

Immune stimulation increases amino acid requirements in nursery pigs fed antibiotic-free starter diets

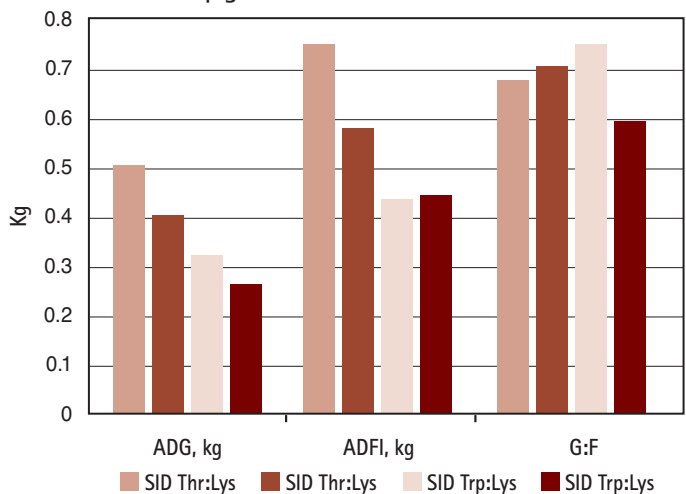
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Weaning is an abrupt and stressful period in a pig's life that can have both immediate and lasting economic impacts. Antimicrobial growth promoters (AGP) have been used in swine starter diets to minimize the negative effects of weaning such as reduced feed intake, diarrhea and poor weight gain that can accompany this transition period. However, mounting public pressure and growing concerns around antibiotic resistance is propelling an industry-wide move to eliminate the use of in-feed AGP.

Under immune-challenge conditions, amino acid (AA) metabolism is altered, resulting in AA being redistributed away from growth and production functions to immune functions. As such, the AA requirements for weaned piglets might be higher with AGP-free starter diets than the NRC-recommended inclusion rates, particularly if piglets are exposed to unclean sanitary conditions. Threonine (Thr) and tryptophan (Trp) are the third or fourth limiting AA in commercial swine starter diets after lysine and methionine. In addition to protein accretion, Trp regulates feed intake and acts as a modulator for controlling immune response and maintaining health in disease-challenged pigs. Thr, in addition to protein synthesis, is essential for maintenance of gut integrity and immunity. For pigs between seven and 25 kg, NRC (2012) recommends a diet with a SID Trp:Lys of 16 per cent and a SID Thr:Lys of 59 per cent, but this does not consider the health status of pigs. Moreover, this value is derived from different studies in piglets fed diets containing AGP.

The Swine Nutrition Program at the University of Manitoba recently concluded a series of trials to determine the optimal SID Trp:Lys and SID Thr:Lys ratios for weaned pigs fed AGP-free starter diets and subjected to immunological challenge. In this research project, sanitation and *Escherichia coli* K88 (*E. coli* K88) models were used to challenge the weaned piglets.

Figure 1. Effect of sanitation on growth performance of weaned piglets.



Optimal SID Thr:Lys and SID Trp:Lys of piglets under clean or unclean sanitary conditions

Optimal SID Thr:Lys – A total of 180 weaned piglets were fed AGP-free starter diets with one of five dietary SID Thr:Lys levels (55, 59, 63, 67 and 71 per cent) under clean (n=90; 21 d period) or unclean (n = 90; 21 d) sanitary conditions. Subjecting weaned piglets to unclean sanitary conditions was used as a model of immune system stimulation. Piglets under unclean sanitary conditions had reduced growth performance (average daily gain; ADG and average daily feed intake; ADFI) compared to those under clean sanitary conditions (Figure 1). The optimal SID Thr:Lys based on feed ef-

