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Does Lysine Level Fed in One Phase Influence Performance During Another Phase in Nursery Pigs?[1]

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Summary
A total of 320 weanling pigs (PIC 1050 barrows, initially 12.6 lb and 21 d of age) were used in a 35-d trial to determine whether the lysine level fed during 1 phase in the nursery influences the response to dietary lysine during another phase. Eight dietary treatments were allotted and arranged as a 2 × 2 × 2 factorial, with 5 pigs per pen and 8 pens per treatment. Diets were fed in 3 phases, with each treatment assigned as low or normal lysine level. Standardized ileal digestible lysine levels were 1.35 vs 1.55% during Phase 1 (d 0 to 7), 1.15 vs 1.35% in Phase 2 (d 7 to 21), and 1.05 vs 1.25% during Phase 3 (d 21 to 35). Pigs and feeders were weighed on d 0, 7, 14, 21, 28, and 35 after weaning to calculate ADG, ADFI, and F/G. There were no dietary interactions between phases ($P > 0.10$). From d 0 to 7, increasing dietary lysine did not influence ($P > 0.10$) ADG (0.35 vs 0.35 lb/d) or ADFI (0.36 vs 0.33 lb/d), but improved ($P < 0.005$) F/G (1.06 vs 0.97). With results similar to those of Phase 1, increasing dietary lysine from d 7 to 21 did not influence ($P > 0.10$) ADG (0.78 vs 0.82 lb/d) or ADFI (1.15 vs 1.13 lb/d), but improved ($P < 0.03$) F/G (1.48 vs 1.39). From d 21 to 35, increasing dietary lysine improved ($P < 0.001$) ADG (1.23 vs 1.32 lb/d) and F/G (1.64 vs 1.54). These results indicate that lysine level fed in each phase did not influence the response to lysine in the subsequent phase. The lysine level fed during the late nursery phase had a greater effect on overall performance than the level fed in earlier phases.

Key words: lysine, phase feeding, requirement

Introduction
In previous trials, increasing standardized ileal digestible (SID) lysine in Phase 1 and 2 nursery diets has improved daily gains and feed efficiency of nursery pigs. However, these gains have not always been maintained throughout subsequent common diets, resulting in a compensatory gain effect. To determine optimal SID lysine levels for nursery pigs, it must first be established whether the response to increasing dietary lysine is maintained through subsequent nursery phases.

In addition to growth performance, diet costs are important considerations for nursery pig diets. To achieve high levels of SID lysine while minimizing soybean meal, it is common to use specialty protein sources, especially in early nursery phases. Because specialty protein sources are typically expensive, diet costs could be reduced if high levels of lysine were not necessary in all nursery dietary phases to achieve maximum

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performance. Thus, the objective of this experiment was to determine whether the lysine level fed during one phase influenced the response to lysine during subsequent phases.

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 Segregated Early Weaning Facility in Manhattan, KS.

A total of 320 weanling pigs (PIC 1050 barrows, initially 12.6 lb and 21 d of age) were used with a 3-phase diet series. Phase 1 diets were fed from d 0 to 7, Phase 2 diets from d 7 to 21, and Phase 3 diets from d 21 to 35 after weaning. Phase 1 diets were prepared and pelleted at the K-State Grain Science Feed Mill. Phase 2 and Phase 3 experimental diets were in meal form and were prepared at the K-State Animal Science Feed Mill. At weaning, pigs were weighed and allotted to the dietary treatments. There were 8 treatments arranged as a 2 × 2 × 2 factorial, with 5 pigs per pen and 8 pens per treatment. Pigs were provided ad libitum access to feed and water via a 4-hole dry self-feeder and a cup waterer in each pen (5 × 5 ft).

For each phase, pigs were fed either a low or normal lysine level. Standardized ileal digestible lysine levels were 1.35 vs 1.55% during Phase 1 (d 0 to 7), 1.15 vs 1.35% in Phase 2 (d 7 to 21), and 1.05 vs 1.25% during Phase 3 (d 21 to 35; Table 1). The lower dietary lysine concentrations were achieved by reducing both crystalline lysine and intact protein sources (Table 2). Pigs and feeders were weighed on d 0, 7, 14, 21, 28, and 35 after weaning to calculate ADG, ADFI, and F/G.

Pen was used as the experimental unit for analysis, and data were analyzed using the MIXED procedure in SAS (SAS Institute, Inc., Cary, NC). A 2 × 2 × 2 factorial arrangement was used in a split-split plot design. The model included dietary treatments and their interactions as fixed effects. Least square means were evaluated using the PDIFF option of SAS.

