High Quality Corn Silage for Dairy Cattle

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Whole-Plant Corn Silage

- Grain ~40-45% of WPDM
  - Avg. 32% starch in WPDM
  - Variable grain:stover

- Stover ~55-60% of WPDM
  - Avg. 41% NDF in WPDM
  - Variable stover:grain

- 80 to 98% Starch D
  - Processing, particle size
  - Fermentation
  - Maturity
  - Endosperm properties
  - Additives (exp.)

- 40 to 70% IVNDF
  - Lignin/NDF
    - Hybrid Type
    - Environment: G x E
    - Maturity
  - Cutting height
  - Additives (exp.)

Variable peNDF as per chop length

Adapted from Joe Lauer, UW Madison Agronomy Dept.
**Corn Silage StarchD**

- Hybrid selection for kernel endosperm properties to improve StarchD very slow to evolve
- Genetic effects on StarchD tempered in corn silage
  - Harvest should be completed pre-blacklayer
  - Kernel processed during harvest
  - Prolonged silo storage increases StarchD
- No standardized agreed upon method for assessing differences in StarchD among samples
  - Test Sample/Assay Sample particle size a challenging confounder
  - Ruminal vs. post-ruminal starch digestion
- StarchD has not been incorporated into university-extension hybrid performance trials
- Altering kernel endosperm properties in WPCS mainly experimental & cannot ignore potential changes in Starch (NDF) %, NDFD or agronomics

**Corn Silage StarchD**

- Genetic or transgenic modifications studied
  - Comparisons of Flint, Dent, Reduced-Vitreousness Dent, Flory, Opaque, Waxy Endosperm in Conventional Hybrids (numerous citations but few feeding trials)
  - **Floury-Leafy Hybrid** (Ferraretto et al., 2015, JDS; Morrison et al., 2014, JDS abstr)
  - **Floury-BMR Hybrid** (Morrison et al., 2016 JDS abstr)
  - **α-Amylase expressed in kernel** (Hu et al., 2010, JDS; trials in progress)
UNL researchers conducted four beef cattle performance trials and one metabolism trial (2012-2016), mostly using EFC as dry rolled corn (DRC).

**Variables examined included:**

- EFC inclusion level (0, 50 and 100% of grain)
- By-products in TMR (WDGS, MDGS, Sweet Bran)

Other factors, including DRC content in overall TMR (52.5 – 69.5% DM) and silage content in TMR (7.5 – 15% DM) varied across studies.
UNL Summary and Conclusions

Overall, UNL trials suggest an improvement in digestion when feeding EFC compared with control corn when fed as DRC.

Results "suggest that cattle producers who utilize the Syngenta Enhanced Feed Corn hybrid with the alpha amylase enzyme trait can expect to see an improvement in feed conversion compared to corn that does not contain the alpha amylase enzyme trait if that corn is processed and fed as DRC. However, the results have been variable when DRC has been fed with Sweet Bran or distillers grains plus solubles."

"These data suggest that cattle fed SYT-EFC corn have increased postruminal and total tract starch digestion compared to cattle fed Negative Isoline corn. When steers utilize an energy source to a greater extent it will result in increased gains and efficiencies which corresponds with our finishing data. "Cattle fed the test corn, regardless of byproduct, had greater total tract DM, OM, and starch digestibilities than the control corn."

To read the research reports on enhanced digestibility of Enogen Feed corn published by the University of Nebraska, refer to the finishing section of the 2016 Nebraska beef report and look for studies on Syngenta Enhanced Feed Corn.

Adapted from slide provided by Dr. Eileen Watson
Silage quality survey

2016 Samples
• Small scale silage samples were collected and vacuum sealed
• Allowed to ferment for 60-75 days before delivery to analytical lab
• NIR data and sugars, starch and in situ SD by wet chemistry now complete
• Final counts of included samples were:
  • 165 Enogen samples
  • 160 GH/NK non-Enogen samples
  • 105 Competitive hybrid samples

2017 program includes paired EFC / isoline comparisons and silage quality, stability and digestion studies (University COI / CRO)
Discriminant Analysis model shows a clear separation of EFC silage vs GH/NK and competitor hybrid silage

Silage starch characteristics

Higher levels of sugar (see next slide) and small particle starch provide more immediately available energy, as confirmed by 14% higher in situ Starch Digestion (isSD7)

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** Wet chemistry data
Silage sugar characteristics

* NIR data  ** Wet chemistry data for glucose, fructose, sucrose, lactose and mannitol

CLASSIFICATION: PUBLIC
Slide courtesy of Dr. Eileen Watson

Silage fiber characteristics
NDFD* prediction by NIR

* Neutral Detergent Fiber Digestibility – a key measure of expected silage fiber digestibility

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Slide courtesy of Dr. Eileen Watson
How is TTNDFD determined?