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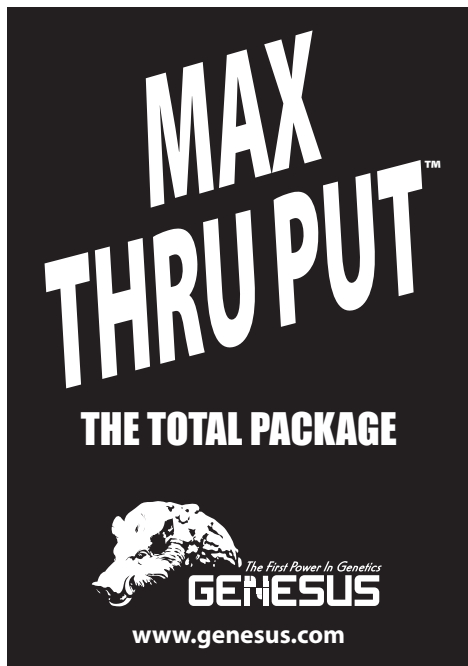
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efficiency (gain:feed; G:F) as a response criteria was 65 per cent and 66.5 per cent for weaned pigs under clean and unclean sanitary conditions, respectively (Table 1).



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Optimal SID Trp:Lys – A total of 180 weaned piglets under clean (n=90; 14 d) or unclean (n = 90; 14 d) sanitary conditions were fed AGP-free starter diets with one of five dietary SID Trp:Lys treatments (18, 19, 20, 22 and 24 per cent). Under unclean conditions, piglets had reduced growth performance compared to those under clean conditions (Figure 1) and a higher optimal SID Trp:Lys than piglets under clean conditions (20.5 per cent vs. 19.7 per cent), based on ADG (Table 1).

Optimal SID Thr:Lys and SID Trp:Lys of piglets challenged with *E. coli* K88

Optimal SID Trp:Lys – 30 weaned piglets were fed AGP-free starter diets with one of five dietary SID Trp:Lys levels (16.1, 18.6, 20.3, 22.9 and 24.6%) and challenged with *E. coli* K88. Based on ADG and G:F, the optimal SID Trp:Lys for weaned piglets subjected to *E. coli*

K88 challenge were 21.7 and 20.1%, respectively (Table 1).

Optimal SID Thr:Lys – Thirty weaned piglets were fed AGP-free starter diets with one of five dietary treatments (SID Thr:Lys 53, 59, 65, 71% and 59% SID Thr:Lys with AGP) and challenged with *E. coli* K88. The optimal SID Thr:Lys based on villous height:crypt depth and plasma urea nitrogen in weaned piglets challenged with *E. coli* K88 was 65.6% and 60.3%, respectively (Table 1).

Summary of findings

Raising nursery pigs under clean sanitary conditions is one of the most important management strategies to reduce pathogenic infections in the swine barn. Dietary nutrient requirements could increase for piglets fed AGP-free starter diets and reared under unclean sanitary conditions. The results from our study demonstrate that weaned piglets raised under sub-optimal sanitary condi-

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tions and fed AGP-free diets need higher dietary threonine:lysine and tryptophan:lysine requirements (Table 1) than NRC (2012) recommendations. Ensuring adequate amino acids in AGP-free starter diets will aid in maintaining good performance under unfavorable health conditions.

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Table 1. Estimated optimal SID threonine:lysine and tryptophan:lysine ratios in weaned pigs fed antibiotic-free starter diets.

Items	Response criteria	Estimated Optimal AA:lysine (%)	NRC (2012) (%)
SID Thr:Lys			
Clean	G:F	65	59
Unclean	G:F	66.5	
SID Trp:Lys			
Clean	ADG	19.7	16
Unclean	ADG	20.5	
SID Trp:Lys			
<i>E. coli</i> challenge	ADG	21.7	16
	G:F	20.1	
SID Thr:Lys			
<i>E. coli</i> challenge	VH:CD	65.6	59
	Plasma urea nitrogen	60.3	

G:F – gain:feed; VH:CD- villous height:crypt depth

Key points

- Providing clean sanitary conditions is one of the most important management strategies to reduce pathogenic infections in nursery pigs
- Under antimicrobial growth promoters-free (AGP-free) feeding, piglets could have elevated nutrient requirements that exceed NRC recommendations
- Under AGP-free feeding, nutrient requirements for piglets in unclean sanitary conditions appear to be even higher than under clean conditions
- Ensuring adequate amino acids in AGP-free starter diets will aid in maintaining good performance

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