Recent Advances in Understanding Ethanol Co-Product Nutrition in Ruminant Diets

Distillers Grains Technology Council Symposium
Kevin Herrick, Ph.D., PAS
May, 2019
How much do we really know about ethanol co-product nutrition in ruminant diets?
Key Points

• Three “categories” of research
  • Value of ethanol co-products
  • Comparison to other ingredients
  • Other research areas
Value of Ethanol Co-Products
Value of Ethanol Co-Products

• Difficult to determine
  • Value to corn or other ingredient
  • Price per unit of protein or energy
  • Formulation software
  • Programs like Sesame or FeedVal
  • Varies by species
Sesame Evaluation - Dairy

$81.47 Greater Value

Dairy Ingredient Comparison
Difference Nutritional and Market Value - $/ton

More value than market price

Based on NEI, dRUP, eNDF, and RDP

Prices accessed on 4.29.19 from Feedstuffs
Sesame Evaluation - Beef

$66.50 Greater Value

Beef Ingredient Comparison
Difference Nutritional and Market Value - $/ton

- $66.50
- $16.90
- $14.00
- $1.59

More value than market price

- $15.77
- $35.69
- $93.53

Less value than market price

Prices accessed on 4.29.19 from Feedstuffs

Based on NEg and CP
Evaluated a series of feeding scenarios over a 12-year period

Alqaisi, et al., 2019

https://doi.org/10.1016/j.inpa.2019.03.004
DDGS inclusion varied based on availability and price of other ingredients.

Alqaisi, et al., 2019
https://doi.org/10.1016/j.inpa.2019.03.004
Even at DDGS/corn price spread of 100%, some scenarios still included DDGS.

Alqaisi, et al., 2019

https://doi.org/10.1016/j.inpa.2019.03.004
Value of Ethanol Co-Products

• Difficult to determine
• Depends on several variables
• Alqasi, et al. 2019 paper:
  • Did not factor different nutritional value
  • Demonstrated value of DDGS

Alfalfa hay. Compared to grain feeding scenarios, the inclusion of DDGS in dairy diets reduced total average feed cost by 8% (i.e. compared to S1). However, comparing scenarios simulated feed for each 1% CP reduction. Therefore, using DDGS will reduce feed cost significantly, but will also increase dietary protein levels.
Comparison to Other Ingredients
Comparison to Other Ingredients

• Accurate characterization of DDGS?
• Older data
• Changes/advancements/evolution of industry
• New products and new processes
• Are all DDGS the same?
Are All DDGS the Same?

Kerr, et al., 2013
Are All DDGS the Same?

Meloche, et al., 2013
Are All DDGS the Same?

- Industry focuses on fat
- Other components vary
- Significance?

<table>
<thead>
<tr>
<th>Component</th>
<th>Average</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Difference</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Matter</td>
<td>90.35</td>
<td>87.93</td>
<td>93.29</td>
<td>5.36</td>
<td>5.93</td>
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<tr>
<td>Protein</td>
<td>29.94</td>
<td>24.58</td>
<td>32.21</td>
<td>7.63</td>
<td>25.48</td>
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<tr>
<td>Fat</td>
<td>7.92</td>
<td>5.25</td>
<td>10.58</td>
<td>5.33</td>
<td>67.30</td>
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<tr>
<td>ADF</td>
<td>13.58</td>
<td>8.38</td>
<td>19.08</td>
<td>10.7</td>
<td>78.79</td>
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<tr>
<td>NDF</td>
<td>28.42</td>
<td>23.42</td>
<td>33.26</td>
<td>9.84</td>
<td>34.62</td>
</tr>
<tr>
<td>Hemicellulose</td>
<td>14.84</td>
<td>10.19</td>
<td>19.18</td>
<td>8.99</td>
<td>60.58</td>
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<tr>
<td>Cellulose</td>
<td>9.66</td>
<td>6.22</td>
<td>11.93</td>
<td>5.71</td>
<td>59.11</td>
</tr>
</tbody>
</table>

Curry, et al., 2016. The Professional Animal Scientist. Pages 687-694
Concentration of DE and ME of DDGS Produced in Illinois
Distillers protein (n=8503 chemistry)

- CP
- SP%CP
- ADICP%CP
- NDICPss%CP
- UCP%CP

Dairyland Laboratories, May 2019 Newsletter
Fiber in DDGS

• Industry perspective?
  • Source of protein
  • Source of energy

• Similar fiber to other ingredients?

