The right SID lysine and NE for optimising performance

The need to produce more animal-based protein for the growing population puts a strain on the world's resources due to the impact production has on the environment, producing greenhouse gas (GHG) emissions and demanding more water and land. Producers face stricter regulations to reduce nitrogen pollution and, particularly in recent years, higher raw feed costs.

by Dr John Htoo, Director Technical Director Technical Consultant Swine, Evonik Operations GmbH. www.evonik.com

One solution that can be explored by pig producers is to improve nutrient utilisation and reduce nitrogen excretion by balancing the diets with the adequate amount of nutrients, particularly amino acids and energy, to closely meet the requirements of the animal.

Lowering the dietary crude protein (CP) level and balancing it with feed-grade amino acids (AA) has been proven to maximise growth, performance and profitability, and lower environmental impact. However, applying low CP pig diets based on the standardised ileal digestibility (SID) of amino acids and net energy (NE) of ingredients requires reliable information about optimal levels of SID lysine (Lys) and NE.

Finishing pigs, typically from 70kg body weight (BW) to slaughter, consume about 50% of the feed in weaned-to-slaughter pork production, which has a large impact on the profitability of the operation.

Making sure SID Lys is set correctly

Lysine is the first limiting amino acid in typical pig diets. With increases in lean gain capacity of modern pigs, the requirement of Lys increases because, unlike other amino acids, the primary role of Lys is to support body protein (lean gain) deposition, significantly impacting the overall performance and carcass quality of the animal. In commercial feed formulations it is common practice to use Lys to balance the level of other amino acids, based on an ideal protein ratio.

To achieve the best possible performance and maximum efficiency, one of the first things for producers to ensure is that the level of SID Lys in the diet is adequate. In growing-finishing pigs, undersupply of Lys at 80% of requirement has been seen to decrease average daily gain (ADG) by 12% and impair feed conversion ratio (FCR) by 11 points. Some available Lys requirement estimates based on dose-response trials with finishing pigs with a body weight range of 80-115kg are summarised in Table 1.

Based on the ADG and gain:feed (G:F) responses, the SID Lys requirement for 78-103kg PIC gilts was estimated at 0.72%.

Similarly, Shelton et al. (2011) estimated the SID Lys requirement of 84-110kg PIC gilts to be 0.89% to optimise the ADG and G:F. For PIC barrows with a body weight range of 95-125kg, ADG and G:F were optimised at the SID Lys levels of 0.63% and 0.74%.

Based on these results, the optimum dietary SID Lys level is 0.74%, which corresponds to 21mg SID Lys/g ADG for finishing pigs.

This estimate is roughly 12% higher than the National Research Council (NRC) 2012 recommendation of 0.67% SID Lys for pigs of similar BW range.

Table 1. SID Lys requirement estimates of finishing pigs.

BW (kg)	Sex[a]	Optimal performance (g)			Optimal SID Lys	
		ADG	ADFI	G:F	Diet (%)	ADG (mg/g)
78-103	G	916	2,545	0.36	0.72	20.0
84-110	G	980	2,540	0.39	0.89	23.0
95-122	B	1,095	3,508	0.31	0.63[b]	20.3
95-125	B	1,081	2,940	0.37	0.74	20.6
80-125					0.74	21.0

[a]B = barrows, G = gilts; [b] The SID Lys was calculated from total Lys content assuming 88% digestibility.

NE and SID Lys:NE ratio affect pig performance and feed cost

Energy makes up the biggest portion (over 50%) of a producer's feed cost, so it is crucial to measure and provide just the right amount of energy in the pig's diet. This helps in maximising the growth of lean muscle tissue while avoiding excessive fat deposition, which can lower the value of the meat.

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BW (kg)	SID Lys (%)	ADFI (g/d)	ADG (g/d)	G:F (g/g)	Carcass (kg)	Back fat (mm)	Lean (%)	Opt. NE (MJ/kg)	SID Lys:NE (MJ/kg)
69-95	0.66	2,400	760	0.32	65.7	19.0	57.3	9.87	0.67
62-101	0.66	2,360	870	0.37	78.1	17.7	49.0	9.83	0.67
63-99	0.79	2,512	918	0.37	–	–	–	10.04	0.77
60-100	0.80	2,022	899	0.46	82.7	13.51	63.18	9.75	0.82
82-101	0.89	3,401	1329	0.39	83.6	17.5	57.3	9.90	0.90
77-105	0.73	3,224	990	0.31	–	–	–	10.10	0.73
60-105								9.90	0.76
								10.36	0.71

Table 2. Optimal NE content and SID Lys:NE ratio in diets and associated performance and carcass traits of finishing pigs.

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The NE system is more accurate than metabolisable energy (ME) because it considers the amount of heat lost during digestion, and subsequent deposition of nutrients in protein and fat tissue.

Although use of the NE system has increased, there is still limited data on NE requirements and SID Lys:NE ratios for finishing pigs.

