Lessons Learned from Feeding Coproducts to Beef Cattle.

Gary Rohwer
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Background

• The use of coproducts such as distiller’s grains and corn gluten feeds has become common in dairy, feedlot, and back grounding rations as well as pasture supplements.

• Coproducts are the “backdoor” products of the industries producing them and are not the primary business.

• These products can be quite variable and generally reflect the conditions found at the individual production facility.

• In the case of distiller’s grains and corn gluten feeds, phosphorus and sulfur levels become concentrated.

• The use of phosphorus and sulfur cleaning agents can add to the levels of these elements in the coproduct depending on the practices at producing facility.

• Proteins from the parent material and microbial growth are also concentrated and may be subjected to heat damage during the drying process.

• Proteins and carbohydrates that are digestible can react with each other and form poorly digestible complexes.
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Background

• Over most of the last 100 years, feed supplementation of beef and dairy animals involved adding protein, phosphorus and in some cases sulfur to meet the nutrient requirements of the animals.

• With the increasing use of distiller’s grains and other coproducts, things have changed. Coproducts when maximized in rations can increase the protein and phosphorus levels beyond the animals requirement.

• Confined feeding nutrient management plans are designed to reduce nitrogen and phosphorus pollution. They may limit how much coproduct can be fed.

• Excessive nitrogen, phosphorus and sulfur in the animal’s diet can reduce livestock performance.

• Until the wide spread use of coproducts, the cases where animal performance was reduced by excessive phosphorus and/or sulfur was rare. It is becoming more common.

• Heat damage during the drying process will reduce digestibility. This can seriously change the economic value of a coproduct such as distiller’s grains.
Background of data to be presented.

- Bar Diamond has been working with a supplement feeding program on an intensive rotational pasture operation for over thirty years.

- The purpose of the operation is to maximize the growing phase of stocker cattle destined for the feedlot.

- Coproducts including distiller’s grains, corn gluten feeds and oat milling products have been maximized in the supplemental feed.

- Problems with acid/base status were observed when either distiller’s grains or corn gluten feed was maximized in the supplemental feeds. The problem was traced to elevated phosphorus and sulfur intake from the coproducts.

- Various strategies have been tested under field conditions to correct the acid/base issues.

- One of the strategies has been the “on farm” treatment of high phosphorus and/or sulfur containing coproducts with highly reactive sources of calcium to reduce the negative impact on acid base balance.
Why is acid base balance important?

Acid base balance is a very complex system.

Strong acid producers in excess such as phosphate, chloride or sulfate will shift acid base balance towards metabolic acidosis.

Being slightly out of the “normal” box towards metabolic alkalosis or acidosis will limit growth or milk production.
Acid/Base Balance 101 -- life’s teeter totter

To much acid is bad, to much base is bad, in balance is good.

Acid producers

- Cl  Chlorine
- S  Sulfur
- P  Phosphorus

Base producers

- K  Potassium
- Na  Sodium
- Ca  Calcium
- Mg  Magnesium

The Goal – happy balance

K + Na + Ca + Mg > Cl + P + S

K > Na
K + Na > Cl
Ca > Mg
Ca + Mg > P + S
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“On Farm” Treatment

Creating a lime slurry

Treating the coproduct

Addition of reactive calcium uniformly to the coproduct.

Steeping for 24 to 36 hours
Background of data to be presented.

- In previous work, gluten feeds with moderate heat damage were treated with calcium hydroxide. Improvements in digestibility were documented using in-situ digestion measures.

- To determine if calcium hydroxide treatment could “improve” the digestibility of heat damaged distiller’s grains and corn gluten feed, a controlled in-situ digestion study was conducted comparing damaged and undamaged samples of both feed types.

- The treated coproducts were prepared by adding 2.5% calcium hydroxide by weight with enough water to match the “on farm” treatments. The samples were allowed to steep for 36 hours before low temperature drying. The control materials were steeped with water only and then dried. This equalized the effect of water and drying from both the treatments and controls.

- In-situ digestions were conducted using 0, 8, 24, 48, and 96 hour time points in duplicate. Methods can be found on [http://bardiamond.com](http://bardiamond.com).

- Soluble, Degradable and Un-degradable fractions as well as the degradation rate of the degradable fraction was determined for each feedstuff.
Feeds used in study
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Golden Distillers Grains

Box 60, Parma, Idaho 83660, USA       208-722 6761     info@bardiamond.com

Heat Damaged Distiller Grains
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Corn Gluten Feed

Heat Damaged Corn Gluten Feed
Results – Mineral Changes
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Mineral Analysis -- Distiller's Grains

Calcium elevated by treatment.
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Minerals -- Acid/Base (equivalents/kg)

Treatment corrected balance

Negative Calcium to (Phosphorus + Sulfur)
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In-Situ Digestion 101

Soluble Fraction is completely utilized.

