Dr. Georg Eller received his veterinary license in 1987. From 1987 to 1991 he worked as an assistant veterinarian with Dr. Frohnapfel, Karlstadt and Dr. Hahn, Saal and in 1991 he received his Dr. med. vet. degree. He established his veterinary practice in Hofheim in 1991 which transformed into "Veterinary Clinic Dr. Eller" in 1994. In 2000 he co-founded HCS Herdenmanagement GmbH Consulting Service, an independent agency for dairy farm veterinary advice.

Subclinical acidosis in dairy cattle

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Subclinical acidosis in dairy cattle

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Feeding dairy cows: Feeding bugs

Rumen physiology

Subclinical acidosis

- symptoms:
  - reduction in DMI
  - mild diarrhea
  - poor body condition
  - laminitis
  - poor therapeutic response
  - high culling rates
Risk factors SARA

- low buffer capacity of less rumen fill
- high fermentable ration
- low amount of forage NDF
- overcrowding
- poor cow comfort
- heat stress

Factors influencing rumen health

Management

feed

animal

Susceptibility to ruminal acidosis varies among cows

- Dry matter intake, meal size
- Surface area for VFA absorption
- Rumen size
- Papillae adaptation
- Parakeratosis
- Rumen motility
- Metabolism of absorbed fermentation acids

Consequences

- Reduced efficiency of production
- Fiber digestion reduced (reduces energy intake)
- Milk fat concentration depressed (reduces milk energy output, value)
- Rumenitis
- Reduced absorptive capacity
- Liver abscesses
- Diarrhea
- Laminitis
International Dairy Nutrition Symposium, Wageningen, 22 October 2015
"Dairy Cow Nutrition and Animal Health"

Georg Eller - Subclinical acidosis in dairy cattle

**Factors influencing rumen health**

- **Diet**
- **Feed analysis**

**Feed analysis**

- **Feed analysis is:**
  - crucial for ration formulation
  - necessary for solving problems
- **Reliable results means:**
  - representative samples
  - Different pieces from various spots at the bunker face
  - Correct handling of samples
- **Which lab to use?**
  - criteria:
    - How fast and how reliable is the lab?
    - Costs?
    - Wet chemistry or NIRS?

**Goal of formulating diets for high producing dairy cows**

- Provide low-fill, highly fermentable diets
- Maintain adequate ruminal pH
- Consistent fermentation over time
Forages provide coarse fiber

- Dilute starch
- Buffering: chewing, cation exchange
- Selective retention vs. fill
- More consistent supply of absorbed fuels

Rumen “mat”

- En traps small feed particles
- Increases digesta mass
- Related to increased rumen movements, rumination
  - Rumen movements increase VFA absorption
  - Rumination increases salivary buffers
- Increases “baseline” of absorbed fuels

Feed intake affected by

- Filling effect of diets (NDF)
- Ruminal fermentability of diets (propionate)

Dietary factors affecting ruminal fill

- Forage NDF content of diet
- Forage particle size
- Non-forage fiber sources
- NDF digestibility (feed, rumen environment)

Feed intake decreases with increasing NDF content of basal ration

Variation of NDF-content in forage

- Alfalfa hay (n = 4697) Average 41.2 ± 2 Stdev. 28.2 - 54.2
- Alfalfa silage (n = 5017) 45.0 32.6 - 57.4
- Grass hay (n = 3343) 64.8 50.6 - 79
- Grass silage (n = 2508) 59.4 43.6 - 75.2
- Corn silage (n = 17358) 46.0 33.4 - 58.6

Source: Northeast DHIA Forage Lab, Ithaca, NY 1995
Non-fiber
Potentially digestible fiber
Indigestible fiber

Higher NDF digestibility
More filling
Slow rate of digestion and passage

Legume
Non-fiber
Potentially digestible fiber
Indigestible fiber

Lower NDF digestibility
Less filling
Fast rate of digestion and passage

Perennial grass
Indigestible fiber

NDF digestibility
- NDF digestibility is an important parameter of forage quality.
- Forage NDF digestibility is extremely variable.
- Forages with high NDF digestibility have the potential to increase energy intake and milk yield.
- Benefits are greater for high-producing cows and cows fed high forage diets.
- NDF digestibility can be estimated by lignin content

variation of starch digestibility
- Type of grain
- Moisture content
- Ensiled?
- Time of harvesting
- Fine or coarse
- Endosperm type

Sites of starch digestion
- ABSORBED
  - VFA
  - GLUCOSE
  - VFA
- RUMEN
- SMALL INTESTINE
- LARGE INTESTINE
- FECES

Effect of ruminal starch digestion on feeding behaviour
- Oba & Allen, 2003

<table>
<thead>
<tr>
<th></th>
<th>high moisture corn</th>
<th>dry ground corn</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMI, kg/d</td>
<td>20.8</td>
<td>22.5</td>
</tr>
<tr>
<td>OM digested in rumen, kg/d</td>
<td>11.3</td>
<td>10.3</td>
</tr>
<tr>
<td>DMI/meal, kg</td>
<td>1.9</td>
<td>2.3</td>
</tr>
<tr>
<td>Intermeal interval, min</td>
<td>93.9</td>
<td>105.0</td>
</tr>
</tbody>
</table>

