrice, NE

November 10, 2016: Lifelong Learning Center
Norfolk, NE
<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00 am</td>
<td>Registration</td>
</tr>
<tr>
<td>10:00 am</td>
<td>Welcome</td>
</tr>
</tbody>
</table>
| 10:15 am – 11:00 am | **Feeding the pre-weaned calf**  
Dr. Pete Erickson, State Dairy Specialist, University of New Hampshire |
| 11:00 am – 11:30 am | **Reducing Cold Stress**  
Kim Clark & Paul Kononoff, Dairy Extension Educators, University of Nebraska-Lincoln |
| 11:30 am - 12:15 pm | **Calf Nutrition: Post-weaning and starter feeding**  
Dr. Pete Erickson, State Dairy Specialist, University of New Hampshire |
| 12:15 pm - 12:45 pm | Lunch                                                                |
| 12:45 pm - 1:30 pm | **Development, growth rate targets, and feeding strategies for growing heifers.**  
Dr. Jill Anderson, Assistant Professor, South Dakota State University |
| 1:30 pm - 2:00 pm | **Dairy Beef: Performance and Carcass Characteristics**  
Dr. Andrea Watson, Research Assistant Professor, University of Nebraska-Lincoln |
| 2:00 pm – 2:30 pm | Break                                                                 |
| 2:30 pm – 3:15 pm | **Utilizing distillers grains and other alternative protein sources in growing heifer rations**  
Dr. Jill Anderson, Assistant Professor, South Dakota State University |
| 3:15 pm      | Conclusion and evaluation                                            |
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Prime:

Choice:
Workshop Speakers

**Dr. Peter Erickson** is Professor of Dairy Management and Extension Dairy specialist at the University of New Hampshire. His teaching includes courses in dairy cattle nutrition, physiology of lactation, technical writing, and advanced dairy herd management. He and his graduate students conduct research in the nutrition of the transition cow, newborn and post-weaned heifer. He is a native of New England having worked on his neighbor’s dairy farm in central Massachusetts. He holds a B.S. in Animal Science from the University of Massachusetts, a M.S. in Animal Science from the University of Maine, and a Ph.D. in Dairy Science from the University of Illinois. He has been employed as a nutritionist with Ralston Purina Canada, Hoffmann-LaRoche, and Agri-King. He lives with his wife and two daughters on a small farm in central New Hampshire.

**Kim Clark** is a dairy extension educator at the University of Nebraska-Lincoln (UNL) in the Animal Science Department. She joined the faculty at UNL in July 2015. Clark earned both her B.S. degree in Animal Science and her M.Ag. degree in Animal Science and Agricultural Economics with a minor in Agriculture Leadership from the University of Nebraska-Lincoln. Her responsibilities include communicating with Nebraska dairy producers on the latest research from UNL and the dairy industry, providing them with educational resources for their operation, collaborating with the Nebraska State Dairy Association (NSDA), dairy organizations, universities across the nation, and planning in-state and multi-state programs. Clark will work with UNL faculty, Nebraska and other state Extension Educators, NSDA and other organizations and for the benefit of Nebraska’s dairy producers.

**Dr. Jill Anderson** is an Assistant Professor of Dairy Production in the Dairy and Food Science Department at South Dakota State University. She joined the faculty at SDSU in 2012. She earned her B.S. degree in Animal Science from the University of Delaware, her M.S., in Animal Science specialization in Dairy Production in 2005 from SDSU and in 2012 earned her Ph.D. in Dairy Science specialization in Production also from SDSU. Her Ph.D. research was focused on the effects on feeding fat from dried distillers grains on dairy heifer growth and development. Jill’s current research program at SDSU is focused on evaluation of different feeding strategies and alternative feed ingredients for growing replacement dairy calves and heifers. Major objectives of this research are to help dairy producers understand their feeding options, improve heifer performance, and decrease rearing cost. Recent research projects have focused on feeding distillers grains, developing oilseed meals, microbially-enhanced feeds, or hydroponically grown feeds to dairy calves or heifers. Jill is a member of Multi-state North Central Cooperative Research Project NC-2042: Management Systems to Improve Economic and Environmental Sustainability of Dairy Enterprises and the South Dakota Oilseed Initiative. Additionally, she is involved with teaching a few courses at SDSU including Introduction to Dairy Science and is co-advisor for the Dairy Club.

**Dr. Andrea Watson** is a Research Assistant Professor in the Animal Science department at UNL focusing on Ruminant Nutrition. Areas of research she is involved in include protein utilization and metabolism as well as nutrient cycling through agriculture systems. She is also the coordinator for an online minor in Beef Cattle Nutrition through the Master of Applied Science degree program.
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Feeding the preweaned calf

Dr. Pete Erickson
Professor of Dairy Management and
Extension Dairy Specialist

Fairchild Dairy Teaching and Research Center,
University of New Hampshire, Durham
Five C's of Successful Calf Rearing
- Colostrum
- Cleanliness
- Consistency
- Calories
- Comfort

Dr. Sheila McGuirk, U of WI School of Veterinary Medicine

- Total cost associated with raising dairy replacements is 15 to 25% of the total cost to operate a dairy.
- 2014 U of WI update (Hoards Dairyman, September) for 40 calf raising operations av. cost of $5.31/day from birth to 61 days and custom raisers av. $3.16/day (weaned at 45 days of age).
- Knowing true costs of raising heifers is critical.
  - Chester-Jones (2015)

- Av cost post weaning in WI to pre-fresh was $1,323 or $2.04/day (648.5 days). Dairy operations averaged 24 months for first freshening. Custom raised heifers freshened at 23 months.
- Knowing true costs of raising heifers is critical.
  - Chester-Jones (2015)
Colostrum

- First secretion after parturition
- Provides calf with Ig
- First source of water
- Calves are born with 3% body fat

Colostrum basics* (Fetrow, 2009)
- Quality -> 50 g/L IgG;
- Quantity–
  - 4 quarts (10% BW) - possibly more (2 qts more)
- Quickness – < 6 h
- Cleanliness-
  - < 100,000 cfu/ml;
  - Feed < 1-2 h
  - or refrigerate < 48 h

Why is colostrum important?

- 7.8 % of preweaned calves die. Primarily due to diarrhea (NAHMS, 2007)
- Almost 20 % of calves have failure of passive transfer (FPT) (serum IgG <10 g/L) (NAHMS, 2007)
- 60% of the colostrum produced in the US fails to meet minimum standards (Morrill et al., 2012)
• Increased IgG uptake has been correlated with increased milk yield 8.5kg of ME milk/ 1 g/L IgG increase (DeNise et al., 1989)
• Reduced morbidity and mortality
• Increased ADG

• 37 Brown Swiss heifers fed 2 L of good quality (> 50g/L colostrum) vs. 31 Brown Swiss heifers fed 4 L of good quality colostrum
• Veterinary costs $/calf = 24.51 for 2L, 14.77 for 4L
• Age of conception 2L = 14 mos, 4L – 13.5 mos.
• ADG 2L 1.8 lb/d, 4L = 2.27 lb/d (P<0.001)
• Faber et al., 2005
Milk yield 2L Lactation 1 = 17,305 lb
Milk yield 4L Lactation 1 = 16,595 lb (P>0.05)
Milk yield 2L Lactation 2 = 18,008 lb
Milk yield 4L Lactation 2 = 20,983 lb (P<0.05)

Feeding 2L more resulted in better overall performance!!

To Improve colostrum management:
1) Improve the quality (IgG) fed.
2) Increase the quantity of colostrum provided.
3) Feed colostrum to the calf as soon after birth as possible.

• Davis and Drackley (1998)
Colostrum Quality

- Good quality colostrum contains greater than 50 g IgG/L
- Fair 25 g – 50g IgG/L
- Poor < 25 g IgG/L
- Colostrum contains other Ig including IgA (3.9 g/L and IgM 4.2 g/L)
<table>
<thead>
<tr>
<th>Brix %</th>
<th>IgG (g/L)</th>
<th>Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;15</td>
<td>0-28</td>
<td>Poor-Fair</td>
</tr>
<tr>
<td>15-20</td>
<td>28-50</td>
<td>Fair</td>
</tr>
<tr>
<td>20-30</td>
<td>50-80</td>
<td>Good</td>
</tr>
<tr>
<td>&gt;30</td>
<td>&gt;80</td>
<td>Excellent</td>
</tr>
</tbody>
</table>
How should colostrum be fed?

- In the US about 2/3 of the dairy producers either use a nipple bottle or an esophageal feeder.
- 1/3 still allow the calf to nurse their dam - not recommended.
- Besser et al. (1991) found that 61.4% of dairy calves that were allowed to nurse failed to attain passive transfer (24 h IgG < 10g/L).

Using an Esophageal feeder and a nipple bottle (Elizondo-Salazar et al. 2011)

- 40 calves
- Colostrum tested 74.92 g/L
- Fed 3.8 L with a nipple bottle remaining colostrum was provided by an esophageal feeder with 1.5 - 2 h after birth

Treatment and blood parameters (24h) of calves fed colostrum by a nipple bottle or both. (Elizondo-Salazar et al., 2011)

<table>
<thead>
<tr>
<th>Item</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calves</td>
<td>1.3</td>
</tr>
<tr>
<td>Nipple, L</td>
<td>0.85</td>
</tr>
<tr>
<td>Tube fed, L</td>
<td>1.85</td>
</tr>
<tr>
<td>Serum IgG, g/L</td>
<td>23.4</td>
</tr>
<tr>
<td>AEA,%</td>
<td>35.3</td>
</tr>
</tbody>
</table>
Heat stress

- Tao et al (2012)
- Cows were exposed to cooling (sprinklers and fans) or heat stress (no sprinklers or fans)
- Calves (12 cooled dams, 9 heat stressed dams)
- All fed 3.78 L maternal colostrum

<table>
<thead>
<tr>
<th>Variable</th>
<th>Heat stress</th>
<th>Cooling</th>
<th>P =</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth weight, kg</td>
<td>36.5</td>
<td>42.5</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Colostrum IgG, g/L</td>
<td>86.8</td>
<td>77.3</td>
<td>0.36</td>
</tr>
<tr>
<td>28d serum IgG, g/L</td>
<td>10.6 +/- 1.7 g/L</td>
<td>15.8 +/- 1.5 g/L</td>
<td>0.03</td>
</tr>
<tr>
<td>Weaning weight, kg</td>
<td>65.9</td>
<td>78.5</td>
<td>0.04</td>
</tr>
<tr>
<td>Estimated 24h IgG, g/L</td>
<td>16</td>
<td>25</td>
<td></td>
</tr>
</tbody>
</table>

Cold Stress

- Norwegian data- Gulliksen et al (2008) indicated that cows calving in the winter months produced colostrum with lower IgG than any other season of the year.
- Cows calving in December, January and February produced colostrum that averaged <50 g/L
• In contrast, Conneely et al (2013) in Ireland indicated that colostrum quality was highest in autumn and lowest in early Spring.
• Breed effects
• Environmental effects

New Data from UNH
• Developed an equation to predict colostrum quality using previous cow DHI data (accepted J. Dairy Sci.)
• Used 111 Holstein cows from 9 NH dairy farms
• Needed to be at least first parity
• Needed to be on DHI
• Cabral et al., (J. Dairy Sci).

Equation
• $\ln IgG = 4.03864 - 0.05018 \times \text{PASWK} + 2.28887 \times \ln FY - 2.15129 \times \ln FP - 2.25429 \times \ln PY + 2.10609 \times \ln PP + 0.14457 \times \ln \text{PAR} - 0.00025683 \times \text{PTAM} + 0.01553 \times \text{D} >; r^2 = 0.56$
• There will be a quiz at the end!
What does this mean?

- Weeks on pasture was a negative
- Previous fat yield was a positive
- Previous fat percent was a negative
- Previous protein yield was a negative
- Previous protein percent was a positive
- Parity was positive
- PTA milk was negative
- Days above 73° F was positive

Feeding the dam

- Garcia et al (2014) fed 78 prepartum cows for 8 weeks
- Control (no supplemental fat)
- 1.7% Saturated Fat
- 2.0% Ca- salts of FA
- Calves born from cows fed supplemental fat had higher 24h serum IgG and a higher AEA
• Gao et al (2012) fed 3 different energy concentrations to prepartum cows for 3 weeks. High (6.48 MJ/kg), Medium (5.88 MJ/kg) and low (5.25 MJ/kg). Calves born from cows fed the higher energy diet had increased numbers of CD4+ cells (T- helper cells)
• Indicator of better immunity

Niacin and Colostrum Quality
• Prepartum cows were given 48 g/d of niacin beginning 4 weeks before freshening
• Results were that colostrum quality was improved by about 20% (increased IgG g/L)

• Aragona et al., 2016 J.Dairy Sci. 99:3529-3538.

Pasteurization
• Gelsinger et al (2014) collected colostrum over 2 years
• Split into 3 categories
• High (>90g/L), Medium (70 g/L), low (50 g/L)
• ½ was pasteurized (60 C for 30 min) and ½ was frozen.
### Plasma IgG after pasteurization

<table>
<thead>
<tr>
<th>Item</th>
<th>Unheated H</th>
<th>Unheated M</th>
<th>Unheated L</th>
<th>Heated H</th>
<th>Heated M</th>
<th>Heated L</th>
<th>P-value T</th>
<th>P-value Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>IgG1</td>
<td>22.4</td>
<td>17.4</td>
<td>13.9</td>
<td>26.4</td>
<td>21.5</td>
<td>15.4</td>
<td>0.03</td>
<td>0.01</td>
</tr>
<tr>
<td>IgG2</td>
<td>0.8</td>
<td>0.7</td>
<td>1.4</td>
<td>1.1</td>
<td>0.9</td>
<td>0.5</td>
<td>0.03</td>
<td>0.01</td>
</tr>
<tr>
<td>IgG</td>
<td>23.3</td>
<td>18.1</td>
<td>13.3</td>
<td>27.5</td>
<td>22.5</td>
<td>14.8</td>
<td>0.03</td>
<td>0.01</td>
</tr>
<tr>
<td>AEA,%</td>
<td>23.1</td>
<td>26.9</td>
<td>24.5</td>
<td>30.9</td>
<td>30.2</td>
<td>28.4</td>
<td>0.01</td>
<td>0.66</td>
</tr>
</tbody>
</table>

- Pasteurization increases IgG uptake.
- Gelsinger et al. (2014) speculate that it might be due to a reduction in absorption of other non-Ig colostral proteins.

### What if colostrum is poor quality or not produced?
- Use a LACTEAL based colostrum replacer!
- Follow manufacturer directions
- Typically try to get 200 g of IgG into the calf from these products by 6 h of life.
- Will not be as good as Mom’s, but is a great substitute
- Colostrum supplements not effective on day 1
- Can be effective after day one added to Milk replacer
Milk and Starter Feeding Phase

- Calves are born non-ruminants
- Must become a ruminant through the consumption of dry feeds
- Typically coarse starter grain
- Must consume milk or milk replacer

- Fermentation of grain results in the production of the VFA’s primarily butyrate results in the production of papillae
- More VFA’s are produced by coarse starter
- If a fine or pelleted starter is fed then feed hay

Comparison of rumen papillae development at 6 weeks in calves fed milk only (A), milk and grain (B), or milk and dry hay (C).