Results and Discussion

Over the first phase (d 0 to 7), there were no differences ($P > 0.32$) in ADG (0.35 vs 0.35 lb/d) or ADFI (0.36 vs 0.33 lb/d) between pigs fed the 2 dietary lysine levels (1.35 or 1.55%; Table 3). However, increasing lysine during Phase 1 did improve ($P < 0.005$) F/G (1.06 vs 0.97). Because the low lysine level was adequate for ADG and ADFI but not F/G, this suggests that a lysine level of 1.35% was marginally deficient during Phase 1.

When dietary lysine levels were increased (1.15 or 1.35%) during Phase 2, no differences ($P > 0.16$) were detected in ADG (0.78 vs 0.82 lb/d) or ADFI (1.15 vs 1.13 lb/d). Also consistent with Phase 1, pigs fed the high lysine diet during the second period had improved ($P < 0.03$) F/G (1.39 vs 1.48) when compared to the pigs fed the low lysine diet. The lysine levels fed during the previous phase did not influence ($P > 0.27$) the results of the second period. Similar to the response in the first phase, the lower lysine level fed during the second phase appears to be marginally deficient, based on the differences in F/G.

During Phase 3, the high lysine diet improved ($P < 0.001$) ADG (1.23 vs 1.32 lb/d) and F/G (1.64 vs 1.54). However, the increase in lysine did not affect ADFI (2.02 vs 2.03) from d 21 to 35. Phase 3 lysine response showed no effect ($P > 0.12$) of lysine level fed during any of the previous phases.

For the overall trial (d 0 to 35), pigs fed the high lysine level during Phase 3 had the greatest improvement ($P < 0.03$) in ADG and F/G compared to those fed the low level. Increasing dietary lysine during Phase 2 also tended ($P < 0.08$) to improve overall F/G. Consistent with the data from the previous phases, increasing the lysine level during any phase did not influence ($P > 0.14$) overall ADFI. There were no interactions ($P > 0.38$) between dietary lysine levels for overall ADG or final BW.

In summary, increasing dietary lysine improved feed efficiency in all phases but did not improve ADG until the final period. There were no dietary interactions between phases ($P > 0.10$), meaning that the lysine level fed in each phase did not influence the response to lysine in subsequent phases. Also, the data indicate that the lysine level fed during the late nursery phase had a greater effect on overall performance than the level fed in earlier phases. This suggests that lower levels of lysine can be fed during the early phases with no long-term negative effects, as long as the lysine level fed is high enough during the late nursery period.

Table 1. Dietary treatments[1]

	Standardized ileal digestible lysine, %							
d 0 to 7	1.35	1.35	1.35	1.35	1.55	1.55	1.55	1.55
d 7 to 21	1.15	1.15	1.35	1.35	1.15	1.15	1.35	1.35
d 21 to 35	1.05	1.25	1.05	1.25	1.05	1.25	1.05	1.25

[1]A total of 320 weanling pigs (PIC 1050 barrows, initially 12.6 lb and 21 d of age) were used in a 35-d trial with 8 pens per treatment. Phase 1, 2, and 3 diets were fed from d 0 to 7, 7 to 21, and 21 to 35 after weaning, respectively.

Table 2. Diet composition (as fed)[1]

	Phase 1		Phase 2		Phase 3	
Item	Low	Normal	Low	Normal	Low	Normal
Ingredient, %						
Corn	45.73	41.26	54.83	48.56	61.36	54.92
Soybean meal (46.5% CP)	9.50	11.61	18.27	23.69	19.80	26.20
Spray-dried animal plasma	5.50	6.70	-	-	-	-
Spray-dried whey	25.00	25.00	10.00	10.00	-	-
DDGS	-	-	10.00	10.00	15.00	15.00
Select menhaden fish meal	4.90	6.00	3.50	4.50	-	-
Spray-dried blood cells	1.35	1.65	-	-	-	-
Soybean oil	5.00	5.00	-	-	-	-
Monocalcium phosphate (21% P)	0.45	0.20	0.43	0.28	0.80	0.75
Limestone	0.50	0.45	0.75	0.65	1.15	1.10
Salt	0.25	0.25	0.30	0.30	0.35	0.35
Zinc oxide	0.38	0.38	0.25	0.25	-	-
Vitamin premix	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
L-Lysine HCl	0.15	0.15	0.33	0.35	0.40	0.45
DL-Methionine	0.12	0.15	0.05	0.10	0.04	0.09
L-Threonine	0.04	0.05	0.08	0.10	0.08	0.11
Medication[2]	0.70	0.70	0.70	0.70	0.50	0.50
Phytase[3]	-	-	0.13	0.13	0.13	0.13
Vitamin E, 20,000 IU	0.05	0.05	-	-	-	-
Total	100.00	100.00	100.00	100.00	100.0	100.00
Calculated analysis						
SID amino acid, %						
Lysine	1.35	1.55	1.15	1.35	1.05	1.25
Isoleucine:lysine	50	49	61	60	60	60
Leucine:lysine	127	123	139	131	152	140
Methionine:lysine	30	31	31	33	31	32
Met & Cys:lysine	56	5	57	57	59	58
Threonine:lysine	62	62	62	62	62	62
Tryptophan:lysine	17	17	16	16	16	16
Valine:lysine	70	70	69	67	72	69
Total lysine, %	1.48	1.69	1.29	1.50	1.19	1.40
CP, %	20.2	22.7	19.7	22.4	19.0	21.5
ME, kcal/lb	1,586	1,592	1,488	1,491	1,498	1,499
Ca, %	0.77	0.77	0.70	0.71	0.68	0.67
P, %	0.71	0.72	0.62	0.64	0.58	0.60
Available P, %	0.53	0.53	0.36	0.37	0.31	0.30

