Developing The Rumen-
Developing The Heifer

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Northeast District

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Question…

• Is a new born calf a ruminant or a monogastric animal?

She is a *monogastric* animal.
Calf versus Adult

Rumen

Calf
0.5 : 1 Volume Ratio
Rumen : Abomasum

Adult
10:1 Volume Ratio
Rumen : Abomasum
**Pre-Ruminant Phase**

- 0 to 3 weeks of age.
- The calf’s rumen is non-functional.
- The abomasum, the main compartment of digestion, makes up **70%** of all compartments.
- May last longer if dry feed is not offered.
Development of the Digestive System

- Occurs during the first 4-8 weeks of a calf’s life.
- Development is chemical not physical.
- Prior to weaning, most of energy and amino acid needs of calf derived from intestinal digestion of milk.
- When calf consumes water and starter, bacterial fermentation is initiated.
Bacterial Fermentation

- Bacterial fermentation produces large amounts of volatile fatty acids:
  - Acetate
  - Butyrate
  - Propionate
- Production of VFA responsible for rapid rumen tissue development.
Why chemical and not physical?

- Research results show rumen development stimulated by VFA’s - not “scratch factor”.
- Milk, hay and grain fermented to produce VFA.
- Sponges did not contribute VFA for rumen development - added “scratch”.

<table>
<thead>
<tr>
<th>Material</th>
<th>Effect on Rumen Development</th>
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<tbody>
<tr>
<td>Milk</td>
<td>++</td>
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<tr>
<td>VFA Salts</td>
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</tr>
<tr>
<td>Acetate</td>
<td>++</td>
</tr>
<tr>
<td>Propionate</td>
<td>+++</td>
</tr>
<tr>
<td>Butyrate</td>
<td>+++++</td>
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<tr>
<td>Grain</td>
<td>+++</td>
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<tr>
<td>Hay</td>
<td>++</td>
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<tr>
<td>Plastic Sponges</td>
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<td>Inert Particles</td>
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Inside the Rumen

- Provide Water
- Provide Grain

Fermentation

VFA
- Propionate
- Butyrate
- Acetate

Absorption of VFA through epithelium stimulates rumen development
Transition Phase

- 4 to 8 weeks of age.
- Rumen begins to take over main digestion of feed.
- Growth of papillae and rumen is stimulated by dry feed intake.
- Will continue as long as milk is fed.
Veal Calf’s Stomach

18 pounds
Rumen 18 x 11”
Abomasum 12 x 5”
Ruminant Phase

- Over 8 weeks of age.
- Functional ruminant.
- Dry feed is the sole source of feed.
- **Rumen makes up 85% of all compartments.**
Dairy Calf’s Stomach

70 pounds
Rumen 24 x 22”
Abomasum 16 x 4”
Ingredients to Initiate Rumen Development

- Bacteria
- Liquid in the rumen
- Muscular movement
- Absorptive ability of the tissue
- Availability of feed stuff in the rumen
Bacteria

- Bacteria are non-existent in the rumen at the time a calf is born.
- Bacteria are introduced into the rumen at the time the calf begins to consume calf starter.
- Bacteria help with the digestion process.
- End products of digestion causes the changes in the rumen.
Liquid in the Rumen

- Offering water from 3 days after birth has shown to:
  - Increase weight gain.
  - Promote starter intake.
  - Reduce incidences of scours.

Source: Kertz, 1984.
• Liquid in rumen provides environment for rapid bacterial growth.
• Milk does not provide sufficient amounts of liquid because it by-passes the rumen.
• However, even small amounts of liquid entering the rumen promote bacterial growth.
Muscular Movement

• Muscular movement encourages mixing feedstuffs in the rumen and necessary for passage through the rumen.
• Types of movement:
  – Rumen pressure
  – Rumen contraction
  – Cud chewing
• Little activity at birth.
• Contractions increase as feed intake increases.
Absorption

- Two layers of the rumen:
  - Muscular (responsible for contractions)
  - Epithelium (responsible for absorption)
- At birth, epithelium layer does not have absorptive ability.
- VFA absorption stimulates epithelium development, which increases surface area.
- Epithelium elongates into “finger-like projections” called papillae.
A Look at the Papillae

Heads or Tails?
Availability of feedstuff

- Offer clean, fresh calf starter at Day Three.
- Should meet NRC recommendations.
- Palatability

<table>
<thead>
<tr>
<th>Nutrient Recommendations For Dairy Calves</th>
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<tbody>
<tr>
<td>Nutrient</td>
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<tr>
<td>% DM</td>
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<td>% Fat</td>
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<td>% TDN</td>
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<td>Mcal Energy</td>
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<tr>
<td>Vitamin A (IU/kg)</td>
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<td>Vitamin D (IU/kg)</td>
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<td>Vitamin E (IU/kg)</td>
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What about hay?

- Digestion of hay provides acetic acid.
- Acetic acid is less crucial for rumen development.
- Hay provides a "scratch factor" to promote healthy growth of papillae.
- Hay should be offered 0-4 weeks after weaning.
Conclusion

• Newborn calf is a monogastric with a non-functional rumen.
• Milk by-passes rumen.
• Rumen development is chemical.
• Free choice water & calf starter needed.
• Feed hay after weaning.