Feeds, Nutrients, and Animal Requirements

NDSU Feedlot School
January 27-28, 2011

Dr. Vern Anderson
Carrington Research Extension Center
The “Art and Science” of Ruminant Nutrition
Microbes in the rumen

Protozoa

Bacteria colonies

Microbes in the rumen
Ruminant Nutrition

- Basic science
  - Process of metabolism
  - Ruminant animal
  - Nutrition research

- Practical application
  - Ration calculations
  - Experience
  - Environment
Feedlot research and industry development in Northern Plains

- Quality calves
- Abundant feeds
- Winter weather
- Market options
- Farmer - feeders
Carrington Research Extension Center
Livestock Research Unit
- 125 Beef cows
- up to 800 feeder cattle
Nutrients in feed

- Water
- Energy – TDN, NEm, NEg, ME
- Protein (nitrogen x 6.25)
- Fiber (form is critical for rumen function)
  - Acid detergent fiber (ADF)
  - Neutral detergent fiber (NDF)
- Fat (x 2.25 = energy value)
- Minerals - Macro and micro
- Vitamins
Measuring energy in feed

- **TDN** – Total Digestible Nutrients
  - Generally used for cow rations

Net Energy System

- **NEm** = Net energy for maintenance
  - Heat, movement, digestion

- **NEg** = Net energy for gain
  - Growth (muscle, fat, bone)
Why are the Mcal values different for NEm and Neg?

i.e. Corn grain NEm=.99       NEg=.68 Mcal/lb

Basal level - no gain

Gain

Maintenance

Less ---------------- Feed Intake--------------------- More
How are NEm and NEg calculated?

- Two step mathematical process
- **Step ONE**
  - ADF is used to calculate TDN (different formulas for different feeds)
  - Alfalfa: \( \text{TDN} \% = 96.35 - (\text{ADF} \% \times 1.15) \)
  - Corn silage: \( \text{TDN} \% = 87.84 - (\text{ADF} \% \times 0.70) \)

(ADF is listed on laboratory analysis)

- IF Alfalfa ADF = 35, then \( \text{TDN} = 54.5 \)
- If Corn silage ADF = 28, then \( \text{TDN} = 68.2 \)

(as ADF decreases, TDN increases)
How are NEm and NEg calculated?

- **Step TWO**
- **TDN** is then used to calculate NEm and Neg

For Alfalfa:
- \( \text{NEm} = (54.5\% \times 0.01318) - 0.132 = 0.58 \)
- \( \text{NEg} = (54.5\% \times 0.01318) - 0.459 = 0.26 \)

For Corn silage
- \( \text{NEm} = (68.2\% \times 0.01318) - 0.132 = 0.77 \)
- \( \text{NEg} = (68.2\% \times 0.01318) - 0.459 = 0.44 \)
Sources of energy in feeds

- Starch - corn, barley, peas, wheat, oats
- Fat
  - Oilseeds (flax, soybean, canola), corn co-products, tallow
- Digestible fiber
  - Primarily hemi-cellulose fraction
  - Under-estimated in co-products
- Excess protein - Nitrogen removed and excreted
- Other – pectin, sugar
Methods of lab analysis

- **Proximate analysis**
  - Very old method - still useful
  - TDN calculated by subtraction

- **Van Soest fiber analysis** (wet chemistry)
  - Widely used, reliable, and reasonably priced
  - Provides ADF and NDF values
  - Kjeldahl protein analysis (nitrogen measure)

- **Near infrared reflectance spectroscopy** (NIRS)
  - Quick and cheap
  - Use only for common homogenous feeds
  - Requires extensive calibration
Protein in Feeds
Protein

**Sources**

- **Natural protein**
  - Nitrogen in feed $\times 6.25 = \text{protein level}$
  - Feeds contain varying levels
- **Non-protein nitrogen** - urea

**Types of protein for ruminants**

- Rumen degradable
- Rumen undegradable
Degradable protein

- Rumen degradable protein (RDP)
- Degradable intake protein (DIP)
- Soluble protein
  - Broken down to ammonia and a CHO chain in the rumen
  - Microbes use N- grow, die, degrade, and nutrients absorbed in the lower gut
- MOST protein sources are highly rumen degradable!
Non-protein nitrogen for cattle

