**Ruminant Nutrition**

The Art and the Science of Feeding

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**Goals**

- Have Fun
- Discuss and focus on nutritional bottlenecks
- Present Real World Cases
- Discover how easy much of this is
- Utilize the dairy cow as a model

**Outline**

1. Foundation
2. Forages and concentrates
3. Cases

**Nutrition & Feeding**

- Optimal Nutrition is an Enabler
  - Nutrition does NOT force processes
  - Lack of nutrition drags processes

- Nutrient Requirements
  - suggestion
  - feed half of that to the males
Focus on the whole picture

- You will miss more by not looking than not knowing
- Be careful on the phone
- Seek simple solutions to complex problems

What is the Most Common and Largest Error in Nutrition?

- Across all species –
  - Including people
- It’s not the animals’ fault
- It is simple
- It does not take a college degree

Weighing Feed

- Requirements are in pounds, kg, oz, mg
- NOT Scoops, skimp, handfuls, coffee-cans
- Not in volume – cups, gallons, teaspoons

The more items to weigh – the greater chance for error

Feed as Profit Potential

- **Early intervention**
  - Monitor before it’s chewed
- **Objective information**
  - Does not start with “… I think…”
- **Know the destination**
  - What animal group will benefit more from “X” feed
    - Not equal to “… where can I put this cheap hay I just got”
- **Evaluate Post Feeding** … hindsight 20/20
  - Measured Intake

Devise a management strategy

**Establish goals**

- Honest approach
- Create a team that is capable of facilitating the objectives
- Avoid the “Neighborhood” plan

**Account for bias**

- Industry - Feed
- Breeders
- Family
The Objective Cycle

Evaluate Objectively
Document
Change or Not

Least Cost v. Profit Max

- **Least Cost**
  - A known set of outputs
  - Minimize input cost
  - to knowing what you will get

- **Profit Maximization**
  - Add additional units for input to achieve additional units of output
  - To a point

Visit the Farm
Visit Other Farms

Poor Dry Cow Nutrition??

bST??

New Ration Change??
Comparison of Digestive Tracts by Location of Primary Digestive Process

<table>
<thead>
<tr>
<th>Class</th>
<th>Species</th>
<th>Dietary Habit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pregastric Fermenters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ruminants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beef, Sheep, Goat</td>
<td></td>
<td>Grazing Herbivore</td>
</tr>
<tr>
<td>Non-ruminants</td>
<td></td>
<td>Selective Herbivore</td>
</tr>
<tr>
<td>Humans, Voles, Kangaroos, Hoopoe-strusts</td>
<td></td>
<td>Selective Herbivore</td>
</tr>
<tr>
<td>Ruminant Fermenters</td>
<td></td>
<td>Selective Herbivore</td>
</tr>
<tr>
<td>Cattle, Sheep, Goat, Cattle</td>
<td></td>
<td>Selective Herbivore</td>
</tr>
<tr>
<td>Small Intestine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Esophagus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rumen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abomasum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glandular Digestion</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Factors of Rumen Degradation Time

- Plant maturity
  - Mature  \(\Rightarrow\) Lignin
- Plant environmental growth conditions
  - Drought  \(\Rightarrow\) N
  - Direct mineral update
- Processing
  - Grinding, mixing, fats, etc.
  - Additives of water
  - Fermentation
  - CHO availability
- Plant Species
  - Wheat, Barley, Oats

Digestive Sequence Nonruminants

I. Carnivore or Omnivore: Dog, Cat, Man
II. Omnivore or Herbivore: Pig, Horse, Zebra
III. Omnivore or Herbivore: Most rodents
Ruminants – “Chewers of the Cud”

Changes in Rumen Anatomy

<table>
<thead>
<tr>
<th>Compartment</th>
<th>Newborn</th>
<th>3 Months</th>
<th>Mature Adult</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reticulum</td>
<td>5%</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Rumen</td>
<td>25%</td>
<td>65%</td>
<td>80%</td>
</tr>
<tr>
<td>Omasum</td>
<td>10%</td>
<td>10%</td>
<td>7-8%</td>
</tr>
<tr>
<td>Abomasum</td>
<td>60%</td>
<td>20%</td>
<td>7-8%</td>
</tr>
</tbody>
</table>