Forage sample

Rate of fiber digestion ($kd$)
Potentially digestible NDF ($pdNDF$)

Rate of fiber passage, ($kp$)

Standardized iv NDFD (24, 30, 48h) and uNDF

Rumen and hindgut digestion

TTNDFD (total tract NDF Digestibility)

Silage fiber characteristics
Predicted total tract NDFD

Total tract fiber digestion as % DM

Enogen Feed Silage
Other Corn Silage

Slide courtesy of Professor Dave Combs, UW Madison

Slide courtesy of Dr. Eileen Watson
On-farm dairy trial - preliminary summary (Brandt, SD)

- 1200 cow dairy farm; free-stall, milking parlor; pen-fed TMR; no BST
- Silage produced on-farm in 2016, in storage ~ 3 months before feeding
- Began feeding EFC silage 12/9/2016
  - Fed as 50:50 blend with conventional silage until 12/20/2016
  - Fed as sole silage from 12/21/2016 until 3/15/2017
- OFF period milk yield data daily by cow 11/8-12/8/2016
- ON period milk yield data daily by cow 12/21-3/15/2017
- Replaced conventional grain with EFC grain 2/22/2017 through 4/19/2017 (1st month with EFC silage, 2nd month with conventional silage)
- Performance tracked through June 15, 2017 – final summary in prep

Summarized by R. D. Shaver
**Methods**

- Milk yield measured daily by cow through parlor electronic system
- Pen dry matter intake (DMI) measured daily through TMR inventory system
- Rations formulated by consulting nutritionist
- Fecal grab samples collected monthly during ON period from 10% of cows in Pen #2 (High Cows) selected randomly.
- Body condition scores assessed monthly during ON period on 10% of cows selected randomly from all Pens.
- Silage analysis performed monthly

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**Results (1/2)**

<table>
<thead>
<tr>
<th>Avg. across Pens 1,2,3,4,6</th>
<th>OFF 11/8-12/8/2016</th>
<th>ON 12/21/16-3/15/17</th>
<th>ON vs OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow #</td>
<td>1092</td>
<td>1088</td>
<td>-4</td>
</tr>
<tr>
<td>DMI, lb/cow/day</td>
<td>58.3</td>
<td>55.7</td>
<td>-2.6</td>
</tr>
<tr>
<td>Milk, lb/cow/day</td>
<td>79.9</td>
<td>83.7</td>
<td>+3.8</td>
</tr>
<tr>
<td>FE, Milk/DMI</td>
<td>1.37</td>
<td>1.51</td>
<td>+0.14</td>
</tr>
<tr>
<td>Days in Milk</td>
<td>170</td>
<td>174</td>
<td>+4</td>
</tr>
<tr>
<td>150-day Adjusted Milk, lb/cow/day</td>
<td>81.2</td>
<td>85.6</td>
<td>+4.4</td>
</tr>
<tr>
<td>Fecal Starch, % of DM</td>
<td>---</td>
<td>1.56% ± 0.38</td>
<td></td>
</tr>
<tr>
<td>Total Tract Starch digestion, % of Starch</td>
<td>---</td>
<td>98.1% ± 0.5</td>
<td></td>
</tr>
</tbody>
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*Summarized by R. D. Shaver*
Results (1/2)

<table>
<thead>
<tr>
<th>Milk Quality Measures</th>
<th>OFF</th>
<th>ON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fat, %</td>
<td>3.94</td>
<td>3.84</td>
</tr>
<tr>
<td>Protein, %</td>
<td>3.02</td>
<td>3.03</td>
</tr>
<tr>
<td>MUN, mg %</td>
<td>9.83</td>
<td>9.32</td>
</tr>
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</table>

Body Condition Score Averages (10% of cows, selected at random)

<table>
<thead>
<tr>
<th>Pen #</th>
<th>Dec 2016</th>
<th>Jan 2017</th>
<th>Feb 2017</th>
<th>March 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.25</td>
<td>3.38</td>
<td>3.16</td>
<td>3.39</td>
</tr>
<tr>
<td>2</td>
<td>2.91</td>
<td>2.96</td>
<td>2.54</td>
<td>3.00</td>
</tr>
<tr>
<td>3</td>
<td>2.96</td>
<td>2.92</td>
<td>3.17</td>
<td>3.08</td>
</tr>
<tr>
<td>4</td>
<td>3.23</td>
<td>3.00</td>
<td>3.13</td>
<td>3.76</td>
</tr>
<tr>
<td>6</td>
<td>2.84</td>
<td>2.84</td>
<td>2.89</td>
<td>2.79</td>
</tr>
<tr>
<td>Overall</td>
<td>3.04</td>
<td>3.03</td>
<td>2.98</td>
<td>3.21</td>
</tr>
</tbody>
</table>

Summarized by R.D. Shaver

EFC Whole-Plant Silage

Shaver Questions

- Is StarchD increase in storage accelerated?
- Is StarchD decrease with delayed harvest maturity or just-average processing reduced?
- Effects of increased sugar in the silo and the cow?
- Positioning greater ivStarchD in rations?
- MOA for uNDF$_{240}$, ivNDFD responses?
Questions?