# EFFECT OF DIETARY LYSINE LEVEL ON PIG PERFORMANCE DURING PHASE 2 OF THE NURSERY PERIOD

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## Story in Brief

Weanling pigs at 10 to 14 days postweaning (average weight and age of 22.3 lb and 37.7 days, respectively) were fed diets containing four levels of lysine from dietary protein to determine the protein requirement of 22 to 44 lb pigs. The study was conducted in two trials and involved a total of 111 pigs. The four diets were formulated by altering the ratio of corn to soybean meal and contained lysine levels ranging from .95% to 1.40% in .15% increments. The trial was for 21 days with gain and efficiency of gain estimates obtained weekly. All pigs were fed the same complex Phase 1 diet containing 1.40% lysine and 19.40% crude protein for the first 14 (Trial 1) or 10 (Trial 2) days following weaning. Average daily gain increased with increasing levels of lysine in the 3-wk experimental period. Although average daily feed intake decreased slightly with increasing levels of dietary lysine, differences were not significant. Gain:feed increased as lysine level increased in the diet. The results of this study indicate that lysine additions from dietary crude protein to a Phase 2 corn-soybean meal-dried whey based diet may improve performance in high lean growth genotype pigs. The response of average daily gain and gain:feed to increasing levels of lysine indicate that 22 to 44 lb pigs of this genotype fed practical diets require at least 1.40% total lysine.

(Key Words: Pigs, Amino Acids, Dietary Lysine, Protein.)

## Introduction

Several experiments have been conducted to determine the protein and lysine needs of 22 lb pigs (Campbell, 1978; Aherne and Nielsen, 1983; Martinez and Knabe, 1990). These pigs are normally weaned at 3 to 4 wk of age and have completed a 7- to 14-day Phase 1 adjustment period before being placed on a Phase 2 diet. However, there is still lack of agreement concerning the lysine requirement during Phase 2 of the nursery period. The NRC (1988) lists the lysine and protein requirements of 22 to 44 lb pigs as .95% and 18% of the diet, respectively. Estimates of nutrient requirements in other countries and values used commercially in the United States are much higher than the NRC (1988) value. It is essential that reliable recommendations for lysine be established for the economical production of pork. This is especially true since

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lysine is regarded as the first limiting amino acid in the starter pig diet (Corley and Easter, 1980, 1983). The objective of this study was to determine the protein and lysine requirement for maximum gain, feed intake, and efficiency of gain during Phase 2 (22 to 44 lb) of the nursery period in pigs fed corn-soybean meal-dried whey based diets. Four different levels of lysine from dietary protein were used to determine the response to dietary lysine level.

## Materials and Methods

Two trials involving a total of 111 Yorkshire, Hampshire and Crossbred (Yorkshire x Hampshire) pigs were used in a 21-day study to determine the effect of level of lysine from dietary protein on performance in 22 to 44 lb pigs. Fifty-four pigs in Trial 1 and fifty-seven in Trial 2 were allotted by sex (boars and gilts), litter and weight into 12 pens with five pigs per pen. Pigs were weaned at an average of 25.7 days of age and an average weight of 14.94 lb. Pens were randomly allotted to one of the four dietary treatments. During the first 10 days in Trial 1 and the first 14 days in Trial 2, all pigs were placed on a common Phase 1 diet (Tables 1 and 2), containing 1.40% lysine and 19.40% crude protein. During Phase 2 (average weight of 22.3 lb), pigs were fed one of the treatment diets formulated by varying the ratio of corn to soybean meal to contain .95, 1.10, 1.25 or 1.40% lysine. All four diets contained .90% calcium and .75% phosphorus which exceeded current NRC (1988) requirements. Pigs were allowed ad libitum access to diets and water.

Pigs were housed in an environmentally controlled nursery in elevated pens (4' 11" x 5') with woven wire floors, nipple waterers and open front self feeders. Environmental temperature was initially 86°F, with a 2°F reduction in temperature each week until the temperature reached 78°F. During the 3-wk trial, individual pig weight was recorded, pen feed intake was measured, and pen feed efficiency was calculated weekly.

Pen was considered the experimental unit and data were analyzed by least squares analysis of variance procedures using the GLM procedure of SAS (1985). The statistical model for average daily gain (ADG), average daily feed intake (ADFI) and feed efficiency included trial, treatment, week, and the trial x treatment, trial x week, treatment x week and trial x treatment x week interactions. Differences between means were determined by t-test. Orthogonal polynomials were used to test for linear, quadratic and cubic effects.