- Urea (45% nitrogen \( \times 6.25 \) = 287% protein)
- Source of ammonia for rumen microbes
- Requires energy to metabolize
- Critical in cow diets with low quality forage
  - Often fed with molasses in commercial products
- In feedlot, used in corn grain finishing diets
  - Measure very carefully - **important**
  - Mix very thoroughly - **important**
- Maximum is 1/3 of total protein needs
  (Need some bypass protein)
Feed the microbes

- Rumen degradable protein (RDP)
- ~60% of crude protein requirement
- Natural protein or non-protein nitrogen (urea)
Undegradable protein

- Rumen undergradable protein (RUP) or
- Undegradable intake protein (UIP) or
- Escape protein or
- By-pass protein

- Does not break down in the rumen
- Absorbed in lower gut
- Contributes to metabolizable protein
Feed the ruminant animal

- Rumen undegradable protein (RUP),
  ~40% of crude protein
- Few feeds with RUP
  - Dry distillers grains
  - Feather meal
  - Blood meal
Schematic of fate of protein/nitrogen in the rumen
Smörgesbord of feeds in ND
Conventional feed grains

- Barley - 48 lb / bu
  - Usually rejected malt barley, 2 or 6 row
- Corn - 56 lb / bu
  - Immature and wet corn is great feed
- Peas – 60 lb / bu (yellow or green)
  - Incredibly useful new grain legume
- Wheat – 60 lb / bu (spring, winter, durum)
  - Diseased or sprouted - feed grade
- Oats, naked oats
Nutrients in barley
(Rodney Dangerfield of feed grains)

- Energy ~85% TDN
  64 Mcal/lb NEg
- Crude protein ~ 13.2+ % protein
- Crude fiber ~ 5.7%, ADF 5.8%
- Fat ~ 2.1%
- Minerals
  - Calcium ~ .05%
  - Phosphorous ~ .38%
  - Potassium ~ .47%
Feeding principles for barley

- Coarse roll - dry or tempered
  - Temper - add 10% moisture – steep 24 hr
- Use in mixed rations with $\geq 15\%$ forage
- Feed with an ionophore
- Avoid feeding with alfalfa – bloat inducing
- Protein and starch are both highly degradable in the rumen
  - Benefit from undegradable protein source
- Often very cost competitive
Practices for feeding barley

- Steers will benefit significantly from RUP
- Mix with moist feed(s)
  - Silage, wet dist grain, CDS, CSB, or water.....
- Inclusion rates
  - Growing diets
    - Up to 50% of DMI
  - Finishing diets
    - Feed up to 80% of DMI
- Cow suppl- up to 4 lbs/hd/day
Steers eating barley, distillers grains and wheat straw
Starch digestion in the rumen

- Starch particles inside protein matrix
  - Loosely wound/bound protein in barley
    - Advantage - more thorough digestibility
    - Disadvantage - rapid rate of fermentation
    - Manage feeding for “steady state” rumen
  - Tightly wound/bound protein in corn
Protein supplementation needed

- Undegradable protein **needed** for optimum growth
  - Fast growing and efficient feedlot steers
  - High producing dairy cows
- Most protein sources degrade rapidly (Soybean, canola, linseed and sunflower meals, wheat midds, corn gluten, peas)
- **Distillers grains** – most economic undegradable protein source
Research studies with barley and distillers grain

#1 Wet and/or dry distillers grains in barley based feedlot diets

#2 Barley with dry distillers grain in receiving diets

#3 Barley with dry distillers grain in finishing diets

#4 Barley-field pea diets with and without distillers grains
Barley fed with **wet and/or dry distillers grains** to feedlot steers

<table>
<thead>
<tr>
<th></th>
<th>Control Canola/urea</th>
<th>Wet and Dry Distillers Grains Comp of 3 tmts</th>
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<tbody>
<tr>
<td>Steers/pens</td>
<td>32/4</td>
<td>96/12</td>
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<tr>
<td>DM intake, lb</td>
<td>24.2</td>
<td>27.2</td>
</tr>
<tr>
<td>Daily gain, lb</td>
<td>3.30</td>
<td>3.62</td>
</tr>
<tr>
<td>End wt., lb</td>
<td>1218</td>
<td>1255</td>
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</table>

