models, as this seemed to be the most common implementation problem. Model fit between competing dose–response models was compared using maximum likelihood–based Bayesian information criterion (BIC). The QP, BLL, and BLQ models fitted on G:F of nursery pigs yielded BIC values of 353.7, 343.4, and 345.2, respectively, indicating a better fit of BLL followed closely by BLQ. The BLL breakpoint estimate of the SID Trp:Lys was 16.5% (95% confidence interval [CI] 16.1–17.0), whereas the BLQ estimate was 16.0% (95% CI 15.5–16.6). Importantly, accounting for heterogeneous variance enhanced inferential precision as the breadth of the CI for mean breakpoint decreased by approximately 44%, from 95% CI 15.8 to 17.4 to 95% CI 16.1 to 17.0 SID Trp:Lys. In summary, we illustrate the use of linear and nonlinear mixed models for dose–response relationships accounting for heterogeneous residual variances, discuss important diagnostics and their implications for inference, and provide practical recommendations for computational troubleshooting.

Key Words: dose–response, heterogeneous variance, linear and nonlinear mixed models

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043 Effects of standardized ileal digestible valine-to-lysine ratio on growth performance of twenty-five– to forty-five–kilogram pigs under commercial conditions. M. A. D. Goncalves[1,*], M. D. Tokach[1], S. S. Dritz[1], N. M. Bello[1], K. J. Touchette[2], R. D. Goodband[1], J. M. DeRouchey[1], J. C. Woodworth[1], *[1]Kansas State University, Manhattan, [2]Ajinomoto Heartland, Inc., Chicago, IL*.

Two experiments were conducted to estimate the standardized ileal digestible (SID) Val:Lys requirement for growth performance in 25- to 45-kg pigs. In Exp. 1, 1134 gilts (PIC 337), initially 31.2 kg (SD 2.0) BW, were used in a 19-d trial with 27 pigs/pen and 7 pens/treatment. In Exp. 2, 2100 gilts (PIC 327), initially 25.4 ± 1.9 kg BW, were used in a 22-d trial with 25 pigs/pen and 12 pens/treatment. In both experiments, treatments were blocked by initial BW in a randomized complete block design. In Exp. 1, there were 6 treatments with SID Val:Lys at 59.0, 62.5, 65.9, 69.6, 73.0, and 75.5%. For Exp. 2, there were 7 treatments with SID Val:Lys at 57.0, 60.6, 63.9, 67.5, 71.1, 74.4, and 78.0%. Diets were formulated to ensure that Lys was the second limiting AA throughout the experiments. Responses were analyzed separately for each experiment using general linear and nonlinear heteroskedastic mixed models, including initial BW as an explanatory covariate and BW block as a random effect. In Exp. 1, ADG linearly increased with increasing SID Val:Lys ($P = 0.009$; 680, 717, 717, 712, 744, and 726 ± 17.1 g, respectively), whereas no significant treatment differences were observed for G:F (0.467, 0.467, 0.472, 0.474, 0.481, and 0.472 ± 0.0084, respectively). In Exp. 2, ADG (quadratic, $P = 0.002$; 621, 662, 717, 708, 708, 726, and 717 ± 16.1 g, respectively) and G:F increased (linear, $P < 0.001$; 0.415, 0.420, 0.437, 0.429, 0.433, 0.441, and 0.439 ± 0.0046, respectively) with increasing SID Val:Lys. There was no evidence of experiment × treatment interaction. Therefore, data from the 2 experiments were combined for analysis using experiment and BW block within experiment as random effects. Competing models, namely a broken-line linear model, a broken-line quadratic model, and a quadratic polynomial (QP), were compared using Bayesian information criterion. In the combined analysis, the best-fitting model for ADG was a QP (prediction equation: $-1.15 + 4.13 \times$ SID Val:Lys $- 2.78 \times$ SID Val:Lys$^2 + 0.012 \times$ initial BW) with optimum ADG estimated at 74.4% (95% confidence interval [CI] 69.5 to > 78.0) SID Val:Lys. The best-fitting model for G:F was also a QP (prediction equation: $-0.04 + 1.36 \times$ SID Val:Lys $- 0.94 \times$ SID Val:Lys^2) with optimum G:F estimated at 72.3% (95% CI 64.0 to > 78.0) SID Val:Lys. In conclusion, 67% SID Val:Lys was able to capture 99% of maximum ADG and G:F in 25- to 45-kg pigs.

Key Words: growth, pig, valine

Table 043. Standardized ileal digestible Val:Lys ratio at different performance levels

	Percent of maximum performance			
Item	95%	97%	99%	100%
ADG	58.9	62.3	67.3	74.4
G:F	< 57.0	60.4	65.5	72.3

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044 Determination of lysine adequacy on a population basis for growing pigs. C. E. Zier-Rush[1], C. Neill[2], S. B. Jungst[2], N. Matthews[2], D. S. Rosero[1,*], R. D. Boyd[1], *[1]The Hanor Company, Inc., Franklin, KY, [2]PIC, Hendersonville, TN*.

Nutrient requirements are primarily determined for a growth phase and mean population without considering population variation and important variables that define population response. For lysine curves to be financially useful, responses must be established using multiple criteria and equations must be developed for financial modeling. This study defined the response to 4 standardized ileal digestible (SID) lysine curves using 6 population growth (whole-body and carcass) and carcass primal parameters. A total of 2048 pigs (PIC Camborough × TR-4 or 327) were used in a growth assay from 20.4 (± 0.3 kg) to 119.0 (± 1.1 kg) with a fixed-time end point (110 d). Pigs were placed in 65 pens (30 to 32 pigs/pen and 0.70 m^2/pig), blocked by BW, and randomly allotted within gender and genotype to 4 dietary treatments administered in 5 phases of growth (20 kg BW phases). Dietary treatments corresponded to 4 different SID lysine curves that deviated from the 2008 PIC lysine specifications. Curves were 92, 98, 104, and 110% of the PIC standard lysine curve {SID lysine:ME [g SID lysine/Mcal ME (NRC, 1998)] = $(2.7 \times 10^{-5} \times \text{BW}^2) - (0.0153 \times \text{BW}) + 4.114)$}. Diets were corn–soybean meal based with 15.0% corn distiller's dried grains with solubles and 2.7% choice white grease as a fat source. Major ingredi-