Heinrichs - Penn State
• Calves fed milk or milk replacer due to the esophageal groove and the chemical composition of the milk or replacer preferentially shunt the milk or milk replacer to the abomasum.

• Production of butyrate and propionate at the expense of acetate
• Forages maintain a higher ruminal pH and decrease the production of VFA
• The increased absorption observed with propionate and butyrate suggest their requirement for rumen development
Pre-ruminant Stomach

Ruminant Stomach

How the stomach changes over time

- Assume calf is fed dry feed and milk replacer or milk

<table>
<thead>
<tr>
<th>Age</th>
<th>Abomasum</th>
<th>Forestomach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth - 2 weeks</td>
<td>70%</td>
<td>30%</td>
</tr>
<tr>
<td>8 weeks</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>3-4 Months</td>
<td>25%</td>
<td>75%</td>
</tr>
<tr>
<td>Maturity</td>
<td>&lt;10%</td>
<td>&gt;90%</td>
</tr>
</tbody>
</table>
Milk and Milk replacer

Types

Starters

Milk Replacer Types

- Should be all milk protein
- Can use some with SPC or Egg protein but must be < 50% of total protein
- Conventional MR 20-22% CP: 20% fat, feed at 4L/calf/d
- Accelerated range fro 26:16 to 28:20 there are some that are 32:30
Free Choice Water

• A MUST !!
• Bacteria that reside in the rumen need an aqueous environment.
• Water is an essential nutrient separate from milk
Where is there more life?

- Feed these up to and over 1.5 kg of powder/d
- All calves get free choice starter
- I prefer coarse starter vs. pelleted starter
- Stimulates rumen development

UNH Data

- Chapman et al., 2016
- 24 newborn Holstein heifer calves
- Daily DMI
- Weekly BW and skeletal measures
- N efficiency during the 5th week
- ½ weaned at d 42 fully weaned at d 49
- Followed for 1 wk after
Nutrient analysis of control, and moderate protein milk replacer, and starter grain

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Control</th>
<th>MR</th>
<th>MMR</th>
<th>Starter</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM, %</td>
<td>98.2</td>
<td>98.2</td>
<td>90.1</td>
<td></td>
</tr>
<tr>
<td>CP, %</td>
<td>19.9</td>
<td>26.3</td>
<td>20.7</td>
<td></td>
</tr>
<tr>
<td>Fat, %</td>
<td>20.7</td>
<td>18.6</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>ADF, %</td>
<td>-</td>
<td>-</td>
<td>7.6</td>
<td></td>
</tr>
<tr>
<td>NDF, %</td>
<td>-</td>
<td>-</td>
<td>16.0</td>
<td></td>
</tr>
<tr>
<td>Starch, %</td>
<td>-</td>
<td>-</td>
<td>32.3</td>
<td></td>
</tr>
<tr>
<td>Ash, %</td>
<td>5.3</td>
<td>5.9</td>
<td>7.5</td>
<td></td>
</tr>
</tbody>
</table>

Preweaning Growth data

<table>
<thead>
<tr>
<th>Item</th>
<th>C</th>
<th>MMR</th>
<th>HMR</th>
<th>SE</th>
<th>TRT</th>
<th>Week</th>
<th>Int</th>
</tr>
</thead>
<tbody>
<tr>
<td>MR int (lb)</td>
<td>0.97</td>
<td>1.47</td>
<td>1.85</td>
<td>0.01</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Starter (lb)</td>
<td>1.18</td>
<td>0.67</td>
<td>0.47</td>
<td>0.15</td>
<td>0.01</td>
<td>&lt;0.001</td>
<td>0.003</td>
</tr>
<tr>
<td>DMI (lb)</td>
<td>2.16</td>
<td>2.13</td>
<td>2.32</td>
<td>0.15</td>
<td>0.65</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>FE ADF (lbs)</td>
<td>0.45</td>
<td>0.56</td>
<td>0.57</td>
<td>0.03</td>
<td>0.02</td>
<td>0.04</td>
<td>0.01</td>
</tr>
<tr>
<td>Water (lbs)</td>
<td>0.75</td>
<td>0.90</td>
<td>0.57</td>
<td>0.22</td>
<td>0.61</td>
<td>0.12</td>
<td>0.27</td>
</tr>
<tr>
<td>ADG (lbs)</td>
<td>0.93</td>
<td>1.32</td>
<td>1.64</td>
<td>0.11</td>
<td>0.002</td>
<td>&lt;0.001</td>
<td>0.01</td>
</tr>
<tr>
<td>WH (in)</td>
<td>32.0</td>
<td>32.2</td>
<td>32.6</td>
<td>0.12</td>
<td>0.01</td>
<td>&lt;0.001</td>
<td>0.06</td>
</tr>
<tr>
<td>HH (in)</td>
<td>33.3</td>
<td>33.3</td>
<td>34.2</td>
<td>0.45</td>
<td>0.001</td>
<td>&lt;0.001</td>
<td>0.35</td>
</tr>
<tr>
<td>SHRA (code)</td>
<td>0.18</td>
<td>0.16</td>
<td>0.15</td>
<td>0.006</td>
<td>0.005</td>
<td>&lt;0.001</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Nitrogen Efficiency

<table>
<thead>
<tr>
<th>Item</th>
<th>Treatment</th>
<th>SE</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>N intake (g/d)</td>
<td>C</td>
<td>51.6</td>
<td>54.9</td>
</tr>
<tr>
<td>N urine output (g/d)</td>
<td>MMR</td>
<td>2.10</td>
<td>3.25</td>
</tr>
<tr>
<td>N in urine (%)</td>
<td>HMR</td>
<td>12.1</td>
<td>17.0</td>
</tr>
<tr>
<td>N in feces (%)</td>
<td>C</td>
<td>5.65</td>
<td>5.55</td>
</tr>
<tr>
<td>N in feces (g/d)</td>
<td>MMR</td>
<td>337</td>
<td>243</td>
</tr>
<tr>
<td>N in milk (g/d)</td>
<td>HMR</td>
<td>13</td>
<td>10.7</td>
</tr>
<tr>
<td>N retention (g)</td>
<td>C</td>
<td>27.2</td>
<td>22.5</td>
</tr>
<tr>
<td>N efficiency (%)</td>
<td>MMR</td>
<td>52.7</td>
<td>48.7</td>
</tr>
</tbody>
</table>
Accelerated vs Conventional Milk Replacer

- 36 Holstein Heifer calves
- Birth until d 56
- Half the calves were “visited” twice more (4X/d)

Preweaning Milk replacer study

<table>
<thead>
<tr>
<th>Item</th>
<th>Treatment</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>BW, lb</td>
<td>Initial</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C0</td>
<td>96.6</td>
</tr>
<tr>
<td></td>
<td>C1</td>
<td>86.6</td>
</tr>
<tr>
<td></td>
<td>A0</td>
<td>91.3</td>
</tr>
<tr>
<td></td>
<td>A1</td>
<td>95.3</td>
</tr>
<tr>
<td></td>
<td>SE</td>
<td>3.90</td>
</tr>
<tr>
<td></td>
<td>Visit</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>MR</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>INT</td>
<td>-</td>
</tr>
<tr>
<td>MR, lb/d</td>
<td></td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td></td>
<td>C0</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>C1</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>A0</td>
<td>2.41</td>
</tr>
<tr>
<td></td>
<td>A1</td>
<td>2.40</td>
</tr>
<tr>
<td></td>
<td>SE</td>
<td>0.01</td>
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<tr>
<td></td>
<td>Visit</td>
<td>0.39</td>
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<tr>
<td></td>
<td>MR</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>INT</td>
<td>0.51</td>
</tr>
<tr>
<td>Starter, lb/d</td>
<td></td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td></td>
<td>C0</td>
<td>1.09</td>
</tr>
<tr>
<td></td>
<td>C1</td>
<td>0.89</td>
</tr>
<tr>
<td></td>
<td>A0</td>
<td>0.52</td>
</tr>
<tr>
<td></td>
<td>A1</td>
<td>0.52</td>
</tr>
<tr>
<td></td>
<td>SE</td>
<td>0.13</td>
</tr>
<tr>
<td></td>
<td>Visit</td>
<td>0.46</td>
</tr>
<tr>
<td></td>
<td>MR</td>
<td>0.006</td>
</tr>
<tr>
<td></td>
<td>INT</td>
<td>0.43</td>
</tr>
<tr>
<td>Water, lb/d</td>
<td></td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td></td>
<td>C0</td>
<td>3.2</td>
</tr>
<tr>
<td></td>
<td>C1</td>
<td>2.42</td>
</tr>
<tr>
<td></td>
<td>A0</td>
<td>4.01</td>
</tr>
<tr>
<td></td>
<td>A1</td>
<td>4.09</td>
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<td></td>
<td>SE</td>
<td>0.64</td>
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<tr>
<td></td>
<td>Visit</td>
<td>0.51</td>
</tr>
<tr>
<td></td>
<td>MR</td>
<td>0.007</td>
</tr>
<tr>
<td></td>
<td>INT</td>
<td>0.56</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>CD</th>
<th>C1</th>
<th>A0</th>
<th>A1</th>
<th>SE</th>
<th>Visit</th>
<th>MR</th>
<th>INT</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADG, lb</td>
<td>0.91</td>
<td>0.89</td>
<td>1.41</td>
<td>1.36</td>
<td>0.19</td>
<td>0.51</td>
<td>0.01</td>
<td>0.93</td>
</tr>
<tr>
<td>ADG/WMH</td>
<td>0.41</td>
<td>0.39</td>
<td>0.53</td>
<td>0.49</td>
<td>0.04</td>
<td>0.35</td>
<td>0.007</td>
<td>0.90</td>
</tr>
</tbody>
</table>
Overall performance

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Treatment</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C1</td>
<td>C2</td>
</tr>
<tr>
<td>DMI lb/d</td>
<td>1.01</td>
<td>1.16</td>
</tr>
<tr>
<td>ADG, lb/d</td>
<td>1.23</td>
<td>1.16</td>
</tr>
<tr>
<td>Water intake, lb/d</td>
<td>6.51</td>
<td>5.48</td>
</tr>
<tr>
<td>Final Weight, lb</td>
<td>162</td>
<td>158</td>
</tr>
<tr>
<td>ADG/DMI</td>
<td>0.36</td>
<td>0.38</td>
</tr>
</tbody>
</table>

Weaning

- Several methods
- ½ pound of starter for 3 consecutive days
- Cut out second feeding of Milk replacer or milk for the weaning week
- Typically 6-8 weeks

Conclusion

- Colostrum is the key
- ASAP
- Remember they have a very naïve immune system
- Keep them dry clean out of drafts
- Milk and Milk Replacers many different ways to feed
• Provide clean, fresh water at all times
• Don’t Forget to dip navels- new recommendation is twice

• THANK YOU

Questions
REDUCING COLD STRESS IN YOUNG STOCK

Rearing Young Stock for Dairy and Beef Production workshop

November 9-10, 2016

By: Kim Clark, Dairy Extension Educator, UNL & Paul Kononoff, Dairy Extension Specialist, UNL

WHAT IS STRESS?

Stress is an adaptive change or nonspecific response initiated by an internal or external environmental stimulus

• Stress can alter the steady state of the body by causing harmful responses interfering with health, comfort, or well-being of the animal
• Stress is not inherently harmful to an animal; it can be beneficial
  • ie: fight-or-flight response
  • Abnormal stress is harmful
  • Too much, too long

WHAT ARE SOME STRESSORS?

Stimulus = Stressor
Response = Stress

• Social Stressors
• Feed and water deprivation
• Introduction to new feeds
• Weaning
• Extreme weather changes
  • Changes in thermoneutral zone

Nutritional Requirements of Beef Cattle, 2016
THERMONEUTRAL ZONE

- The range of environmental temperatures over which the heat produced by a ‘warm-blooded’ animal remains fairly constant. Hence, it is the range in which the animal is ‘comfortable’, having neither to generate extra heat to keep warm nor expend metabolic energy on cooling mechanisms, such as panting. Animals adapted to cold environments tend to have broader thermoneutral zones than ones living in hot environments.

Encyclopedia.com. 27 October 2016

THERMONEUTRAL ZONE SHIFTS

- Age
- Amount of feed intake
- Amount of subcutaneous fat
- Length and thickness of hair coat

Dairy NRC, 2001

Ken Nordlund, DVM
Dairyland Initiative Workshop, February 14, 2014
NEWBORN CALF

- 3% body fat
- Thermoneutral zone is 50 and 78°F (newborn calf)
  - This range shifts as the calf grows
  - Temperatures outside the thermoneutral zone means the calf is using additional body energy so the animal can remain in the thermoneutral zone.

If extra energy is required outside the thermoneutral zone, what is sacrificed?

GROWTH

<table>
<thead>
<tr>
<th>Body Weight (lb)</th>
<th>Carnivore gaining 1.6 lb/day</th>
<th>Carnivore gaining 1.8 lb/day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>kcal/100 kcal/100 lb</td>
<td>kcal/100 kcal/100 lb</td>
</tr>
<tr>
<td>55</td>
<td>0.96</td>
<td>0.73</td>
</tr>
<tr>
<td>65</td>
<td>1.09</td>
<td>0.75</td>
</tr>
<tr>
<td>75</td>
<td>1.21</td>
<td>0.79</td>
</tr>
<tr>
<td>85</td>
<td>1.33</td>
<td>0.82</td>
</tr>
<tr>
<td>95</td>
<td>1.46</td>
<td>0.86</td>
</tr>
<tr>
<td>105</td>
<td>1.58</td>
<td>0.90</td>
</tr>
<tr>
<td>115</td>
<td>1.67</td>
<td>0.94</td>
</tr>
<tr>
<td>125</td>
<td>1.78</td>
<td>0.98</td>
</tr>
<tr>
<td>140</td>
<td>2.04</td>
<td>1.09</td>
</tr>
<tr>
<td>200</td>
<td>2.53</td>
<td>1.11</td>
</tr>
</tbody>
</table>

GROWTH RATE

- Weight gain during the first 50 days of life affects milk yield as an adult
  - Average daily gain of 2.2 pounds in the first 50 days yields an additional 1,800 pounds of milk in the first lactation

Soberon et al., J. Dairy Sci., 2012
WHAT ROLE DOES AMBIENT TEMPERATURE PLAY?

Dairy NRC, 2001

HOW DO WE MAINTAIN GROWTH IN WINTER MONTHS?

• Add a third feeding
• If feeding twice:
  • add 1/3 more volume
  • Calves may not be able to consume that much in one feeding
• Add supplemental fat (first 14 days)

WHY AVOID COLD STRESS?

• The calf uses more energy to stay warm thus decreasing growth rate
• Cold stress can decrease the immune system
  • Scours, pneumonia, navel infection

<table>
<thead>
<tr>
<th>Time of year</th>
<th>Morbidity</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>13%</td>
<td>1%</td>
</tr>
<tr>
<td>Winter</td>
<td>52%</td>
<td>21%</td>
</tr>
</tbody>
</table>

Godden et al., 2005
WHEN DOES COLD STRESS HAPPEN?