Anderson and Schoonmaker, NDSU, 2005
Trial #2 Protocol - Barley with distillers dry grains in *receiving* diets

- Finishing study – 130 head 4 reps
- Treatments
  - 0% dry distillers grains (canola meal)
  - 12% dry distillers grains
  - 24% dry distillers grains
  - 36% dry distillers grains (excess protein)
Barley based receiving rations with increasing distillers grains (% DM basis)

<table>
<thead>
<tr>
<th></th>
<th>0% DDG</th>
<th>12% DDG</th>
<th>24% DDG</th>
<th>36% DDG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>56.02</td>
<td>49.55</td>
<td>38.17</td>
<td>27.76</td>
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<tr>
<td>Distillers Grains</td>
<td>1.18</td>
<td>13.51</td>
<td>25.94</td>
<td>36.74</td>
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<tr>
<td>Corn Silage</td>
<td>21.44</td>
<td>20.80</td>
<td>20.94</td>
<td>20.76</td>
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<tr>
<td>Canola meal</td>
<td>6.32</td>
<td>1.49</td>
<td>0.16</td>
<td>0.04</td>
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<tr>
<td>Oat hay</td>
<td>12.57</td>
<td>12.33</td>
<td>12.43</td>
<td>12.40</td>
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<tr>
<td>Supplement</td>
<td>2.47</td>
<td>2.31</td>
<td>2.36</td>
<td>2.40</td>
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Anderson and Ilse, NDSU, 2010
Performance of *receiving* steers fed barley with increasing distillers grains

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<th>36% DDG</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM Intake, lb/hd/day *</td>
<td>16.31</td>
<td>17.35</td>
<td>17.04</td>
<td>17.40</td>
</tr>
<tr>
<td>ADG, lb *</td>
<td>4.08</td>
<td>4.41</td>
<td>4.44</td>
<td>4.37</td>
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<tr>
<td>Feed/gain</td>
<td>4.00</td>
<td>3.94</td>
<td>3.86</td>
<td>3.98</td>
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</tbody>
</table>

Anderson and Ilse, NDSU, 2010

* P value < 0.05
Trial #3 Barley with increasing level of distillers dry grains in *finishing* diets

- **Finishing study** – 130 head 4 reps
- **Treatments**
  - 0% dry distillers grains (canola meal)
  - 12% dry distillers grains
  - 24% dry distillers grains
  - 36% dry distillers grains (excess protein)
Barley finishing rations with increasing distillers grains- (% DM basis)

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<th>12% DDG</th>
<th>24% DDG</th>
<th>36% DDG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>77</td>
<td>68</td>
<td>52</td>
<td>44</td>
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<tr>
<td>Distillers Grains</td>
<td>0</td>
<td>12</td>
<td>12</td>
<td>36</td>
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<tr>
<td>Canola meal</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Forage</td>
<td>17</td>
<td>17</td>
<td>17</td>
<td>17</td>
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<tr>
<td>Supplement</td>
<td>2</td>
<td>2</td>
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Anderson et al., NDSU, 2007
Performance of *finishing* steers fed barley with increasing distillers grains

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<th>24% DDG</th>
<th>36% DDG</th>
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</thead>
<tbody>
<tr>
<td>DM Intake, lb/hd/d</td>
<td>24.75</td>
<td>24.96</td>
<td>27.92</td>
<td>26.24</td>
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<tr>
<td>ADG, lb</td>
<td>3.68</td>
<td>3.72</td>
<td>4.34*</td>
<td>4.04</td>
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<tr>
<td>Feed/gain</td>
<td>6.54</td>
<td>6.50</td>
<td>6.23</td>
<td>6.31</td>
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<tr>
<td>Final wt, lb</td>
<td>1297</td>
<td>1293</td>
<td>1358*</td>
<td>1311</td>
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</tbody>
</table>

Anderson et al., NDSU, 2007

* P value < 0.05
Carcass traits of steers fed barley with increasing distillers grains

