Effect of Standardized Ileal Digestible Lysine Level on Growth Performance of Nursery Pigs from 15 to 25 lb[1]

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Summary

A total of 294 nursery pigs (PIC TR4 × 1050, initially 14.9 lb and 3 d postweaning) were used in a 28-d growth trial to evaluate the effects of standardized ileal digestible (SID) lysine level on pig growth performance. Pigs were allotted to 1 of 6 dietary treatments. There were 7 pigs per pen and 7 pens per treatment. Pigs and feeders were weighed on d 0, 7, 14, 21, and 28 to calculate ADG, ADFI, and F/G. A 2-phase diet series was used, with treatment diets fed from d 0 to 14 and a common diet fed from d 14 to 28. All diets were in meal form. The 6 SID lysine levels were 1.15, 1.23, 1.30, 1.38, 1.45, and 1.53%. From d 0 to 14, ADG and ADFI increased (quadratic; $P < 0.002$) as SID lysine level increased from 1.15 to 1.30% where it began to plateau with no additional benefit observed from the three highest dietary lysine levels. Feed efficiency also improved (linear; $P < 0.0001$) with increasing dietary lysine. From d 14 to 28, when the common diet was fed, there were no differences ($P > 0.36$) in ADG, ADFI, or F/G. For the overall trial (d 0 to 28), the greatest improvement (quadratic; $P < 0.05$) in ADG and ADFI was observed in pigs fed 1.30% SID lysine from d 0 to14; however, there was no difference ($P > 0.11$) in overall F/G. In conclusion, the SID lysine requirement of 15- to 25-lb pigs was 1.30% or 3.86 g lysine/Mcal ME.

Key words: lysine, amino acid requirements, nursery pig

Introduction

Lysine is the first limiting amino acid in many corn-soybean meal swine-diet formulations and is used as a reference point to formulate the required levels of other essential amino acids. These amino acid levels are typically expressed as a ratio relative to lysine. In addition, several experiments have been conducted to replace expensive specialty protein sources (fish meal, blood products, poultry meal, etc.) in the diet with crystalline amino acids for 15- to 25-lb pigs. Use of the amino acids has resulted in similar performance to that of the specialty protein sources in some trials, but not in others. To allow diet formulations with higher levels of synthetic amino acids while removing specialty protein sources, we conducted a series of experiments to determine the reason for response inconsistency between experiments and to help determine the minimum ratio for the key amino acids relative to lysine.

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To establish essential amino acid requirements of nursery pigs relative to lysine, the first step is to confirm an appropriate lysine level. Therefore, the objective of this study was to establish the standardized ileal digestible (SID) lysine level required for optimal growth performance of 15- to 25-lb pigs fed a Phase-2 nursery diet. This information can then be used to conduct further trials to determine the requirements of other essential amino acids.

Procedure

The Kansas State University (K-State) Institutional Animal Care and Use Committee approved the protocol used in this experiment. The study was conducted at the K-State Swine Teaching and Research Center in Manhattan, KS.

A total of 294 nursery pigs (PIC TR4 × 1050, initially 14.9 lb) were used in a 28-d growth trial to evaluate the effects of SID lysine level on growth performance. Pigs were weaned at approximately 21 d of age and fed a common diet for 3 d. At weaning, pigs were allotted to pens by initial BW to achieve the same average weight for all pens. On d 3 after weaning, pens were allotted to 1 of 6 dietary treatments. Thus, d 3 after weaning was d 0 of the experiment. There were 7 pigs per pen and 7 pens per treatment. Each pen contained a 4-hole, dry self-feeder and a nipple waterer to provide ad libitum access to feed and water. Pigs and feeders were weighed on d 0, 7, 14, 21, and 28 to calculate ADG, ADFI, and F/G.

A 2-phase diet series was used, with treatment diets fed from d 0 to 14 and a common diet fed from d 14 to 28 (Table 1). The 6 SID lysine levels were 1.15, 1.23, 1.30, 1.38, 1.45, and 1.53% (Table 2). Large batches of the 1.15 and 1.53% lysine diets were made and then blended to achieve the intermediate lysine levels. Treatment diets were corn-soybean meal based and contained 10% dried whey and 4.5% fish meal. The common diet fed in Phase 3 was a corn-soybean meal-based diet formulated to 1.26% SID lysine. All experimental diets were in meal form and were prepared at the K-State Animal Science Feed Mill.

