Kansas Agricultural Experiment Station Research Reports

Volume 11
Issue 7 *Swine Day*

Article 34

2025

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## Recommended Citation

Navales, Ron Aldwin S.; Jenkins, Abigail K.; Kim, Ty H.; Arroyave, Julian; DeRouchey, Joel M.; Gaffield, Katelyn N.; Gebhardt, Jordan T.; Goodband, Robert D.; Tokach, Mike D.; and Woodworth, Jason C. (2025) "Effect of Standardized Ileal Digestible Lysine to Crude Protein Ratio on Growth Performance of 100 to 275 lb Pigs," *Kansas Agricultural Experiment Station Research Reports*: Vol. 11: Iss. 7. https://doi.org/10.4148/2378-5977.8768

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## Summary

Four experiments were conducted to determine the effect of SID Lys to CP ratio (SID Lys:CP) on growth performance and blood urea nitrogen (BUN) of 100 to 275 lb pigs. In each experiment, pens of pig were blocked by BW and randomly assigned to one of five dietary treatments in a randomized complete block design. There were eight to 10 pigs per pen and 13 or 14 replications per treatment in each experiment. A total of 621, 663, 624, and 609 pigs were used in Exp. 1 through 4, respectively. The pigs were DNA 600 × 241 and had initial BW of 100.3 ± 1.17 lb, 121.5 ± 1.08 lb, 187.0 ± 1.88 lb, and 228.7 ± 1.34 lb for Exp. 1 to 4, respectively. Pens were mixed gender, and each experiment lasted 21 d. Dietary treatments were corn-soybean meal-based and formulated to contain 0.94, 0.83, 0.71, and 0.63% SID Lys for Exp. 1 to 4, respectively. Within each experiment, diets provided SID Lys:CP ratios of 85.0, 92.5, 100.0, 107.5, and 115.0% of requirement estimates calculated from NRC (2012). Intermediate SID Lys:CP levels were achieved by blending diets with the lowest and highest SID Lys:CP ratio. Pen weight, number of pigs per pen, and feed delivery were recorded to calculate ADG, ADFI, and F/G. Blood samples were collected on d 14 of each experiment and analyzed for BUN. Dose response curves were evaluated using linear, quadratic polynomial, cubic polynomial, and broken-line linear (BLL) models. In Exp. 1, increasing SID Lys:CP had no effect on final BW and ADG, but it increased (linear, $P < 0.001$) ADFI and worsened (linear, $P < 0.001$) F/G. In Exp. 2, increasing SID Lys:CP ratio did not influence final BW, but tended to decrease (linear, $P = 0.053$) ADG, increase (quadratic, $P = 0.025$) ADFI, and worsen (linear, $P < 0.001$) F/G. In Exp. 3, increasing SID Lys:CP ratio decreased (linear, $P \leq 0.046$) final BW and ADG, and worsened (linear, $P < 0.001$) F/G. In Exp. 4, increasing SID Lys:CP had no influence on final BW and ADG, but tended to increase (linear, $P = 0.069$) ADFI and worsened (linear, $P = 0.009$) F/G. Across experiments, increasing SID Lys:CP decreased (linear, $P \leq 0.001$) nitrogen (N) intake and BUN. The cubic models provided the best fit for Exp. 1, 2 and 4, while the linear model provided the best fit for Exp. 3. In conclusion, increasing SID Lys:CP worsened F/G and decreased BUN in 100 to 275 lb pigs. Based on the local minimum determined using the cubic models, the estimated SID Lys:CP ratios to optimize F/G for pigs weighing 100 to 153 lb, 121 to 172 lb, and 228 to

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275 lb were 5.55%, 5.43%, and 5.23%, respectively. For pigs weighing 187 to 238 lb, the requirement was estimated to be below 5.13% based on the linear model. These SID Lys:CP ratios are below NRC (2012) estimates.

