

## AMINO ACIDS

# The isoleucine requirement in nursery piglets



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## Abstract

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To bring down the protein content in diets for young piglets without compromising production performance, it is essential to have adequate information on the requirements of post-weaning piglets for next-limiting amino acids, including isoleucine. Therefore, a dose-response study was performed with 384 post-weaning piglets (d 6-34 post weaning) to determine the dietary requirement for isoleucine (Ile). Performance parameters were measured over the experimental period of four weeks. Over the total experimental period (d 0-28), feed intake and average daily gain (both  $P < 0.001$ ) and feed conversion ratio (FCR) of piglets ( $P < 0.05$ ) were affected significantly by treatment. The requirement values for isoleucine, based on regression analysis with the exponential model, were estimated at 6.2 and 6.1 g SID Ile per kg of diet for feed intake and average daily gain, respectively. It was concluded from the present study that the Ile requirement in nursery piglets amounts 6.1 g SID Ile per kg of diet, equivalent to 51% relative to SID lysine.

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## Background

Lysine (Lys), methionine (Met), threonine (Thr), tryptophan (Trp), and valine (Val) are available for use in pig diets for a substantial period. More recently, isoleucine (Ile) has become available in crystalline form for use in animal feeds. The increased availability of free amino acids allows to further reduce the dietary protein content and increase the nitrogen efficiency in animals. Moreover, lowering the dietary protein level largely supports the reduction of the environmental footprint of animal production with regard to nitrogen and ammonia emission [1].

In plant-based diets, Ile is expected to be sixth limiting

AA after Val for pigs [2-4]. Because the branched chain AAs i.e. Val, leucine (Leu), and Ile are sharing a common catabolism [5], dietary interactions between these amino acids potentially influence their requirements [6]. Literature shows a clear evidence that a deficiency in Ile leads to a decrease in feed intake and consequently to poor performance in nursery piglets [7], however, there is conflicting information about the accurate Ile requirement, because literature and established requirement systems suggest different values for the optimal Ile requirements in 5 – 25 kg piglets.

## Methods

A dose-response study was performed using six diets with increasing levels of dietary standardized ileal digestible (SID) Ile by supplementing free L- Ile (BESTAMINO™) in order to determine the Ile requirements.

The diets mainly based on corn (43.5 %), wheat (29.0 %) and barley (8.45 %). The basal diet (treatment 1) was a diet with about 150 g/kg CP, 12.0 g SID Lys per kg and limiting in isoleucine (4.4 g/kg SID Ile) and supplemented with other essential amino acids (Lys, Met, Thr, Trp, Val) to meet their assumed requirement values according to CVB (1996) and CJ Europe. The diets for treatments 2 until 6 contained incremental levels of SID Ile by supplementing free L- Ile at the expense of starch until levels of 4.95, 5.50, 6.05, 6.60 and 7.15 g SID Ile per kg were achieved,

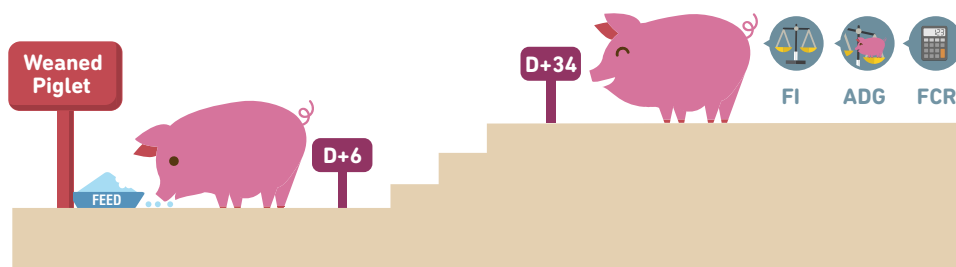
respectively.

A total of 384 piglets (Topigs Norsvin 70 Norwegian Landrace x pure bred York-Z) were divided into six treatments. The experiment last for 28 days, starting 6 days post-weaning, in an artificially heated, ventilated, and lighted pig unit.

Performance results were initially analyzed by ANOVA (Genstat 5, release 18.1). The Least Significant Difference test was used to evaluate the differences between treatment means. The response of the piglets to the experimental treatments for feed intake (FI), average daily gain (ADG) and feed conversion ratio (FCR) were subjected to regression analysis with a broken line model and an exponential model to derive requirement values of post-weaning piglets for Ile.

### MATERIALS AND METHODS

- 384 piglets (Topigs Norsvin 70 Norwegian Landrace x pure bred York-Z)
- 6 treatments (4.95, 5.50, 6.05, 6.60, 7.15g SID Ile per kg)



## Results

The results of the technical performance of the piglets in the treatment groups were presented in Table 1. Over the total experimental period (d 0 - 28) FI and ADG were affected significantly by treatment ( $P < 0.001$ ). FI and ADG increased by addition of Ile until treatment 4. Afterwards a steady state is achieved. For the FCR, only the value for treatment 1 was higher compared to all other treatments ( $P < 0.05$ ).

