Making or Breaking Rations With Forage Digestibility & Quality

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To do anything well (and repeatably), we need to understand what we are dealing with.

How do we work with forages to make rather than break rations?
Forage In Dairy Cow Rations

- What cows are designed to use
- Include as much forage as possible
- Meet requirements

Forage 50-60%
NonForage 40-50%

14 herds, 13,000 – 16,800 kg RHA

Shaver and Kaiser, 2011
You can’t push a cow to produce…..

…..But you can get the obstacles out of her way so she can.

Forage quality sets limits for amount of forage fed and production.

We must balance rations without breaking rules.
Not good. Not normal.
We broke the rules.
Body Condition Changes

OK?

Depending on days in milk....

Too Thin.
What Does Forage Do?

- Nutrients to meet requirements
- Physical form for healthy gut function
- It is and makes good use of farm resources
- Recycles manure, reduces erosion
What Is “Quality”? 

“Quality”: how a feed complements the rest of the ration to meet cow needs.
Not High or Low, but Right Quality
What fits the need?

- Digestibility
- Composition
- Form
- Amount
Physically Effective Fiber

- Enhances rumen function
- Increases rumination
- Reduces rumen acidosis
- Rumen retention & passage
- Allows rations to work

Affected by particle size, digestion, density, hydration, “softness” ......

Fine  Medium  Coarse
At least 50% of all cows not sleeping, drinking, or eating should be chewing their cuds.

Manure, ok.
Fecal Particle Size

Good ruminal retention = better digestion

Reduced ruminal retention = poorer digestion
Cows have very few hobbies, so they sort their feed. Use moist rations. Particle size?
Measuring Digestibility in the Lab

- Measuring digestibility or rate in the lab.
- Digestion% vs. Hour of Fermentation.
- Lag: Initial phase with no digestion.
- Digested: Where digestibility or rate is determined.
- Maximum Digestion: Peak of digestion.

Graph showing digestion trend over time.
Fiber Digestibility

- Highly variable
- Crop variety, maturity, growing conditions, ...
- Determines available nutrients

30 hour NDF digestibility

Grass
- 26% Digested
- 74% Undigested

Corn silage
- 37% Digested
- 63% Undigested

Digested
Undigested

Hall and Mertens, 2012
Alfalfa and Barley Silages

Figure 1: Dry matter disappearance curves for barley and alfalfa silages.

How quickly they digest to give nutrients
How quickly they break down to leave the rumen

Univ. of Alberta, Dairy Research Highlights, Nikkhah et al., 1995(?)
(In)Digestibility and Intake

As digestibility ↑, intake ↑ to a point

There's only so much undigestible material a cow can fit in her rumen/gut!

Undigestible feed limits intake.

NDF is the least digestible part of the diet.

Bigger pieces of feed cannot pass until they are digested & ruminated to reduce their size.

Conrad et al., 1964, J. Dairy Sci. 47:54
NDF Digestibility Precision

For good analyses done in 1 lab: variability is ± 5% NDFD.

For good analyses done across labs: variability is ± 7% NDFD.

Very good for ranking samples within lab.

9.8, 13.3
Composition

**Sugars**
- Molasses
- Bakery waste
- Fresh forages/hays
- Beet & citrus pulps
- Almond hulls

**Soluble Fiber**
- Legume forages
- Beet & citrus pulps

**Starch**
- Grain silages
- Corn, sorghum
- Small grains
- Bakery waste
- Wheat middlings
- Potatoes
cull/waste

**Fiber**
- Forages
- Nonforage fiber sources
- Crop residues
- Wheat middlings
- Corn gluten feed
- Bagasse

**Protein**
- Legume forages
- Soy & Canola
- Corn gluten meal
Eaten Doesn’t Mean Digested

Poorly chopped/processed corn silage

Coarse corn meal
Forage: Current Recommendations

- Composition
- Physical form
- Digestibility

<table>
<thead>
<tr>
<th></th>
<th>Min. Forage NDF</th>
<th>Min. Dietary NDF</th>
<th>Max. Dietary NFC</th>
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<tbody>
<tr>
<td></td>
<td>19</td>
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- NDF from Forage as 0.9 to 1% of body weight (Mertens)
- 75% NDF from forage

Dairy NRC, 2001
# How Much Can You Feed?

Starting Point:
Allowable NDF = 28% x 75% from forage = 21%
Allowable Forage = Allowable NDF% / Forage NDF%

<table>
<thead>
<tr>
<th>Forage NDF</th>
<th>Diet %</th>
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<tbody>
<tr>
<td>Straw</td>
<td>80%</td>
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<tr>
<td>Barley Silage</td>
<td>55%</td>
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<tr>
<td>Alfalfa Silage</td>
<td>45%</td>
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<tr>
<td>50:50 Barley:Alf</td>
<td>50%</td>
</tr>
<tr>
<td>Corn Silage</td>
<td>45%</td>
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</tbody>
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Formulating For NFC

- 5% sugars
- 25% starch
- 7% soluble fiber

Allowable starch relative to amount of forage/effective fiber?

Hall and Van Horn, 2001
Moldy Feed / Mycotoxins

What is the costs of preventably sick cows?

 Spoilage
Sorting This Out On The Farm

- Balance first with forages. They dictate the ration’s base.
- Aim to meet cow fiber & energy needs within bounds of present recommendations.
- …Then work with the cows to figure out the details.
Sorting This Out On The Farm

Things you can evaluate

- Digestibility and composition
- Particle size & sorting
- Rumination and manure evaluation
- Intake, performance, and feed efficiency
- Body condition score change
Questions?