## Introduction

Low-protein, AA-fortified diets offer an opportunity to reduce N excretion in swine waste. However, replacing too much dietary protein with feed-grade AA may affect growth performance, as N from intact protein is needed for the synthesis of non-essential AA.[2] The SID Lys:CP ratio can be used as an indicator to ensure sufficient N is available for synthesis of non-essential AA in low protein, AA-fortified diets. Using NRC (2012)[3] estimates for N requirements and an N to CP conversion of 6.25, the calculated maximum SID Lys:CP ratios are approximately 6.2% for 44 to 165 lb pigs, 6.0% for 165 to 220 lb pigs, and 5.8% for pigs from 220 to 276 lb. These numbers, to our knowledge, have not been validated in empirical studies. Therefore, the objective of this study was to determine the effect of SID Lys:CP ratio on growth performance and BUN of 100 to 275 lb pigs.

## Materials and Methods

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in these experiments. The experiments were conducted at the Kansas State University Swine Teaching and Research Center. Each pen provided 7.83 $ft^2$ per pig and was equipped with a dry, two-hole feeder (Farmweld, Teutopolis, IL) and one-cup waterer to provide *ad libitum* access to feed and water. Pens were located over a completely slatted, concrete floor with a 4-ft deep pit underneath for manure storage. Daily feed additions to each pen were accomplished using a robotic feeding system (FeedPro, FeedLogic by ComDel Innovation, Wahpeton, ND) able to record feed deliveries for individual pens.

### *Animals and diets*

Four experiments were conducted using two groups of pigs per experiment. In Exp. 1, 621 pigs (DNA 600 × 241; initially 100.3 ± 1.17 lb) were housed in pens of nine pigs each, with 13 or 14 pens per treatment. Experiment 2 used 663 pigs (initially 121.5 ± 1.08 lb) in pens of nine or 10 pigs, with 14 pens per treatment. In Exp. 3, 624 pigs (initially 187.0 ± 1.88 lb) were housed in pens of eight or nine pigs, with 14 pens per treatment. Experiment 4 involved 609 pigs (initially 228.7 ± 1.34 lb) housed in pens of eight to 10 pigs, with 13 pens per treatment. The same pigs used in Exp. 1 were also used for Exp. 3 and those in Exp. 2 were used in Exp. 4. There was a 21 d washout period between the experiments during which all pigs were fed a common diet formulated above the pigs' AA requirements. All pens were mixed gender and were equipped with adjustable gates to allow space allowance per pig to be maintained if a pig died or was removed during the experiment. Pens of pigs were allotted by BW and randomly assigned to one of five dietary treatments in a randomized complete block design.

The dietary treatments were corn-soybean meal-based and formulated to contain 0.94, 0.83, 0.71, and 0.63% SID Lys for Exp. 1 to 4, respectively. Within each experiment,

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[2] Lu, L., X. Liao, and X. Luo. 2017. Nutritional strategies for reducing nitrogen, phosphorus and trace mineral excretions of livestock and poultry. J. Integr. Agric. 16:2815–2833. doi:10.1016/S2095-3119(17)61701-5.

[3] Nutrient requirements of swine: Eleventh revised edition. 2012. National Academies Press, Washington, D.C. Available from: http://www.nap.edu/catalog/13298

diets provided SID Lys:CP of 85.0, 92.5, 100.0, 107.5, and 115.0% of requirement estimates calculated from NRC (2012; Table 1). Intermediate SID Lys:CP ratio treatments were created by blending the diets containing the lowest and highest SID Lys:CP ratio (Table 2). The SID Lys levels in each phase were determined using the prediction models developed by Royall et al. (2022),[4] applying the requirement estimate calculated for pig weight at the end of each phase so as not to be above the pig's Lys requirement estimate. These levels corresponded to at least 80% of the requirement at the beginning and up to 100% at the end of each phase. All other nutrients met or exceeded NRC (2012) requirements.

Before diet formulation, duplicate samples of two sets of corn and soybean meal, one used for the first group and the other for the second group, were analyzed for CP and AA profiles (University of Missouri Agricultural Experiment Station Chemical Laboratories), and the analyzed values were used in diet formulation. Diets were manufactured in meal form at the O.H. Kruse Feed Technology Innovation Center at Kansas State University. Representative diet samples were collected and stored at -4°F, then analyzed in duplicate for N content at the Kansas State University Swine Laboratory (Table 2).