Characteristics of the Mature Rumen Environment

- **pH**: 6.7 – 7.2 optimum
- **Temperature**: 100.4 – 105.8°F
- **Bacteria**: 10^7 – 10^9/ml fluid
- **Gas Phase**: Anaerobic, CO₂, CH₄
- **Liquid Phase**: Volatile Fatty Acids (VFA), Ammonia, Minerals, Soluble Protein
- **VFA’s**: Acetate, Propionate, Butyrate

Essential Nutrients to Sustain Life for all Species

- **Oxygen**: Minutes → Death
- **Water**: Days → Death
- **Energy**: Weeks → Death
  - Carbohydrates
  - Lipids (Fat)
  - Protein

Essential Nutrients to Sustain Life for all Species

- **Minerals**: Months → Dysfunction, Death
  - Macrominerals
  - Microminerals (Trace)
  - Ultra-trace minerals
- **Vitamins**: Months → Dysfunction, Death
  - Fat soluble
  - Water soluble
The most important nutrient

Healthy animals will regulate their own water intake

Clean, Free choice water

Warm water increases intake
Check for stray voltage
Test water for pH, minerals, and bacteria
It is often neglected

Dry Matter

Determine the moisture content of feed
Heat sample in drying oven until constant weight
Expressed as percentage: \( \frac{\text{dry weight}}{\text{wet weight}} \times 100 \)
Most difficult technique
- Volatile substances
- Introduces largest variation

Dry Matter Techniques

Oven
Microwave
Koster Tester

Nutrient Analysis

- Wet Chemistry
  - Proximate Analysis
  - Van Soest Detergent
  - Accurate – individual tests
- Near Infrared Spectroscopy (NIR)
  - Variation of geography, plant sp.
  - Good for N estimation
  - Very poor for minerals
Energy Determination

- Sources: CHO, Fat, Protein
- Not directly measured, derived from regression equations in the field
  - Species specific equations
  - Models use: ADF, DF, NDF
- Terminology:
  - Total Digestible Nutrients (TDN)
  - Digestible Energy (DE)
  - Metabolizable Energy (ME)
  - Net Energy (NE)

Energy

- **Gasoline for animals**
  - Drives all reactions within the body
    - Nerve, muscle, metabolism
  - Sugars, carbohydrate, fiber
  - Expressed as Net Energy (NE), Digestible Energy (DE), Total Digestible Nutrients (TDN)
  - Energy feed - grains, hay, fat, oilseeds

CHO Terms

- **NSC** - Nonstructural CHO
  - Non cell wall CHO
  - 100 = (NDF + CP + EE + Ash)

- Lignin
  - Totally unavailable cell wall
  - Impact CHO availability
Rumen Bugs

- Starch digesting bacteria create a low pH environment which reduces fiber digesting bacteria

Low Rumen pH < 6

- Decreased fiber digestion
- Decreased milk fat production
- Decreased rumen contraction

Species with highest rate of acidosis?

GOAT

Rumen Bugs

<table>
<thead>
<tr>
<th>Class of Organism</th>
<th>Primary Substrate</th>
<th>Specific Requirements</th>
<th>Primary Endproduct</th>
<th>pH Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellulolytic Bacteria</td>
<td>Starch, Hemicellulose, Pectin</td>
<td>Ammonia, Amino acids</td>
<td>Propionate, Butyrate, Ammonia</td>
<td>Neutral 6.2 - 6.8</td>
</tr>
<tr>
<td>General Purpose Bacteria</td>
<td>Cellulose, Starch</td>
<td>Ammonia, Amino Acids</td>
<td>Propionate, Butyrate, Ammonia</td>
<td>Acid 5.5 - 6.6</td>
</tr>
<tr>
<td>Nonstructural CHO Bacteria</td>
<td>Starch, Sugars</td>
<td>Amino Acids, Ammonia</td>
<td>Propionate, Butyrate, Ammonia</td>
<td>Acid 5.0 - 6.6</td>
</tr>
</tbody>
</table>