<table>
<thead>
<tr>
<th>Carcass wt, lb</th>
<th>0% DDG</th>
<th>12% DDG</th>
<th>24% DDG</th>
<th>36% DDG</th>
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<tbody>
<tr>
<td></td>
<td>755</td>
<td>760</td>
<td>806</td>
<td>781</td>
</tr>
<tr>
<td>Dressing Percent</td>
<td>60.9</td>
<td>61.5</td>
<td>62.2</td>
<td>62.5</td>
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<tr>
<td>Marbling score</td>
<td>389</td>
<td>426</td>
<td>432</td>
<td>446</td>
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<tr>
<td>Yield Grade</td>
<td>2.91</td>
<td>3.11</td>
<td>3.23</td>
<td>3.30</td>
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<tr>
<td>USDA Ch, %</td>
<td>31</td>
<td>53</td>
<td>66</td>
<td>69</td>
</tr>
</tbody>
</table>

Anderson et al., NDSU, 2007
Corn grain

- Feed dry rolled
  - Whole corn acceptable in finishing diets
- Energy
  - TDN – 89%
  - NEg .68 Mcal/lb
- Crude protein = 9 - 10% (60% UIP)
- Calcium = .02%
- Phosphorous = .30%
High moisture corn

- Harvest at 25 to 35% moisture
  - Save drying costs
  - Raise longer season corn - 3.4 bu/acre/day RM
- Roll or crack before piling
- Pack and store in bunker or bag
- Performance from HM light corn (42 lb) = to 56 lb dry corn
- Earlage (HM corn and cob meal) very useful for growing calves
Corn Silage

- Harvest moisture critical
  - 60-70% - ideal = 65%
  - Too wet - reduces fermentation
- TDN = 70% (immature ~65%)
  - NEg - .47 Mcal/lb
- Crude protein = 8-9%
- Calcium = .23%
- Phosphorous = .22%
- Value/ton ~ 7-8 bushels of dry corn/ton
Distillers grains with solubles - DGS

- From dry corn milling (ethanol)
- Crude protein - 26-32%
- Dry = ~55% RUP, Wet = ~65% RUP
- Energy - varies with solubles (CDS) and fat
  - Wet – TDN 89%, NEg .75 Mcal/lb
  - Dry – TDN 86%, NEg .68 Mcal/lb
- Acid detergent fiber - 14%
- Sulfur levels vary
  - Can be problematic
Distillers grains

- Very palatable feed
- Much research proves usefulness
- Marketed as:
  - Wet – 30-40% dry matter
  - Modified – 50-60% dry matter
  - Dry – 89% dry matter
- Storage issues with wet and modified
  - Mold growth
- Flow issues with dry dist grains
Liquid co-products from corn processing

Use to enhance palatability and add nutrients

- Condensed distillers solubles (CDS)
  - From ethanol production
  - Protein = 20%
  - Fat (energy) source = 10-15%

- Corn syrup is not the correct term
  - This is what you put on pancakes
Field peas

- Annual legume popular in crop rotations
- Harvested as grain or forage
- Grain is very nutrient dense feed
  - Excellent protein source
    - 22-26%
  - Energy (equal to corn)
    - TDN – 89+%
    - NEg .70 Mcal/lb
  - Acid detergent fiber - 8% (hull)
Field peas

- Very palatable feed
  - Receiving diets
  - Creep feed
  - Excellent feedlot performance
- Peas improve tenderness and juiciness in ribeye steaks!
- Field pea products for feed
  - Lower grade peas and lentils
  - Chips, splits, screenings, hulls
    - Nutrients can vary
Feeding wheat (and durum)

- Minimally process - coarse roll
- Feed with an ionophore
- Avoid feeding with high levels of alfalfa
- Sprouts and scab do not affect feed value
- Feed in mixed diets, <50% of grain
- Change ration ingredients slowly
- Mix thoroughly and manage bunks carefully
Wheat middlings (midds, mill run)

- Residue from milling wheat or durum
  - Germ and bran plus some starch
  - 20-22% of grain by weight
- Energy
  - TDN ~ 83%, NEg .59 Mcal/lb
- Crude protein ~ 18.0 %
- Acid detergent fiber – 11%
- Usually pelleted, some fines
- Widely used in commercial formula feeds
Purchasing wheat midds

