We cannot solve our problems with the same thinking we used when we created them.

*Albert Einstein*

Everything is connected with everything else: but not all things are connected by the short and straight roads we expected.

*C. S. Lewis*
Distillers Grains; Potentials and Implications for the Livestock Industry

Shawn Archibeque

Colorado State University
Department of Animal Sciences
Feb. 13, 2007
### By The Numbers

<table>
<thead>
<tr>
<th></th>
<th>1915</th>
<th>1967</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. Population</td>
<td>100 million</td>
<td>200 million</td>
<td>300 million*</td>
</tr>
<tr>
<td>World Population</td>
<td>1.8 billion</td>
<td>3.5 billion</td>
<td>6.5 billion</td>
</tr>
<tr>
<td>Life Expectancy</td>
<td>54.5 years</td>
<td>70.5 years</td>
<td>77.8 years</td>
</tr>
<tr>
<td>A gallon of Milk</td>
<td>$0.36 ($7.22 in 2006 $)</td>
<td>$1.03 ($6.24 in 2006 $)</td>
<td>$3.00</td>
</tr>
</tbody>
</table>

December 2006 Issue of National Geographic By: Siobhan Roth

<5 million in Ag, < 2.4 in production Ag
Food Supply

- There are 750,000,000 malnourished people in the world
- 75,000 starve each day
- Farmers must produce as many calories in the next 40 years as in the history of mankind in order to feed the world
Food Supply

Water

- Polar caps, swamps, deserts, very high mountains: 12%
- Too cold, wet, rocky, steep, dry, paved, etc.: 10%
- Tillable: 3%

75%
Urban-Agriculture Interaction

Population interaction index (PII), 2000

Source: ERS analysis of 2000 census of population block data.

www.ers.usda.gov
U.S. Cattle Industry

- Approximately 33% of current beef cattle population enters a feedlot
- Enter at 314 kg
- Exit at 573 kg (45% of mass in feedlot)
- Very visible
- Concentration of nutrients
  - Odor, N, and P
U.S. Ethanol Biorefinery Locations

Source: Renewable Fuels Association
2.08.07
Colorado Ethanol Plants

• In Operation
  – Sterling – 50 mg/yr
  – Windsor – 40 mg/yr
  – Golden – 3 mg/yr

• Planned
  – Yuma – 45 mg/yr (Online Spring, 2007?)
  – Yuma – 40 mg/yr
  – Evans – 40 mg/yr
  – Walsh – 2 mg/yr
Distillers grains

• In 2005, 9 million metric tons of distillers grains

• 12-14 million metric tons by 2012 (RFA, 2006)

• 75-80 % fed to ruminants (dairy and beef cattle)

• Nutritionally dense (3.18 Mcal ME/kg, 29.5% CP, 0.83% P, 0.4-1.0 % S)
Starch Removal Concentrates Other Nutrients

Source: Dan Loy, ISU
Challenges

• Nutritional needs of cattle
  – CP, P, fat
• Ethanol production
  – Reduced corn availability
  – Increased competition for “other” feeds
  – Distillers grains
• Nutrient balance/waste production
Distillers grains and finishing cattle

• Primarily corn-based rations
• Replace corn with distillers grains
• Excess of N and P
  – Environmental concerns?
• Decreased starch
  – Meat quality?
• Increased lipid
  – Adipose composition?
# Nebraska data

<table>
<thead>
<tr>
<th>WDGS Level</th>
<th>ADG</th>
<th>F:G</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3.47</td>
<td>6.44</td>
</tr>
<tr>
<td>10</td>
<td>3.70</td>
<td>6.16</td>
</tr>
<tr>
<td>20</td>
<td>3.83</td>
<td>5.95</td>
</tr>
<tr>
<td>30</td>
<td>3.87</td>
<td>5.81</td>
</tr>
<tr>
<td>40</td>
<td>3.81</td>
<td>5.74</td>
</tr>
<tr>
<td>50</td>
<td>3.66</td>
<td>5.73</td>
</tr>
</tbody>
</table>

ADG = \(-0.0005x^2 + 0.0279x + 3.4669\)

F:G = \(0.0003x^2 - 0.0309x + 6.4367\)

Erickson, 2006
Iowa State data

Marbling score vs. Wet DGS

Trenkle, 2006

Linear P = 0.075
Cellulosic Ethanol?

