α-galactosidase and xylanase in fattening pigs fed diets with soybean and rapeseed meals

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Energy digestibility in pigs

Source: FEDNA (2015)
Antinutritional factors in legume meals

- **Oligosaccharides (15%)**
  - α-galactosides (raffinose, stachyose,...) (7-8%)
  - sucrose (6-7%)

- **Non-starch polysaccharides (NSPs)**
  - Non-cellulosic polymers (15%)
    - Arabinoxylans
    - Pectins
    - β-Glucans
    - Mannans

- **Phytic acid (<3%)**
- **Trypsin inhibitors**
- **Resistant starch**

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This project has received funding from the European Union’s Seventh Framework Programme for research, technological development and demonstration under grant agreement No. 311794.
Objectives

• To test the effect of combining α-galactosidase and endo-1,4-xylanase on the performance of growing-fattening pigs fed diets with soybean meal (SBM) and rapeseed meal (RSM).

• 2 doses of enzyme preparation: 300 vs 500 g/MT (40,000 GALU/g; 50,000 AXC/g).

• Added on top or with a 3% restriction in diet NE.
Materials & Methods

- 2 trials: 72 pigs per trial (36 entire male + 36 female pigs ([Duroc x Landrace] x Pietrain).
- Individually housed; blocked by BW and sex.
- 26 kg BW and 10 weeks of age.
- 3 pelleted diet specifications:
  - Grower-1 (d 0-34); 9.67 MJ NE/kg; 9.0 g SID-Lys/kg.
  - Grower-2 (d 34-69); 9.54 MJ NE/kg; 7.6 g SID-Lys/kg.
  - Finisher (d 69-100); 9.54 MJ NE/kg; 7.0 g SID-Lys/kg.
Materials & Methods

• Animals were weighed and feed intake registered at 0, 28, 63 and 100 d of trial. Feed efficiency calculated.

• Trial 2: Carcass yield at slaughter.
## Trial 1 – Diets

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Grower-1</th>
<th>Grower-2</th>
<th>Finisher</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SBM</td>
<td>RSM</td>
<td>SBM</td>
</tr>
<tr>
<td>Wheat</td>
<td>37.67</td>
<td>31.45</td>
<td>40.82</td>
</tr>
<tr>
<td>Barley</td>
<td>40.00</td>
<td>40.00</td>
<td>40.00</td>
</tr>
<tr>
<td>Soybean meal, 44% CP</td>
<td>18.09</td>
<td>13.14</td>
<td>16.31</td>
</tr>
<tr>
<td>Rapeseed meal</td>
<td>-</td>
<td>10.00</td>
<td>-</td>
</tr>
<tr>
<td>Lard</td>
<td>1.25</td>
<td>2.68</td>
<td>0.32</td>
</tr>
<tr>
<td>DCP</td>
<td>1.14</td>
<td>0.99</td>
<td>0.85</td>
</tr>
<tr>
<td>CaCO₃</td>
<td>0.52</td>
<td>0.46</td>
<td>0.64</td>
</tr>
<tr>
<td>Salt</td>
<td>0.44</td>
<td>0.43</td>
<td>0.41</td>
</tr>
<tr>
<td>L-Lysine-HCl</td>
<td>0.31</td>
<td>0.31</td>
<td>0.18</td>
</tr>
<tr>
<td>L-Threonine</td>
<td>0.09</td>
<td>0.07</td>
<td>0.02</td>
</tr>
<tr>
<td>DL-Methionine</td>
<td>0.07</td>
<td>0.05</td>
<td>0.03</td>
</tr>
<tr>
<td>L-Tryptophane</td>
<td>0.00</td>
<td>0.00</td>
<td>-</td>
</tr>
<tr>
<td>Ethoxyquin</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Minerals &amp; vitamins</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
</tr>
</tbody>
</table>
Trial 1 - Treatments

- **T-1**: Control SBM (no enzyme)
- **T-2**: Control SBM + Enzyme preparation (300 g/Tm)*
- **T-3**: Control SBM + Enzyme preparation (500 g/Tm)*
- **T-4**: Control SBM-RSM (no enzyme)
- **T-5**: Control SBM+RSM + Enzyme preparation (300 g/kg)*
- **T-6**: Control SBM+RSM + Enzyme preparation (500 g/kg)*

*Enzyme activity: 40,000 GalU/g; 50,000 AXC/g*
Trial 1 - Body weight (kg)

- Increase of bodyweight (107 vs. 109 kg).