Major VFA’s

- Acetate
- Propionate
- Butyrate

Adapted from Chase, L.E. and C.J. Stiffler, Cornell University
Protein

- Building blocks for the body
- Subunits are amino acids
- Muscle, hormone and enzyme maintenance
- Ruminants utilize microbial protein and amino acids
- CP (%) or MP (%, kg, or lbs)
  - CP = % nitrogen in feed \* 6.25
  - Nitrogen is 16% of feed protein
- Protein feeds - soy, canola, alfalfa hay

CP – Crude Protein

Total N\% x 6.25

Plant Protein is 16% N

1/6.25 = .16

SIP – Sol. CP = Soluble Protein

- Dietary protein that goes into solution in the rumen
- Rapidly available NH\(_3\)_
- High Soluble Protein can be toxic

Microbial Protein Synthesis

\[
\text{CARBOHYDRATE} \rightarrow \text{ATP} \rightarrow \text{NPN} \rightarrow \text{NH}_3 \rightarrow \text{MICROBIAL PROTEIN}
\]

\[
\text{CARBON SKELETONS} \rightarrow \text{SULFUR COFACTORS}
\]
**RDP – (DIP)**
Rumen Degradable Protein
(Degradable Intake Protein)

- Dietary protein which is fermented in rumen to an end product – $\text{NH}_3 / \text{NH}_2$

**RUP – (UIP)**
Rumen Undegradable Protein
(Undegradable Intake Protein)

- Bypass protein
- Very slow to rumen fermentation
- Digestion in abomasum

**MP – Metabolizable Protein**

- Dietary protein, including both DIP and UIP, that has been digested and is available for absorption

**NPN – Non-protein Nitrogen**

- N compounds without linkages
- Urea
- Biuret
- Ammonia

**ADF – N ADIN**
Unavailable Protein

- Protein not available to any digestion
- Heat damage

**Microbial Protein Synthesis Relative to Dairy Protein Needs**

<table>
<thead>
<tr>
<th>Efficiency of Microbial Protein Synthesis</th>
<th>Daily Milk Yield</th>
<th>% of protein from microbes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gm N/kg MP digested</td>
<td>55 lbs</td>
<td>77 lbs</td>
</tr>
<tr>
<td>20</td>
<td>49</td>
<td>42</td>
</tr>
<tr>
<td>30</td>
<td>73</td>
<td>64</td>
</tr>
<tr>
<td>40</td>
<td>98</td>
<td>85</td>
</tr>
</tbody>
</table>
Amino Acids

- Limiting Amino Acids
  - Methionine
  - Lysine
- Limiting When??

Minerals

- Minerals are structural and metabolic components
- Macro Minerals - needed in large amounts
  - Ca, P, Na, K, Cl, S, and Mg
    - Express in %
- Micro Minerals - needed in small amounts
  - Mn, Co, Se, I, Fe, Cu, Mo, Zn
    - Express in ppm
- In premixes, complete feeds and formulas

Mineral Analysis

- Atomic Absorption Spectroscopy
  - Expensive procedure
  - Variable results
- Macrominerals
  - Ca, P, Mg, K, Na, Cl, S
- Microminerals
  - Cu, Fe, Mn, Mo, Se, Zn