Rate of fermentation by grain type
- Fast
  - Wheat
  - Barley
  - Ground high moisture corn
- Slow
  - Dry rolled corn
  - Steam flaked sorghum
  - Dry rolled sorghum
Grain in corn silage

- Concentration is highly variable (<20% to >50%)
  - Typically adjusted by diet formulation
- Digestibility is highly variable (<50% to >90%)
- Starch digestibility affects
  - Energy density of the diet
  - Feed intake
  - Efficiency of milk production

Factors affecting starch digestibility for corn silage

- Kernel moisture content
  - Maturity at harvest
  - Ratio of kernel DM to whole plant DM
  - “stay-green” hybrids
  - Environmental effects
- Endosperm type
  - Floury
  - Vitreous

Endosperm

Vitreousness Increases with Increasing DM

Starch Digestibility Decreases as Vitreousness Increases

Effect of conservation method and coarseness of grind on site of digestion of corn grain
Non-Forage Fiber Sources

- Fiber concentration (NDF + soluble fiber) similar to forages
  - Most 40-60%
  - Some > 75% NDF
- pH, acetate:propionate
  - Increase when substituted for grains
  - Decrease when substituted for forage
- Small particle size
  - Less filling
  - Some long particles required for mat formation

Categories of NFFS

- Starch dilution
  - Oat hulls, cottonseed hulls, ground corn cobs
  - Starch dilution & fermentable fiber
    - Soy hulls, beet pulp
  - Starch dilution, fermentable fiber & protein
  - Brewer's grains, corn gluten feed
  - Starch dilution, fermentable fiber, protein & fat
    - Whole linted cottonseeds, distiller's grains

NFFS reduce ruminal starch digestibility

Beet pulp substituted for high moisture corn
0, 6, 12, and 24% of diet DM
Reduced true ruminal starch digestibility linearly from 47% to 17% without reducing ruminal or total tract digestibility of OM (Voelker and Allen, 2002)

Factors influencing rumen health

<table>
<thead>
<tr>
<th>DMI</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tbody>
</table>

Building a blueprint:

Goals for every working area:

<table>
<thead>
<tr>
<th>Feeding</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Qualitative goals</td>
<td>Quantitative goals</td>
<td></td>
</tr>
<tr>
<td>Mixing and delivering feed</td>
<td>DMI &lt; 24 kg</td>
<td></td>
</tr>
<tr>
<td>Push up feed</td>
<td>Refusals &lt; 3% of consumption</td>
<td></td>
</tr>
<tr>
<td>Feed storage</td>
<td>Daily milk &gt; 35kg</td>
<td></td>
</tr>
<tr>
<td>Look for manure consistency</td>
<td>Milk fat &gt; 3.9%</td>
<td></td>
</tr>
<tr>
<td>Control refusals</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>Maintenance on routine basis</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Air, Bunk, & Comfort

<table>
<thead>
<tr>
<th>2 Row Barn</th>
<th>3 Row Barn</th>
<th>4 Row Barn</th>
<th>6 Row Barn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>Bunk</td>
<td>Comfort (Heat)</td>
<td>Preference</td>
</tr>
<tr>
<td>Best</td>
<td>2'/Cow</td>
<td>Best</td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>&gt;1.5'/Cow</td>
<td>Good</td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>2'/Cow</td>
<td>Standard</td>
<td></td>
</tr>
<tr>
<td>Less</td>
<td>&gt;1.5'/Cow</td>
<td>Less</td>
<td></td>
</tr>
</tbody>
</table>

### DMI and overcrowding

![Graph showing DMI and overcrowding](image)

### Feeding systems

- TMR
- partial TMR plus Transponder
- AMS

### Feed mixing:

Questions:

- Is the weighing scale working and calibrated?
- How homogenous is the TMR?
- Is the feed mushy or particles short chopped?
- Smallest components?
- In which order the single components are filled in?
- Is the mixer waggon overloaded?
- How many different feeders are working?
**Bunk management:**

- How many hours is feed available??
- Is the first feed looking similar to the ration after several hours?
- How often is feed delivered and pushed up?
- Are there daily records of feed intake?
- How much refusals are left?
- Is the TMR heating up during the day?
- Eating behaviour and bunk use of the cows?
- Is the water supply adequate?

**Sorting of feed**

- Fresh ration - 18% on top
- Feed after 12h - 46% on top

**Behavior and control of cows**

- Control of cud chewing (50 chewing movements/bite)
- Control of manure (consistency, undigested fibre and kernel particles, smell, colour...)
- Control of behavior (standing, use of free stalls, walking, eating, breathing)
- General condition (health)
- Milk yield, components
- BCS

**Take home messages**

- Always look on the big picture
- Cows don´t lie