

Amino Acid and Crude Protein Levels in Nursery Diets

Nursery pigs have a rapid growth rate and a high capacity for lean deposition relative to feed intake. Therefore, dietary amino acids and crude protein are essential to optimize growth performance in the nursery and have a significant influence on nursery diet cost. The practical approaches for determining dietary amino acids and crude protein levels in nursery diets are discussed in this fact sheet.

Amino acid requirements

The amino acid requirements of nursery pigs have increased significantly over time. As pigs have been growing faster with lower feed intake, the amino acid requirements as percentage of the diet have increased.

Current statistical modelling techniques have been applied to determine the [dose-response](#) to individual amino acids. Recently, the requirements of lysine (Graham et al., 2017; Nichols et al., 2018) and ratios for methionine and cysteine, threonine, tryptophan, isoleucine, valine, and histidine relative to lysine have been estimated for nursery pigs (Gonçalves et al., 2015; Jayaraman et al., 2015; Clark et al., 2017b,c; Kahindi et al., 2017; Cemin et al., 2018). By doing so, it is possible to determine the requirement to maximize growth performance and also predict the change in growth performance at a particular amino acid level. From a practical feeding standpoint, it is not always economical to feed diets at the amino acid levels to maximize growth performance. In many cases, it is more advantageous to feed diets with amino acid levels to achieve 95 to 99% of maximal growth performance than at levels to achieve 100% of maximal growth in the nursery (**Table 1**).

Table 1. Amino acid to lysine ratios for varying levels of growth performance of nursery pigs

Amino acid relative to lysine, %	95% of maximum performance	100% of maximum performance
Methionine	28	30
Methionine + Cysteine	56	60
Threonine	62	65
Tryptophan	19	21
Valine	67	72
Isoleucine	52	52
Histidine	30	31

Crude protein level

The crude protein level in nursery diets can pose an additional burden on weanling pigs. High-protein diets increase the quantity of undigested proteins and microbial fermentation in the hindgut, which predisposes the occurrence of post-weaning diarrhea (Heo et al., 2013). A practical approach is to feed low-protein, amino acid-fortified diets to decrease the burden imposed to the gut of weanling pigs. Typically, initial nursery diets contain up to 22% crude protein, but using feed-grade amino acids the crude protein level can be reduced to approximately 18%. The reduction in crude protein allows to minimize the inclusion of soybean meal that cause a hypersensitivity reaction in pigs, as well as the inclusion of specialty protein sources that increase diet cost. The low-protein diets should be supplemented with feed-grade amino acids to meet the amino acid requirements and support growth performance.

Lysine level

The lysine level influences the dietary crude protein content. A practical approach is to feed more moderate levels of lysine in initial nursery diets (1.35 to 1.40% SID Lys from 12 to 25 lb) that are typically composed of more expensive specialty protein sources. The lower lysine levels allow the reduction in crude protein and savings in diet cost. This approach leads to an excellent overall growth performance in the nursery as long as the lysine levels in late nursery diets are adequate (1.30 to 1.35% SID Lys from 25 to 50 lb). Thus, feeding lower lysine in early nursery and adequate levels in late nursery allows the reduction in crude protein and savings in diet cost while maintaining growth performance throughout the nursery period (Nemeček et al., 2018).

The dietary lysine level is also important to determine the level of other essential amino acids relative to lysine. Amino acid ratios are more critical in diets with lysine levels below the requirements than in diets with lysine at the requirements. Thus, using higher amino acid ratios in low-lysine diets is important to improve growth performance, whereas more moderate amino acid ratios can be used in diets with adequate lysine levels (Clark et al., 2017a).

Feed-grade amino acids

The use of feed-grade amino acids is key to meeting the amino acid requirements of nursery pigs, with accompanying reduction in dietary crude protein and savings in diet cost. The replacement of intact protein sources by feed-grade amino acids increases as feed-grade amino acids become available and economically justifiable. Currently, feed-grade lysine, methionine, threonine, tryptophan, and valine are all economical to include in nursery diets in the United States.

The maximum inclusion of feed-grade amino acids is often dictated by the ratio of lysine to crude protein and by the most limiting amino acid in the diet. Lysine to crude protein ratio is used to ensure a sufficient supply of nitrogen for synthesis of non-essential amino acids in low-protein, amino acid-fortified diets. For nursery pigs, up to a ratio of SID Lys:CP of 6.35 or total Lys:CP of 7.20 is recommended (Millet et al., 2018a,b). Also, the inclusion of feed-grade amino acids is determined by the next limiting amino acid in the diet, which can be isoleucine or histidine when all five first-limiting amino acids are available for feed-grade inclusion. However, low-protein diets fortified with the five first-limiting amino acids are typically able to meet the histidine requirements for nursery pigs (Cemin et al., 2018).

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