- North wind
- Sudden temperature drop
- Wet bedding
- Wet calf
- Lack of bedding/heat absorbant bedding
- Cold drafts in buildings

SIGNS OF COLD STRESS

- Shivering
  - Warming of the muscles to maintain body temperature
  - More lost energy
- Decreased feed and water intake
- Lowered body temperature <102°F

MAINTAIN BODY TEMPERATURE

- Feed body temperature milk and water (102°F)
- Face calf hutch to the south
- Use calf jackets
- Add additional straw, husks, or shavings.
  - Determine nesting score
  - Bedding must be dry
  - Wet bedding causes loss in body heat
  - Include drainage below the bedding; this pulls moisture away
- Move indoors
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- Face calf hutches to the south
- Use calf jackets
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  - Determine nesting score
  - Bedding must be dry
  - Wet bedding causes loss in body heat
  - Include drainage below the bedding; this pulls the moisture away
- Move indoors

MAINTAIN BODY TEMPERATURE

- Feed body temperature milk and water (102°F)
- Face calf hutches to the south
  - Provide a wind block
- Use calf jackets
- Add additional straw, husks, or shavings.
  - Determine nesting score
  - Bedding must be dry
  - Wet bedding causes loss in body heat
  - Include drainage below the bedding; this pulls the moisture away
- Move indoors

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• Use calf jackets
• Add additional straw, husks, or shavings.
  • Determine nesting score
  • Bedding must be dry
  • Wet bedding causes loss in body heat
  • Include drainage below the bedding; this pulls the moisture away
• Move indoors
SUMMARY

- Energy requirements for maintenance increases as temperature drops
- Add a 3rd feeding
- Feed a fat supplement
- Calves develop fat reserves as they age
- Face hutches to the south
- Use calf jackets
- Bedding should have a nesting score of at least 2
Calf Nutrition- Postweaning and Starter Feeding

Dr. Pete Erickson
Professor of Dairy Management and Extension Dairy Specialist
University of New Hampshire

Outline

• How many heifers do you need?
• What does it cost to raise a dairy heifer?
• Breeding size for dairy heifers
• What is the correlation between calf growth and milk yield?
• New updates on calf starter composition
• Precision Feeding heifers
• Bunk and water space
• UNH Research
• Conclusions

• Heifers are either the third or second most costly enterprise on a dairy farm
• Most farms have TOO many heifers!
• Why do we have so many heifers?
• They are a sizable cost to any enterprise
How many heifers do you need?

- The answer is – It depends
- Questions
  1) Are you expanding your dairy
  2) If not, the following questions apply to you.
     a) How many cows do you have? (A)
     b) What is your cull rate? (B)
     c) What is your calf mortality rate? (C)
     d) What is your age of first calving? (D)

\[ \text{Number of calves on the farm} = 2 \times (A \times (B/100) \times (C+1.0) \times (D/24)) \]

Example: You own a 100 cow dairy with a 35% cull rate, a 5% heifer mortality rate and a 26 age at first calving.

- Calves = \(2 \times [(100 \text{ cows} \times 0.35) \times (1.05) \times (26/24)]\) = 80 calves
- Cost of raising calves = $2.50/days \times 80 \text{ calves} \times 780 \text{ days} = $156,000

- MOST HERDS HAVE TOO MANY HEIFERS

What if you changed your heifer management

- Age of first calving = 22 months (UNH Average)
- Calf mortality = 2% (UNH average)
- Number of heifers = \(2 \times [(100 \text{ cows} \times 0.35) \times (1.02) \times (22/24)]\) = 66 calves
- Cost of raising calves = $2.50/days \times 66 \text{ calves} \times 660 \text{ days} = $108,900
- By improving management this farm saved $47,100 over two years.
- This does include increased lifetime milk!!
How many heifers can you expect per year?

- Equation = Herd size × 12/calving interval × calf sex ratio × (1- mortality rate) × 24/ Age at first calving
- Same 100 cow herd
- Calving interval is 13 months
- Historically 55% of the calves born in a year are heifers
- Mortality rate is 5%
- Age at first calving is 26 months
- Number of heifers = 100 × 12/13 × 0.55 × 0.95 × 24/26 = 44 heifer calves year

What if they reduce their age of first calving to 22 months and reduced their mortality to 2%?

- Number of heifers = 100 × 12/13 × 0.55 × 0.98 × 24/22 = 54 heifer calves year
- Based on the earlier equation - They could sell 108-66 = 42 heifers!!
- Which ones do you sell??

- Goodling, R.C., 2012. Herd data key to managing dairy replacement heifers. Penn State Extension

When to breed a heifer

- For a Holstein heifer 48 inches at the withers
- This should be about 13 months of age.
- Heifer should weigh 55% of mature body weight at breeding age
- Should calve at 85% mature body weight

- To plot your specific herd Penn State has an Excel sheet which can be found at http://extension.psu.edu/animals/dairy/nutrition/heifers/monitoring-heifer-growth/customized-dairy-heifer-growth-chart
Is there a relationship between calf performance and future milk yield

• We know that colostrum intake has a positive effect.
• Some studies suggest that first lactation milk production increases 850 pounds for every 1 pound increase in ADG (Soberon et al., 2012). Other studies do not support this relationship (at least to that point)
• Recently Gelsinger et al., (2016) compared this response over nine experiments

• They used 9 studies with 21 treatment groups
• Observations were that milk replacer intake was negatively correlated to starter intake – as milk replacer intake increased starter intake was lower (difficult weaning)
• They observed that calves that consumed at least 100 g of starter along with milk or milk replacer produced 306 more pounds of milk in their first lactation
How can we get there?

• Starter composition
  • Recently a lot of data on starter composition
  • Traditionally calf starter was a molasses based, steam flaked corn, rolled oats, and protein pellet
  • Recent research suggests that level of molasses and physical form of the grains can impact calf performance.

Molasses level

• Lesmeister and Heinrichs (2005)
• Fed 46 Holstein calves
• 4 L of milk replacer/d (20 %CP, 20% fat)
• Calf starter containing roasted corn, oats and a premix pellet with either 5% or 12 % liquid cane molasses
• Background –some cases adding molasses increases weight gain in growing beef cattle due to more intake, but the opposite was true in dairy cattle due to depressed intakes

<table>
<thead>
<tr>
<th>Item</th>
<th>5% cane molasses</th>
<th>12% cane molasses</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starter intake, week 1-6, (lb/d)</td>
<td>1.12</td>
<td>0.87</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>ADG, week 1-6 (lb)</td>
<td>0.99</td>
<td>0.86</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Final body weight, lb</td>
<td>138.5</td>
<td>131.1</td>
<td></td>
</tr>
</tbody>
</table>

This range in molasses concentration is commonly used in starter.
Results

• Adding additional molasses to 12% negatively affected calf performance.
• It is recommended to keep molasses in starter at 5%

Particle size and preference

• Terre et al. (2016)
• Conducted three experiments on particle size and processing of grains in calf starter.
• They used three studies two with 63 calves and one with 37 calves. Calves entered the study at 10d of age
• Experiment 1 evaluated calf performance based on taste preference feeds contained canola (not preferred protein source), soybean meal (preferred protein source), wheat highly preferred energy source or oats poorly preferred energy source

• They observed a slight improvement in feed efficiency in calves fed wheat and soybean meal compared to calves fed wheat and canola or oats and soybean meal as the primary protein and energy sources of their starter. No other differences
Experiment 2

• Calves were given a choice of starter containing whole grains or steamed rolled grains.
• Results indicated that calves preferred starter containing whole grains during week 1 and steam-rolled grains during week 2, 4 and 5

Experiment 3

• Calves were fed essentially the same starter but one had whole grains, while the other had steam rolled grains
• Starter consumption was higher preweaning when calves received the whole grains during week five and six, all other performance measures were similar. Weaning was at week six. No differences post weaning

• Studies indicate that adding whole grains to starters increase starter intake
• Recommend Starter containing whole corn and oats along with a pellet and 5 % molasses improves intake
• Starter should be about 18% CP as fed
What about hay?

- If you feeding a pelleted starter (no whole or rolled grains)
- Add finely chopped hay to improve rumen retention time
- Should be free choice, but not as a replacement for starter

How much ADG is needed for dairy heifers?

- Conventional information states 1.8 pounds/day
- As greater gains may result in fat deposition in the mammary gland during the allometric growth period up to 9 months of age (irreversible).
- These data did not consider what the gain was comprised of.
- At UNH it is routine for our heifers to gain close to 2.5 pounds/day without getting fat.
- Need to consider what we are feeding these animals
What I don’t want to see!!

Following the target growth system of BAMN

- What is the mature body weight of cows in the herd?
- Multiply mature weight by 0.82 (0.85 Heinrichs)
- What is your desired age at first calving? (22 months I hope!!)
- Multiply mature weight by 0.55 to get weight of heifers at breeding

<table>
<thead>
<tr>
<th>Mature body weight, lb</th>
<th>AFC, mo</th>
<th>Current age</th>
<th>Age at first breeding</th>
<th>Target weight before breeding</th>
<th>Target weight after calving</th>
<th>ADG</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>22</td>
<td>4</td>
<td>820</td>
<td>550</td>
<td>14</td>
<td>1.2</td>
</tr>
<tr>
<td>1400</td>
<td>22</td>
<td>4</td>
<td>1150</td>
<td>770</td>
<td>13</td>
<td>1.8</td>
</tr>
<tr>
<td>1800</td>
<td>24</td>
<td>4</td>
<td>1475</td>
<td>990</td>
<td>15</td>
<td>1.9</td>
</tr>
</tbody>
</table>

Precision feeding heifers - Heinrichs-Penn State

- Feed represents the single largest cost on any dairy farm
- Heifers either the second or third greatest cost
- Feed efficiency is rarely discussed in the dairy world unlike beef or swine industries.
- Recently we started to evaluate milk production efficiency, but rarely do we evaluate heifer feed efficiency
Facts about precision feeding

• The more digestible the ration the more efficient the heifer will be in utilizing the nutrients in the diet.
• The greater the DMI fed as a percent of body weight the lower the feed efficiency.
• The more efficient the heifer the less nutrient waste (manure).
• Free choice forages are not fed.
• The diet is fed as a TMR and fed once daily.

Nutrients (how to precision feed heifers)

Protein

• Pre-pubertal heifers (up to 9 months) 14-15% CP of a DMI of 2.15% BW (a 500 pound heifer would be fed 10.75 pounds of DM/d)
• Post pubertal heifers should be fed 13-14% CP on a DMI of 1.65% BW
• Diets should contain 30-35% soluble protein. MCP synthesis is adequate.
• Hi Bypass feeds are not necessary. RUP is of limited value to the heifer,
• But if high RUP feeds are more economical than they can be used.

• Maximum protein efficiency is obtained when heifers are fed diets containing 14-15% CP.
Energy and fiber

• Heifers should be fed diets for about 1.8 pounds of gain per day
• Or using metabolic body size- 130 kcal of ME/BW(to the 0.75 power)
• Typically 70-90% forage (but used to help meet protein and energy requirements)- not free choice

Vitamins and mineral

• Supplementation of vitamins and minerals are the same as in conventionally fed heifers

Monitor weights

• Use scales
• Weigh tapes to track gains
• Every time a heifer is handled she should be weighed (at least monthly)
• Weigh heifers at the same time each day you weight (gut fill)
• If needed adjust feed intake patterns
Grouping

- Group heifers of the same size
- 200 pounds of weight variation
- (about 2-4 month variation in age)
- After breeding the number can be increased to 300 pound variation

Bunk space

- Using this feeding method and overcrowding heifers will not work
- Since heifers are limited in feeding, They MUST be able to access the bunk all at one time!
- From 4 months to 22 months of age heifers will need 14-24 inches of bunk space
- Try to use headlocks
- If bunk space is a problem try splitting the feedings into two relatively close together so the bigger heifers will eat first (7 and 9 am)

What to expect

- At the start- lots of noise
- This will last for about 10-14 days
- This is due to the reduction in rumen size and gut size needed to accommodate reduced feed intake.
- As long as heifers are gaining at the recommended weight (1.8 pounds/day), they are adequately fed.
Transitioning to the pre-fresh pen

- Precision fed heifers can enter the prefresh pen and receive those diets beginning at 30-45 days before calving with no adverse effects on calf birth weight, dystocia or metabolic problems.
- Rumen and gut volume will increase dramatically when the heifers are put on the prefresh diet.

Nutrient Recommendations for the precision fed heifer (Heinrichs)

<table>
<thead>
<tr>
<th>Age, mos</th>
<th>BW, lbs</th>
<th>DMI, lbs/d</th>
<th>ME, Mcal/d</th>
<th>CP, lbs/d</th>
<th>NDF, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>215</td>
<td>5.72</td>
<td>7.8</td>
<td>0.9</td>
<td>23</td>
</tr>
<tr>
<td>5</td>
<td>250</td>
<td>7.45</td>
<td>10.1</td>
<td>1.1</td>
<td>24</td>
</tr>
<tr>
<td>6</td>
<td>350</td>
<td>9.07</td>
<td>12.2</td>
<td>1.4</td>
<td>26</td>
</tr>
<tr>
<td>7</td>
<td>450</td>
<td>10.62</td>
<td>14.1</td>
<td>1.6</td>
<td>27</td>
</tr>
<tr>
<td>8</td>
<td>550</td>
<td>12.11</td>
<td>16.0</td>
<td>1.8</td>
<td>28</td>
</tr>
<tr>
<td>10</td>
<td>650</td>
<td>13.55</td>
<td>17.9</td>
<td>2.0</td>
<td>29</td>
</tr>
<tr>
<td>11</td>
<td>750</td>
<td>14.95</td>
<td>19.6</td>
<td>2.2</td>
<td>30</td>
</tr>
<tr>
<td>12</td>
<td>850</td>
<td>16.32</td>
<td>21.3</td>
<td>2.4</td>
<td>30</td>
</tr>
<tr>
<td>13</td>
<td>950</td>
<td>17.65</td>
<td>23.0</td>
<td>2.6</td>
<td>31</td>
</tr>
<tr>
<td>14</td>
<td>1050</td>
<td>18.96</td>
<td>24.6</td>
<td>2.8</td>
<td>32</td>
</tr>
<tr>
<td>15</td>
<td>1150</td>
<td>20.24</td>
<td>26.2</td>
<td>3.0</td>
<td>33</td>
</tr>
<tr>
<td>16</td>
<td>1250</td>
<td>21.50</td>
<td>27.7</td>
<td>3.1</td>
<td>33</td>
</tr>
<tr>
<td>17</td>
<td>1350</td>
<td>22.76</td>
<td>29.2</td>
<td>3.2</td>
<td>33</td>
</tr>
</tbody>
</table>

Bunk Space and waterers

- Ranges from 14 inches to 2 feet based on size. All heifers need to be able to eat at the same time
- Headlocks are great (a boss cow can control eight feet of bunk space—probably heifers too)
- Water space 1 waterer per 20 animals, 2 waterers per pen
Stall and pack requirements

• Weaned calf needs 30 sq feet of bedded pack
• 4-8 month old needs 40 sq ft
• 8-12 month old needs 50 sq ft or a 69 by 36 inch stall
• 12-16 month old needs 60 sq ft or a 84 by 40 inch stall
• 16-20 month old needs 70 sq ft or a 96 by 43 inch stall
• 20 to precalving needs 80 sq ft or a 102 by 45 inch stall
• 2-4 week precalving heifer needs 120 sq ft or a 108 by 48 inch stall

UNH Research

• Cinnamaldehyde (essential oil)
• Possible replacement for ionophore
• Reduces coccidiosis in poultry
• Our data (Chapman et al., 2016) no positive or negative effects when compared to control and monensin in 12 week old heifers

• Na-butyrate supplementation- Polish data indicates that adding to preweaned calf diets increases rumen development
• We are investigating the supplementation of Na-butyrate to 3 month to six month old heifers
• Wet Brewer’s Grains in heifer diets (limited data) plan on starting in the Spring
Conclusions/ Take home messages

• Do you have too many heifers
• Can you improve your heifer management?
• Establish goals of freshening at 22 mos of age
• There appears to be a relationship between DMI around weaning to future milk production- optimize this by keeping your calves healthy
• Consider limit feeding follow the recommendations here and work with UNL staff to accomplish this
• Make sure calves have enough living space

Thank You!!
Development, growth rate targets, and feeding strategies for growing heifers

Jill Anderson, Ph.D.
Assistant Professor, Dairy and Food Science Dept, SDSU

University of Nebraska- Extension Workshop
November 9 and 10, 2016

Outline

• Overall Goals/Importance
• Development
• Growth Targets
• Feeding Strategies
  – Ad libitum TMR – high forage
  – Limit Feeding/Target feeding
  – Component feeding

Overall Objectives

• Heifers must grow at an optimal rate so they are large enough to:
  – Breed on time
  – Avoid calving problems
  – Produce large amounts of milk – reach genetic potential
Importance of a successful calf & heifer management program

• Investment
  – approx. $1,500-2,000 to raise a heifer to 24 mo. of age (bid portion of this is feed costs)
  – Delay in entering the milking herd costs (>2.00/d beyond 24 mo.) plus no milk $

• Genetic potential of calves and heifers
  – Should be better than for the average cow presently in the herd
  – Future of the herd
  – Want to feed and manage properly to reach genetic potential

Development of Heifers 4 months – 2 years old

• Not just changes in body size
  – Digestive system
  – Puberty/Reproduction
  – Mammary

Digestive System Development

Digestive System

- Size changes → differences in passage rate
  - Consumption capacity
  - Efficiency of utilizing forage?
    - How should diets change with age?