• Effectiveness?

• Digestibility?

_Time to look at DDGS fiber differently!_
NDF Digestibility

• Only for alfalfa?
• Laboratory assays now available
  • Less expensive
  • Quicker
• Variability
NDF Digestibility

- Rates – 4.22 to 6.53% per hour
- >40% difference

Confidential Internal Data – POET Nutrition. Cumberland Valley Analysis
Does NDF Digestibility Matter?

• Value of NDF Digestibility of DDGS
• Formulation software to predict
• Assumptions
• Formulate diets with high/low NDF digestibility
NDF Digestibility

- Elaborate models
- Very dynamic
- Predict performance
- Models vs actual performance?
NDF Digestibility of DDGS

<table>
<thead>
<tr>
<th>Item</th>
<th>Low-NDF Digestibility DDGS</th>
<th>Mid-NDF Digestibility DDGS</th>
<th>High-NDF Digestibility DDGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDFD (% of NDF)</td>
<td>50.0</td>
<td>62.0</td>
<td>67.0</td>
</tr>
<tr>
<td>NDFD hours</td>
<td>24</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>NDFD kd (%/hr)²</td>
<td>6.7</td>
<td>12.2</td>
<td>21.8</td>
</tr>
<tr>
<td>ME Allowable Milk (kgs/hd/day)²</td>
<td>44.6</td>
<td>45.2</td>
<td>45.6</td>
</tr>
<tr>
<td>MP Allowable Milk (kgs/hd/day)²</td>
<td>44.2</td>
<td>45.0</td>
<td>45.6</td>
</tr>
</tbody>
</table>

²Estimated by AMTS software

Range for NDF disappearance for samples in previous figure: 54 to 70% at 24 hours
NDF Digestibility

- Formulated with 7% DDGS inclusion
- At $18 cwt milk, this means over $0.24 more revenue
- $0.06 / lb of DDGS more value
- Performance differences
- Interesting exercise
Other Research Areas
Other Research Areas

• Reduced oil
• See less research as industry moves to less fat
• Research lag: still see higher fat
DDGS Fat Content - Beef

- 5.6% vs 8.3% fat DDGS
- 160 crossbred Angus steers
- Combined growing and finishing study
## DDGS Fat Content - Beef

### Backgrounding Diets

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>10% DDGS</th>
<th>10% DDGS</th>
<th>20% DDGS</th>
<th>20% DDGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn Silage</td>
<td>60.00</td>
<td>60.00</td>
<td>60.00</td>
<td>60.00</td>
</tr>
<tr>
<td>Barley</td>
<td>24.30</td>
<td>24.30</td>
<td>15.00</td>
<td>15.00</td>
</tr>
<tr>
<td>Low-oil DDGS</td>
<td>10.00</td>
<td>---</td>
<td>20.00</td>
<td>---</td>
</tr>
<tr>
<td>Med-oil DDGS</td>
<td>---</td>
<td>10.00</td>
<td>---</td>
<td>20.00</td>
</tr>
<tr>
<td>Supplement</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Urea</td>
<td>0.70</td>
<td>0.70</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

### Finishing Diets

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>5% DDGS</th>
<th>5% DDGS</th>
<th>10% DDGS</th>
<th>10% DDGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn Silage</td>
<td>10.00</td>
<td>10.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>Barley</td>
<td>79.65</td>
<td>79.65</td>
<td>75.00</td>
<td>75.00</td>
</tr>
<tr>
<td>Low-oil DDGS</td>
<td>5.00</td>
<td>---</td>
<td>10.00</td>
<td>---</td>
</tr>
<tr>
<td>Med-oil DDGS</td>
<td>---</td>
<td>5.00</td>
<td>---</td>
<td>10.00</td>
</tr>
<tr>
<td>Supplement</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Urea</td>
<td>0.35</td>
<td>0.35</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