[1] A total of 320 weanling pigs (PIC 1050 barrows, initially 12.6 lb and 21 d of age) were used in a 35-d trial with 8 pens per treatment. Phase 1, 2, and 3 diets were fed from d 0 to 7, 7 to 21, and 21 to 35 after weaning, respectively.
[2] Neo/Oxy 10/10 (Penfield Animal Health, Omaha, NE).
[3] Phyzyme 600 (Danisco Animal Nutrition, St. Louis, MO) provided 231 FTU/lb, with a release of 0.10% available P.

Table 3. Effects of lysine level fed during each phase (P) on nursery pig performance[1]

	SID Lysine, %									Probability, $P <$						
d 0 to 7	1.35	1.35	1.35	1.35	1.55	1.55	1.55	1.55								
d 7 to 21	1.15	1.15	1.35	1.35	1.15	1.15	1.35	1.35								
d 21 to 35	1.05	1.25	1.05	1.25	1.05	1.25	1.05	1.25	SEM	P1×P2×P3	P1×P2	P2×P3	P1×P3	P1	P2	P3
d 0 to 7																
ADG, lb	0.36	0.33	0.34	0.36	0.34	0.36	0.35	0.36	0.04	0.38	0.98	0.68	0.74	0.69	0.89	0.72
ADFI, lb	0.38	0.36	0.35	0.36	0.32	0.33	0.33	0.36	0.03	0.83	0.32	0.47	0.53	0.37	0.94	0.55
F/G	1.06	1.09	1.05	1.03	0.98	0.92	0.94	1.02	0.06	0.12	0.33	0.56	0.88	0.005	0.97	0.73
d 7 to 14																
ADG, lb	0.80	0.80	0.81	0.82	0.76	0.73	0.82	0.83	0.04	0.73	0.27	0.59	0.74	0.41	0.18	0.98
ADFI, lb	1.19	1.17	1.13	1.15	1.12	1.12	1.10	1.14	0.04	0.95	0.46	0.43	0.72	0.16	0.49	0.78
F/G	1.49	1.46	1.40	1.41	1.47	1.52	1.35	1.39	0.02	0.62	0.32	0.68	0.21	0.83	0.03	0.38
d 21 to 35																
ADG, lb	1.24	1.36	1.28	1.35	1.22	1.26	1.19	1.31	0.06	0.23	0.89	0.75	0.65	0.20	0.78	0.001
ADFI, lb	2.06	2.02	2.08	2.11	2.00	1.95	1.95	2.04	0.09	0.59	0.76	0.12	0.70	0.37	0.53	0.85
F/G	1.67	1.49	1.63	1.57	1.64	1.55	1.64	1.57	0.01	0.28	0.82	0.12	0.31	0.68	0.45	<.0001
d 0 to 35																
ADG, lb	0.89	0.93	0.90	0.94	0.86	0.87	0.87	0.93	0.03	0.55	0.57	0.55	0.77	0.15	0.30	0.03
ADFI, lb	1.64	1.60	1.61	1.65	1.57	1.55	1.53	1.61	0.05	0.86	0.88	0.14	0.60	0.38	0.74	0.65
F/G	1.55	1.45	1.50	1.47	1.52	1.48	1.47	1.46	0.01	0.44	0.43	0.10	0.14	0.47	0.08	0.002
Wt, lb																
d 0	12.60	12.56	12.62	12.51	12.60	12.67	12.59	12.58	0.12	0.92	0.46	0.11	0.05	0.59	0.24	0.43
d 7	15.08	14.90	14.97	15.01	14.98	15.19	15.05	15.06	0.41	0.38	0.89	0.96	0.45	0.67	0.91	0.85
d 21	26.30	26.15	26.34	26.46	25.72	25.47	26.48	26.64	0.78	0.92	0.31	0.66	0.97	0.54	0.14	0.94
d 35	43.60	45.50	44.20	45.40	42.86	43.15	43.15	44.94	0.88	0.38	0.57	0.75	0.68	0.14	0.37	0.04

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