Experimental data were analyzed for linear and quadratic effects of increasing SID lysine using the PROC MIXED procedure of SAS (SAS Institute, Inc., Cary, NC). Pen was the experimental unit for all data analysis.

Results and Discussion

From d 0 to 14, ADG and ADFI increased (quadratic; $P < 0.002$, Table 3) as SID lysine increased from 1.15 to 1.30%. There was no further increase in growth rate with the three highest dietary lysine levels. Feed efficiency improved linearly ($P < 0.0001$) with increasing SID lysine.

From d 14 to 28, when the common diet was fed, there was no difference ($P > 0.36$) in ADG, ADFI, or F/G. This suggests that the lysine level fed from d 0 to 14 had no effect on subsequent pig performance.

Because of the improvement in ADG and ADFI from d 0 to 14, ADG and ADFI increased (quadratic; $P < 0.05$) for the overall trial (d 0 to 28) as SID lysine increased. Again, the greatest ADG and ADFI was observed in pigs fed the 1.30% SID lysine

during Phase 1. There was no difference (P > 0.11) in F/G for the overall period. In conclusion, 1.30% SID lysine was required for optimal growth of 15- to 25-lb pigs.

Table 1. Diet composition (as-fed basis)

	Phase 1 standardized ileal digestible lysine, %[1]						Common
Item	1.15	1.23	1.30	1.38	1.45	1.53	Phase 2[2]
Ingredient, %							
Corn	61.12	58.85	56.58	54.31	52.04	49.77	65.05
Soybean meal (46.5% CP)	20.80	23.00	25.21	27.41	29.62	31.83	30.73
Spray-dried whey	10.00	10.00	10.00	10.00	10.00	10.00	-
Select menhaden fish meal	4.50	4.50	4.50	4.50	4.50	4.50	-
Soybean oil	1.00	1.00	1.00	1.00	1.00	1.00	-
Monocalcium phosphate (21% P)	0.55	0.53	0.51	0.49	0.47	0.45	1.08
Limestone	0.55	0.55	0.55	0.55	0.55	0.55	0.95
Salt	0.30	0.30	0.30	0.30	0.30	0.30	0.35
Zinc oxide	0.25	0.25	0.25	0.25	0.25	0.25	-
Trace mineral premix	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Vitamin premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25
L-Lysine HCl	0.225	0.250	0.275	0.300	0.325	0.350	0.360
DL-Methionine	0.080	0.102	0.124	0.146	0.168	0.190	0.130
L-Threonine	0.100	0.118	0.136	0.154	0.172	0.190	0.130
L-Tryptophan	0.040	0.043	0.046	0.049	0.052	0.055	-
L-Valine	0.005	0.021	0.037	0.053	0.069	0.085	-
Phytase[3]	0.085	0.085	0.085	0.085	0.085	0.085	0.165
TOTAL	100	100	100	100	100	100	100
Calculated analysis							
Standardized ileal digestible (SID) amino acids, %							
Lysine	1.15	1.23	1.30	1.38	1.45	1.53	1.26
Isoleucine:lysine	62	61	60	60	59	59	61
Leucine:lysine	132	128	125	122	119	116	129
Methionine:lysine	34	34	35	35	36	36	33
Met & Cys:lysine	58	58	58	58	58	58	58
Threonine:lysine	64	64	64	64	64	64	63
Tryptophan:lysine	20	20	20	20	20	20	17.4
Valine:lysine	70	70	70	70	70	70	68
Total lysine, %	1.27	1.35	1.43	1.51	1.59	1.67	1.39
ME, kcal/lb	1,528	1,528	1,528	1,529	1,529	1,530	1,503
SID lysine:ME, g/Mcal	3.41	3.64	3.86	4.08	4.30	4.52	3.80
CP, %	19.3	20.2	21.1	22.0	22.9	23.8	20.8
Ca, %	0.71	0.71	0.72	0.72	0.72	0.72	0.69
P, %	0.64	0.64	0.65	0.65	0.66	0.66	0.62
Available P, %	0.47	0.47	0.47	0.47	0.47	0.47	0.42

[1] Treatment diets were fed from d 0 to 14.
[2] Common diet was fed from d 14 to 28.
[3] Phyzyme 600 (Danisco Animal Nutrition, St. Louis, MO.) provided 231 FTU/lb, with a release of 0.10% available P.