- Seasonal price swings
  - Lowest price in spring/summer
- Storage can be a problem
  - Moisture content affects storage
  - Potential for mold
  - Use aeration bin or flat storage
- Several sources across the state
- ~1000 tons per day in ND
Using wheat midds

- Very consistent product
- Growing calves
  - Up to 50% of diet
  - Mix with grains and/or forages
- Finishing calves
  - Maximum of 30% of diet
- Laxative at higher levels
- Can partially replace forage
- High phosphorous, need to add calcium
Canola meal

- Abundant supply
- Competitively priced - usually
- Pelleted or meal
- Crude protein – 36 - 41%
- Energy
  - NEg .45 Mcal/lb
  - TDN - 69%
- Acid detergent fiber - 18%
Glycerol (glycerin) from biodiesel

- Liquid - yet 85% dry matter
  - Used in cosmetics, industry, etc.
  - 10% volume of base oil
- Feed is salvage market
  - Energy equal to corn
  - Essentially zero protein and minerals
  - Methanol level set by FDA
  - Does not flow in cold weather
  - Use at 10% of diet
Hulless oats

- Extremely nutrient dense grain
  - Protein - 17.8%
  - Energy-
    - NEg .67 Mcal/lb
    - TDN est. 93% (9 -10% fat)
  - Acid detergent fiber - 4%
- Usually fed on farms where grown
- Limit feed, mix with other grains
- Minimal processing required
Sugar beet co-products

- Beet pulp – usually sold wet
  - Crude protein – 9.1%
  - Energy-
    - $\text{NEg} = 49 \text{ Mcal/lb}$
    - TDN – 72%+
  - Acid detergent fiber – 31%
  - High in digestible fiber (hemi-cellulose)
  - Price vs. performance

- Beet tailings
  - High moisture, dirty, variable, often free
Liquid co-products from sugar beets

*Use to enhance palatability*

- Beet molasses
  - Base for commercial liquid feeds
  - Reduced availability
- De-sugared molasses (CSB)
  - “Condensed separator by-product”
  - Modest protein and energy
    - 20% protein
    - Neg = .42 Mcal/lb
Screenings of all kinds

- Wheat, corn, sunflowers, barley, pulse crops
- Highly variable in nutrient content
  - Check moisture content for storage
- Usually contain weed seeds
  - Not very digestible
  - Recommend grinding w/hammer mill
- Use with care
  - < half of concentrate
- Compost manure to kill weed seeds
Feed quality issues

- Barley with **deoxynivalenol** (DON)
  - Researched up to 35 ppm DON in barley
  - Safe for cows
  - No difference in feedlot intake and gain

- Wheat with **fusarium head blight** (scab)
  - Concentrated in wheat midds
  - No measurable effect on cattle

- **Sclerotinia** in sunflowers – a fungus
  - No effect on beef cows
Nutrient Requirements of Feedlot Cattle
Published nutrient requirements

Nutrient Requirements of Beef Cattle
Seventh Revised Edition, 1996
Subcommittee on Beef Cattle Nutrition
Committee on Animal Nutrition
Board on Agriculture
National Research Council
NATIONAL ACADEMY PRESS
Washington, D.C. 1996
UPDATED in 2001
Protein requirements

"Average Requirement"
Increased genetic potential for gain increases protein requirements.
Effect of DMI on gain

DMI, lb

Pen 1

Pen 2

Gain

Maint
Effect of environmental stress (maintenance) on gain

DMI, lb

- Summer
- Winter

Gain
Maint
## Nutrient requirements of weaned calves, DM basis, NRC, 1996

<table>
<thead>
<tr>
<th>Item</th>
<th>Normal</th>
<th>Stressed</th>
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<tbody>
<tr>
<td>Crude Protein, %</td>
<td>13.9</td>
<td>up to 17.0</td>
</tr>
<tr>
<td>NEm, Mcal/lb</td>
<td>.75</td>
<td>.60 -.85</td>
</tr>
<tr>
<td>NEm, Mcal/lb</td>
<td>.47</td>
<td>.35 -.55</td>
</tr>
<tr>
<td>Calcium, %</td>
<td>.5</td>
<td>.6 -.8</td>
</tr>
<tr>
<td>Phosphorous, %</td>
<td>.3</td>
<td>.4 -.5</td>
</tr>
<tr>
<td>Potassium, %</td>
<td>.6</td>
<td>1.2 -1.4</td>
</tr>
<tr>
<td>Manganese, ppm</td>
<td>20</td>
<td>40 -70</td>
</tr>
<tr>
<td>Zinc, ppm</td>
<td>30</td>
<td>75 -100</td>
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</table>
# Nutrient requirements for feedlot steers