Puberty

- What is puberty?
  - Many definitions
  - Often defined as when the heifer becomes cyclic or has begun to regularly ovulate
  - Usually occurs around 8-10 months of age

Puberty and ADG

Le Cozler et al., 2008
Factors that affect puberty

- Age
- Body Weight
- Breed/genetics
- Environment
- Body composition
- Nutrition

Puberty - Why is it important?

- May affect age at breeding
- Fertility at breeding
- Related to mammary development
  - Steroid hormones → secondary sex characteristics

Fig. 1. Summary of the possible metabolic mediators of reproduction. IGF = insulin-like growth factor; TNFa = tumor necrosis factor; TNFα = tumor necrosis factor; T3 = triiodothyronine; T4 = thyroxine; Epi = epinephrine; NOREN = noradrenaline; FA = fatty acids; ac = amino acids; GH = growth hormone; LDL = low density lipoprotein; HDL = high density lipoprotein; IGFBP = insulin-like growth factor binding protein. Spicer, 2001
Milk yield potential

- Combined data from 8 studies on Holstein Heifers
- All data from within 15 years (1990-2005)
- 21 levels of ADG
- 21 heifers per level (n=21)

Influence of ADG on Milk yield

Found that 0.8 kg/d or 1.76 lbs/d of ADG resulted in most milk yield

WHY???

Mammary Growth

- Isometric approx. 3 months of age
- Allometric (duct formation) Puberty
- Isometric Gestation
Mammary Structure

- White adipose tissues – Mammary Fat Pad
- Parenchymal tissues
  - Epithelial structures
    - Ducts (formed during prepubertal growth)
    - Alveoli (formed during gestation)
- Stromal tissues
  - Connective tissues, fibroblast, endothelial cells associated with vascular structures

Mammary gland structure

See Figure 2.

Mammary Growth Periods

- Basic structures formed in utero, non-epithelial structures formed (cardiovascular, stroma)
- Birth to 3 months: isometric, only non-epithelial tissues
- 3 months to puberty: allometric, epithelial structure form and invade fat pad
- Puberty to conception: isometric, but limited development
- Gestation: Large amount of growth, alveoli and epithelial branches develop on pre-formed ducts
Prepubertal heifer mammary gland

Over conditioning may lead to more fat deposition in the fat pad of the mammary gland.

Regulation of mammary growth and development

• Still not fully understood
• Key players are thought to be:
  – Ovary secretions – estrogen
  – Growth Hormone and IGF-I
• Other growth factors and hormones

Rate of gain affects hormones too…

• GH acts on mammary tissues via IGF-I – stimulates epithelial growth
• High rate of gain has been shown to reduce GH, but increase IGF-I
• Hypothesized that sensitivity of mammary tissue to IGF-I is reduced at high ADG due to locally produced BP, in particular IGFBP-3 and perhaps other GF

(Sejrsen et al., 2000)(Akers et al., 2000)
How does this relate to management?

Holstein Heifer Targets

- Size when to breed: ~ 55% of expected mature weight \((1,500 \text{ lbs} \times 0.55 = 825)\)
- Want to calve at ~82% of expected mature weight \((1,500 \text{ lbs} \times 0.82 = 1,230)\)
- Age when to breed: 13-15 months
- Age at calving: 22-24 months

Monitoring Heifer Growth

- **Weight**: goal just under ADG of 2 lbs (especially around and before puberty)
- **Height**: goal 50 inches at 13 months – 55 inches at calving (measure at top point of withers)
  - Ideally monitor weight and height measurements
- **Body Condition Scores**: Avoid fat heifers!
- Useful charts to track progress: [http://extension.psu.edu/animals/dairy/nutrition/heifers/monitoring-heifer-growth](http://extension.psu.edu/animals/dairy/nutrition/heifers/monitoring-heifer-growth)
Body Measurements

- Every couple months or when handled:
  - Body weights
  - Heart girth – weight tape if no scale
  - Withers height
  - Hip height

- Recommend observing (every 2 weeks) body condition score (BCS) on scale of 1 (emaciated) to 5 (obese) - (Wildman et al., 1982)
How do we achieve these targets?

Feeding Strategies

**Overall Goal:** Assure you are meeting heifer nutrient requirements while avoiding over feeding energy.
1. Ad libitum TMR
2. Limit-feeding/Target-feeding
3. Component feeding

All three strategies can work effectively, but each have pros and cons...
(Housing system also may affect practicality too!)
Ad libitum TMR feeding

- Total Mixed Ration
- Very common
- Must be high forage
  - Bulk density/gut fill of forage assures energy intake will not be excessive
- Feed for 5-10% refusals
- Recommended for older heifers – especially as approaching calving

Ad libitum TMR

- Pros
  - More flexibility on group uniformity
  - Better rumen health – more stable
  - Bunk space less of a concern as feed is always available

Ad libitum TMR

- Cons
  - Have wasted feed each day
  - Less efficient nutrient digestion/utilization
  - Some heifers may overeat and get over conditioned
Example TMR Feed Ingredients
(10-months old)

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>% DM Basis</th>
<th>% As Fed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grass Hay</td>
<td>34.91</td>
<td>24.76</td>
</tr>
<tr>
<td>Corn Silage</td>
<td>33.96</td>
<td>53.59</td>
</tr>
<tr>
<td>Corn, ground</td>
<td>10.01</td>
<td>7.02</td>
</tr>
<tr>
<td>DDGS</td>
<td>5.01</td>
<td>3.51</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>13.53</td>
<td>9.49</td>
</tr>
<tr>
<td>Limestone</td>
<td>0.81</td>
<td>0.51</td>
</tr>
<tr>
<td>Heifer Smart</td>
<td>1.00</td>
<td>0.63</td>
</tr>
<tr>
<td>Salt</td>
<td>0.50</td>
<td>0.32</td>
</tr>
<tr>
<td>Energy booster</td>
<td>0.27</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Schossow and Anderson, unpublished

Example TMR Nutrient Composition:
(10-months)

<table>
<thead>
<tr>
<th>Nutrient, % DM</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Matter, %</td>
<td>63.11</td>
</tr>
<tr>
<td>Crude Protein</td>
<td>14.7</td>
</tr>
<tr>
<td>Rumen degradable protein</td>
<td>9.4</td>
</tr>
<tr>
<td>Rumen undegradable protein</td>
<td>5.3</td>
</tr>
<tr>
<td>Neutral Detergent Fiber</td>
<td>40.0</td>
</tr>
<tr>
<td>Acid Detergent Fiber</td>
<td>23.5</td>
</tr>
<tr>
<td>Non-fibrous Carbohydrate</td>
<td>37.1</td>
</tr>
<tr>
<td>Ether Extract (Fat)</td>
<td>3.0</td>
</tr>
<tr>
<td>Calcium</td>
<td>0.82</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>0.34</td>
</tr>
<tr>
<td>Sulfur</td>
<td>0.21</td>
</tr>
<tr>
<td>ME Mcal/Kg DM</td>
<td>2.36</td>
</tr>
<tr>
<td>NEd Mcal/Kg DM</td>
<td>0.88</td>
</tr>
</tbody>
</table>

Schossow and Anderson, unpublished

Limit-Feeding

- More nutrient dense diets fed at a set amount to meet requirements – also usually TMR
- Most research conducted using corn and soybean based diets (show some later with DDGS)
- Slower rate of passage, resulting in increased ruminal degradation and nutrient utilization
- Improved feed efficiency even when high-forage diets are fed

Tamminga et al., 1979; Loerch, 1990; Hoffman et al., 2007; Tanton and Heinrichs, 2007
Limit-Feeding

• Can adjust the rate of feeding
• Does not negatively impact growth in dairy heifers (Zanton and Heinrichs, 2007)
• Lactation performance is maintained or improved in limit-fed heifers (Hoffman et al., 2007)

Limit-feeding

• Pros
  – Nutrient utilization and feed efficiency
  – No feed waste
  – More regulated or controlled rates of gain – less likely to get over conditioned heifers

Limit-feeding

• Cons
  – Must weigh heifers frequently to monitor ADG
  – Need to frequently (every week or two weeks) adjust the amount fed
  – Need adequate bunk space (up to 24” for older heifers)
  – Works best when heifers are grouped by age and uniform in size
  – Heifers need adjustment and may show signs of hunger
  – Most consider type of bedding
**Example Limit-Fed Rations**

Formulated two age groups for ADG of 1.8 pounds/day.

<table>
<thead>
<tr>
<th>Ingredient, % of DM</th>
<th>Lower Forage 4 Months</th>
<th>Lower Forage 23 Months</th>
<th>Higher Forage 4 Months</th>
<th>Higher Forage 23 Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fed at % BW</td>
<td>2.33</td>
<td>1.56</td>
<td>2.39</td>
<td>1.63</td>
</tr>
<tr>
<td>Grass Hay</td>
<td>8</td>
<td>15</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td>Corn Silage</td>
<td>12</td>
<td>25</td>
<td>30</td>
<td>35</td>
</tr>
<tr>
<td>Whole Shelled Corn</td>
<td>40.75</td>
<td>31.25</td>
<td>18.70</td>
<td>18.25</td>
</tr>
<tr>
<td>Soybean Meal</td>
<td>9</td>
<td>0</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>Distiller’s Grains</td>
<td>7</td>
<td>15</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Wheat Middlings</td>
<td>10</td>
<td>10</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Molasses</td>
<td>10</td>
<td>0</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Urea</td>
<td>0.50</td>
<td>0.75</td>
<td>0.30</td>
<td>0.75</td>
</tr>
<tr>
<td>Mineral Mixture</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>


**Example Limit-Fed Rations**

Example rations formulated for ADG of 1.8 pounds/day.

<table>
<thead>
<tr>
<th>Ingredient, % of DM</th>
<th>Lower Forage 4 Months</th>
<th>Lower Forage 23 Months</th>
<th>Higher Forage 4 Months</th>
<th>Higher Forage 23 Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body weight, pounds</td>
<td>250</td>
<td>1350</td>
<td>250</td>
<td>1350</td>
</tr>
<tr>
<td>DMI, pounds/d</td>
<td>5.56</td>
<td>21.00</td>
<td>5.98</td>
<td>22.08</td>
</tr>
<tr>
<td>DM, % BW</td>
<td>2.23</td>
<td>1.56</td>
<td>2.39</td>
<td>1.63</td>
</tr>
<tr>
<td>ME, Mcal/pound DM</td>
<td>1.25</td>
<td>1.17</td>
<td>1.16</td>
<td>1.12</td>
</tr>
<tr>
<td>CP, %</td>
<td>16.05</td>
<td>14.62</td>
<td>15.04</td>
<td>14.09</td>
</tr>
<tr>
<td>CP, % CP</td>
<td>29.22</td>
<td>38.43</td>
<td>30.26</td>
<td>40.26</td>
</tr>
<tr>
<td>DR, % CP</td>
<td>32.44</td>
<td>33.16</td>
<td>33.31</td>
<td>32.02</td>
</tr>
<tr>
<td>NSC, %</td>
<td>22.43</td>
<td>33.87</td>
<td>34.93</td>
<td>39.97</td>
</tr>
</tbody>
</table>


**Example Limit-Fed Ration**

(fed at 2.45% BW to 4.5-10.5 months)

<table>
<thead>
<tr>
<th>Item, % DM</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grass Hay</td>
<td>39.79</td>
</tr>
<tr>
<td>Corn Silage</td>
<td>24.86</td>
</tr>
<tr>
<td>Ground Corn</td>
<td>15.91</td>
</tr>
<tr>
<td>SBM</td>
<td>8.95</td>
</tr>
<tr>
<td>SoyPlus</td>
<td>8.95</td>
</tr>
<tr>
<td>Limestone</td>
<td>0.40</td>
</tr>
<tr>
<td>Premix</td>
<td>0.78</td>
</tr>
<tr>
<td>Salt</td>
<td>0.36</td>
</tr>
</tbody>
</table>

Anderson et al., 2015
Component Feeding

- Give a grain mix or pellet once or twice a day at a limited amount and then allow ad libitum intake of hay/forage or pasture.

**Pros**
- Less time at feeding — little or no mixing
- Less feeding equipment
- Easy to adjust grain mix or pellet allowance

**Cons**
- Rumen pH/health
- Efficiency of nutrient utilization?
- Need adequate feeder space
### Example Component Fed Rations

<table>
<thead>
<tr>
<th>Item, % DM</th>
<th>CON</th>
<th>DDG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grass hay - estimated</td>
<td>68.5</td>
<td>68.5</td>
</tr>
<tr>
<td>DDGS</td>
<td>0.0</td>
<td>30.0</td>
</tr>
<tr>
<td>Ground corn</td>
<td>12.0</td>
<td>0.0</td>
</tr>
<tr>
<td>SBM</td>
<td>8.12</td>
<td>0.0</td>
</tr>
<tr>
<td>Expellers SBM</td>
<td>6.27</td>
<td>0.0</td>
</tr>
<tr>
<td>Soyhulls</td>
<td>3.65</td>
<td>0.0</td>
</tr>
<tr>
<td>Vitamins and Minerals&lt;sup&gt;1&lt;/sup&gt;</td>
<td>1.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

<sup>1</sup>Contained: 50% vitamin and mineral mix, 25% calcium carbonate, and 25% salt.