<table>
<thead>
<tr>
<th>Macrominerals</th>
<th>Major Function</th>
<th>Deficiency Disease or Symptoms</th>
<th>Interrelationships or Toxicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca</td>
<td>Bone formation, muscle contraction, milk component</td>
<td>Milk fever, osteoprosis, fracture, muscle weakness</td>
<td>Cardiac arrest, Milk fever</td>
</tr>
<tr>
<td>P</td>
<td>Bone formation, reproduction</td>
<td>Rickets, rickets, osteoporosis, poor conception, poor estrus</td>
<td>Ca deficiency, milk fever</td>
</tr>
<tr>
<td>Na</td>
<td>Extracellular fluid balance</td>
<td>Weakness, pica</td>
<td>Salt toxicity – water deprivation</td>
</tr>
<tr>
<td>Cl</td>
<td>Extracellular fluid balance, acid-base balance</td>
<td>Pica, hypovolemia</td>
<td>Salt toxicity – water deprivation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
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<th>Interrelationships or Toxicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>Extracellular fluid balance</td>
<td>Pica</td>
<td>Cardiac arrest</td>
</tr>
<tr>
<td>Mg</td>
<td>Muscle contraction, neuromuscular transmission, protein, CHO, and lipid metabolism</td>
<td>Grass tetany, fibrilary paralysis, twitching, hyperesthesia</td>
<td>Brain tumor</td>
</tr>
<tr>
<td>S</td>
<td>Amino acid formation</td>
<td>Hair loss, milk reduction</td>
<td>Zilch acropoditis, osteoporosis, Ca deficiency</td>
</tr>
</tbody>
</table>
**Microminerals and Ultra-trace Minerals**

<table>
<thead>
<tr>
<th>Micromineral</th>
<th>Major Function</th>
<th>Deficiency Disease or Symptoms</th>
<th>Interrelationships or Toxicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cobalt (Co)</td>
<td>Immunoglobulin synthesis; Bone formation; Myelin formation; Immune function</td>
<td>Megaloblastic anemia, ketosis, reduced growth, body weight, Toxicity unlikely</td>
<td>Cobalt needs to be supplied to rumen microbes; Toxicity unlikely</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>Immune function</td>
<td>Anemia, ketosis, reduced growth, body weight</td>
<td>Copper is functional in the blood</td>
</tr>
<tr>
<td>Iodine (I)</td>
<td>The thyroid</td>
<td>Goiter, stillbirth, infertility, hair loss, immune failure</td>
<td>High intake reduces uptake efficiency; Toxic intake results in goiter, fetal malformations</td>
</tr>
<tr>
<td>Manganese (Mn)</td>
<td>Bone formation; Action of enzymes with Glu-Lipid; protein metabolism</td>
<td>Fractures, Neonatal disease, Death</td>
<td>Excess Mn and Se inhibit utilization and storage in ruminants; Toxicity variable in species, results in reduced growth</td>
</tr>
<tr>
<td>Selenium (Se)</td>
<td>The thyroid</td>
<td>Goiter, stillbirths, infertility, Hair loss; Immune failure</td>
<td>High intake reduces uptake efficiency; Toxic intake results in goiter, fetal malformations</td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>Immune function</td>
<td>Immune function</td>
<td>Cobalt needs to be supplied to rumen microbes; Toxicity unlikely</td>
</tr>
</tbody>
</table>

**Micromineral Diagnostics**

- Understand at what level the mineral is functional
- If it is functional in the blood then use blood to measure and monitor
- If it is functional in the tissue then use the tissue to measure and monitor

**Micromineral** | **Diagnostic Criteria** | **Comments**
---|---|---
Cobalt (Co) | Serum or urinary | Concentrations increased in deficiency
Copper (Cu) | Serum, plasma Cu | Decreased in severe deficiency

**Copper (Cu)**

- Serum, plasma Cu
- Liver Cu
- Centrolamin concentration
- RBC Superoxide dismutase activity
- Hair Cu

**Comments**

- Decreased in severe deficiency
- Decreased in toxicosis
- Decreased in severe deficiency
- Decreased in toxicosis
- Of no value for diagnosis
### Micromineral Diagnostics

<table>
<thead>
<tr>
<th>Micromineral</th>
<th>Diagnostic Criteria</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iodine (I)</td>
<td>Struvite, plasma, thyroid, T3</td>
<td>Normal or increased</td>
</tr>
<tr>
<td></td>
<td>Total iron binding capacity</td>
<td>Increased, influenced by inflammation</td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>Serum, plasma Fe, Hgb, MCV, RVV</td>
<td>Normal or increased, not sensitive</td>
</tr>
</tbody>
</table>