## Results and Discussion

ADG, ADFI, and gain:feed ratio during the 14-day Phase 1 adjustment period following weaning were 1.48 lb, 2.00 lb, and .74 lb gain/lb feed, respectively for Trial 1 and 1.16 lb, 2.36 lb, .62 lb gain/lb feed, respectively, for the 10-day Phase 1 period in Trial 2; performance was similar among the treatment groups within the experiment.

**Table 1. Composition of experimental diets used to determine the effect of ideal protein formulation on pig performance[a]**

| | Phase 1 diet | Phase 2 diet | | | |
|---|---|---|---|---|---|
| | | Treatment | | | |
| Ingredient | | 1 | 2 | 3 | 4 |
| AP300 | | 2.75 | 2.75 | 2.75 | 2.75 |
| AP820 | 5.00 | | | | |
| Whey, dehydrated | 20.00 | 5.00 | 5.00 | 5.00 | 5.00 |
| Dried skim milk | 10.00 | | | | |
| SBM,44% | | 27.75 | 27.75 | 23.80 | 23.80 |
| Corn, ground | 38.67 | 58.50 | 58.37 | 62.20 | 62.04 |
| Oats, steam rolled | 10.00 | | | | |
| Soybean oil | 4.00 | | | | |
| Pro-88 | 5.00 | | | | |
| Fishmeal, menhaden | 5.00 | 3.00 | 3.00 | 3.00 | 3.00 |
| Lysine, HCL | .28 | | | .14 | .14 |
| DL-Methionine | .02 | | .13 | | .16 |
| Threonine | | | | .04 | .04 |
| Mecadox-10 | .25 | | | | |
| Tylan 40 | | .125 | .125 | .125 | .125 |
| Turbozyme-160 | .20 | | | | |
| Flavor, berry | .10 | | | | |
| Salt | | .40 | .40 | .40 | .40 |
| Copper sulfate | .08 | .075 | .075 | .075 | .075 |
| Calcium carbonate | | .47 | .47 | .45 | .45 |
| Dicalcium phosphate | .90 | 1.55 | 1.55 | 1.64 | 1.64 |
| Vitamin TM PMX [b] | .38 | .38 | .38 | .38 | .38 |
| Special premix | .12 | | | | |
| | | | | | |
| Calculated composition | | | | | |
| Lysine | 1.50 | 1.40 | 1.40 | 1.40 | 1.40 |
| Crude protein | 19.66 | 22.16 | 22.28 | 20.85 | 20.99 |
| Calcium | .90 | .90 | .90 | .90 | .90 |
| Phosphorus | .79 | .75 | .75 | .75 | .75 |
| M.E. (Kcal/lb) | 1582.46 | 1474.66 | 1472.64 | 1476.19 | 1473.70 |
| Tryptophan | .26 | .30 | .30 | .28 | .28 |
| Threonine | .93 | .92 | .92 | .91 | .91 |
| Met & Cyst | .76 | .71 | .84 | .68 | .84 |

[a] As fed basis.
[b] See Rose et al., 1994.

**Table 2. Effect of diet formulation based on ideal protein composition on average daily gain, average daily feed intake and feed efficiency[a].**

| Item | Treatments 1 | 2 | 3 | 4 | SEM |
|---|---|---|---|---|---|
| No. of pigs | 17 | 18 | 18 | 18 | — |
| Average daily gain | | | | | |
| Week 1 | .71 | .78 | .82 | .73 | .18 |
| Week 2 | 1.21 | 1.29 | 1.18 | 1.43 | .23 |
| Week 3 | 1.50 | 1.46 | 1.52 | 1.50 | .08 |
| Week 4 | 1.37 | 1.48 | 1.50 | 1.52 | .15 |
| Overall (wk 1-4) | 1.19 | 1.26 | 1.25 | 1.30 | .11 |
| ADFI | | | | | |
| Week 1 | 1.25 | 1.20 | 1.27 | 1.29 | .11 |
| Week 2 | 1.70 | 1.69 | 1.68 | 1.67 | .17 |
| Week 3[b] | 2.48 | 2.29 | 2.26 | 2.22 | .11 |
| Week 4 | 2.47 | 2.50 | 2.56 | 2.50 | .16 |
| Overall (wk 1-4) | 1.96 | 1.92 | 1.94 | 1.92 | .11 |
| G:F | | | | | |
| Week 1 | .566 | .655 | .650 | .560 | .0550 |
| Week 2 | .710 | .762 | .700 | .855 | .042 |
| Week 3[c] | .621 | .640 | .671[d] | .680[d] | .0075 |
| Week 4[c] | .522 | .596 | .586 | .611 | .0160 |
| Overall (wk 1-4)[e] | .610 | .655 | .646 | .676[d] | .0141 |

[a] Least squares means.
[b] Protein effect, P<.05.
[c] Methionine effect, P<.1.
[d] Means with a superscript differ from Treatment 1 (P < .05).
[e] Methionine effect, P<.05.