Grain Mixes – fed at 0.8% of BW – Hay Ad libitum

(Manthey et al., 2016)

### Other general recommendations

- Avoid too much dietary starch → fat heifers
- A little bit of dietary fat is a good thing, may help reproductive and mammary development
- It is better to slightly overfeed protein than to underfeed protein

### What are the take home points?

...
Conclusions

• Heifers are developing
  – Digestive system, puberty, mammary gland
• Monitor your heifers’ growth and progress – Weight, Height, BCS
• Many ways to feed heifers – avoid over feeding energy

Thank You!
Questions?

SDSU Dairy Research and Training Facility
Brookings, SD
Dairy Beef: Performance and Carcass Characteristics

Andrea Watson
Department of Animal Science
University of Nebraska-Lincoln

- A good start is key
  - Colostrum
  - Vaccinations
  - Environment

- Historical
  - Overly large carcasses
  - Odd shaped ribeye
  - Resulting in poor quality
    - No longer true!
    - Can be overcome with good management

22% of US beef production = > 5 billion pounds of beef
Holsteins = 86-90%
30-35% of all Prime beef = dairy

• Quality grade
  • To predict the tenderness, juiciness, and flavor of beef

<table>
<thead>
<tr>
<th>Relationship between marbling, maturity and carcass quality grade.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree of Marking</td>
</tr>
<tr>
<td>----------------------</td>
</tr>
<tr>
<td>Slight</td>
</tr>
<tr>
<td>Moderate</td>
</tr>
<tr>
<td>Small</td>
</tr>
<tr>
<td>Trace</td>
</tr>
<tr>
<td>Fracitally devol</td>
</tr>
</tbody>
</table>

Figure 2: USDA Beef Grading chart
1. Assume that thickness of fat is comparable developed with the degree of marbling and that the marbling is not a dark cut
2. The order of choice is from A to G. Figure is only for rib or loin.

Kenny Eng  “How are Holsteins different?”

• Gentle and playful
  • Don’t leave as bulls!
• Easily bored
  • More sorting of feed
  • More buller issues
  • More dust
• Increased risk for bloat, acidosis, liver abscesses
  • Less risk for founder, respiratory
• More heat tolerant
  • Less cold tolerant
• Increased feed and water intake
  • Pens wetter, more manure
• Difficult to chase an animal that insists on following you
  • Suicidal tendencies

Kenny Eng  “How are Holsteins different?”

• Relatively small gene pool
  • Predictable performance
• High quality beef
  • Size/shape of ribeye
  • Fat cover/marbling
• Easily age and source verified
• Price of feed critical
  • 3 tons of feed to finish vs < 2
+ 25 lb HCW
+ 0.85 in² REA
Same # of steaks/loin
+ 0.23 g of steaks/lb HCW
Increase in REA depth


<table>
<thead>
<tr>
<th>Holstein Select</th>
<th>Holstein Choice</th>
<th>Charolais cross-bred Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loin, n</td>
<td>24</td>
<td>22</td>
</tr>
<tr>
<td>Juiciness¹</td>
<td>5.0</td>
<td>5.3</td>
</tr>
<tr>
<td>Tenderness¹</td>
<td>5.5</td>
<td>5.9</td>
</tr>
<tr>
<td>Flavor¹</td>
<td>5.8</td>
<td>5.9</td>
</tr>
<tr>
<td>Overall¹</td>
<td>5.5</td>
<td>5.8</td>
</tr>
<tr>
<td>Shear force, kg</td>
<td>3.6</td>
<td>3.4</td>
</tr>
</tbody>
</table>

¹On a scale of 1-8 with 5 being slightly juicy, tender, or agreeable.


No differences in beef quality/palatability

<table>
<thead>
<tr>
<th>Beef Steers</th>
<th>Holstein Steers</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 300</td>
<td>&lt; 300</td>
</tr>
<tr>
<td>4-500</td>
<td>4-500</td>
</tr>
<tr>
<td>6-800</td>
<td>6-800</td>
</tr>
<tr>
<td>&gt;900</td>
<td>&gt;900</td>
</tr>
<tr>
<td>% of animals</td>
<td>63.6 13.2 16.3 6.8</td>
</tr>
<tr>
<td>Cut weight, lb</td>
<td>1108 1161 1266 1382</td>
</tr>
<tr>
<td>Days on feed</td>
<td>316 234 159 104</td>
</tr>
<tr>
<td></td>
<td>370 284 192 125</td>
</tr>
</tbody>
</table>

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 300</td>
<td>4-500</td>
<td>6-800</td>
<td>&gt;900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of animals</td>
<td>1.0</td>
<td>12.7</td>
<td>77.0</td>
<td>9.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>63.6</td>
<td>13.2</td>
<td>16.3</td>
<td>6.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DMI, lb/d</td>
<td>14.5</td>
<td>16.6</td>
<td>20.4</td>
<td>23.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>15.0</td>
<td>18.3</td>
<td>21.4</td>
<td>23.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADG, lb</td>
<td>2.46</td>
<td>2.75</td>
<td>3.22</td>
<td>3.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.62</td>
<td>2.78</td>
<td>2.94</td>
<td>2.64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feed:Gain</td>
<td>5.92</td>
<td>6.10</td>
<td>6.39</td>
<td>7.67</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.75</td>
<td>6.66</td>
<td>7.42</td>
<td>9.43</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Considerations

- **Type of diet**
- **Age**
  - Shorter backgrounding period
  - Start on finishing diet sooner
- **Feed additives**
  - β-agonist
- **Compared to beef cattle**
  - Lower dressing % (GI tract and bone vs carcass)
  - Less muscling (greater marbling at lower weight)
  - Less efficient at putting on fat (leaner at finished weights)
  - Increased lean trim value
- **Hide value** (thinner, larger, no brands)

---

**Liver Abscess Classification**

- Courtesy of Elanco Animal Health

---

### Table: Beef and Holstein Steers

<table>
<thead>
<tr>
<th></th>
<th>Beef Steers</th>
<th>Holstein Steers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;300  4-500 6-800 &gt;900</td>
<td>&lt;300  4-500 6-800 &gt;900</td>
</tr>
<tr>
<td>% of animals</td>
<td>1.0 12.7 77.0 9.3</td>
<td>63.6 13.2 16.3 6.8</td>
</tr>
<tr>
<td>Cost of gain, $/lb</td>
<td>0.53 0.53 0.53 0.59</td>
<td>0.54 0.57 0.61 0.75</td>
</tr>
<tr>
<td>Death Loss, %</td>
<td>4.81 2.82 1.17 0.75</td>
<td>4.08 2.98 1.65 0.92</td>
</tr>
</tbody>
</table>


Siemens, 1996.
Total Liver Abscesses (%), Tylan fed Cattle

<table>
<thead>
<tr>
<th></th>
<th>Steers</th>
<th>Heifers</th>
<th>Holsteins</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>15.2</td>
<td>14.1</td>
<td>29.0</td>
</tr>
<tr>
<td>2013</td>
<td>17.4</td>
<td>15.5</td>
<td>50.9</td>
</tr>
<tr>
<td>2016</td>
<td>17.8</td>
<td>16.5</td>
<td>35.6</td>
</tr>
</tbody>
</table>


Total Liver Abscesses (%), Tylan fed Holsteins

<table>
<thead>
<tr>
<th></th>
<th>Central Plains</th>
<th>High Plains</th>
<th>Southwest</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>33.4</td>
<td>19.3</td>
<td>15.8</td>
</tr>
<tr>
<td>2013</td>
<td>71.0</td>
<td>58.4</td>
<td>17.6</td>
</tr>
<tr>
<td>2016</td>
<td>53.4</td>
<td>46.4</td>
<td>24.9</td>
</tr>
</tbody>
</table>

CO, KS OK, NM, TX AZ, CA


Yield Grade

- Prediction of red meat yield
  - 12th rib fat thickness, % KPH fat, HCW, Ribeye Area
  - YG 1 = >52% yield
  - YG 5 = <45% yield
  - Premiums (YG 1 and 2)
  - Discounts (YG 4 and 5)

- Yield Grade
  - Explains 40% of variation in red meat yield for beef cattle
  - 0% for Holstein cattle

Ty Lawrence
West Texas A&M University
### Yield Grade

- **KPH (Kidney Pelvic and Heart fat)**
  - Typically estimated/standard values, not measured

- **12th rib backfat**
  - Good relationship for beef cattle
  - No relationship for Holsteins

- **HCW**
  - Limited relationship
  - Better in Holstein than beef breeds

- **Ribeye area**
  - Best measure for estimating YG in beef or Holstein breeds

---

### Summary

- Almost ¼ of U.S. beef production
  - >30% of all prime
  - High quality beef

- Manage differently than beef cattle
  - Diet, β-agonist, implant, age…
  - Acidosis leading to liver abscesses
  - Feed price important!
  - Environment
    - Thinner hide, less hair cover and external fat
    - Heat vs cold stress

- **Marketing**
  - Emphasize quality, not yield grade

---

### Questions?

beef.unl.edu
dairy.unl.edu
Utilizing Distillers Grain and Other Alternative Protein Sources in Growing Heifer Rations

November 9 and 10, 2016
University of Nebraska Extension Workshop: Rearing young stock for dairy and beef production
Jill Anderson, Ph.D. Assistant Professor Dairy and Food Science Department SDSU

Outline

• Feeding Distillers
  – Different types of distillers grains
  – Using distillers grains in different feeding strategies for heifers

• Other proteins sources
  – New oilseed meals

Feeding Distillers Grains

• Abundance of research on feeding distillers grains (DG) to mature dairy cattle and beef cattle
• Limited info on feeding DG to growing dairy heifers
  → Main goal for today: share our research findings to-date from SDSU
Feeding Heifers Distillers Grains

• What type of DG?
  – Wet vs Dry
  – Low fat DDGS vs traditional DDGS
• What should you feed it with?
• How much can you feed to growing heifers?

Types of DG
(Nutrient composition examples)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>% DM</td>
<td>88.37</td>
<td>31.80</td>
<td>28.9</td>
<td>89.0</td>
<td>94.5</td>
<td>96.1</td>
</tr>
<tr>
<td>CP</td>
<td>33.16</td>
<td>34.42</td>
<td>30.4</td>
<td>30.6</td>
<td>41.6</td>
<td>32.8</td>
</tr>
<tr>
<td>NDF</td>
<td>31.71</td>
<td>36.79</td>
<td>32.1</td>
<td>32.1</td>
<td>26.2</td>
<td>24.4</td>
</tr>
<tr>
<td>ADF</td>
<td>15.54</td>
<td>19.72</td>
<td>16.2</td>
<td>10.0</td>
<td>8.3</td>
<td>12.6</td>
</tr>
<tr>
<td>EE</td>
<td>9.67</td>
<td>10.75</td>
<td>10.9</td>
<td>15.2</td>
<td>4.3</td>
<td>8.67</td>
</tr>
<tr>
<td>Ash</td>
<td>4.17</td>
<td>3.68</td>
<td>4.9</td>
<td>4.75</td>
<td>2.22</td>
<td>4.82</td>
</tr>
<tr>
<td>Sulfur</td>
<td>0.90</td>
<td>0.90</td>
<td>-</td>
<td>0.58</td>
<td>0.63</td>
<td>0.74</td>
</tr>
</tbody>
</table>

Must know what you are feeding!

Wet vs. Dried

• Wet:
  – Harder to store
  – Improves mixing of diet
  – Winter feeding?
• Dried:
  – Digestibility impacted by drying?
  – Easier to store – more like other grains
  – More cost effective to ship
Wet vs. Dried

- Limited research in dairy heifers
- Been some studies with lactating cows (Anderson et al., 2006)
  - Need to account for moisture in ration
  - Worked well at 10 or 20% of diet
- Research on feeding DWGS to heifers
  - Ensiled with Soyhulls (SH) (Anderson et al., 2009)
  - Ensiled with Corn Stalks (CS) (Anderson et al., 2015)

DWGS Heifer Studies

- SH or CS compliment nutrient profile of WDGS by being low in CP, fat, and high in fiber
- Ensiled in silo bags and then conducted trials with feeding heifers
  - Palatability
  - Growth
  - Gain:Feed

DWGS & SH Experiment Design

- DWGS and SH ensiled at
  - 53.2:46.8% on DM basis
  - or 70:30 as-fed basis.
- 24 heifers (8 hd/treatment) (150 d of age) fed for 8 wk
  - Control
  - Low DWGS & SH blend (24%) (LWSH)
  - High DWGS & SH blend (48%) (HWSH)
### Diet Formulations

<table>
<thead>
<tr>
<th>Item, % DM</th>
<th>Control</th>
<th>LWSH</th>
<th>HWSH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brome Grass Hay</td>
<td>50.00</td>
<td>50.00</td>
<td>50.00</td>
</tr>
<tr>
<td>WDGSH Blend</td>
<td>0</td>
<td>24.43</td>
<td>48.62</td>
</tr>
<tr>
<td>Corn, cracked</td>
<td>35.93</td>
<td>17.93</td>
<td>0</td>
</tr>
<tr>
<td>SBM</td>
<td>12.71</td>
<td>6.36</td>
<td>0</td>
</tr>
<tr>
<td>Min &amp; Vit Pre-mix</td>
<td>0.86</td>
<td>0.86</td>
<td>0.86</td>
</tr>
<tr>
<td>Limestone</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>Vit E</td>
<td>0.03</td>
<td>0.03</td>
<td>0.03</td>
</tr>
</tbody>
</table>

### Diet Nutrient Compositions

<table>
<thead>
<tr>
<th>Item, % DM</th>
<th>Control</th>
<th>LWSH</th>
<th>HWSH</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM, % diet</td>
<td>89.76</td>
<td>79.32</td>
<td>69.20</td>
</tr>
<tr>
<td>CP</td>
<td>16.16</td>
<td>17.28</td>
<td>18.12</td>
</tr>
<tr>
<td>NDF</td>
<td>34.78</td>
<td>45.38</td>
<td>54.80</td>
</tr>
<tr>
<td>Ash</td>
<td>9.87</td>
<td>8.31</td>
<td>9.24</td>
</tr>
<tr>
<td>NFC</td>
<td>37.19</td>
<td>25.78</td>
<td>13.23</td>
</tr>
<tr>
<td>Starch</td>
<td>26.75</td>
<td>14.35</td>
<td>2.02</td>
</tr>
<tr>
<td>ME, Mcal/Kg</td>
<td>2.54</td>
<td>2.49</td>
<td>2.44</td>
</tr>
<tr>
<td>NEg, Mcal/Kg</td>
<td>1.03</td>
<td>0.99</td>
<td>0.94</td>
</tr>
</tbody>
</table>

### Performance

<table>
<thead>
<tr>
<th>Item</th>
<th>Control</th>
<th>LWSH</th>
<th>HWSH</th>
<th>SEM</th>
<th>P-value (Linear)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, Initial, Kg</td>
<td>150</td>
<td>150.3</td>
<td>148.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>BW, Initial, Kg</td>
<td>183.0</td>
<td>184.1</td>
<td>185.4</td>
<td>11.25</td>
<td>0.67</td>
</tr>
<tr>
<td>BW, Final, Kg</td>
<td>252.3</td>
<td>253.6</td>
<td>256.4</td>
<td>12.33</td>
<td>0.59</td>
</tr>
<tr>
<td>ADG, Kg/d</td>
<td>1.24</td>
<td>1.24</td>
<td>1.27</td>
<td>0.05</td>
<td>0.67</td>
</tr>
<tr>
<td>DMI, Kg/d</td>
<td>6.78</td>
<td>6.56</td>
<td>5.76</td>
<td>0.34</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Gain:Feed</td>
<td>0.186</td>
<td>0.193</td>
<td>0.233</td>
<td>0.015</td>
<td>0.02</td>
</tr>
<tr>
<td>RCS, initial</td>
<td>3.33</td>
<td>3.27</td>
<td>3.38</td>
<td>0.15</td>
<td>0.60</td>
</tr>
<tr>
<td>RCS, final</td>
<td>3.63</td>
<td>3.51</td>
<td>3.51</td>
<td>0.09</td>
<td>0.10</td>
</tr>
</tbody>
</table>

No differences among treatments for frame measurements.
DWGS & CS
Experiment Design
• Two bag silos were made of WDGS:CS
  – 66.7:33.3 as-fed basis or 43.1:56.9 DM basis
  – Untreated (UNT)
  – Treated (TRT): 1/1000 kg with SiloKing\textsuperscript{a}/GPX
• 9 Holstein, 3 Brown Swiss (185± 26 d)
  – (4 hd/treatment)
• 6 weeks of feeding treatment diets:
  – Control (C), UNT, and TRT
  – CO diet limited fed, UNT and TRT diets were fed ad
  libitum

Diet Formulations

<table>
<thead>
<tr>
<th>Ingredient, % of DM</th>
<th>CON</th>
<th>UNT &amp; TRT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grass/Alfalfa Hay</td>
<td>69.7</td>
<td>-</td>
</tr>
<tr>
<td>Grain Mix*</td>
<td>30.3</td>
<td>-</td>
</tr>
<tr>
<td>WDG-CS blend (U or T)</td>
<td>-</td>
<td>99.0</td>
</tr>
<tr>
<td>Min and Vit Pre Mix</td>
<td>-</td>
<td>1.0</td>
</tr>
</tbody>
</table>

* Grain mix contains 47.62% steam-flaked corn, 33.33% LOL–Intense calf diet 22860, 9.56% rolled oats, 3.33% dry molasses, 1.43% liquid molasses, and 4.76% fish meal.

