Amino Acids

Establishing farm specific amino acid requirements is an essential step in diet formulation that is based on understanding the growth of the pigs. How to determine amino acid requirements, reasons amino acid requirements change in the grow-finish period, and feed-grade amino acid usage in diet formulation will be discussed.

Determining AA Requirements

Establishing the dietary concentration of amino acids that meet the growth and maintenance needs for grow-finishing pigs is vital to establishing a profitable nutrition program. The pig's amino acid requirements can be acquired from internal production system research, growth rate and feed intake data, protein accretion curves at the farm level, genetic companies, or research data conducted at the university level. Advantages and disadvantages exist in each of these methods in terms of their accuracy in estimating amino acid requirements and cost to obtain the data.

Once the dietary energy level is determined, a lysine:calorie ratio needs to be set. The lysine requirement is expressed as a ratio to energy because changes in dietary energy will affect feed intake and/or growth rate.

Differences in feed intake, environmental conditions, and production goals can affect the decision on which lysine:calorie ratio to use. Thus, it is best to determine the lysine requirement within the specific production system. Protein deposition curves can also be utilized to estimate lysine requirements. By using these curves, producers can understand the changes in protein deposition rates of grow-finish pigs as they approach market weight and better estimate lysine requirements. If this data is not available, lysine requirements can be derived from growth rate and feed intake data. In general, grow-finish pigs require approximately 20 g standardized ileal digestible (SID) lysine / per kg of gain (Rostagno, 2017). After determining the lysine requirement, the other AA ratios relative to lysine can be determined.

AA requirement changes in the grow-finish period

Rate of protein deposition is the main determining factor in amino acid requirements. With increasing body weight, protein deposition decreases relative to feed and energy intake, therefore decreasing the dietary lysine level required to support growth. However, as the pig becomes heavier, maintenance requirements increase relative to those used for growth (Moughan, 2003). This relationship explains why requirements for amino acids involved in maintenance functions, like threonine and sulfur-containing amino acids (methionine and cysteine) increase as ratios relative to lysine as body weight increases. Furthermore, tissue turnover rates relative to protein deposition change with increasing age which explains why the ratios of threonine and methionine and cysteine relative to lysine increase but tryptophan ratios are similar throughout the grow-finish period (Mahan and Shields, 1998).

Establishing the requirements of the other amino acids relative to lysine is important as amino acid imbalances in the diet can occur. Imbalances in amino acids are caused by an amino acid being supplied at levels lower or higher than what is required to optimize growth. These imbalances can potentially lead to reduced feed intake and poor growth performance (Baker, 2004). Recommendations for minimum amino acid requirements in the grow-finish phase are provided (Table 1).

Feed-Grade Amino Acids

Feed-grade amino acids have become more readily available and economical to use in diet formulation. Feed-grade lysine, methionine, threonine, tryptophan, valine, and isoleucine are currently commercially available for swine diets. Increased cost of intact proteins and increased availability of feed-grade amino acids has led producers to use more low-protein, feed grade amino acid fortified diets. Low protein diets offer the opportunity to reduce nitrogen excretion in swine waste, a benefit for the environment.

If not formulated correctly, low-protein, feed grade amino acid fortified diets can result in an overall fatter carcass compared to that of feeding a higher crude protein diet (Hinson et al., 2009; Li et al., 2016). This is the result of feed-grade amino acids replacing a lower energy ingredient (soybean meal) with a higher energy ingredient (corn) in the diet. The energy system being utilized in diet formulation should be understood when formulating with feed-grade amino acids as energy utilization is attributed differently based on ingredient composition. In the ME and DE systems, energy in the diet is overestimated when protein ingredients are included while the NE system takes utilization inefficiency of energy from protein into account. Cereal grains, like corn, increase in the diet when feed-grade AA are used and the NE system can capture this difference in energy utilization more accurately than the DE or ME systems (van Milgen et al., 2001; Li et al., 2018). The NE system will more accurately represent how the energy is being utilized by the pig with the inclusion of feed-grade amino acids to avoid increased fat deposition.

When feed-grade amino acids are supplemented in low crude protein diets to maintain amino acid ratios, growth performance is similar to that of feeding high crude protein diets (Kerr et al., 2003; Molist et al., 2016). There are questions on whether there is a minimum level of crude protein or soybean meal that should be included in late-finishing diets. It has been observed that reducing dietary crude protein level below 13% with feed-grade amino acids reduces growth performance of finishing pigs (Soto et al., 2019). More knowledge about requirements for nonessential amino acids or ratios between essential amino acids is needed to allow for lower crude protein diets to be fed to late finishing pigs without negatively impacting growth performance.

The use of feed-grade amino acids in grow-finish diets is an effective way to reduce feed costs and nitrogen excretion, but producers must consider the situations where high levels of feed-grade amino acid supplementation may not be appropriate to avoid decreases in growth and carcass performance.