*Ribeiro, et al., 2017 - CJAS*
DDGS Fat Content - Beef

- ADG (kg)
- P-value: 0.03 for DDGS and 0.06 for level
- P-value: 0.71 for DDGS and 0.50 for level

Values:
- LOW 10%: 1.43
- MED 10%: 1.39
- LOW 20%: 1.52
- MED 20%: 1.42
- LOW 5%: 1.87
- MED 5%: 1.88
- LOW 10%: 1.90
- MED 10%: 1.92
DDGS Fat Content - Beef

**NEg (Mcal/kg)**

- P-value: 0.09 for DDGS and 0.97 for level
- P-value: 0.22 for DDGS and 0.66 for level

<table>
<thead>
<tr>
<th>Treatment</th>
<th>NEg (Mcal/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW 10%</td>
<td>1.14</td>
</tr>
<tr>
<td>MED 10%</td>
<td>1.17</td>
</tr>
<tr>
<td>LOW 20%</td>
<td>1.15</td>
</tr>
<tr>
<td>MED 20%</td>
<td>1.17</td>
</tr>
<tr>
<td>LOW 5%</td>
<td>1.28</td>
</tr>
<tr>
<td>MED 5%</td>
<td>1.33</td>
</tr>
<tr>
<td>LOW 10%</td>
<td>1.28</td>
</tr>
<tr>
<td>MED 10%</td>
<td>1.34</td>
</tr>
</tbody>
</table>
Low-fat DDGS in Dairy Diets

• Morris, et al., 2018
• Combination with monensin
• Almost 30% DDGS
• Significant milk-fat response
Low-fat DDGS in Dairy Diets

- Testroet et al., 2018
- 20% reduced-fat DDGS
- 2 × 2 crossover design
- No difference in production
Lancet – EAT Report
Methane

• Can ethanol co-products affect methane production?
  • Judy et al., 2019
  • Corn oil reduced methane production 6.4% compared with a control diet
  • Fat replaces carbohydrates, fat may affect rumen methanogens, fat can increase biohydrogenation = sink for hydrogen
Methane

- Castillo-Lopez et al., 2017
- Suggests fat may affect methane production?
Methane

• Castillo-Lopez, et al., 2017
• “DDGS may shift the abundance of bacteria which affect methane production”
• “Replacing corn and soybean meal with DDGS may reduce proportion of dietary energy wasted as methane”
Corn Oil Supplementation - Beef

- Winders, et al., 2019
- Finishing study
- 3% corn oil

<table>
<thead>
<tr>
<th>Table 3. Effects of corn oil supplementation (3% of diet DM) on methane production from cattle fed finishing diets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>DMI, lb²</td>
</tr>
<tr>
<td>Methane</td>
</tr>
<tr>
<td>g / d</td>
</tr>
<tr>
<td>g / lb DMI¹</td>
</tr>
<tr>
<td>g / lb DMI²</td>
</tr>
<tr>
<td>g / ADG³</td>
</tr>
</tbody>
</table>

¹DMI over the 127 d trial
²DMI in the methane barn across all 3 periods of collection
³ADG, lb over the 127 d trial
Corn dried distillers grains with solubles (cDDGS) in the diet of pigs change the expression of adipose genes that are potential therapeutic targets in metabolic and cardiovascular diseases.

Maria Oczkowicz¹*, Tomasz Szmatola¹, Małgorzata Świątkiewicz², Klaudia Pawlina-Tyszko¹, Artur Gurgul¹ and Tomasz Ząbek¹
More Research

• High protein DDGS
• Different fiber
• Yeast components
• Etc.…

What else could go wrong today?
Conclusion

• Ethanol co-products provide significant value
• Areas such as methane – commercial value?
• Still a lot of research to do
Questions?

WHEN YOU'RE ALL TRYING TO FIT

INTO THE GROUP SELFIE