- Similar performance for SBM and RSM except for T-4 (SBM-RSM diet with 300 g/MT enzyme).

- T-4: 107 vs. 113 kg.
• ADFI with SBM+RSM was numerically increased with enzymes in a dose-dependent manner.
• Improved growth in SBM-RSM diet with 300 mg/kg of enzyme alongside improved F/G.
# Trial 2 - Diets

<table>
<thead>
<tr>
<th>Ingredients, %</th>
<th>Grower-1</th>
<th></th>
<th>Grower-2</th>
<th></th>
<th>Finisher</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Positive</td>
<td>Negative</td>
<td>Positive</td>
<td>Negative</td>
<td>Positive</td>
<td>Negative</td>
</tr>
<tr>
<td>Maize</td>
<td>61.41</td>
<td>63.03</td>
<td>50.00</td>
<td>50.00</td>
<td>40.00</td>
<td>40.00</td>
</tr>
<tr>
<td>Wheat</td>
<td>-</td>
<td>-</td>
<td>17.32</td>
<td>18.90</td>
<td>29.87</td>
<td>31.45</td>
</tr>
<tr>
<td>Soybean meal, 44% CP</td>
<td>24.00</td>
<td>24.00</td>
<td>18.62</td>
<td>18.62</td>
<td>16.39</td>
<td>16.39</td>
</tr>
<tr>
<td>Rapeseed meal</td>
<td>10.00</td>
<td>10.00</td>
<td>10.00</td>
<td>10.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>Lard</td>
<td>2.23</td>
<td>0.61</td>
<td>1.82</td>
<td>0.25</td>
<td>1.74</td>
<td>0.17</td>
</tr>
<tr>
<td>Dicalcium phosphate</td>
<td>1.12</td>
<td>1.11</td>
<td>0.92</td>
<td>0.90</td>
<td>0.84</td>
<td>0.83</td>
</tr>
<tr>
<td>Calcium carbonate</td>
<td>0.31</td>
<td>0.32</td>
<td>0.43</td>
<td>0.43</td>
<td>0.33</td>
<td>0.33</td>
</tr>
<tr>
<td>Salt</td>
<td>0.44</td>
<td>0.44</td>
<td>0.41</td>
<td>0.41</td>
<td>0.39</td>
<td>0.39</td>
</tr>
<tr>
<td>L-Lysine-HCl</td>
<td>0.08</td>
<td>0.07</td>
<td>0.07</td>
<td>0.06</td>
<td>0.03</td>
<td>0.03</td>
</tr>
<tr>
<td>Ethoxiquin</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Minerals &amp; vitamins*</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
</tr>
</tbody>
</table>

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Trial 2 - Treatments

- **T-1**: Positive Control (SBM/RSM diet without enzyme)
- **T-2**: Positive control + Enzyme preparation (500 g/Tm)*
- **T-3**: Negative Control (SBM/RSM diet with 3% reduction of NE without enzyme)
- **T-4**: Negative Control + Enzyme preparation (500 g/kg)*

*Enzyme activity: 40,000 GalU/g; 50,000 AXC/g*
Trial 2 - Body weight (kg)

**Final Weight (Kg)**

<table>
<thead>
<tr>
<th>Control</th>
<th>Enzyme</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>95</td>
</tr>
<tr>
<td>100</td>
<td>105</td>
</tr>
<tr>
<td>110</td>
<td>115</td>
</tr>
</tbody>
</table>

