WRAPPED BALED SILAGE

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World Dairy Expo
Madison, WI

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Silage Biology

- **Relative Level**
- **Time**: 0, 1, 2, 14, days

- **Aerobic Phase**
- **Lag Phase**
- **Fermentation Phase**
- **Stable Phase**

- **pH**
- **Anaerobic bacteria**

Temperature graph over time.
Silage Biology

• How Long Should Aerobic Phase Last?
  ✓ Short as possible

• Why Should This Phase Be Short?
  ✓ Valuable substrate is consumed, heat produced

• Is Prolonged Heating Bad?
  ✓ Damages protein availability, reduces available substrate

• What’s Produced During Ensiling Phase?
  ✓ Mainly Lactic and Acetic
# Silage Biology

- **Typical Fermentation Report:**

<table>
<thead>
<tr>
<th>Moisture % w.b.</th>
<th>50 – 60%</th>
<th>40 – 50%</th>
<th>30 – 40%</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>4.3 – 4.7</td>
<td>4.7 – 5.0</td>
<td>5.0 – 5.6</td>
</tr>
<tr>
<td>Lactic acid</td>
<td>4.0 – 7.0</td>
<td>2.0 – 4.0</td>
<td>0.1 – 2.0</td>
</tr>
<tr>
<td>Acetic acid</td>
<td>1.0 – 3.0</td>
<td>0.5 – 2.0</td>
<td>&lt; 0.5</td>
</tr>
<tr>
<td>Propionic acid</td>
<td>&lt; 0.3</td>
<td>&lt; 0.2</td>
<td>&lt; 0.1</td>
</tr>
<tr>
<td>Butyric acid</td>
<td>&lt; 0.1</td>
<td>&lt; 0.1</td>
<td>&lt; 0.1</td>
</tr>
<tr>
<td>Ethanol</td>
<td>&lt; 1.0</td>
<td>&lt; 0.5</td>
<td>&lt; 0.3</td>
</tr>
</tbody>
</table>
Baleage vs. Dry Hay

- **Advantages Baled Silage**
  - ✓ Less field drying time
    - • Greater harvest window
    - • Less weather risk
  - ✓ Lower losses
    - • Harvest and storage
  - ✓ More uniform product
  - ✓ No taxable structure

- **Advantages Baled Hay**
  - ✓ More marketable
    - • Horses
    - • Lower trucking costs
  - ✓ No fermentation
  - ✓ Less equipment
  - ✓ No film disposal issues
Baleage vs. Chopped Silage

- **Advantages Baled Silage**
  - ✓ Less expensive equipment
  - ✓ Wider moisture range
  - ✓ Targeted feeding
  - ✓ No taxable structure
  - ✓ Ideal for small operator

- **Advantages Chopped Silage**
  - ✓ Better fermentation
  - ✓ More versatile
  - ✓ High capacity
  - ✓ Easier TMR mixing
  - ✓ Less sorting
Tube vs. Individual Wrapping

- **Advantages – Tubes**
  - Less plastic used
  - Greater productivity
  - Less labor

- **Advantages – Individual**
  - Targeted feeding
  - Marketable product
  - Occupies less area
  - Less aerobic loss @ feedout
# Right Baling Moisture

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 65%</td>
<td>Danger of “sour” fermentation, botulism</td>
</tr>
<tr>
<td>55 – 65%</td>
<td>Plenty of fermentation, surface condensation</td>
</tr>
<tr>
<td>45 – 55%</td>
<td>Ideal, good fermentation</td>
</tr>
<tr>
<td>35 – 45%</td>
<td>Some fermentation, more layers of wrap</td>
</tr>
<tr>
<td>25 – 35%</td>
<td>Very little fermentation, feed quickly</td>
</tr>
<tr>
<td>&gt;25%</td>
<td>Baled hay</td>
</tr>
</tbody>
</table>
# Right Baling Moisture

<table>
<thead>
<tr>
<th></th>
<th>1st Cutting – 157 days</th>
<th>2nd Cutting – 348 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tube</td>
<td>3.8</td>
<td>2.0</td>
</tr>
<tr>
<td>Individual</td>
<td>3.7</td>
<td>2.7</td>
</tr>
<tr>
<td>LRB</td>
<td>3.2</td>
<td>2.3</td>
</tr>
<tr>
<td>LSB</td>
<td>4.4</td>
<td>2.5</td>
</tr>
<tr>
<td>High (~52%)</td>
<td>4.5</td>
<td>2.7</td>
</tr>
<tr>
<td>Low (~37%)</td>
<td>3.1</td>
<td>2.0</td>
</tr>
</tbody>
</table>

After Shinners et al., 2009
How Soon To Wrap

• How Soon After Baling Should You Wrap?

