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The effects of dietary lysine level on performance of pigs weaned at two weeks of age

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THE EFFECTS OF DIETARY LYSINE LEVEL ON PERFORMANCE OF PIGS WEANED AT TWO WEEKS OF AGE

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Summary

One-hundred fifty pigs weaned at 14 ± 2 days of age and averaging 9.8 ± 2.8 lb were used to determine the effects of increasing levels of dietary lysine on pig performance. Pigs were fed a pelleted corn-soybean meal diet (1.10% lysine) containing 20% dried skim milk and 14.4 % lactose or diets containing 1.25, 1.40, 1.55, or 1.70% lysine provided by L-lysine HCl. Average daily gain (ADG), feed conversion (F/G), and plasma urea concentrations were determined on day 7, 14, and 21 of the experiment. On day 7, ADG increased linearly ($P < .05$) with increasing lysine level. By day 21, ADG was increased 12% (linear and quadratic $P < .15$) for those pigs fed the 1.40% lysine diet. On day 7, 14, and 21, F/G improved (linear and quadratic $P < .02$) and plasma urea concentrations decreased (linear, quadratic, and cubic $P < .01$) as lysine level increased. Feed intake was not affected by dietary treatment ($P > .20$). At the end of the 21 day experimental period, all pigs were switched to a corn-soybean meal diet (1.25% lysine) containing 15% dried whey for an additional 21 days to determine any compensatory performance from previous lysine treatment. During this period (22 to 42 days), there were no differences in pig performance. For the overall experiment (0 to 42 days), ADG was increased 5% ($P > .30$) and F/G improved 6% (linear $P < .11$; quadratic $P < .01$) as lysine level was increased during the first 3 wk postweaning. Our results indicate that growth performance of early weaned pigs (< 10 lb) was optimized by a diet containing at least 1.40% lysine for the first 3 wk postweaning.

(Key Words: Lysine Requirement, Growth, Two-Week Old Pigs, Compensatory Gain.)

Introduction

The average age at weaning has gradually decreased over the past 10 to 15 yr from approximately 6 to 8 wk to 3 to 4 wk of age. This has been a result of the need for shorter farrowing intervals to increase productivity on commercial hog operations. However, because of ranges in breeding dates, the actual age of pigs weaned at an average of 21 days of age may vary from 14 to 28 days. Because of the dramatic changes that occur early in the pig's life, the nutrient needs are very different between a 14- and a 21-day-old pig. Since little is known about the lysine requirement of 14-day-old pigs, and most of the requirements are extrapolated from data with older pigs, we conducted a study designed to evaluate the effects of dietary lysine on pigs weaned at 2 wk of age.

Procedures

One-hundred and fifty pigs weaned at 14 days of age were allotted to one of five dietary treatments (Table 1). Pigs were fed a pelleted corn-soybean meal diet formulated to contain 1.10% lysine. All other nutrients were calculated to exceed present recommendations for other amino acids, vitamins and minerals to ensure that no other nutrient would limit performance. Pigs were blocked by weight and randomly assigned to treatments (five pigs per pen and six replications per treatment) containing either 1.10, 1.25, 1.40, 1.55, and 1.70% lysine. Pigs were housed in 5 X 4 ft pens with woven wire flooring over a Y-flush gutter.

Each pen was equipped with a self feeder and a nipple waterer. Feed and water were provided ad libitum. Pigs and feeders were weighed weekly, and feed additions were recorded to determine average daily gain (ADG), average daily feed intake (ADFI), and feed conversion (F/G). On day 7, 14, and 21 of the experiment, all pigs were bled, and plasma was collected for determination of urea concentrations. At the end of the 21 day experimental period, all pigs were switched to a corn-soybean meal diet (1.25% lysine) containing 15% dried whey. Pig performance was recorded for an additional 21 days to determine any compensatory performance to initial lysine treatment.

Results and Discussion

Pig health was excellent throughout the 42-day study ; no pigs died or were removed from the trial. During the first week (day 0 to 7), ADG increased (linear $P < .05$) and F/G improved (linear and quadratic $P < .05$) with increasing lysine level (Table 2). Average daily gain was maximized for pigs fed the 1.40% lysine diet, which was 22% greater than ADG of pigs fed the 1.10% lysine diet. Feed conversion was optimized at a lysine level of 1.55%, which was 27% better than that of pigs fed the 1.10% lysine diet. That response is typical of other amino acid studies, which demonstrate a slightly higher lysine requirement to maximize F/G than is needed to maximize ADG.