**B a s a l**

**3 % N E**

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**T-1 (PC)**

- d0: 25.3
- d28: 44.4
- d63: 70.1
- d98: 102.1b

**T-2 (PC + Enzy.)**

- d0: 25.3
- d28: 43.9
- d63: 70.9
- d98: 104.3b

**T-3 (NC; -3% NE)**

- d0: 25.3
- d28: 44.4
- d63: 72.2
- d98: 108.9a

**T-4 (NC + Enzy.)**

- d0: 25.3
- d28: 43.7
- d63: 70.3
- d98: 103.7b

**Root MSE**

- 2.36
- 4.22
- 6.83

**E (P<)**

- NS
- NS
- NS

**Enzy. (P<)**

- NS
- NS
- NS

**E x Enzy. (P<)**

- NS
- NS
- *

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NS P>0.1; † P<0.1; * P<0.05; ** P<0.01; *** P<0.001

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Trial 2 – ADFI (g/d) and F/G

- Feed intake similar to positive control when enzyme added to lower-energy diet.
- Enzymes numerically reduced F/G both added to basal and to energy restricted diets.
Trial 2 - Carcass yield

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Carcass weight (kg)</th>
<th>Carcass yield (%)</th>
<th>Loin depth (mm)</th>
<th>Backfat thickness (mm)</th>
<th>Lean meat (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-1 Positive Control</td>
<td>84.6</td>
<td>78.0</td>
<td>60.7</td>
<td>14.4a</td>
<td>62.8a</td>
</tr>
<tr>
<td>T-2 PC + Enzyme (500 g/Tm)</td>
<td>84.4</td>
<td>76.5</td>
<td>59.3</td>
<td>16.0b</td>
<td>61.1b</td>
</tr>
<tr>
<td>T-3 Negative Control (3% NE reduction)</td>
<td>88.9</td>
<td>77.8</td>
<td>59.4</td>
<td>16.5b</td>
<td>60.7b</td>
</tr>
<tr>
<td>T-4 NC + Enzyme (500 g/Tm)</td>
<td>85.2</td>
<td>77.1</td>
<td>61.0</td>
<td>13.6a</td>
<td>63.5a</td>
</tr>
<tr>
<td>Root MSE</td>
<td>5.48</td>
<td>2.53</td>
<td>4.81</td>
<td>2.54</td>
<td>2.46</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Effect</th>
<th>Pr&gt;F</th>
<th>F</th>
<th>F</th>
<th>F</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial BW Effect</td>
<td>**</td>
<td>NS</td>
<td>NS</td>
<td>†</td>
<td>†</td>
</tr>
<tr>
<td>Sex Effect</td>
<td>NS</td>
<td>*</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Energy level Effect</td>
<td>†</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Enzyme Effect</td>
<td>NS</td>
<td>†</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Energy x Enzyme Effect</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>***</td>
<td>***</td>
</tr>
</tbody>
</table>

NS P>0.1; † P<0.1; * P<0.05; ** P<0.01; *** P<0.001

- Enzymes added on top increased carcass fat deposition and lowered lean yield.
- Lower-energy diet without enzymes resulted in greater fat deposition than with enzymes.
Conclusions

• A numerical increase of bodyweight and lower feed conversion of fattening pigs was observed when a combination of α-galactosidase and xylanase were added on top to Soybean-Rapeseed meal based diets.

• 3% NE restriction in the diet:
  - Compensated in treatment receiving enzyme.
  - In Negative Control, lower energy density might be counteracted by greater feed intake and protein deposition.

• Energy restriction was compensated by the enzymes and similar carcass performance was obtained.
Conclusions

• In the NC treatment, higher fat deposition might be due to much higher feed intake to compensate for lower energy density of the diet.

• Adjusted dose of these enzymes to diets with legumes other than soybean meal and combined energy and protein restriction need to be explored.
...THANKS FOR ATTENTION!