Diet Composition

<table>
<thead>
<tr>
<th>Item\textsuperscript{1}</th>
<th>CON\textsuperscript{2}</th>
<th>UNT</th>
<th>TRT</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM</td>
<td>88.3</td>
<td>43.9</td>
<td>44.2</td>
</tr>
<tr>
<td>CP</td>
<td>20.8</td>
<td>19.3</td>
<td>18.2</td>
</tr>
<tr>
<td>ADF</td>
<td>26.7</td>
<td>34.8</td>
<td>36.4</td>
</tr>
<tr>
<td>NDF</td>
<td>39.9</td>
<td>54.0</td>
<td>54.6</td>
</tr>
<tr>
<td>Starch</td>
<td>12.9</td>
<td>3.3</td>
<td>2.8</td>
</tr>
<tr>
<td>EE</td>
<td>2.09</td>
<td>4.96</td>
<td>4.88</td>
</tr>
<tr>
<td>Ash</td>
<td>9.28</td>
<td>10.82</td>
<td>11.41</td>
</tr>
<tr>
<td>NFC\textsuperscript{3}</td>
<td>32.7</td>
<td>13.1</td>
<td>13.0</td>
</tr>
<tr>
<td>ME, Mcal/kg</td>
<td>2.35</td>
<td>2.31</td>
<td>2.31</td>
</tr>
<tr>
<td>NE, Mcal/kg</td>
<td>0.86</td>
<td>0.86</td>
<td>0.86</td>
</tr>
</tbody>
</table>

\textsuperscript{1} % DM unless otherwise indicated.
\textsuperscript{2} Nutrient analyses was conducted on hay and concentrate mix individually and used for calculation of dietary concentrations.
\textsuperscript{3} NFC = 100 - (NDF + CP + EE + Ash) (NRC, 2001).
### Gain: Feed

<table>
<thead>
<tr>
<th>Item, kg/d</th>
<th>CON</th>
<th>UNT</th>
<th>TRT</th>
<th>SEM</th>
<th>Treatment P-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADG</td>
<td>0.95</td>
<td>1.16</td>
<td>1.02</td>
<td>-</td>
<td>N5</td>
</tr>
<tr>
<td>BW, Kg</td>
<td>252.7</td>
<td>259.9</td>
<td>255.5</td>
<td>5.54</td>
<td>0.67</td>
</tr>
<tr>
<td>DMI, Kg</td>
<td>5.51</td>
<td>4.60</td>
<td>4.61</td>
<td>0.145</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Gain:Feed</td>
<td>0.183</td>
<td>0.267</td>
<td>0.234</td>
<td>0.008</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

1. Calculated using regression analysis of body weight measurement by days of feeding.
2. Values within row with unlike superscripts differ by P < 0.05.
3. No significant Trt X Week effects

Reminder 1 kg = 2.2 lbs
2.5 cm = 1 inch

### Body Frame Sizes

<table>
<thead>
<tr>
<th>Item, cm</th>
<th>CON</th>
<th>UNT</th>
<th>TRT</th>
<th>SEM</th>
<th>Treatment P-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wither height</td>
<td>115.1</td>
<td>114.8</td>
<td>114.1</td>
<td>0.38</td>
<td>0.19</td>
</tr>
<tr>
<td>Hip height</td>
<td>120.7</td>
<td>120.7</td>
<td>119.6</td>
<td>0.37</td>
<td>0.06</td>
</tr>
<tr>
<td>Body length</td>
<td>102.4</td>
<td>103.7</td>
<td>102.0</td>
<td>0.87</td>
<td>0.39</td>
</tr>
<tr>
<td>Heart girth</td>
<td>141.8</td>
<td>141.7</td>
<td>140.6</td>
<td>0.80</td>
<td>0.54</td>
</tr>
<tr>
<td>BCS</td>
<td>2.82</td>
<td>2.86</td>
<td>2.92</td>
<td>0.047</td>
<td>0.29</td>
</tr>
</tbody>
</table>

No significant Trt X Week effects

Reminder 1 kg = 2.2 lbs
2.5 cm = 1 inch

### Conclusions of Ensiling Trials

- Feeding the ensiled WDGS blends resulted in similar heifer frame growth compared to Control fed heifers
- Heifers fed the WDGS blends had improved G:F compared to Control fed heifers
  - high ADG on WDG&SH study
- Including silage additive in the ensiled WDGS-CS improved total tract digestibility of nutrients (data not shown)
DDGS vs Low Fat DDGS?
Effects of feeding fat from distillers grains on growth, metabolic profile, and later performance of dairy heifers.
(Anderson et al., 2015a, 2015b, 2015c)

Feeding Fat
• Not well-researched in dairy heifers
• Conflicting results in ruminant research:
  – Negative impacts on fiber utilization
  – Improved feed efficiency
  – PUFA may improve mammary development (McFadden et al., 1990; Thibault et al., 2003)
  – PUFA may help reproduction in cattle (Funston, 2004; Ambrose et al., 2006, Martin et al., 2007)
  – Some beef studies have found breed-dependent responses on reproduction (Lammoglia et al., 2000)

Dietary Fat from DDGS?
• Feeding fat in replacement of starch may cause changes in metabolic profile that could alter development and performance
  – Increase plasma lipids and metabolic hormones?
  – Alter onset of puberty?
  – Alter mammary development?
Experimental Design

- Three treatment diets:
  - Control (C): soybean products and corn
  - Low-Fat (LFDG): low fat DDG and corn
  - High-Fat (HFDG): traditional DDGS
- Thirty-three Holstein heifers (133 ± 18 days old)
- 24 week feeding period

Diet Formulations (fed at 2.45% BW)

<table>
<thead>
<tr>
<th>Item, % DM</th>
<th>Control</th>
<th>LFDG</th>
<th>HFDG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grass Hay</td>
<td>39.79</td>
<td>39.78</td>
<td>39.79</td>
</tr>
<tr>
<td>Corn Silage</td>
<td>24.86</td>
<td>24.86</td>
<td>24.86</td>
</tr>
<tr>
<td>DDGS</td>
<td>-</td>
<td>-</td>
<td>33.80</td>
</tr>
<tr>
<td>DDG HP</td>
<td>-</td>
<td>21.88</td>
<td>-</td>
</tr>
<tr>
<td>Ground Corn</td>
<td>15.91</td>
<td>11.93</td>
<td>-</td>
</tr>
<tr>
<td>SBM</td>
<td>8.95</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SoyPlus</td>
<td>8.95</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Limestone</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>Premix</td>
<td>0.78</td>
<td>0.78</td>
<td>0.78</td>
</tr>
<tr>
<td>Salt</td>
<td>0.36</td>
<td>0.36</td>
<td>0.36</td>
</tr>
</tbody>
</table>

Diet Composition (Analysis)

<table>
<thead>
<tr>
<th>Item</th>
<th>Treatment</th>
<th>C</th>
<th>LFDG</th>
<th>HFDG</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM%</td>
<td></td>
<td>71.0</td>
<td>71.8</td>
<td>70.7</td>
</tr>
<tr>
<td>Ash%</td>
<td></td>
<td>7.02</td>
<td>6.29</td>
<td>7.20</td>
</tr>
<tr>
<td>CP%</td>
<td></td>
<td>15.8</td>
<td>16.3</td>
<td>16.7</td>
</tr>
<tr>
<td>ADF%</td>
<td></td>
<td>23.0</td>
<td>24.0</td>
<td>25.2</td>
</tr>
<tr>
<td>NDF%</td>
<td></td>
<td>42.2</td>
<td>44.5</td>
<td>48.6</td>
</tr>
<tr>
<td>EE(diethyl)</td>
<td></td>
<td>2.91</td>
<td>3.08</td>
<td>7.00</td>
</tr>
<tr>
<td>OR (com. Lab)</td>
<td></td>
<td>1.97</td>
<td>2.22</td>
<td>4.72</td>
</tr>
<tr>
<td>NFC%</td>
<td></td>
<td>32.1</td>
<td>29.9</td>
<td>20.6</td>
</tr>
<tr>
<td>Starch</td>
<td></td>
<td>20.4</td>
<td>19.0</td>
<td>8.3</td>
</tr>
<tr>
<td>M%</td>
<td></td>
<td>2.48</td>
<td>2.45</td>
<td>2.46</td>
</tr>
<tr>
<td>N%</td>
<td></td>
<td>0.97</td>
<td>0.96</td>
<td>0.96</td>
</tr>
</tbody>
</table>

1. % DM, unless otherwise indicated.
2. Results from analysis of monthly composites.
3. Results from analysis of four-month composites.
4. % NFC = 100 - (% Ash + % CP + % NDF + % EE) (NRC, 2001).
5. Values are calculated based on inputting sample nutrient analysis into ration formulations in the Dairy NRC computer program (2001).
Dry Matter Intakes

**Dry Matter Intakes**

**Body Weights**

**Gain:Feed**

**Reminder**: 1 kg = 2.2 lbs
2.5 cm = 1 inch
Wither Height

- C
- LFDG
- HFDG

Treatment: $P = 0.36$
Week: $P = 0.02$
Treatment x Week: $P = 0.20$

Body Condition Score

- C
- LFDG
- HFDG

Treatment: $P = 0.49$
Week: $P = 0.02$
Treatment x Week: $P = 0.45$

Total Tract Digestion of Nutrients

- C
- LFDG
- HFDG

No Significant Differences

DM
OM

No Significant Differences
Short-Term Energy Status

- Short term energy status similar among treatments (Glucose, NEFA, BHBA, Insulin, IGF-1)
- Energy from forage utilization and fermentation may offset differences in dietary fat and starch provided by concentrate mixes
Long-Term Energy Status

- Leptin indicates similar long-term energy status
- No differences in body fat (white adipose) deposition among treatments
- Leptin maybe more affected by total amount of dietary energy versus form of energy source

Cholesterol

- Other studies have also found that feeding increased dietary fat to heifers increased plasma cholesterol (Park et al., 1983; Talavera et al., 1984; Thomas et al., 1997; Lammoglia et al., 2000)

- Cholesterol is precursor to steroid hormones
  - Progesterone more than Estradiol (Talavera et al., 1985)
Puberty

• Results indicate that puberty occurred at younger ages and lower BW in HFDG fed heifers.
• BW and ADG were similar among treatments.
• Leptin indicates body fat deposition were similar.
• Possibly related to Cholesterol → Steroid hormones?
• Small heifer numbers – more research needed!

Post-trial

• Heifers were managed in general herd.
• Data was collected from herd health and DHIA records.
• Body measurements were obtained at 3 wk prepartum and at parturition.
Post-trial

<table>
<thead>
<tr>
<th>Item</th>
<th>Treatments</th>
<th>P values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CON</td>
<td>LFDG</td>
</tr>
<tr>
<td>AI Services</td>
<td>2.11</td>
<td>2.89</td>
</tr>
<tr>
<td>Age at conception, d</td>
<td>455</td>
<td>483</td>
</tr>
<tr>
<td>Age at parturition, d</td>
<td>733</td>
<td>764</td>
</tr>
<tr>
<td>Body Measures: Age at parturition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BW, Kg</td>
<td>634.3</td>
<td>620.6</td>
</tr>
<tr>
<td>Wither height, cm</td>
<td>145.8a</td>
<td>147.6a</td>
</tr>
<tr>
<td>Hip height, cm</td>
<td>150.6</td>
<td>149.9</td>
</tr>
<tr>
<td>Heart girth, cm</td>
<td>203.8</td>
<td>206.2</td>
</tr>
<tr>
<td>Body length, cm</td>
<td>144.3a</td>
<td>141.2ab</td>
</tr>
<tr>
<td>BCS</td>
<td>3.29</td>
<td>3.12</td>
</tr>
<tr>
<td>Calf BW, kg</td>
<td>40.81</td>
<td>41.60</td>
</tr>
<tr>
<td>Calving problems, n</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Successfully transitioned, n</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

Post-trial

• Reproductive performance was similar

• Despite earlier puberty, milk production was maintained in the heifers fed the HFDG diet compared to CON fed heifers

• In LFDG: Slightly older at calving → improved milk production?
Study Summary

- Feeding either DG type maintained frame growth and ADG
- Plasma lipid profiles may be altered by increased dietary fat from DDGS which may affect development
- Long term performance parameters were maintained by feeding DG compared to traditional feeds like corn and soybean products

How much DDGS can you feed in limit-fed diets?

Evaluation of growth performance, nutrient utilization, metabolic profile, and onset of puberty in dairy heifers fed distillers dried grains in replacement of forage in limit-fed rations.