Feed intake was not affected by dietary treatment ($P > .20$). Plasma urea concentrations on day 7 decreased (linear and quadratic $P < .05$) as lysine level increased but appeared to level off after the 1.40% lysine level. The high urea concentrations of pigs fed the 1.10 and 1.25% lysine diets indicate that other amino acids were being deaminated since lysine was limiting growth. However, as dietary lysine level increased and approached the requirement, other amino acids were no longer being deaminated but rather were available for protein synthesis.

During the second week (day 0 to 14), ADG was not affected by dietary lysine level (Table 3). However, for the overall 21 day period, pigs fed the 1.40% lysine diet maintained a 12% greater ADG (linear and quadratic $P < .15$) compared to those fed the 1.10% lysine diets (Table 4). Feed intake was again not affected by dietary treatment ($P < .20$). Feed conversion continued to be improved (linear and quadratic $P < .05$) as lysine level increased and was similar for pigs fed the 1.40 or 1.55% lysine diets, which were 17% better than those fed diets containing 1.10% lysine.

Plasma urea concentrations on day 14 and 21 were similar to those observed on day 7, again leveling off after the 1.40% lysine level.

From day 22 to 42, there were no differences in ADG, ADFI, or F/G (Table 5). However, for the overall experimental period (day 0 to 42), pigs fed diets containing 1.25% lysine or higher during the first 3 wk postweaning had a 5% improvement in ADG compared to pigs fed 1.10% lysine. In addition, F/G for the overall study was improved 6% (linear $P < .11$; quadratic $P < .01$) as dietary lysine level during the first 3 wk postweaning was increased.

Our data indicate that for pigs weaned at 2 wk of age (< 10 lb), growth performance was optimized by a diet containing at least 1.40% lysine for the first 3 wk postweaning. In addition, the improvements in gain (5%) and feed conversion (6%) for pigs fed 1.40% lysine or higher appeared to be maintained for at least an additional 3 wk. Further research will be required to determine how long this improvement can be maintained.

Table 1. Diet Composition, %

Ingredient	Day 0 to 21 ^a	Day 22 to 42 ^b
Corn	22.0	46.1
Soybean meal (48%)	15.8	
Soybean meal (44%)		31.1
Dried skim milk	20.0	
Dried whey		15.0
Lactose	14.4	
Oat groats	10.0	
Soybean oil	5.0	4.0
Dried fat	6.25	
Monocalcium phosphate	1.86	1.27
Limestone	.56	.69
Vitamin premix	.50	.50
Trace mineral premix	.10	.10
Salt	.30	.20
Selenium premix	.05	.05
Copper sulfate	.10	.10
Methionine	.28	
Threonine	.15	
Tryptophan	.06	
Antibiotic	.25	.25
Sucrose	1.57	
Sucrose/L-lysine HCl	.77	.25

^aDiet was pelleted and fed from day 0 to 21. Calculated to contain 18.3% crude protein, 1.10% lysine, .27% tryptophan, .92% threonine, .90% Ca, and .80% P. Sucrose was replaced by L-lysine HCl to provide dietary lysine levels of 1.25, 1.40, 1.55, and 1.70%.

^bDiet was fed from day 22 to 42. Calculated to contain 20.1% crude protein, 1.25% lysine, .25% tryptophan, .89% threonine, .80% Ca, and .70% P.

Table 2. The Effects of Increasing Levels of Dietary Lysine on Two-Week-Old Pig Performance (day 0 to 7)^a

Item	Lysine, %				
	1.10	1.25	1.40	1.55	1.70
Avg daily gain, lb ^b	.31	.31	.38	.34	.37
Daily feed intake, lb	.42	.38	.44	.36	.43
Feed/gain ^{cd}	1.38	1.24	1.15	1.08	1.18
Plasma urea, mg/dl ^{cd}	16.25	9.37	4.47	4.11	4.33

^aA total of 150 pigs weaned at 14 days of age. Average initial weight of 9.8 lb. There were five pigs per pen and six replications per treatment. Pigs were fed the pelleted experimental diets until day 21 then switched to a 15% dried whey-corn-soybean meal diet from day 22 to 42. Average final weight 23.0 and 50.0 lb on day 21 and 42, respectively.