No trial by treatment or week by treatment interactions were observed, therefore, data from the two trials and over the 3 weeks of the trial were combined for analysis. The effect of lysine level from dietary protein on ADG is shown in Table 3. ADG over the entire 21-day experimental period increased linearly (P<.03) with increasing level of natural lysine in the diet. Pigs fed Treatment 4 (1.40% lysine) grew 12.5% faster than those fed the .95% lysine diet (Treatment 1, P<.04) and 10% faster than those fed the 1.10% lysine diet (Treatment 2, P<.10). Average daily gain was greater in wk 2 (P<.05) and wk 3 (P<.001) than in wk 1. Similarly, pigs grew faster in wk 3 than in wk 2 (P<.005). Least squares means for ADG for wk 1 to 3 were 1.05, 1.16, and 1.32 lb/day, respectively.

**Table 3. Effect of dietary protein level during Phase 2 of the nursery period on performance[a].**

| | Treatment | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | SEM |
| ADG, lb[b] | 1.11[e] | 1.14[ef] | 1.18[ef] | 1.25[f] | ±.10 |
| ADFI, lb | 2.01 | 1.92 | 1.94 | 1.89 | ±.12 |
| Feed Efficiency (G:F)[cd] | .56[e] | .60[e] | .61[ef] | .66[f] | ±.0221 |

[a] Least squares means.
[b] Linear increase in gain with increasing levels of lysine (P<.02).
[c] Linear increase in feed efficiency with increasing levels of lysine (P<.02).
[d] Treatment 1 differs from Treatment 3 (P<.10).
[e,f] Means in the same row with different superscripts differ (P<.05).

Research by other workers (Fetuga et al., 1975; Campbell and Biden, 1978; Campbell et al., 1988) consistently reported similar improvement in growth rate as the dietary protein levels increased up to 20% in a variety of different diets. Furthermore, other research (Campbell, 1978; Aherne and Nielsen, 1983; Martinez and Knabe, 1990) suggests that as dietary lysine increased in 20 to 44 lb pigs there was an increase in ADG once a minimum level of crude protein was met.

ADFI (Table 3) was not significantly affected by protein level for the overall 21-day experimental period, although ADFI tended to decrease as the percentage of lysine in the diet increased.

Average daily feed intake does not appear to change as dietary protein level increases in the diet of the 22 to 44 lb pig (Campbell and Biden, 1978; Aherne and Nielsen, 1983). Lewis et al. (1981) observed a tendency for increased ADFI when lysine was added to the diet, but otherwise no changes in ADFI were observed as dietary lysine was increased.

Efficiency of feed utilization increased linearly (P<.02) with increasing lysine level in the diet over the entire 21-day experimental period (Table 3). Pigs fed Diet 4 gained 18% more per lb of feed (P<.002) than those fed Diet 1, 11% more per lb of feed (P<.04) than those fed Diet 2, and 8% more per lb (P<.12) than those fed Diet 3 during the overall 21-day experimental period. There was also a trend (P<.10) for pigs on Treatment 3 (1.25% lysine) to utilize feed more efficiently than those on Treatment 1 (.95% lysine). These results indicate that increasing the level of dietary lysine improved gain to feed and

had the greatest effect when added at the highest level (1.40%) in the diet. Feed efficiency was similar between the two experiments (P>.23) and was affected by week (P<.06). Least squares means for wk 1 to 3 were 1.40, 1.26, and 1.35 lb gain/lb feed, respectively.

Similar to our results, other researchers have reported an improvement in feed efficiency as dietary protein levels increase (Lunchick et al., 1978; Aherne and Nielsen, 1973; Campbell and Biden, 1988). Also other studies (Aherne and Nielsen, 1983; Martinez and Knabe, 1990; Mahan, 1992) reported an improvement in feed efficiency as dietary lysine increased up to about 1.15% dietary lysine in nursery pigs.

In general, the results of this study indicate that faster growth and a higher gain to feed ratio can be achieved in 22 to 44 lb high lean growth genotype pigs if natural lysine content from dietary crude protein is increased to 1.40% in a corn-soybean meal-dried whey based diets. Further studies are necessary to evaluate the effect of higher lysine from crude protein on growth and performance. In addition, more research should be conducted to determine the limits of substitution of synthetic lysine from natural lysine sources.

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