**Comments:**
- Decreased – diagnostic
- Too low to detect
- Decreased – diagnostic
- Decreased – sensitive to acute changes
- Decreased – chronic indicator
- Of no value except for toxicosis

### Vitamins

- **Vitamins protect and enable organ function.**
- **Fat Soluble Vitamins**
  - A, D, E, and K
  - Expressed as IU or KIU
- **Water Soluble Vitamins**
  - B's, C
  - Expressed as mcg, mg
- In vitamin mineral premixes and complete feeds and formulas

### Water Soluble Vitamin Deficiency Signs

<table>
<thead>
<tr>
<th>Vitamin</th>
<th>Function</th>
<th>Signs</th>
</tr>
</thead>
<tbody>
<tr>
<td>B&lt;sub&gt;12&lt;/sub&gt;</td>
<td>Decarboxylation of tetrahydrobiopterin</td>
<td>Hyperhomocysteinemia</td>
</tr>
<tr>
<td>Niacin</td>
<td>Reduce lipolysis</td>
<td>Early ketosis, dementia</td>
</tr>
<tr>
<td>Biotin</td>
<td>Protein formation, carboxylation reaction</td>
<td>Laminitis</td>
</tr>
<tr>
<td>Choline</td>
<td>Lipid transfer, methyl donor</td>
<td>Early ketosis Poor Reproduction</td>
</tr>
<tr>
<td>Vit C</td>
<td>Antioxidant, hydroxylation</td>
<td>Mastitis, anemia</td>
</tr>
</tbody>
</table>

### Progression of Trace Mineral Deficiencies

![Progression of Trace Mineral Deficiencies Diagram](image)
Fat Soluble Vitamin Deficiency Signs

<table>
<thead>
<tr>
<th>Vitamin</th>
<th>Function</th>
<th>Signs</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Vision, glucose synthesis, cellular protection</td>
<td>Poor reproduction, blindness, Retarded plumula, anorexia, depression, atrophy</td>
</tr>
<tr>
<td>D</td>
<td>GI absorption of Ca, bone formation, CHO metabolism</td>
<td>Milk fever,rickets</td>
</tr>
<tr>
<td>E</td>
<td>Antioxidant</td>
<td>Muscular, immune dysfunction, muscle dystrophy, reproductive failure, BP</td>
</tr>
<tr>
<td>K</td>
<td>Blood Clotting, Prothrombin formation</td>
<td>Anemia, hemorrhage</td>
</tr>
</tbody>
</table>

Feed Components

Summary

- Consider the end result of the feed
  - Ruminant
  - Monogastric
- Ruminants-
  - Microbial digestion
  - Enzyme and acid digestion
- Monogastric- Enzyme and Acid digestion

Summary

- Water – clean and free choice
- Protein – utilize microbial protein first
- Energy – powers all systems and rxns
- Vitamins - protect the body and are the aids to organ function
- Minerals – hold the body together
Forages and Concentrates

Its what’s for Dinner

Feedstuff Categories

- Forages
  - Roughages
- Concentrates
  - Energy
  - Protein
  - By products
- Vitamin Supplements
- Mineral Supplements
- Additives
  - Antibiotics
  - Growth promotants

Forages – The Base of a Ration

Forage Quality

Influencing Factors

- Plant Species
- Plant Maturity
- Fertilization
- Environmental Conditions
- Water Availability
- Time of Cutting
- Storage Practices

Alfalfa Hay

<table>
<thead>
<tr>
<th>Stage</th>
<th>Crude Protein</th>
<th>ADF</th>
<th>NDF</th>
<th>NEI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-bloom</td>
<td>&gt;19</td>
<td>&lt;30</td>
<td>&lt;35</td>
<td>.70</td>
</tr>
<tr>
<td>Early bloom</td>
<td>17-19</td>
<td>30-35</td>
<td>35-39</td>
<td>.66</td>
</tr>
<tr>
<td>Mid bloom</td>
<td>13-16</td>
<td>36-41</td>
<td>41-47</td>
<td>.62</td>
</tr>
<tr>
<td>Late bloom</td>
<td>&lt;13</td>
<td>&gt;41</td>
<td>&gt;48</td>
<td>.56</td>
</tr>
</tbody>
</table>