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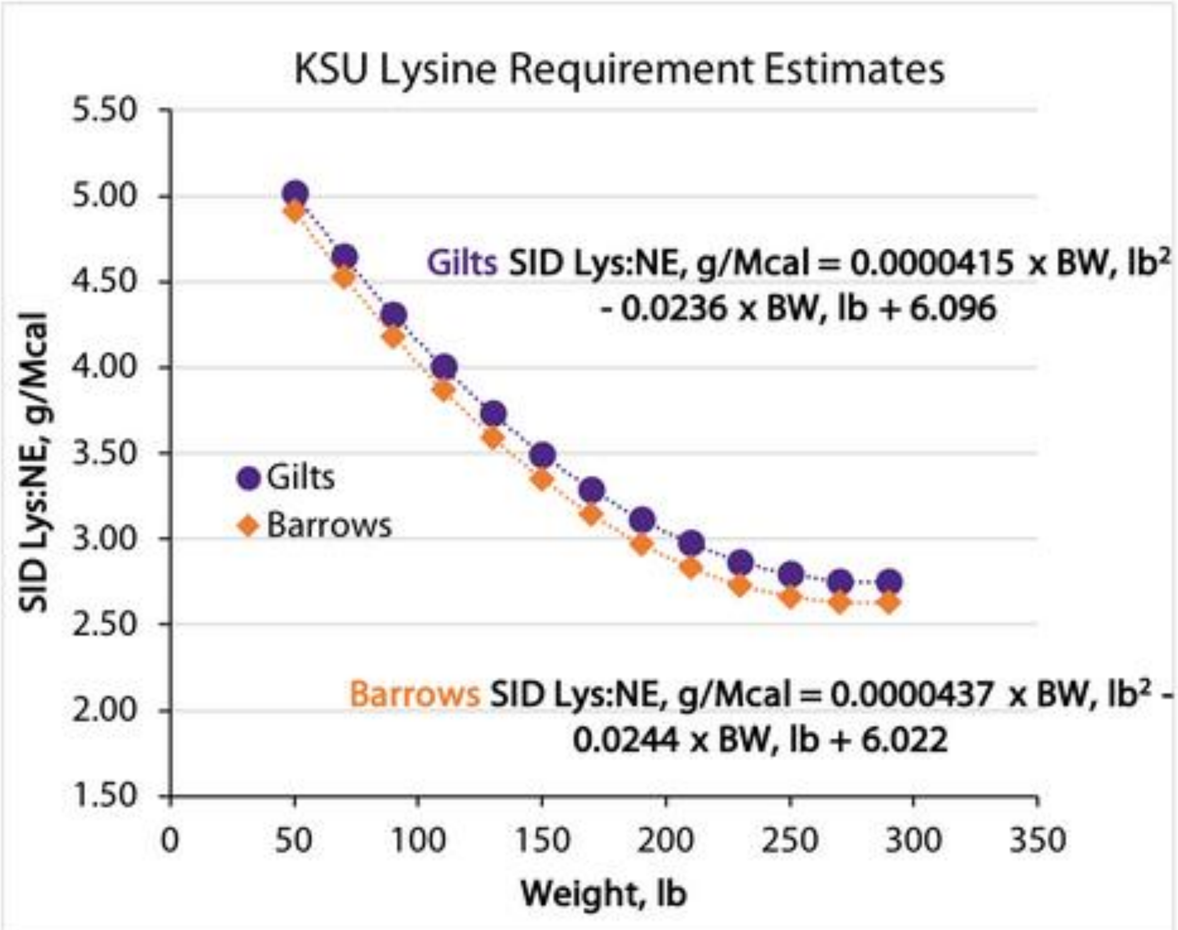

Figure 1. KSU Lysine recommendations for grow-finish pigs .

Table 1. Minimum standardized ileal digestible lysine and amino acid to lysine ratios for growing-finishing pigs

	Growing-finishing pigs weight range, lb			
SID amino acids[1]	55 to 130	130 to 175	175 to 220	220 to 285
Lysine, %[2]	1.08	0.88	0.78	0.70
Amino acid to lysine ratio, %[3]				
Methionine	28	28	28	28
Methionine + Cysteine	56	56	57	58
Threonine	62	62	63	64
Tryptophan	18	18	18	18
Isoleucine	52	52	52	52
Valine	68	68	68	68

[1]Minimum levels based on the NRC (2012) ingredient loading values.

[2]Minimum lysine levels containing a diet with 1,150 kcal NE/lb.

[3]Minimum ratios to achieve approximately 95% of maximum growth performance. Minimum ratios of threonine, tryptophan, isoleucine, and valine may need to be increased depending on diet formulation.