Comparative efficacy of L-methionine and DL-methionine in piglets

Jaap VAN MILGEN\textsuperscript{1}, Jean NOBLET\textsuperscript{1}, Philippe LOOTEN\textsuperscript{2}, Patrick FUERTES\textsuperscript{2}, Christian DELPORTE\textsuperscript{2}

\textsuperscript{1}INRA-Agrocampus Ouest, UMR1348 PEGASE, F-35590 Saint-Gilles, France
\textsuperscript{2}Roquette Frères, F-62136 Lestrem, France
Introduction

- L-Methionine:
  - essential amino acid
  - component of structural and functional proteins
  - implicated in methylation reactions
  - precursor for the synthesis of Cys

- Sources of methionine:
  - dietary protein
  - synthetic isomers (DL-Met) or analogs (DL-HMB) of L-Met
D-Met has to be converted to L-Met by the animal to become biologically active.

- D-methionine
- keto-methionine
- L-methionine

Hasegawa et al., 2005
Introduction

- There is a wealth of data (and debate) of the comparative efficacy of DL-Met and hydroxy analogues of Met.
- Little information is available on the relative efficacy of DL-Met and L-Met in pigs:
  - $D$-Met : $L$-Met = 50% (Kim and Bayley, 1983)
  - $D$-Met : $L$-Met = 100% (Reifsnyder et al., 1984; Chung and Baker, 1992)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Feed intake, g/d</th>
<th>Daily gain, g/d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control*</td>
<td>605a</td>
<td>268a</td>
</tr>
<tr>
<td>Control + L-Met</td>
<td>999b</td>
<td>498b</td>
</tr>
<tr>
<td>Control + D-Met</td>
<td>969b</td>
<td>498b</td>
</tr>
<tr>
<td>Control + DL-Met</td>
<td>1019b</td>
<td>516b</td>
</tr>
</tbody>
</table>

* deficient in Met

Chung and Baker, 1992
Two sources of Met of different origin and composition

<table>
<thead>
<tr>
<th></th>
<th><strong>DL-Met</strong></th>
<th><strong>L-Met</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Production method</strong></td>
<td>chemical synthesis (commercially available)</td>
<td>fermentation* (experimental)</td>
</tr>
<tr>
<td><strong>Met source</strong></td>
<td>99% DL-Met (50% D-Met and 50% L-Met)</td>
<td>85.9% L-Met</td>
</tr>
</tbody>
</table>

*method developed by METabolic EXplorer and Roquette Frères
Diets

- Diets based on barley (64%), corn (22%), and pea protein (9%)
- 1 control diet, limiting in total sulfur amino acid supply:

<table>
<thead>
<tr>
<th></th>
<th>Control diet</th>
<th>NRC (1998)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SID Lys</td>
<td>1.00%</td>
<td>1.09-0.93%</td>
</tr>
<tr>
<td>SID Met:Lys</td>
<td>20%</td>
<td>30%</td>
</tr>
<tr>
<td>SID (Met+Cys):Lys</td>
<td>42%</td>
<td>60%</td>
</tr>
</tbody>
</table>

- 6 diets based on the control diet and supplemented with 2 sources (L-Met or DL-Met) and 3 levels (0.05, 0.10, and 0.15% of “pure” Met)
Experimental design

77 piglets
P x (LW x LR)
50% ♂, 50% ♀
housed individually
ad libitum feeding

~11 kg
(6 wks of age)

21 days
1 of 7 diets

~23 kg
Statistical analysis: bent-stick model

- A common intercept for both Met sources
- Straight lines, potentially different between Met sources
- A transition phase to account for the decline in the Met requirement during the experimental period
- A common plateau where the Met supply is no longer limiting performance
Effect of level and source of Met on growth in piglets

![Graph showing the effect of level and source of Met on growth in piglets. The graph displays the daily gain (g/d) on the y-axis and Met supplementation (Met supplementation, %) on the x-axis. The graph includes three lines: Control, L-Met, and DL-Met, each representing different treatments. The graph indicates that Met supplementation has a positive effect on daily gain, with L-Met and DL-Met showing comparable effectiveness.]
Comparative efficacy of using L-Met and DL-Met for growth in piglets

<table>
<thead>
<tr>
<th></th>
<th>Feed intake</th>
<th>Daily gain</th>
<th>Feed efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slope-ratio L-Met vs DL-Met</td>
<td>1.15 (0.12)</td>
<td>1.12 (0.09)</td>
<td>0.99 (0.12)</td>
</tr>
<tr>
<td>Probability slope-ratio ≠ 1</td>
<td>0.17</td>
<td>0.16</td>
<td>0.82</td>
</tr>
<tr>
<td>Residual SD, g/d</td>
<td>109</td>
<td>67</td>
<td>0.04</td>
</tr>
</tbody>
</table>
Conclusions

- There is no difference in the efficiency of using DL-Met or L-Met for growth in piglets (at equal Met levels)
- D-Met is converted efficiently to L-Met in pigs
- The limited response at higher levels of Met supplementation suggests that the Met requirement was lower than anticipated