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To cite this version:

HAL Id: hal-01210465
https://hal.science/hal-01210465
Submitted on 3 Jun 2020

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Meta-analysis of the response of growing pigs to the valine content in the diet

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Introduction and objective

- Recent experimental evidence suggests that Val is the next-limiting amino acid for pigs in cereal-soybean meal based diets (after Lys, Met, Thr, and Trp, but before Ile).
- Information on the Val requirement for growing pigs is scarce.
- L-Val is now available as a free amino acid, allowing the formulation of diets with a very low protein content.
- Objective: perform a meta-analysis of available data on the response of growing pigs to the Val supply.

Data and statistical analysis

- 28 dose-response studies with at least 4 levels of Val were obtained from 20 publications (9 of which were peer-reviewed).
- The composition of feed ingredients (Sauvant et al., 2004) was used to calculate the standardized ideal digestibility (SID) and nutrient composition.
- Data were standardized (Figures 1 and 2):
  - relative to the NRC (1998) Val requirement estimate (as a % in the diet or relative to Lys, depending on the design of the study)
  - relative to the response at the highest level of Val supplementation.

Results

- The responses of feed intake and daily gain to the Val supply were very similar (Figure 2).
- Val requirement estimates ranged from 87-111% of the NRC (1998) value for feed intake, and from 84-114% for daily gain (94% on average, which corresponds to 64% SID Val:Lys).
- Increasing the SID Val:Lys supply from 64% to 69% resulted in a 5% performance increase.
- A 10% reduction in Val supply below the requirement reduced feed intake and growth by respectively 33% and 27%.
- The Val requirement may increase with increasing amino acid or protein level (Figure 4).

Conclusions

- Most of the studies on Val requirements have been carried out in pigs weighing <35 kg.
- Most of the response to a Val deficiency occurs through a reduction in feed intake.
- To maximize growth, 69% SID Val:Lys is required.
- A Val deficiency results in a strong reduction in performance.
- The amino acid or protein content of the diet may have an impact of the Val requirement.

Figure 1. Meta-design of the study. The horizontal line indicates the duration of the study (body weight range) and the vertical line the range in Val contents (% of the NRC (1998)value).

Figure 2. Response of pigs to the Val supply (● feed intake; ○ daily gain). Studies indicated by a ■ were not analyzed further because of the high level of the response (response > 50% or there was no indication for a linear or quadratic response (P < 0.25). The study of Jackson et al. (1953) was not considered further because of the low genetic potential of the pigs at that time.

Figure 3. A bent-stick model was used to account for the decline in Val requirement during the experiment. The green area (left panel) illustrates that, in a dose-response experiment, a partial response will be observed for some of the treatments because the Val requirement declines (solid line) while the Val supply remains constant during the experiment (the 5 dashed lines). If a broken-line relationship is assumed to be true at a given point in time, a bent-stick relationship will be observed for full duration of the experiment (right panel).

Figure 4. Relation between the Val requirement estimate and the Phe content in the diet. Both values are expressed as a percentage of the NRC (1998) requirement estimate.

Table 1. Correlation coefficients between the Val requirement estimate and the amino acid content in the diet.

<table>
<thead>
<tr>
<th>Amino acid</th>
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<tbody>
<tr>
<td>Lys</td>
<td>0.67</td>
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<tr>
<td>Phe</td>
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<tr>
<td>Met</td>
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<tr>
<td>Leu</td>
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<tr>
<td>Met+Cys</td>
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<tr>
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<tr>
<td>Arg</td>
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