However, Table 2 provides a summary of what the optimal NE content and SID Lys:NE ratio is in diets of finishing pigs (60-105kg BW) with references, alongside the associated performance and carcass traits. Chen et al. (2011) conducted two experiments comparing with finishing barrows to test five different NE levels in their diets.

The first experiment found that both the performance (ADG, G:F) and carcass traits (back fat, lean gain) were optimised at a dietary NE content of 9.87 MJ/kg.

In the second experiment they found the greatest ADG and G:F, as well as optimal carcass traits, at the NE content of 9.83 MJ/kg.

Similarly, Zhang et al. (2011) reported that ADG and G:F maximised at a dietary NE level of 10.04 MJ/kg for 63-99kg barrows. Htoo and Morales (2017) studied mixed-sex pigs and found that the ADG of pigs was maximised at 0.80% SID Lys and 9.75 MJ/kg NE, but carcass parameters were not affected.

Quiniou and Noblet (2012) evaluated the effect of the dietary NE level on feed intake and performance of individually housed crossbred pigs.

From 82-101kg (day 42-56 of the trial), both ADG and G:F were maximised in pigs fed 9.9 MJ/kg NE diet. Interestingly, finishing pigs (77-105kg) fed a reduced CP diet containing 10.10 MJ/kg NE maintained similar (numerically better) growth performance in comparison to pigs fed higher NE diets.

Based on these results, the optimal NE concentration in diets for 60-105kg pigs is 9.90 MJ (2.37 Mcal/kg) which is slightly (110 kcal/kg) lower than the NRC (2012) recommendation of 10.36 MJ/kg (2.48 Mcal/kg) for similar BW range.

This may be because today's high lean pigs with less body fat would need lower NE compared with their counterparts having a greater body fat, because energy need for lean tissue deposition is considerably less than that for fat tissue deposition.

NE system compliments low CP diets to minimise N output

Swine diets formulated using NE are typically lower in CP compared to those using ME, because the NE system considers the heat lost during catabolism and excretion of excess protein, making it more precise. For maintaining optimal growth, low CP diets should be balanced by applying the ideal protein concept, and accounting for an adequate level of all essential amino acids on a SID basis, using the NE system.

As shown in Table 3, several trials have demonstrated that there was no differences in ADG, FCR, dressing percentage, or backfat thickness, of pigs with a wide BW range from 70-173kg that were fed low CP diets relative to those fed typical high CP diets when dietary amino acids and NE were balanced.

Nitrogen balance studies with 74-152 kg finishing pigs demonstrated that reducing the dietary CP levels by 2 to 7%-points did not affect the nitrogen retained (g/d) but improved nitrogen retention (% of intake), provided that diets were well balanced for EAA and adequate energy.

Overall, 1%-point dietary CP reduction results on average 9% reduction in nitrogen excretion in pigs.

Thus, the additional benefit of feeding low CP, AA-supplemented diets to minimise nitrogen excretion to the environment is getting more attention in countries with intensive production and stricter governmental policy.

In addition, depending on actual raw material prices, low CP diets using feed-grade AA in growing-finishing pig diets can result in lower feed cost.

Conclusions

By feeding low CP diets with balanced SID Lys, the nitrogen excretion can be minimised while still supporting optimal growth, performance and carcass quality. Fine-tuning optimal NE content, particularly in low CP diets, can also maximise nitrogen efficiency, meaning a larger proportion of the dietary nitrogen is retained by the pig's body for productive purposes rather than being excreted.

It is also an opportunity for producers to save on feed costs.

Consequently, this approach reduces the environmental impact of pig production and contributes to sustainable pig farming practices. ■

References are available from the author on request

Table 3. Effects of feeding low CP, AA-supplemented diets on the performance and carcass traits of finishing pigs.

BW (kg)	Dietary CP (%)		Energy	Lys	Low CP performance (relative to High CP)*			
	High	Low	MJ/k (g)	SID (%)	ADG, (g)	FCR	Dres. (%)	BF (cm)
69-95	16.0	12.0	10.5 NE	0.67	-40	+0.16	+1.10	+0.80
		11.2	10.1 NE	0.66	+10	+0.00	-0.10	0.00
		11.9	9.9 NE	0.66	+10	+0.04	+0.10	-0.60
70-100	18.0	13.5	13.5 ME	0.81	-36	-0.01	+0.93	-0.46
83-173	12.0	9.8	13.2 ME	0.65a	+21	+0.03	+0.60	+0.30
75-120	12.6	9.1	11.3 NE	0.64a	0	-0.15	-1.30	
77-108	15.2	12.1	11.1 NE	0.75a	-50	+0.12	+0.20	
85-119	13.4	9.7	13.9 ME	0.54	-50	+0.20	+1.70	
	13.3	9.5	13.8 ME	0.54	+60	-0.03	+1.20	

*Abbreviations: Dres. = Dressing percentage; BF = Back fat; a Total Lys content.