Feeding value of the starch concentrate of dehulled faba bean (Vicia faba L.) for broilers and swine

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The humble bean...for starters
Beyond the beans...

Air fractionation separates ground bean into protein-rich and starch-rich fractions.

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### Chemical compositions, %

<table>
<thead>
<tr>
<th></th>
<th>Faba bean</th>
<th>Starch concentrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross energy, MJ/kg</td>
<td>18.7</td>
<td>16.6</td>
</tr>
<tr>
<td>Crude protein</td>
<td>29.0</td>
<td>16.8</td>
</tr>
<tr>
<td>Starch</td>
<td>44.7</td>
<td>48.9</td>
</tr>
<tr>
<td>Lysine</td>
<td>1.76</td>
<td>1.12</td>
</tr>
<tr>
<td>Arginine</td>
<td>2.30</td>
<td>1.67</td>
</tr>
<tr>
<td>Methionine</td>
<td>0.21</td>
<td>0.12</td>
</tr>
<tr>
<td>Methionine + Cystine</td>
<td>0.54</td>
<td>0.35</td>
</tr>
</tbody>
</table>

Potential source of protein and amino acids for poultry and swine

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Experiment 1

Amino acid digestibility for bean starch concentrate for broilers

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Apparent amino acid digestibility (AIAAD)

AIAAD, %

Apparent digestibility for essential amino acids ranged from 68 to 90%
Standardised amino acid digestibility (SIAAD)

Standardised digestibility for essential amino acids ranged from 70 to 91%

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Amino acid digestibility compared

Except for Met, AA digestibility is comparable to other important cereal grains and soybean meal.

BSC – bean starch concentrate; SBM – soybean meal; www.beans4feeds.net
Digestible amino acid compared

Methionine will be a limitation in BSC

BSC – bean starch concentrate; SBM – soybean meal; www.beans4feeds.net
Experiment 2

Metabolisable energy

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<table>
<thead>
<tr>
<th>Predicted ME, MJ/kg</th>
<th>Actual ME, MJ/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.40</td>
<td>13.41</td>
</tr>
</tbody>
</table>

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Metabolisable energy content of BSC is comparable to maize and higher than wheat

BSC – bean starch concentrate; www.beans4feeds.net
Experiment 3

Amino acids digestibility for swine

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Objective

• To establish feeding value of BSC for growing and finishing pigs
  – Standardised ileal digestibility of amino acids (SID AA)

• To consider to what extent soya bean meal can be replaced with BSC on the basis of feeding value

BSC – bean starch concentrate

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Apparent N digestibility

Ileal and total tract N digestibility about 79%

Ileal and faecal digestibility comparison.

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Ileal amino acids digestibility

Amino acid digestibility – generally > 80%

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Experiments 4 & 5

Growth performance for growing and finishing pigs
<table>
<thead>
<tr>
<th></th>
<th>Grower</th>
<th>Finisher</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SBM</td>
<td>BSC</td>
</tr>
<tr>
<td>SBM</td>
<td>140</td>
<td>0</td>
</tr>
<tr>
<td>BSC</td>
<td>0</td>
<td>300</td>
</tr>
<tr>
<td>Wheat</td>
<td>283</td>
<td>116</td>
</tr>
<tr>
<td>Soya oil</td>
<td>18</td>
<td>24</td>
</tr>
<tr>
<td>Barley</td>
<td>284</td>
<td>284</td>
</tr>
<tr>
<td>Molasses</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>RSM</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>Wheat feed</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>Lysine</td>
<td>1.40</td>
<td>1.00</td>
</tr>
<tr>
<td>Methionine</td>
<td>0.06</td>
<td>0.72</td>
</tr>
<tr>
<td>Threonine</td>
<td>0.00</td>
<td>0.82</td>
</tr>
<tr>
<td>Tryptophan</td>
<td>0.00</td>
<td>0.09</td>
</tr>
<tr>
<td>DCP</td>
<td>5.5</td>
<td>4.7</td>
</tr>
<tr>
<td>Limestone</td>
<td>11.6</td>
<td>12.9</td>
</tr>
<tr>
<td>Salt</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Premix</td>
<td>2.5</td>
<td>2.5</td>
</tr>
</tbody>
</table>
Pigs, housing and diets

• Seventy-two grower and finisher pigs
  – Growers initial BW: 30.0±0.74 kg
  – Finishers initial BW: 63.1±0.95 kg

• Six test diets
  – 0, 6, 12, 18, 24 and 30% BSC

• Gradually and completely replacing SBM
• Gradual reduction in wheat by ~65% (from ~27 to 10%)
Growers: daily weight gain

Statistics

Diet: P=0.864
Linear: P=0.734
Quadratic: P=0.613

No significant effect on weight gain

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Growers: FCR

Statistics
- Diet: $P = 0.679$
- Linear: $P = 0.821$
- Quadratic: $P = 0.976$

No significant effect on FCR
Finishers: daily weight gain

Statistics
- Diet: P=0.026
- Linear: P=0.114
- Quadratic: P=0.011

Quadratic effect of BSC inclusion on weight gain after 6% inclusion

Complete replacement of SBM did not reduce weight gain
Finishers: FCR

Quadratic effect of BSC inclusion on FCR after 6% inclusion

Complete replacement of SBM had no negative effect on FCR

Statistics

<table>
<thead>
<tr>
<th>Type</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diet</td>
<td>0.080</td>
</tr>
<tr>
<td>Linear</td>
<td>0.673</td>
</tr>
<tr>
<td>Quadratic</td>
<td>0.039</td>
</tr>
</tbody>
</table>

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Broiler chickens studies

- Bean starch concentrate can compete with wheat or maize as source of amino acids in broilers
- Met is a limiting amino acid in bean starch concentrate
- Bean starch concentrate is a viable energy and protein feedstuff for broilers

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Pigs studies

- Gradual exchange of SBM/wheat for BSC resulted in similar growth responses in grower pigs but unexpected quadratic responses in finisher pigs
  - detrimental response over 12, 18 and 24%
  - similar between 0 and 30% BSC in absence of SBM

- Similar conclusion for replacing SBM with whole peas or faba beans (Smith et al., 2013)
Can BSC reduce reliance on SBM?

<table>
<thead>
<tr>
<th></th>
<th>SID Lys (g/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bean starch concentrate</td>
<td>9.2</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>26.6</td>
</tr>
</tbody>
</table>

- Complete replacement
  - ~3 units of BSC for each unit of SBM

- Grower-finisher diets with an average of 10% SBM can be replaced with 30% BSC
  - Additional AA to balance protein quality
  - From other feedstuffs or pure AA

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This research is part of “Development of protein-rich and starch-rich fractions from faba beans for salmon and terrestrial animal production respectively” (ref 101096) funded by Innovate UK
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