- Technology
- Cost?
Cellulosic Ethanol?

- Technology
- Cost?
- Fuel Source
  - What has good fiber, is cheap, and is in close proximity to an ethanol plant???
Cellulosic Ethanol?

• Technology
• Cost?
• Fuel Source
  – What has good fiber, is cheap, and is in close proximity to an ethanol plant???
  – Distillers grains!
Cellulosic Ethanol?

- Technology
- Cost?
- Fuel Source
  - What has good fiber, is cheap, and is in close proximity to an ethanol plant???
  - Distillers grains!
  - Oil for biodiesel?
Potential

- Low- moderate quality forages
- Distillers grains supplements
- Improve nutrient availability for forage-fed ruminants
- Determine optimum levels of distillers grains to optimize production
- Utilize forages to improve manure value
  - N:P ratio
Experimental Design

• 9 wethers with chronic indwelling catheters
• Moderate quality brome-hay
• 100 g of supplement
  – Corn (n=4) or DDGS (n=5)
• Balance trial
• Nutrient flux
Hepatic Artery
Mesenteric Vein
Portal Vein
Hepatic Vein
pAH Infusion
Portal venous sample
Hepatic venous sample
Arterial sample
## Balance data (n = 9)

<table>
<thead>
<tr>
<th></th>
<th>Corn</th>
<th>DDGS</th>
<th>SE</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N intake, g/d</td>
<td>18.41</td>
<td>21.46</td>
<td>1.38</td>
<td>0.14</td>
</tr>
<tr>
<td>N dig., %</td>
<td>47.23</td>
<td>55.90</td>
<td>2.64</td>
<td>0.04</td>
</tr>
<tr>
<td>N balance, g/d</td>
<td>2.54</td>
<td>4.45</td>
<td>0.79</td>
<td>0.15</td>
</tr>
<tr>
<td>P intake, g/d</td>
<td>1.57</td>
<td>1.83</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>P balance, g/d</td>
<td>0.16</td>
<td>0.36</td>
<td>0.06</td>
<td>0.05</td>
</tr>
<tr>
<td>Manure N:P</td>
<td>11.24</td>
<td>11.57</td>
<td>0.19</td>
<td>0.23</td>
</tr>
</tbody>
</table>
Nutrient flux

Splanchnic release, mmol/h

Corn

DDGS

AAN, P = 0.04  Urea-N, P = 0.36
Summary

• Distillers grains are a viable supplement for ruminants grazing moderate quality forages
• Improve splanchnic release of AAN
• More amino acids = more building blocks for productivity.
• Improve P balance without altering manure N:P
Future Research

• Core questions of NCBA
  – Focus is on finished beef cattle
  – Increasing levels (>30%) of co-products and the ultimate effect on end product quality
  – Levels and associated effects of fat, S, P, N, etc. on end product quality
  – Links to environment and health
  – Pathogens
Proposed Research

- 36 finishing beef steers
  - Chronic E. coli shedders

- Grain type and distillers inclusion
  - Steam flaked and dry rolled
  - 0, 30, 60% DGS

- Balance trial (24 from 36)
  - N, P, S, Cu, and antibiotics
Proposed Research

• Mineral metabolism
  – Liver biopsies during finishing phase

• Odor Production
  – Manure slurry incubations
  – Odorous compound formation

• Lipogenic potential of adipose tissues
  – Meat quality
Where to go?

• Integrated systems
  – Forages, silages, cattle production, fertilizer

• New uses for old systems
  – Distillers grains
  – Forage finishing

• Ensiling
  – Straw, stover, etc.
Thank You!
Questions?
Virginiamycin

- Streptogramins, synergimycins, or pristinamycins
- Type A
  - Virginiamycin M1
- Type B
  - Virginiamycin S
- Work synergistically
Virginiamycin

- Virginiamycin M1
  - Inactivated when held at 90 °C for 20 min.
- Virginiamycin S
  - No loss of activity when held at 90 °C for 20 min.

Lee et al. 1996