**NRC, 1996**

<table>
<thead>
<tr>
<th>Steer Wt. lb</th>
<th>ADG lb</th>
<th>DMI lb</th>
<th>CP %</th>
<th>NEg Mc/lb</th>
<th>Ca %</th>
<th>Ph %</th>
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<tbody>
<tr>
<td>660</td>
<td>2.0</td>
<td>18.4</td>
<td>10.2</td>
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<td>.19</td>
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<td>660</td>
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<td>.48</td>
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<td>780</td>
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<td>.20</td>
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<tr>
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<td>3.0</td>
<td>21.6</td>
<td>10.8</td>
<td>.48</td>
<td>.39</td>
<td>.20</td>
</tr>
<tr>
<td>840</td>
<td>3.8</td>
<td>20.4</td>
<td>12.8</td>
<td>.61</td>
<td>.48</td>
<td>.24</td>
</tr>
</tbody>
</table>
### Nutrient requirements for feedlot steers

**NRC, 1996**

<table>
<thead>
<tr>
<th>Steer Wt. lb</th>
<th>ADG lb</th>
<th>DMI lb</th>
<th>CP %</th>
<th>NEg Mc/lb</th>
<th>Ca %</th>
<th>Ph %</th>
</tr>
</thead>
<tbody>
<tr>
<td>660</td>
<td>2.0</td>
<td>18.4</td>
<td>10.2</td>
<td>.35</td>
<td>.36</td>
<td>.19</td>
</tr>
<tr>
<td>660</td>
<td>3.0</td>
<td>18.0</td>
<td>13.0</td>
<td>.48</td>
<td>.49</td>
<td>.24</td>
</tr>
<tr>
<td>780</td>
<td>3.0</td>
<td>20.4</td>
<td>11.4</td>
<td>.48</td>
<td>.42</td>
<td>.21</td>
</tr>
<tr>
<td><strong>840</strong></td>
<td><strong>3.0</strong></td>
<td><strong>21.6</strong></td>
<td><strong>10.8</strong></td>
<td><strong>.48</strong></td>
<td><strong>.39</strong></td>
<td><strong>.20</strong></td>
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<td><strong>840</strong></td>
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<td><strong>.61</strong></td>
<td><strong>.48</strong></td>
<td><strong>.24</strong></td>
</tr>
</tbody>
</table>
Protein Levels in Feedlot Rations

- Growing Diets
  - Crude protein requirements - 13.5 to 15%
  - DIP 10 - 11% - UIP 3.5 - 4%
  - NPN -urea (100% DIP) not often used

- Finishing Diets
  - Crude protein requirements - 12 to 14%
  - DIP 8.5 -10% - UIP 3.5 - 4%
Macro-mineral requirements
(From NRC, 1996)

Entire Diet, Dry matter basis
- Salt 0.3%
- Calcium 0.50-0.60%
- Phosphorous 0.25-0.30%
- Magnesium 0.10%
- Potassium 0.60%
Sulfur requirements and toxic levels
(From NRC, 1996)

- Entire Diet, Dry matter basis
  - Sulfur 0.15% min, 0.40% is MAXIMUM
    - Potential issue with distillers grains
    - Polio can occur at 0.25%
    - DG may be up to 1.25% sulfur

- Grain rations more sensitive ~ .30% max
- Forage rations less sensitive ~ .50% max
Micro-minerals or trace minerals
(From NRC, 1996)

- Entire diet, DM basis
  - Copper: 10-15 ppm
  - Zinc: 30-45 ppm
  - Manganese: 20 ppm
  - Cobalt: .10 ppm
  - Iron: 50 ppm
  - Iodine: .5 ppm
  - Selenium: .2 ppm
Limit stress at all opportunities

