Evaluation of a Heat Stable Xylanase Enzyme Under Typical Feed Industry Manufacturing Parameters

C.R. Stark¹ and C.L. Wyatt²

¹North Carolina State University and ²AB Vista
Introduction

• Enzyme recovery at North American commercial and integrated feed mills has been historically low in comparison to European feed mills using commercial phytase or xylanase enzymes.
Introduction

- Intrinsic thermo-tolerant feed enzymes that appear to withstand temperatures up to 90-93°C (195-200°F) have been developed.
Enzyme Premix Options

- Liquid Premixes
- Dry Premixes
  - Coated products
  - Intrinsically thermostable
<table>
<thead>
<tr>
<th>Mixer</th>
<th>Post-pellet</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Micro-ingredient system</td>
<td>• Liquid</td>
</tr>
<tr>
<td>• Hand-add</td>
<td>• Dry powder</td>
</tr>
<tr>
<td>• Thermostable enzymes required</td>
<td>• Requires mass flow equipment that must be precisely calibrated to measure the feed and enzyme</td>
</tr>
</tbody>
</table>
Mass Flow System
Liquid Application Equipment

Spray Into a Plenum or Weir
Addition of Dry Powder
Micro-ingredient System

Multiple Hopper Scale  Single Hopper Scale
Objectives

• Determine if the Econase XT premix can be uniformly distributed in a complete feed.
• Determine the thermo-tolerance of a xylanase (Trichoderma reesei; Econase® XT).
Materials and Methods
## Diet Composition
Experiments 1 and 2

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>75.9</td>
</tr>
<tr>
<td>Soybean Meal</td>
<td>17.5</td>
</tr>
<tr>
<td>Minerals</td>
<td>3.1</td>
</tr>
<tr>
<td>Amino Acids/Vitamins</td>
<td>0.5</td>
</tr>
<tr>
<td>Poultry Fat</td>
<td>3.0</td>
</tr>
</tbody>
</table>
Treatments

Experiment 1
• 80 g/ton
• 100 g/ton
• 150 g/ton

Experiment 2**
• 85°C (185°F)
• 88°C (190°F)
• 91°C (195°F)
• 93°C (200°F)

**Inclusion rate – 100 g/ton
Mixer Specifications and Parameters

Experiment 1

- Scott, Model SRM 304 (500 lb)
  - Double ribbon

- Mixing Times
  - Dry mix: 60 sec
  - Wet mix: 120 sec

- Sampling: 10 samples
Pellet Mill Specifications and Pelleting Parameters
Experiment 2

- CPM, Model 1112-2 (30 hp)
- Pellet diameter: 4.4 mm (11/64")
- Die Thickness: 35 mm (1 3/8")
- Conditioner: 46 cm x 122 cm (18”x48”)
- Conditioner retention time: 30 sec
Data Collection

- Pellet production rate (kg/30 sec)
- Conditioning temperature (°C)
Data Collection

- Hot pellet temperature (°C)
- Pellet durability index (% pellets)
Data Collection

Hand Probed 10 Bags

Sample Splitting Riffle Divider
Experimental Design

• Randomized complete block design
• Three replications per treatment
• GLM procedure of SAS
• LS Means used to separate means
Results

Mixer Uniformity

Experiment 1
## Mixer Uniformity

<table>
<thead>
<tr>
<th>Item</th>
<th>80 $\text{g/ton}$</th>
<th>100 $\text{g/ton}$</th>
<th>150 $\text{g/ton}$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean</strong> $(\text{BXU/kg})$</td>
<td>18,443</td>
<td>21,409</td>
<td>31,400</td>
</tr>
<tr>
<td><strong>Std Dev</strong> $(\text{BXU/kg})$</td>
<td>498</td>
<td>1,162</td>
<td>1,962</td>
</tr>
<tr>
<td><strong>CV, %</strong></td>
<td>2.70</td>
<td>5.43</td>
<td>6.25</td>
</tr>
</tbody>
</table>
Results
Thermostability
Experiment 2
Pellet Quality

Pellet Durability Index (%)

Pelleting Temperature (°C)

- 85°C: 46%
- 88°C: 51%
- 91°C: 55%
- 93°C: 62%
## Xylanase Activity and Recovery

<table>
<thead>
<tr>
<th>Item</th>
<th>85°C</th>
<th>88°C</th>
<th>91°C</th>
<th>93°C</th>
<th>SE</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Meal</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(BXU/kg)</td>
<td>20,491</td>
<td>20,491</td>
<td>20,491</td>
<td>20,491</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pellet</strong></td>
<td>18,676</td>
<td>19,395</td>
<td>18,558</td>
<td>18,755</td>
<td>257</td>
<td>0.18</td>
</tr>
<tr>
<td>(BXU/kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Recovery</strong></td>
<td>91.2</td>
<td>94.7</td>
<td>90.6</td>
<td>91.5</td>
<td>1.9</td>
<td>0.49</td>
</tr>
</tbody>
</table>
Discussion

• The Econase 25 XT premix was uniformly distributed in the feed.
• The CV at each of the levels (80, 100, and 150 g/ton) was below 10%.
• Recovery rates were 91 to 95%, with no difference between treatment temperatures (85, 88, 91, and 93°C).
Conclusion

• The results indicated that the intrinsic thermostable non-coated xylanase enzyme was uniformly distributed in feed and retained 90% of its activity after conditioning (93°C for 30 sec) and pelleting.
Questions ?

NC State Feed Mill Education Unit