Table 2. Analyzed nutrient composition of experimental diets (as-fed basis)[1]

	Phase 1 standardized ileal digestible lysine, %					
Nutrient, %	1.15	1.23	1.30	1.38	1.45	1.53
DM	88.58	88.30	88.66	88.52	88.69	88.72
CP	18.52	19.42	20.21	20.44	22.70	23.09
Indispensable AA						
Arg	1.10	1.17	1.21	1.25	1.35	1.40
His	0.50	0.49	0.51	0.52	0.53	0.57
Ile	0.78	0.79	0.84	0.89	0.92	0.95
Leu	1.63	1.68	1.73	1.76	1.84	1.89
Lys	1.20	1.24	1.34	1.39	1.46	1.50
Met	0.41	0.42	0.46	0.48	0.47	0.51
Phe	0.91	0.94	0.98	1.00	1.06	1.10
Thr	0.83	0.85	0.90	0.95	0.97	1.01
Trp	0.26	0.26	0.28	0.30	0.32	0.32
Val	0.86	0.90	0.96	1.00	1.07	1.09
Total indispensable AA	8.48	8.74	9.21	9.54	9.99	10.34
Dispensable AA						
Ala	0.99	0.96	0.99	1.03	1.10	1.12
Asp	1.79	1.88	1.99	2.06	2.20	2.28
Cys	0.27	0.28	0.29	0.30	0.31	0.32
Glu	3.12	3.26	3.40	3.51	3.70	3.84
Gly	0.80	0.82	0.86	0.90	0.94	0.96
Pro	1.00	1.02	1.07	1.11	1.07	1.19
Ser	0.88	0.92	0.97	1.00	1.04	1.09
Tyr	0.54	0.56	0.58	0.59	0.64	0.63
Total dispensable AA	9.39	9.70	10.15	10.50	11.00	11.43

[1] A representative sample of each diet was collected and analyzed for amino acid composition.

Table 3. Evaluation of standardized ileal digestible (SID) lysine on growth performance of nursery pig diets[1, 2]

	SID lysine, %[3]							Probability, $P <$	
	1.15	1.23	1.30	1.38	1.45	1.53	SEM	Linear	Quadratic
d 0 to 14									
ADG, lb	0.64	0.67	0.75	0.72	0.73	0.63	0.03	0.80	0.001
ADFI, lb	0.86	0.87	0.96	0.87	0.88	0.74	0.04	0.04	0.002
F/G	1.35	1.29	1.27	1.21	1.21	1.18	0.02	0.0001	0.30
d 14 to 28									
ADG, lb	1.04	1.06	1.04	1.05	1.00	1.04	0.04	0.54	0.96
ADFI, lb	1.76	1.79	1.82	1.76	1.77	1.75	0.04	0.61	0.36
F/G	1.70	1.69	1.76	1.68	1.77	1.68	0.05	0.79	0.44
d 0 to 28									
ADG, lb	0.84	0.87	0.90	0.89	0.87	0.83	0.03	0.81	0.05
ADFI, lb	1.31	1.33	1.39	1.32	1.33	1.24	0.03	0.17	0.03
F/G	1.56	1.53	1.55	1.49	1.53	1.50	0.03	0.11	0.86
wt, lb									
d 0	14.9	14.9	14.9	14.9	14.9	14.9	1.28	0.95	0.90
d 14	23.8	24.3	25.4	25.0	25.1	23.7	3.40	0.75	0.001
d 28	38.4	39.1	40.2	39.8	39.1	38.3	6.65	0.82	0.11

[1] A total of 294 nursery pigs (initially 14.9 lb) were used in a 28-d growth trial to evaluate the effects of SID lysine level on growth performance. There were 7 pigs per pen and 7 pens per treatment. Pigs were weaned at approximately 21 d of age, fed a common diet for 3 d, and then started on test.

[2] Treatment diets were fed from d 0 to 14 and a common diet fed from d 14 to 28.

[3] Corresponding SID Lysine:ME, g/Mcal ratios were 3.41, 3.64, 3.86, 4.08, 4.30 and 4.52, respectively.