Fiber for function 1st and 4th cuttings

Grass Hay

<table>
<thead>
<tr>
<th>Stage</th>
<th>Crude Protein</th>
<th>ADF</th>
<th>NDF</th>
<th>NEI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-heading</td>
<td>&gt;17</td>
<td>&lt;29</td>
<td>&lt;55</td>
<td>.70</td>
</tr>
<tr>
<td>Early heading</td>
<td>12-17</td>
<td>30-35</td>
<td>55-60</td>
<td>.65</td>
</tr>
<tr>
<td>Heading</td>
<td>8-12</td>
<td>36-44</td>
<td>61-65</td>
<td>.58</td>
</tr>
<tr>
<td>Post heading</td>
<td>&lt;8</td>
<td>&gt;45</td>
<td>&gt;65</td>
<td>.52</td>
</tr>
</tbody>
</table>

Ration limited by intake and mixing
Grass Silage

<table>
<thead>
<tr>
<th>Stage</th>
<th>Crude Protein</th>
<th>ADF</th>
<th>NDF</th>
<th>NEI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Late Veg</td>
<td>16</td>
<td>26</td>
<td>50</td>
<td>.70</td>
</tr>
<tr>
<td>Mid bloom</td>
<td>12</td>
<td>34</td>
<td>61</td>
<td>.63</td>
</tr>
</tbody>
</table>

Check for nitrates in stress silage
Cut every 26 to 28 days
Needs to be inoculated

Corn Silage

<table>
<thead>
<tr>
<th>Stage</th>
<th>Crude Protein</th>
<th>ADF</th>
<th>NDF</th>
<th>NEI</th>
</tr>
</thead>
<tbody>
<tr>
<td>50% grain</td>
<td>8.1</td>
<td>22</td>
<td>42</td>
<td>.73</td>
</tr>
<tr>
<td>10% grain</td>
<td>9.0</td>
<td>26</td>
<td>48</td>
<td>.64</td>
</tr>
</tbody>
</table>

Energy Feed
Focus on fiber
Optimal DM =35%

Sensory Analysis
Feed Evaluation
- Stage of Maturity
- Leafiness
- Color
- Odor
- Foreign Material

Forage$

High quality forage is the foundation of a dairy ration

Poor forage quality can not be fully compensated for with grain or by-product feeds

Forage Value

Harvested and purchased forages need to be assessed for value in dollars and fit into the feeding situation
- Dry Matter
- CP
- ADF
- NDF
- Lignin

Corn silage 1
- 30% Dry Matter
- $28/ton
- $28/3 = $93/ton of Dry Matter

Corn Silage 2
- 25% Dry Matter
- $25/ton
- $25/25 = $100/ton of Dry Matter
**Forage Value**

<table>
<thead>
<tr>
<th>Alfalfa Hay 1 – 4th</th>
<th>Alfalfa Hay 2 – 1st</th>
</tr>
</thead>
<tbody>
<tr>
<td>$143/ton</td>
<td>$138/ton</td>
</tr>
<tr>
<td>90% Dry Matter</td>
<td>88% Dry Matter</td>
</tr>
<tr>
<td>23% CP</td>
<td>24% CP</td>
</tr>
<tr>
<td>28% ADF</td>
<td>30% ADF</td>
</tr>
<tr>
<td>34% NDF</td>
<td>35% NDF</td>
</tr>
<tr>
<td>5.2% Lignin</td>
<td>5.8 Lignin</td>
</tr>
</tbody>
</table>

**Maximize Silage Efficiency**

- Inoculate all silage – corn and grass
- Cover all silage
- Pack tight
- Remove molded silage
- Keep an active face - with 6 inches of penetration daily
- Choose equipment for defacing appropriate for the silage storage and feeding situation