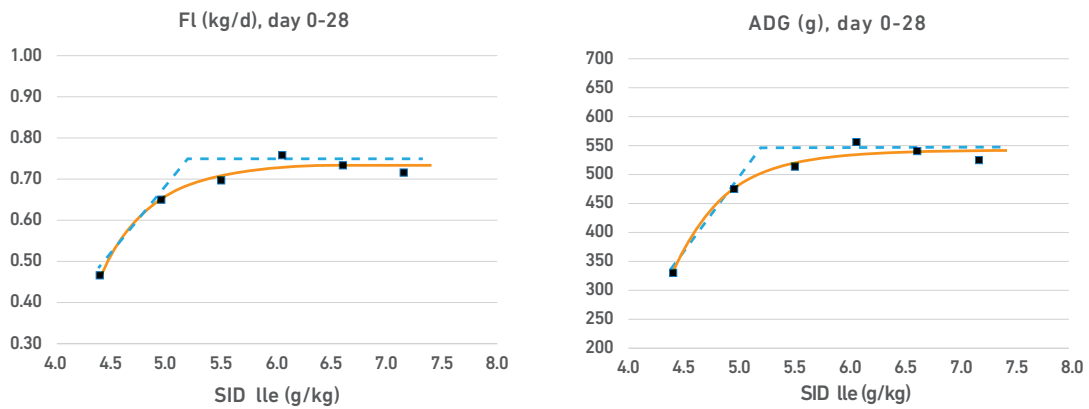


**Table 1.** Means of feed intake, average daily gain and feed conversion ratio as a response to addition of isoleucine.

	FI (kg/d)	ADG (g/d)	FCR
1	0.466 <sup>a</sup>	329 <sup>a</sup>	1.418 <sup>b</sup>
2	0.648 <sup>b</sup>	475 <sup>b</sup>	1.359 <sup>a</sup>
3	0.699 <sup>c</sup>	512 <sup>c</sup>	1.363 <sup>a</sup>
4	0.758 <sup>d</sup>	555 <sup>d</sup>	1.365 <sup>a</sup>
5	0.734 <sup>cd</sup>	541 <sup>cd</sup>	1.357 <sup>a</sup>
6	0.716 <sup>cd</sup>	524 <sup>cd</sup>	1.365 <sup>a</sup>
P	<0.001	<0.001	0.038
LSD	0.044	35	0.84

<sup>a,b,c</sup> Values with a different superscript in the same column differ significantly at  $P < 0.05$ . LSD: least significance difference

Over the total period (Figure 1), the estimated requirement for FI was 5.19 g/kg SID Ile (43 % Ile:Lys) and 6.18 g/kg SID Ile (52 % Ile:Lys) with the broken line and exponential model, respectively. ADG was optimized at 5.17 g/kg SID Ile (broken line model) and 6.11 g/kg SID Ile (exponential model). None of the models were fitting to FCR data.



**Figure 1.** Response of feed intake and average daily weight gain of the treatment groups over d 0-28 of the experimental period based on a broken line model (blue) and an exponential model (orange).

## Discussion

Considering the established nutritional recommendation standards, the optimal digestible Ile to Lys ratio varies between 51 % [8] and 58 % [9]. Mainly a Leu oversupply may affect the requirement of Val and Ile because Leu acts as a stimulator for the common enzyme system [10] and consequently reduces the availability of Val and Ile. However, in cereal-based diets with a low CP value, the Leu content of the diets is usually rather low, this leads to comparable lower Ile requirements. Soumeh et al. (2014) found in a dose response Ile requirement study with piglets (8 - 15 kg) a clear response of FI and ADG, while the FCR responded to less [11]. They concluded that the optimum SID

Ile:Lys was 52% in order to maximize FI and ADG and 48% in order to minimize FCR using diets which contained 11.4 g SID Lys/kg. Van Milgen et al. (2012) performed a meta-analysis on studies on the Ile requirement of post-weaning piglets [12]. They concluded that a dietary Ile concentration below the requirement resulted in significant reduction in both FI and ADG as also observed in the present study. The use of blood products in a diet leads to high Leu content. Thus, Leu level of feed is an important factor for the response to the dietary Ile concentration. In diets without blood products, the Ile requirement was found to be lower than the NRC (2012) recommendations (52% relative to the requirement for SID Lys). The meta-analysis concluded that an Ile:Lys requirement ratio of at least 50% on a SID basis is recommended for post weaning piglets.

The results of this study show that piglets in the post-weaning phase respond rather drastically towards lowering the dietary Ile level in terms of reducing FI and ADG, indicating that Ile deficiencies should be prevented when lowering protein level in diets for post-weaning piglets.



## Conclusions

It can be concluded from the present dose response study that the Ile requirement in nursery piglets amounts 6.1 g SID Ile per kg of diet, containing 12.0 g of SID Lys per kg, equivalent to 51% relative to the concentration of SID Lys.

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