✓ No brainer – sooner the better

✓ Makes aerobic phase shorter, temperature lower
Wrap Timing

After Undersander et al., 1998
Film Wrap Information

- Blown low-density polyethylene ~1-mil thick
- Stretching increases cling and makes tight seal
  - Stretching also reduces thickness by up to 25%
- High temps makes film more permeable
- More layers increases distance $O_2$ must travel
New Trends in Film Wrap

- Higher density resins – better $O_2$ barrier allows for:
  - Thinner (19 vs. 26 μm) with same permeability
  - Longer rolls 1,500 to 2,100 m
- More pre-stretching
  - Less necking at wrapping
  - Narrower rolls (730 vs. 750 mm width)
- Thinner, narrower but longer = about same weight
# New Trends in Film Wrap

<table>
<thead>
<tr>
<th></th>
<th>Film Type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Conventional</td>
</tr>
<tr>
<td>Number of layers</td>
<td>6</td>
</tr>
<tr>
<td>Plastic Use lb./ton</td>
<td>16</td>
</tr>
<tr>
<td>DM loss % of total</td>
<td>~8</td>
</tr>
<tr>
<td>Relative Cost</td>
<td>-</td>
</tr>
</tbody>
</table>

After Borreani and Tabacco, 2010
Number of Wraps

• Lots of Variables Here:
  ✓ Film quality, thickness, material density
  ✓ Generally minimum of 4 layers (2 turns at 50% overlap)
  ✓ More layers needed as:
    • Moisture decreases
    • Maturity increases
    • Baling crops with sharp stems
Number of Wraps

After Undersander et al., 1998
Aerobic Stability

• At Feeding:
  ✓ Aerobic microorganisms reactivate
  ✓ Low pH and high acid content slow growth rate

• Limiting Oxygen Exposure Important:
  ✓ Especially at low moisture
  ✓ Advantage of individual versus tube wrap?
  ✓ Advantage of baleage versus bunk or bag silo?
Aerobic Stability

After Shinners et al., 2009
Getting The Most from Baleage

• Starts at Cutting:
  ✓ Lay wide, condition well, and don’t cut too low

• Windrow Formation:
  ✓ Avoid raking soil into windrow

• When to Bale:
  ✓ Ideal moisture 45 – 55%
  ✓ Avoid rains

• Make Uniform Bale Shape & Size
Getting The Most from Baleage

• Use Good Quality Plastic.

• Avoid treated twine.

• How To Wrap:
  ✓ Stretch to 70 – 80% of original width
  ✓ Minimum 5 (high moisture) to 8 layers (low moisture)
  ✓ Avoid wet conditions (film losses tackiness)

• Wrap Close to Storage Site
Getting The Most from Baleage

• Handling:
  ✓ Minimum possible, avoid after 12 h
  ✓ Use squeeze, avoid over pinching

• Storing:
  ✓ Avoid woods, sharp stubble, poorly drained areas, wildlife
  ✓ Stack where possible, saves room
  ✓ Store round bales on end—more plastic, less “squish”
  ✓ Avoid stacking at high moisture
Troubleshooting Baleage

• Caramelized or Tobacco Smell:
  ✓ Heat damage – long delay from baling to wrapping

• Molds:
  ✓ O₂, insufficient wraps, low moisture, low density, inoculation

• Rancid Odor:
  ✓ High moisture, clostridia, low sugar, insufficient LAB

• Heating, Mold At Feedout:
  ✓ Low moisture, high pH, feedout rate too slow
Film Recycling

• Generally unlawful to open burn.

• No matter if allowed; open, low-temp burning bad idea:
  ✓ Dioxins released are toxic and potential carcinogens

• Most State DNR can provide info on regional recyclers
Recycling Practices

• Try to keep clean until removal.

• May need to separate plastic types.

• Store plastic indoors, under cover, or in special container.

• Keep plastic clean and dry.

• Increase density prior to shipping.
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