(Angela Manthey, Ph.D)

Experimental Design

- Three treatment diets:
  - 30% DDGS: 68.5% Grass Hay (30DG); 2.65% BW
  - 40% DDGS: 58.5% Grass Hay (40DG); 2.50% BW
  - 50% DDGS: 48.5% Grass Hay (50DG); 2.35% BW
    - All had 1.5% mineral mix

- Experimental design:
  - 48 heifers – 16 per treatment
  - Fed from 7 to 11 months of age (Calan Gates)
  - 2 wk adaptation, 16 wk feeding
  - Trial ran from Sept 2013-Sept 2014
### Formulated Diets

<table>
<thead>
<tr>
<th>Ingredients, % DM</th>
<th>30DG</th>
<th>40DG</th>
<th>50DG</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDGS</td>
<td>30.0</td>
<td>40.0</td>
<td>50.0</td>
</tr>
<tr>
<td>Grass Hay</td>
<td>68.5</td>
<td>58.5</td>
<td>48.5</td>
</tr>
<tr>
<td>Vitamin and Minerals Mix</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

**Kg/d fed to a 250 Kg Heifer**

| DM fed as % of BW | 2.65 | 2.50 | 2.35 |
| Estimated DMI     | 6.63 | 6.25 | 5.88 |
| DDGS              | 1.99 | 2.50 | 2.94 |
| Grass Hay         | 4.54 | 3.66 | 2.85 |
| Vitamin and Minerals Mix | 0.099 | 0.094 | 0.088 |

Reminder 1 kg = 2.2 lbs

### Diet Formulation

<table>
<thead>
<tr>
<th>Nutrient, % DM*</th>
<th>30DG</th>
<th>40DG</th>
<th>50DG</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM, % diet</td>
<td>87.50</td>
<td>87.50</td>
<td>87.50</td>
</tr>
<tr>
<td>CP</td>
<td>16.50</td>
<td>19.40</td>
<td>21.30</td>
</tr>
<tr>
<td>NDF</td>
<td>52.80</td>
<td>48.30</td>
<td>45.20</td>
</tr>
<tr>
<td>EE</td>
<td>3.5</td>
<td>4.0</td>
<td>4.5</td>
</tr>
<tr>
<td>NFC</td>
<td>23.40</td>
<td>25.90</td>
<td>27.50</td>
</tr>
<tr>
<td>Sulfur, g/d</td>
<td>0.0038</td>
<td>0.0045</td>
<td>0.0051</td>
</tr>
<tr>
<td>ME, Mcal/kg DM</td>
<td>0.024</td>
<td>0.026</td>
<td>0.028</td>
</tr>
<tr>
<td>NE, Mcal/kg DM</td>
<td>0.079</td>
<td>0.080</td>
<td>0.090</td>
</tr>
</tbody>
</table>

*Based on Dairy NRC software (2001).

### Diet Nutrient and Energy Intake

<table>
<thead>
<tr>
<th>Item</th>
<th>30DG</th>
<th>40DG</th>
<th>50DG</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP, kg/d</td>
<td>1.09</td>
<td>1.19</td>
<td>1.26</td>
</tr>
<tr>
<td>EE, kg/d</td>
<td>0.20</td>
<td>0.23</td>
<td>0.26</td>
</tr>
<tr>
<td>ME, Mcal/kg DM</td>
<td>14.70</td>
<td>14.80</td>
<td>14.70</td>
</tr>
<tr>
<td>NE gain, Mcal/kg DM</td>
<td>5.25</td>
<td>5.59</td>
<td>5.78</td>
</tr>
</tbody>
</table>

* Actual diet nutrient and energy intake.

Reminder 1 kg = 2.2 lbs

2.5 cm = 1 inch
Body Weight

- Means:
  - 30DG = 264.0
  - 40DG = 266.2
  - 50DG = 266.4

- ADG, kg/d: 30DG = 0.91, 40DG = 0.96, and 50DG = 0.95. P = 0.67

- Trt P = 0.97
- Wk P < 0.01
- Trt x Wk P = 0.72
- L = 0.82; Q = 0.91

Dry Matter Intake

- Means:
  - 30DG = 6.89
  - 40DG = 6.21
  - 50DG = 5.84

- Trt P = 0.03
- Wk P < 0.01
- Trt x Wk P = 0.97

Gain:Feed

- Means:
  - 30DG = 0.141
  - 40DG = 0.156
  - 50DG = 0.172

- Trt P < 0.01
- Wk P < 0.01
- Trt x Wk P < 0.05
- L = 0.03; Q = 0.93

Reminder 1 kg = 2.2 lbs
2.5 cm = 1 inch
**Withers Height**

Means:
- 30DG = 121.0
- 40DG = 121.7
- 50DG = 121.6

Trt $P = 0.41$
Wk $P = 0.01$
Trt × Wk $P = 0.88$

L = 0.28; Q = 0.44

Reminder: 1 kg = 2.2 lbs
2.5 cm = 1 inch

**Body Condition Score**

Means:
- 30DG = 3.11
- 40DG = 3.12
- 50DG = 3.07

Trt $P = 0.34$
Wk $P = 0.09$
Trt × Wk $P = 0.14$

L = 0.24; Q = 0.37

**Rumen Fermentation**

<table>
<thead>
<tr>
<th>Item</th>
<th>30DG</th>
<th>40DG</th>
<th>50DG</th>
<th>SEM</th>
<th>Trt</th>
<th>Wk</th>
<th>Trt × Wk</th>
<th>L</th>
<th>Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.67</td>
<td>6.54</td>
<td>6.53</td>
<td>0.087</td>
<td>0.42</td>
<td>0.10</td>
<td>0.46</td>
<td>0.22</td>
<td>0.02</td>
</tr>
<tr>
<td>NH₃-N, mg/dL</td>
<td>15.36</td>
<td>17.04</td>
<td>19.27</td>
<td>0.850</td>
<td>0.03</td>
<td>0.52</td>
<td>0.25</td>
<td>&lt;0.01</td>
<td>0.84</td>
</tr>
<tr>
<td>Total VFA, mM</td>
<td>73.1</td>
<td>73.2</td>
<td>74.2</td>
<td>2.430</td>
<td>0.93</td>
<td>0.09</td>
<td>0.08</td>
<td>0.73</td>
<td>0.88</td>
</tr>
</tbody>
</table>

1. 30% dietary inclusion rate of DDGS (30DG), 40% dietary inclusion rate of DDGS (40DG), 50% dietary inclusion rate of DDGS (50DG).
2. Significance of effects for treatment (Trt), week (wk), treatment × week (Trt × wk), and linear (L) and quadratic (Q) orthogonal contrasts.
Rumen Fermentation

![Bar chart showing rumen fermentation with different nutrients and their respective percentages.]

Total Tract Digestibility

![Bar chart showing total tract digestibility with different nutrients and their respective percentages.]

Plasma Metabolites and Hormones

- No differences in
  - Glucose
  - Insulin
  - IGF-1
  - Leptin
  - Triglycerides
- Shifts in plasma fatty acid profile
Plasma Urea Nitrogen

- **Means:**
  - 30DG = 17.83
  - 40DG = 17.82
  - 50DG = 19.90

- **Significance:**
  - Trt P < 0.01
  - Wk P < 0.01
  - Trt x Wk P = 0.90

Cholesterol

- **Means:**
  - 30DG = 93.48
  - 40DG = 89.15
  - 50DG = 97.13

- **Significance:**
  - Trt P = 0.17
  - Wk P < 0.01
  - Trt x Wk P = 0.39

% Heifers Pubertal

- **Significance:**
  - Trt P = 0.42
  - Age P = 0.01
  - Trt x Age P = 0.01
Post study - Reproductive Performance

<table>
<thead>
<tr>
<th>Item</th>
<th>Treatment 1</th>
<th>Treatment 2</th>
<th>Treatment 3</th>
<th>SEM</th>
<th>Trt</th>
<th>L</th>
<th>Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at first service, d</td>
<td>411.5</td>
<td>413.6</td>
<td>399.0</td>
<td>5.13</td>
<td>0.09</td>
<td>0.08</td>
<td>0.19</td>
</tr>
<tr>
<td>Age at conception, d</td>
<td>412.6</td>
<td>413.3</td>
<td>434.8</td>
<td>25.8</td>
<td>0.51</td>
<td>0.31</td>
<td>0.59</td>
</tr>
<tr>
<td>AI service, no.</td>
<td>1.80</td>
<td>1.61</td>
<td>2.17</td>
<td>0.75</td>
<td>0.52</td>
<td>0.45</td>
<td>0.39</td>
</tr>
<tr>
<td>Age at calving, d</td>
<td>698.2</td>
<td>682.9</td>
<td>715.2</td>
<td>25.1</td>
<td>0.34</td>
<td>0.44</td>
<td>0.20</td>
</tr>
</tbody>
</table>

10% dietary inclusion rate of DDGS (30DG); 40% dietary inclusion rate of DDGS (40DG); 50% dietary inclusion rate of DDGS (50DG).

Significance of effects for treatment (Trt) and linear (L) and quadratic (Q) orthogonal contrasts.

Study Summary

- Can feed DDGS at very high inclusion rates to dairy heifers
  - Maintained growth performance
  - Improves gain to feed
  - Changes in metabolic profile and some shifts in puberty
  - Limited effects on post-trial performance

- Note: Need to be aware of drinking water Sulfur content
Component Feeding Distillers grains
Growth performance, rumen fermentation, nutrient utilization, and metabolic profile of heifers limit-fed distillers dried grains with ad libitum forage
(Angie Manthey, Ph.D.)

Experimental Design
• Two treatment diets:
  – Corn and soybean product concentrate mix (CON)
  – Distillers grains concentrate mix (DDG)
  – Both treatments fed ad libitum grass hay
• Twenty-four heifers (18 Holstein, 6 Brown Swiss)
  – Randomized Complete Block Design
  – Blocks of 2 heifers by breed, size, and age
  – 12/treatment diet
• 4 month feeding period
  – 2 wk adaptation, 16 wk feeding
  – Fed from 6 to 10 months of age

Diet Formulation

<table>
<thead>
<tr>
<th>Item, % DM</th>
<th>CON</th>
<th>DDG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grass hay-estimated</td>
<td>68.5</td>
<td>68.5</td>
</tr>
<tr>
<td>DDGS</td>
<td>0.0</td>
<td>30.0</td>
</tr>
<tr>
<td>Ground corn</td>
<td>12.0</td>
<td>0.0</td>
</tr>
<tr>
<td>SBM</td>
<td>8.12</td>
<td>0.0</td>
</tr>
<tr>
<td>Expellers SBM</td>
<td>6.27</td>
<td>0.0</td>
</tr>
<tr>
<td>Soyhulls</td>
<td>3.65</td>
<td>0.0</td>
</tr>
<tr>
<td>Vitamins and Minerals</td>
<td>1.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

1Contained: 50% vitamin and mineral mix, 25% calcium carbonate, and 25% salt.
### Diet Intake Composition

<table>
<thead>
<tr>
<th>Nutrient, %</th>
<th>CON</th>
<th>DDG</th>
<th>SEM</th>
<th>Trt</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM</td>
<td>89.20</td>
<td>89.80</td>
<td>0.100</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>CP</td>
<td>15.60</td>
<td>15.00</td>
<td>0.400</td>
<td>0.26</td>
</tr>
<tr>
<td>NDF</td>
<td>55.60</td>
<td>62.40</td>
<td>0.800</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>ADF</td>
<td>31.50</td>
<td>33.10</td>
<td>0.530</td>
<td>0.04</td>
</tr>
<tr>
<td>EE</td>
<td>02.21</td>
<td>04.45</td>
<td>0.095</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>NFC</td>
<td>29.20</td>
<td>19.90</td>
<td>0.400</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Starch</td>
<td>10.80</td>
<td>01.63</td>
<td>0.420</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

1. Based on heifer intakes.
2. Trt x wk interactions were insignificant.

### Nutrient Intake Amount

<table>
<thead>
<tr>
<th>Nutrient, kg/d</th>
<th>CON</th>
<th>DDG</th>
<th>SEM</th>
<th>Trt</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP</td>
<td>0.97</td>
<td>0.97</td>
<td>0.027</td>
<td>&lt;0.67</td>
</tr>
<tr>
<td>NDF</td>
<td>3.62</td>
<td>4.15</td>
<td>0.199</td>
<td>&lt;0.07</td>
</tr>
<tr>
<td>ADF</td>
<td>2.04</td>
<td>2.21</td>
<td>0.114</td>
<td>&lt;0.33</td>
</tr>
<tr>
<td>EE</td>
<td>0.14</td>
<td>0.29</td>
<td>0.007</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>NFC</td>
<td>1.85</td>
<td>1.33</td>
<td>0.052</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Starch</td>
<td>0.66</td>
<td>0.10</td>
<td>0.014</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

1. Based on heifer intakes.
2. Trt x wk interactions were insignificant.

### Body Weight and Feed Efficiency

<table>
<thead>
<tr>
<th>Item</th>
<th>CON</th>
<th>DDG</th>
<th>SEM</th>
<th>Trt</th>
<th>Trt x wk</th>
</tr>
</thead>
<tbody>
<tr>
<td>BW, kg</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>269.3</td>
<td>266.3</td>
<td>0.84</td>
<td>0.83</td>
<td>0.57</td>
</tr>
<tr>
<td>Initial</td>
<td>229.9</td>
<td>229.6</td>
<td>0.04</td>
<td>0.92</td>
<td></td>
</tr>
<tr>
<td>Final</td>
<td>320.8</td>
<td>317.7</td>
<td>10.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADG, kg/d</td>
<td>000.99</td>
<td>000.96</td>
<td>0.050</td>
<td>0.73</td>
<td>0.27</td>
</tr>
<tr>
<td>DMI, kg/d</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>006.40</td>
<td>006.62</td>
<td>0.26</td>
<td>0.57</td>
<td>0.63</td>
</tr>
<tr>
<td>Final</td>
<td>007.70</td>
<td>008.18</td>
<td>0.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gain:Feed</td>
<td>000.168</td>
<td>000.156</td>
<td>000.0099</td>
<td>0.39</td>
<td>0.24</td>
</tr>
</tbody>
</table>

1. Based on heifer intakes.
2. Trt x wk interactions were insignificant.
Frame Growth and BCS

<table>
<thead>
<tr>
<th>Item</th>
<th>Treatment</th>
<th>P-values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CON</td>
<td>DDG</td>
</tr>
<tr>
<td>Withers height, cm</td>
<td>119.20</td>
<td>119.20</td>
</tr>
<tr>
<td>Hip height, cm</td>
<td>123.30</td>
<td>122.80</td>
</tr>
<tr>
<td>Heart girth, cm</td>
<td>140.60</td>
<td>139.90</td>
</tr>
<tr>
<td>Paunch girth, cm</td>
<td>179.20</td>
<td>178.20</td>
</tr>
<tr>
<td>Body length, cm</td>
<td>117.50</td>
<td>117.30</td>
</tr>
<tr>
<td>Hip width, cm</td>
<td>036.70</td>
<td>036.20</td>
</tr>
<tr>
<td>BCS&lt;sup&gt;1&lt;/sup&gt;</td>
<td>003.10</td>
<td>003.11</td>
</tr>
</tbody>
</table>

<sup>1</sup> Body Condition Score: 1 = emaciated and 5 = obese (Wildman et al., 1982)

Rumen Fermentation

<table>
<thead>
<tr>
<th>Volatile Fatty Acid</th>
<th>CON</th>
<th>DDG</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Propionate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Butyrate</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Metabolic Profile

<table>
<thead>
<tr>
<th>Item</th>
<th>Treatment</th>
<th>P-values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CON</td>
<td>DDG</td>
</tr>
<tr>
<td>Cholesterol, mg/dL</td>
<td>81.10</td>
<td>102.20</td>
</tr>
<tr>
<td>Glucose, mg/dL</td>
<td>75.20</td>
<td>071.70</td>
</tr>
<tr>
<td>Insulin, ng/mL</td>
<td>00.55</td>
<td>00.70</td>
</tr>
<tr>
<td>PUN, mg/dL</td>
<td>12.50</td>
<td>011.60</td>
</tr>
<tr>
<td>Triglycerides, mg/dL</td>
<td>19.60</td>
<td>021.00</td>
</tr>
</tbody>
</table>
Study Conclusion