- Weaning – Fenceline, creep, drylot
- Trucking – Time, comingling, cold
- Environment
  - Weather and cold – bedding, wind, rations
  - Mud, shade, pests
- Health – Preventive vaccinations, nutrition
  - Early and thorough observation
  - Punctual and continual treatment
- Diet – Balanced and palatable
  - Maintain stable rumen function
## Effects of temperature on feed intake
**Alberta Feedlot Mgt, 2000**

<table>
<thead>
<tr>
<th>Cold</th>
<th>% Change</th>
<th>Heat</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>59 - 77 F</td>
<td>0</td>
<td>59 – 77 F</td>
<td>0</td>
</tr>
<tr>
<td>41 - 59 F</td>
<td>+3%</td>
<td>77 – 95 F</td>
<td>-10%</td>
</tr>
<tr>
<td>23 to 41 F</td>
<td>+5%</td>
<td>&gt;95 F w/nite cooling</td>
<td>-10%</td>
</tr>
<tr>
<td>5 to 23 F</td>
<td>+7%</td>
<td>&gt;95 F w/o nite cooling</td>
<td>-35%</td>
</tr>
<tr>
<td>&lt;5 F</td>
<td>+16%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Temperature effects on feed intake and maintenance requirements

Adapted from Ames, 1980
Other considerations for winter feeding

- Condition cattle prior to severe weather
  - Not always possible
- **Bed feedlot cattle** and growing heifers
  - Increase gain, improve efficiency, and increase carcass quality
    - Up to $80/head benefit after cost of straw
    - Increased nutrient sequestering in manure 3x
- Modest amount needed
- Bed consistently
- Balance diet with adequate forage
Effects of straw bedding amount on feedlot cattle in the winter

(Anderson et al, 2004)

<table>
<thead>
<tr>
<th></th>
<th>No bedding</th>
<th>Modest bedding</th>
<th>Generous bedding</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM Intake</td>
<td>21.99</td>
<td>21.96</td>
<td>22.16</td>
</tr>
<tr>
<td>ADG **</td>
<td>2.83</td>
<td><strong>3.69</strong></td>
<td>3.53</td>
</tr>
<tr>
<td>Feed/gain *</td>
<td>7.63</td>
<td><strong>5.81</strong></td>
<td>6.21</td>
</tr>
<tr>
<td>Yield Grade</td>
<td>2.98</td>
<td>3.03</td>
<td>3.09</td>
</tr>
<tr>
<td>Marbling Score **</td>
<td>361</td>
<td>392</td>
<td><strong>415</strong></td>
</tr>
<tr>
<td>Percent Choice *</td>
<td>23</td>
<td>45</td>
<td><strong>63</strong></td>
</tr>
</tbody>
</table>
Effects of different residues for bedding on feedlot cattle in the winter
(Anderson and Schoonmaker, 2005)

<table>
<thead>
<tr>
<th></th>
<th>No bedding</th>
<th>Wheat Straw</th>
<th>Corn Stover</th>
<th>Soybean Residue</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMI, lb *</td>
<td>20.24</td>
<td>20.30</td>
<td>19.62</td>
<td>20.59</td>
</tr>
<tr>
<td>ADG, lb **</td>
<td>3.63</td>
<td>3.91</td>
<td>3.72</td>
<td>3.84</td>
</tr>
<tr>
<td>Feed/gain *</td>
<td>5.59</td>
<td>5.18</td>
<td>5.29</td>
<td>5.35</td>
</tr>
<tr>
<td>Yield Grade **</td>
<td>3.37</td>
<td>3.53</td>
<td>3.22</td>
<td>3.42</td>
</tr>
</tbody>
</table>
Other considerations for winter feeding

- **Wind protection** critically important
  - Slotted wind fences
  - Shelter belts north and west of pens
    - Set back from pens for snow catch
- **Storm systems** affect intake
  - Alter diet with increased forage
- **Water intake decreases** during severe cold
  - Avoid selling animals at during cold snap
  - Allow rehydration period - 4-7 days
Concluding thoughts:

- There is an abundant supply and a wide variety of feedstuffs available at competitive prices.
- Good information and research on feedstuffs.
- Choose feeds on least cost per nutrient basis.
  - Include logistics considerations.
- Manage cattle and formulate diets for least-cost performance.
- Practice good animal husbandry.