**Silage Evaluation**

- **Temperature of the stack**
  - Less than 10 degrees above ambient
- **Check pH**
  - Grass 4.0 – 4.8 >5 = bad
  - Corn 3.8 – 4.2 >4.5 = bad
- **Feel** – should feel spongy
- **Smell** – Fermentation analysis
  - Vinegar – Acetate
  - Alcohol – Yeast
  - Rancid – Butyric acid
  - Caramel – Heat damage

**Silage Evaluation**

- **Foreign objects**
- **Manure contamination**
  - Field application
  - Contaminated feed handling equipment
- **MOLD**
  - Taste and Mycotoxins
- **VFA analysis**

**WCS – Whole Cottonseed**

<table>
<thead>
<tr>
<th>Crude Protein</th>
<th>ADF</th>
<th>NDF</th>
<th>NE1</th>
<th>Mcal/lb</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>1.01-1.05</td>
</tr>
<tr>
<td>22-24</td>
<td>34-37</td>
<td>43-47</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

High Fiber
- 40% UIP

High Energy
- 20% lipid

Gossypol – 6 to 8 pound maximum
### Soybean Meal

<table>
<thead>
<tr>
<th>Process</th>
<th>Crude Protein</th>
<th>ADF</th>
<th>NDF</th>
<th>NEI</th>
<th>Mcal/lb</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBM 44</td>
<td>49%</td>
<td>4%</td>
<td>7%</td>
<td>.88</td>
<td></td>
</tr>
<tr>
<td>SBM 48</td>
<td>55%</td>
<td>4%</td>
<td>7%</td>
<td>.92</td>
<td></td>
</tr>
</tbody>
</table>

- UIP = 30%
- Sol. CP = 20%
- Lipid = 1%
- NFC = 27%

### Corn

<table>
<thead>
<tr>
<th>Process</th>
<th>Crude Protein</th>
<th>ADF</th>
<th>NDF</th>
<th>NEI</th>
<th>Mcal/lb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rolled</td>
<td>9%</td>
<td>2%</td>
<td>8%</td>
<td>1.03</td>
<td></td>
</tr>
<tr>
<td>Ground</td>
<td>9%</td>
<td>2%</td>
<td>8%</td>
<td>1.05</td>
<td></td>
</tr>
</tbody>
</table>

- NFC = 75%

### Barley

<table>
<thead>
<tr>
<th>Process</th>
<th>Crude Protein</th>
<th>ADF</th>
<th>NDF</th>
<th>NEI</th>
<th>Mcal/lb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rolled</td>
<td>9%</td>
<td>4%</td>
<td>21%</td>
<td>.91</td>
<td></td>
</tr>
</tbody>
</table>

- Lower energy than corn
- Higher NDF
- NFC ~ 65%
- PNW barley lower
- ~$5/ton difference

### Canola

<table>
<thead>
<tr>
<th>Crude Protein</th>
<th>ADF</th>
<th>NDF</th>
<th>NEI</th>
<th>Mcal/lb</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>.18</td>
<td>.26</td>
<td>.83</td>
<td></td>
</tr>
</tbody>
</table>

- UIP = 28%
- 3.5% lipid
- NFC = 25%
- $40 - $50 / ton difference from SBM 48

### Distillers - DDG

<table>
<thead>
<tr>
<th>Crude Protein</th>
<th>ADF</th>
<th>NDF</th>
<th>NEI</th>
<th>Mcal/lb</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 - 30</td>
<td>11-18</td>
<td>32 -43</td>
<td>.92</td>
<td>.96</td>
</tr>
</tbody>
</table>

- UIP ~ 50%
- Sol CP ~5%
- Lipid 8% - 13%
- NFC ~14%

### Summary of Feedstuffs

- Don't assume feedstuff analysis
- Sample DM at least weekly
- Sample forages once a month and with new lots
- Sample all new lots of commodities
- Recognize the art and the science of nutrition
Where are the opportunities??

- DMI – formulated → Reformulated
- Communication
- Definitive Diagnosis – Width of Knowledge
  - It is always the nutritionist fault
  - Fat cows

Planning ?

http://oachistes.com