DDGS can be limit-fed as the primary concentrate ingredient with ad libitum grass hay to:
- Maintain growth performance and energy status
  - Despite changes in metabolic profile
- Maintain dry matter intake and gain: feed
- Maintain nutrient digestibility

How do other types of alternative protein sources compare to the DDGS?
Introduction
Camelina (Camelina sativa) & Carinata (Brassica carinata)
• Brassica family includes canola, cabbage, mustard
• Non-food oil seeds – used for biodiesel production
• Good Agronomy characteristics for great plains
• Healthful fatty acids
• Co-product is value as animal feeds?
• Good protein
• Concern with glucosinolates

Materials and Methods
Rumen in situ
• Five grams of each sample were incubated in replicates
• 10x20 cm dacron bags
• Incubation time: 0, 2, 4, 8, 12, 24, and 48 h.
• Hour 12 included six extra replicates for in vitro procedure

Test Feed Nutrient Composition

<table>
<thead>
<tr>
<th>Item*</th>
<th>Camelina Meal*</th>
<th>Carinata Meal</th>
<th>Canola Meal</th>
<th>DDGS</th>
<th>Linseed Meal</th>
<th>Soybean Meal</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM, %</td>
<td>92.3</td>
<td>92.9</td>
<td>96.4</td>
<td>96.1</td>
<td>89.0</td>
<td>97.8</td>
</tr>
<tr>
<td>CP</td>
<td>37.7</td>
<td>44.3</td>
<td>44.0</td>
<td>32.8</td>
<td>39.0</td>
<td>51.1</td>
</tr>
<tr>
<td>Fat</td>
<td>14.3</td>
<td>2.1</td>
<td>2.8</td>
<td>8.7</td>
<td>4.0</td>
<td>1.8</td>
</tr>
<tr>
<td>NDF</td>
<td>25.7</td>
<td>23.7</td>
<td>28.1</td>
<td>24.4</td>
<td>27.1</td>
<td>9.0</td>
</tr>
<tr>
<td>Ash</td>
<td>5.0</td>
<td>7.6</td>
<td>7.8</td>
<td>4.8</td>
<td>6.5</td>
<td>6.8</td>
</tr>
</tbody>
</table>

*DM basis
*Mechanically-extracted
### CP Rumen Degradation

<table>
<thead>
<tr>
<th>Item</th>
<th>Camelina Meal</th>
<th>Carinata Meal</th>
<th>Canola Meal</th>
<th>DDGS</th>
<th>Unseed Meal</th>
<th>Soybean Meal</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total CP, % DM</td>
<td>40.9</td>
<td>43.9</td>
<td>45.3</td>
<td>35.0</td>
<td>40.4</td>
<td>53.9</td>
<td></td>
</tr>
<tr>
<td>CP digestible, % CP</td>
<td>36.2(^a)</td>
<td>40.7(^a)</td>
<td>23.8(^b)</td>
<td>24.9(^b)</td>
<td>23.4(^b)</td>
<td>19.3(^b)</td>
<td>0.57</td>
</tr>
<tr>
<td>B(^1)</td>
<td>56.4(^b)</td>
<td>53.4(^b)</td>
<td>76.0(^a)</td>
<td>71.2(^a)</td>
<td>69.0(^a)</td>
<td>80.7(^a)</td>
<td>1.46</td>
</tr>
<tr>
<td>C(^2)</td>
<td>7.4</td>
<td>6.0</td>
<td>0.1</td>
<td>3.9</td>
<td>7.6</td>
<td>0.0</td>
<td>1.73</td>
</tr>
<tr>
<td>K(^3), % h</td>
<td>14.95(^a)</td>
<td>7.64(^b)</td>
<td>5.34(^c)</td>
<td>2.23(^d)</td>
<td>7.30(^b)</td>
<td>5.70(^b)</td>
<td>0.459</td>
</tr>
<tr>
<td>RDP(^4), % CP</td>
<td>76.4(^a)</td>
<td>70.5(^b)</td>
<td>52.0(^c)</td>
<td>44.1(^c)</td>
<td>61.2(^c)</td>
<td>58.4(^b)</td>
<td>0.95</td>
</tr>
</tbody>
</table>

\(^1\) Soluble CP; \(^2\) Potentially degradable CP; \(^3\) Undegradable CP; \(^4\) Rate of CP degradation; \(^5\) Ruminally degradable protein (RDP).

Values with unlike superscripts differ by P < 0.05 using Tukey’s Test.

---

### CP Intestinal digestibility

<table>
<thead>
<tr>
<th>Item(^1)</th>
<th>Camelina Meal</th>
<th>Carinata Meal</th>
<th>Canola Meal</th>
<th>DDGS</th>
<th>Unseed Meal</th>
<th>Soybean Meal</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUP(^2)</td>
<td>23.6(^a)</td>
<td>29.4(^b)</td>
<td>48.0(^a)</td>
<td>55.5(^a)</td>
<td>38.8(^b)</td>
<td>41.6(^a)</td>
<td>0.95</td>
</tr>
<tr>
<td>IDP(^3), % of RUP</td>
<td>80.9(^a)</td>
<td>80.9(^a)</td>
<td>70.9(^b)</td>
<td>63.2(^b)</td>
<td>81.6(^a)</td>
<td>90.5(^a)</td>
<td>2.61</td>
</tr>
<tr>
<td>IADP(^4)</td>
<td>19.1(^b)</td>
<td>23.8(^b)</td>
<td>34.0(^b)</td>
<td>35.4(^b)</td>
<td>31.2(^b)</td>
<td>37.6(^b)</td>
<td>1.42</td>
</tr>
<tr>
<td>TDP(^5)</td>
<td>95.5(^a)</td>
<td>94.4(^b)</td>
<td>86.0(^b)</td>
<td>79.5(^b)</td>
<td>92.9(^b)</td>
<td>96.0(^b)</td>
<td>1.22</td>
</tr>
</tbody>
</table>

\(^1\) % of CP unless otherwise noted; \(^2\) Ruminally undegradable protein (RUP); \(^3\) Estimated intestinal digestible protein (IDP) after 12h rumen incubation and pepsin-pancreatin digestion; \(^4\) Intestinally absorbable digestible protein (IADP) = Rumen undegradable protein (RUP, % of CP) × intestinal CP digestion (% of RUP); \(^5\) Total Digestible Protein (TDP) = RDP + IADP. Values with unlike superscripts differ by P < 0.05 using Tukey’s Test.
Evaluation of camelina meal as a feedstuffs for growing dairy heifers

(Rhea Lawrence, M.S)

Materials and Methods

Experimental Design

- Forty two heifers – 33 Holstein, 9 Brown Swiss
- Start age 144.8 ± 22 d, BW 171.8 ± 24.3 kg
- (4 heifers dropped)
- Randomized complete block design
- Blocked by breed and age in groups of 3
- Staggered start dates by block (June 2014- March 2015)
- Experimental period
- 2 wk adaptation, 12 wk feeding
- Three treatment diets: 10% of diet as test feed
  1) Camelina Meal  2) Linseed Meal  3) DDGS

Formulated Diets

<table>
<thead>
<tr>
<th>Ingredients, % DM</th>
<th>CAM</th>
<th>DDGS</th>
<th>LIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grass Hay</td>
<td>60.01</td>
<td>60.02</td>
<td>60.02</td>
</tr>
<tr>
<td>Corn, Ground</td>
<td>23.96</td>
<td>22.07</td>
<td>22.46</td>
</tr>
<tr>
<td>Camelina Meal</td>
<td>10.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DDGS</td>
<td>-</td>
<td>10.00</td>
<td></td>
</tr>
<tr>
<td>Linseed Meal</td>
<td>-</td>
<td>10.00</td>
<td></td>
</tr>
<tr>
<td>Soybean Meal</td>
<td>4.53</td>
<td>6.41</td>
<td>6.00</td>
</tr>
<tr>
<td>Vit and Min Pre-mix</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Limestone</td>
<td>0.30</td>
<td>0.30</td>
<td>0.30</td>
</tr>
<tr>
<td>Salt</td>
<td>0.21</td>
<td>0.21</td>
<td>0.21</td>
</tr>
</tbody>
</table>

1 Based on Dairy NRC software (2001). Fed at 2.65% of BW
Diet Nutrient Composition

<table>
<thead>
<tr>
<th>Item, % DM</th>
<th>CAM SE</th>
<th>DDGS SE</th>
<th>LIN SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM</td>
<td>87.3</td>
<td>0.50</td>
<td>87.3</td>
</tr>
<tr>
<td>CP</td>
<td>12.5</td>
<td>0.30</td>
<td>12.5</td>
</tr>
<tr>
<td>NDF</td>
<td>44.9</td>
<td>0.51</td>
<td>44.9</td>
</tr>
<tr>
<td>ADF</td>
<td>25.4</td>
<td>0.47</td>
<td>24.8</td>
</tr>
<tr>
<td>EE</td>
<td>3.3</td>
<td>0.16</td>
<td>2.5</td>
</tr>
<tr>
<td>NFC</td>
<td>32.0</td>
<td>0.60</td>
<td>32.7</td>
</tr>
<tr>
<td>ME, Mcal/kg</td>
<td>2.3 - 2.2 - 2.2 -</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEg, Mcal/kg</td>
<td>0.80 - 0.75 - 0.76 -</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glucosinolates mg/g</td>
<td>1.2 - -</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 % DM unless otherwise indicated, based on results from analysis of monthly composites; 2 Calculated by nutrient analysis input into NRC formulation; 3 DDGS and LIN do not contain glucosinolates

Intakes and Feed Efficiency

<table>
<thead>
<tr>
<th>Item</th>
<th>Treatment</th>
<th>P-values</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CAM</td>
<td>DDGS</td>
<td>LIN</td>
</tr>
<tr>
<td>n</td>
<td>12</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Body Weight, Kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>199.5</td>
<td>205.4</td>
<td>211.4</td>
</tr>
<tr>
<td>ADG, Kg/d</td>
<td>0.67</td>
<td>0.76</td>
<td>0.75</td>
</tr>
<tr>
<td>ADG, Kg/d</td>
<td>0.65</td>
<td>0.72</td>
<td>0.80</td>
</tr>
<tr>
<td>DMI, Kg/d</td>
<td>4.9</td>
<td>5.1</td>
<td>4.9</td>
</tr>
<tr>
<td>Gain: Feed</td>
<td>0.14</td>
<td>0.13</td>
<td>0.17</td>
</tr>
</tbody>
</table>

1 Calculated using regression analysis of body weight by day; 2 Calculated using biweekly BW.

Withers Height

Means:
CAM = 112.3
DDGS = 115.5
LIN = 115.9
Trt P = 0.83
Wk P = < 0.01
Trt x Wk = 1.00
Evaluation of carinata meal as feedstuffs for growing dairy heifers

Karla Rodriguez-Hernandez, Ph.D.

Materials and Methods

Experimental Design

- 24 Holsteins
  - 6.5-10.5 months
- Randomized complete block design
  - Blocked by breed and age in groups of 2
- Experimental period
  - 2 wk adaptation, 16 wk feeding
- Two treatment diets: 10% of diet as test feed
  1) Carinata meal  2) DDGS

Means:
- CAM = 144.7
  - CAM = 0.44
  - CAM = 0.44
- DDGS = 157.5
  - DDGS = 0.42
  - DDGS = 0.42
- LIN = 154.5
  - LIN = 0.37
  - LIN = 0.37

Trt P = 0.09
Trt × Wk = 0.81
Wk P = < 0.01

Trt P = 0.65
Trt × Wk = 0.24
Wk P = 0.16

Trt × Wk = 0.81
Wk P = < 0.01

Trt × Wk = 0.24
Carinata Meal

<table>
<thead>
<tr>
<th>Ingredients, % DM</th>
<th>CRM</th>
<th>DDGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grass Hay</td>
<td>63.53</td>
<td>63.53</td>
</tr>
<tr>
<td>Corn, Ground</td>
<td>14.51</td>
<td>13.01</td>
</tr>
<tr>
<td>Carinata Meal</td>
<td>10.00</td>
<td></td>
</tr>
<tr>
<td>DDGS</td>
<td>-</td>
<td>10.00</td>
</tr>
<tr>
<td>Soybean Meal</td>
<td>10.51</td>
<td>12.01</td>
</tr>
<tr>
<td>Vitamin and mineral premix</td>
<td>0.65</td>
<td>0.65</td>
</tr>
<tr>
<td>Calcium carbonate</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>Salt</td>
<td>0.40</td>
<td>0.40</td>
</tr>
</tbody>
</table>

Both diets were limit-fed at 2.65% of Body Weight.

Carinata Meal – Results

<table>
<thead>
<tr>
<th>Item</th>
<th>CRM</th>
<th>DDGS</th>
<th>SEM</th>
<th>P-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body weight, lbs</td>
<td>595.0</td>
<td>592.8</td>
<td>3.1</td>
<td>0.60</td>
</tr>
<tr>
<td>Withers height, in</td>
<td>48.3</td>
<td>48.2</td>
<td>0.2</td>
<td>0.46</td>
</tr>
<tr>
<td>Body condition score</td>
<td>3.01</td>
<td>2.99</td>
<td>0.01</td>
<td>0.47</td>
</tr>
<tr>
<td>ADG, lbs/d</td>
<td>1.84</td>
<td>1.82</td>
<td>0.07</td>
<td>0.76</td>
</tr>
<tr>
<td>DM Intake, lbs/d</td>
<td>14.4</td>
<td>14.1</td>
<td>0.3</td>
<td>0.58</td>
</tr>
<tr>
<td>Gain: feed</td>
<td>0.131</td>
<td>0.130</td>
<td>0.004</td>
<td>0.93</td>
</tr>
</tbody>
</table>

Laboratory analysis still in progress – but initial growth performance shows potential

Conclusions- Oilseed Meals

- The protein in camelina meal and carinata meal is highly degradable and digestible (comparable to SBM) by dairy cattle
- Dairy heifers fed camelina meal had comparable growth performance to heifers fed linseed meal and DDGS at 10% of diet
- Glucosinolates appear to have some affect on thyroid hormones and may prevent camelina-fed heifers from having better performance
- Carinata meal can also be fed at 10% of heifers diets compared to DDGS
Overall Conclusions
What are the take home points?

Implications
• Distillers grains can be fed at high inclusions in dairy heifer rations and used in a variety of feeding strategies
• Dietary fat provided from distillers grains may be beneficial to developing heifers
• Distillers grains is a good source of RUP and TDP
• New oilseed meals are other potential protein sources for heifers and can be included at 10% of diet DM.

Acknowledgements
• Drs. Kalscheur, Garcia, Schingoethe, Hippen, Perry, and Clapper
• Students: Angie Manthey, Rhea Lawrence, Karla Rodriguez-Hernandez and others.
• This work was supported by:
  – SDSU Ag Experiment Station
  – AgriKing Inc. Fulton, IL
  – USDA-ARS Agreement No. 58-5447-7-322
  – SDSU ABS Undergraduate Research Awards
  – Minnesota Corn Research and Promotion Council (Minnesota Corn Growers) and MN AURI
  – South Dakota Oilseed Initiative
Thank you!

Questions?

References


References (cont)