Degradable Fraction is partially utilized. Depends on rate of degradation and passage rate through the rumen.

Un-degradable Fraction escapes the animal.
Results – *In-Situ* Digestion
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Degradation Curves -- Distiller Grains

- Golden Distillers
- Heat Damaged Distillers
- Treated Golden Distillers
- Treated Heat Damaged Distillers

Heat Damaged
In the case of heat damaged distillers grains, the treatment with calcium hydroxide improved the digestibility. However, the amount of change did not materially change the economic value.

In higher quality distillers grains, the treatment slightly improved digestibility during the initial 48 hours in the rumen. However, treatment did not improve overall digestibility.

More importantly, the treated, heat damaged distillers grain has a significantly lower digestibility than the higher quality control. This would limit heat damaged grain’s use and market value.

Take Away: The current discounts for heat damage are inadequate even though the calcium treatment migrated the effects of excessive phosphorus and sulfur as well as making some improvement in digestibility.

Take Away: The improvement in digestibility pays the cost difference between calcium hydroxide and fine powered limestone.
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Degradation Curves -- Gluten Feed

- Gluten
- Gluten Treated
- Heat Damaged Gluten
- Heat Damage Gluten Treated

Heat damaged
In the case of heat damaged gluten feed, the treatment with calcium hydroxide significantly improved the digestibility.

In higher quality gluten feed, the treatment slightly improved digestibility during the initial 24 hours in the rumen. However, treatment did not improve overall digestibility.

More importantly, treated, heat damaged gluten feed has a significantly lower digestibility than either treated or untreated gluten feed without heat damage. The low digestibility severely reduces the economic value of the heat damaged coproduct.

Take Away: The current discounts for heat damage are generally inadequate on gluten feeds.

Take Away: The improvement in digestibility pays the cost difference between calcium hydroxide and fine powered limestone.
What did the heat damage do?
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Distiller's Grains

Heat damage converted 100% digestible soluble fraction into undegradable.
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Heat damage converted 100% digestible soluble fraction into undegradable.
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How laboratory analysis compares to the *In-Situ* measures

<table>
<thead>
<tr>
<th></th>
<th>Crude Protein</th>
<th>Fat</th>
<th>NDF</th>
<th>ADF</th>
<th>Ash</th>
<th>Mass ADF:NDF</th>
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</thead>
<tbody>
<tr>
<td>Golden Distiller's</td>
<td>28.29</td>
<td>10.63</td>
<td>57.89</td>
<td>23.51</td>
<td>4.29</td>
<td>0.41</td>
</tr>
<tr>
<td>Heat Damaged Distiller's</td>
<td>27.81</td>
<td>10.34</td>
<td>65.26</td>
<td>35.44</td>
<td>4.29</td>
<td>0.54</td>
</tr>
<tr>
<td>Treated Golden Distiller's</td>
<td>27.16</td>
<td>9.99</td>
<td>56.41</td>
<td>22.31</td>
<td>6.65</td>
<td>0.40</td>
</tr>
<tr>
<td>Treated Heat Damaged Distiller's</td>
<td>28.04</td>
<td>10.7</td>
<td>63.15</td>
<td>34.61</td>
<td>6.58</td>
<td>0.55</td>
</tr>
</tbody>
</table>

The mass ratio of ADF to NDF can provide a useful index.

It is calculated as Mass ADF:NDF = ADF**0.66 / NDF**0.66

For the ADF to increase with heat damage, means that digestible fractions are converted to the undegradable fraction.

NDF increases because ADF is part of the NDF
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Take Away

- The use of highly reactive calcium is a reasonable tool to help mitigate some of the issues created by elevated phosphorus and sulfur found in some coproducts.

- Simple “on farm” use of calcium hydroxide will yield some improvement in the digestibility of heat damaged coproducts. It is quite effective in assisting acid base management. The digestibility improvement pays for the increased cost from using calcium hydroxide.

- The use of Mass ADF:NDF index can assist in determining if a coproduct has reduced digestibility and if the coproduct should be considered for use.

- It would be worthwhile to determine if improvements in digestibility of coproducts can be accomplished at the producing facility -- thus improving the economic value.

- Methods to lower phosphorus and sulfur should be considered. This would increase the amount of coproduct that can be used while staying within guidelines of a nutrient management plan.
Questions

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Research Steers Can Have Fun Too !!!
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