^bLinear effect of lysine (P<.05).

^cLinear effect of lysine (P<.02).

^dQuadratic effect of lysine (P<.02).

Table 3. The Effects of Increasing Levels of Dietary Lysine on Two-Week-Old Pig Performance (day 0 to 14)^a

Item	Lysine, %				
	1.10	1.25	1.40	1.55	1.70
Avg daily gain, lb	.43	.44	.49	.44	.42
Daily feed intake, lb	.59	.53	.57	.52	.56
Feed/gain ^{bc}	1.39	1.22	1.18	1.21	1.23
Plasma urea, mg/dl ^{bcd}	15.05	5.13	3.95	4.11	3.36

^aA total of 150 pigs weaned at 14 days of age. Average initial weight of 9.8 lb. There were five pigs per pen and six replications per treatment. Pigs were fed the pelleted experimental diets until day 21 then switched to a 15% dried whey-corn-soybean meal diet from day 22 to 42. Average final weight 23.0 and 50.0 lb on day 21 and 42, respectively.

^bLinear effect of lysine (P<.02).

^cQuadratic effect of lysine (P<.02).

^dCubic effect of lysine (P< .01).

Table 4. The Effects of Increasing Levels of Dietary Lysine on Two-Week-Old Pig Performance (day 0 to 21)^a

Item	Lysine, %				
	1.10	1.25	1.40	1.55	1.70
Avg daily gain, lb ^{bc}	.58	.63	.66	.62	.64
Daily feed intake, lb	.82	.79	.80	.75	.81
Feed/gain ^{de}	1.40	1.25	1.21	1.20	1.27
Plasma urea, mg/dl ^{def}	15.46	6.39	4.20	4.31	4.08

^aA total of 150 pigs weaned at 14 days of age. Average initial weight of 9.8 lb. There were five pigs per pen and six replications per treatment. Pigs were fed the pelleted experimental diets until day 21 then switched to a 15% dried whey-corn-soybean meal diet from day 22 to 42. Average final weight 23.0 and 50.0 lb on day 21 and 42, respectively.

^bLinear effect of lysine (P<.15).

^cQuadratic effect of lysine (P<.15).

^dLinear effect of lysine (P<.01).

^eQuadratic effect of lysine (P<.01).

^fCubic effect of lysine (P<.01).

Table 5. Compensatory Performance of Early Weaned Pigs to Initial Dietary Lysine Level (day 21 to 42)^a

Item	Lysine, %				
	1.10	1.25	1.40	1.55	1.70
Avg 21-day weight	22.1	23.1	23.6	22.7	23.3
Avg daily gain, lb					
day 21 to 24	.98	.97	.90	1.05	.97
day 21 to 42	1.32	1.39	1.33	1.38	1.35
day 0 to 42	.94	1.00	.98	.99	.99
Daily feed intake, lb					
day 21 to 28	2.13	2.41	2.06	2.06	2.05
day 21 to 42	2.42	2.49	2.43	2.48	2.50
day 0 to 42	1.60	1.62	1.60	1.59	1.63
Feed/gain					
day 21 to 28	2.21	2.10	2.37	1.98	2.16
day 21 to 42	1.85	1.79	1.84	1.80	1.86
day 0 to 42 ^{bc}	1.71	1.62	1.62	1.60	1.66
Avg final weight, lb	48.4	50.9	50.2	50.3	50.2

^aA total of 150 pigs weaned at 14 days of age. Average initial weight of 9.8 lb. There were five pigs per pen and six replications per treatment. Pigs were fed the pelleted experimental diets until day 21 then switched to a 15% dried whey-corn-soybean meal diet from day 22 to 42. Average final weight 23.0 and 50.0 lb on day 21 and 42, respectively.

^bLinear effect of lysine ($P < .11$).

^cQuadratic effect of lysine ($P < .01$).