Pen weight, number of pigs per pen, and feed delivery were recorded weekly to calculate ADG, ADFI, and F/G. On day 14 of the experiment, 7 mL of blood was collected via jugular venipuncture from three pigs per pen (two barrows and one gilt) after a 10-h fasting period. Serum urea nitrogen concentrations were determined using the Urea Nitrogen Colorimetric Detection Kit (Arbor Assays, Ann Arbor, MI).

### *Statistical analysis*

Experimental data were analyzed using R Studio (Version 4.3.1, R Core Team. Vienna, Austria) with pen serving as the experimental unit, treatment as fixed effect, and initial BW as a blocking factor in a randomized complete block design. Orthogonal linear and quadratic contrasts were evaluated to determine the response to increasing SID Lys:CP ratios. Results were considered significant $P \leq 0.05$, and marginally significant at $P \leq 0.10$. Dose response curves were evaluated using linear, quadratic polynomial, cubic polynomial, and broken-line linear (BLL) models using SAS v.9.4 (SAS Institute, Inc., Cary, NC). The best-fitting models were selected using the Bayesian Information Criterion (BIC) with improved model fit accepted when BIC decreased by at least 2.0.

## Results and Discussion

### *Experiment 1*

In pigs weighing 100 to 153 lb, increasing SID Lys:CP did not affect final BW or overall ADG (Table 3). However, ADFI increased and F/G worsened (linear, $P < 0.001$) as SID Lys:CP ratio increased. Conversely, N intake and BUN levels decreased (linear, $P < 0.001$) as SID Lys:CP increased. Among the models evaluated, the cubic model yielded the lowest BIC for F/G with the local minimum at an SID Lys:CP ratio of 5.55% (Figure 1).

### *Experiment 2*

In pigs weighing 121 to 172 lb, increasing SID Lys:CP did not affect final BW (Table 4). However, ADG tended to decrease (linear, $P = 0.053$), ADFI increased

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[4] Royall, R.Q., R. D. Goodband, M. D. Tokach, J. M. DeRouchey, J. C. Woodworth, and J. T. Gebhardt. 2022. Effects of standardized ileal digestible lysine level on growth performance and economic return for 18 to 128 kg Duroc-sired pigs. Transl. Anim. Sci. 6(4):txac103. doi:10.1093/tas/txac103.

(quadratic, $P = 0.025$) and F/G worsened (linear, $P \le 0.001$) with increasing SID Lys:CP ratio. Conversely, N intake and BUN levels decreased (linear, $P < 0.001$) as SID Lys:CP ratio increased. Among the models evaluated, the cubic model yielded the lowest BIC for F/G with the local minimum at an SID Lys:CP ratio of 5.43% (Figure 2).

### *Experiment 3*

In pigs weighing 187 to 238 lb, increasing the SID Lys:CP ratio decreased (linear, $P \le 0.046$) the final BW and overall ADG (Table 5). Average daily feed intake was not influenced by SID Lys:CP ratio and F/G worsened (linear, $P \le 0.001$) as SID Lys:CP ratio increased. Nitrogen intake and BUN levels decreased (linear, $P < 0.001$) as SID Lys:CP ratio increased. Among the models evaluated for F/G, the linear model yielded the lowest BIC (Figure 3) indicating an SID Lys:CP ratio requirement below 5.13%.

### *Experiment 4*

In pigs weighing 228 to 275 lb, increasing SID Lys:CP ratio did not affect final BW or ADG (Table 6). However, ADFI tended to increase (linear, $P = 0.069$) and F/G worsened (linear, $P = 0.009$) with increasing SID Lys:CP ratio. Conversely, N intake and BUN levels decreased (linear, $P < 0.001$) as SID Lys:CP ratio increased. Among the models evaluated for F/G, the cubic model yielded the lowest BIC with the local minimum at the SID Lys:CP ratio of 5.23% (Figure 4).

In conclusion, increasing the SID Lys:CP ratio worsened F/G and decreased BUN in 100 to 275 lb pigs. Based on the local minimum determined using the cubic models, the estimated SID Lys:CP ratio requirements to minimize F/G for pigs weighing 100 to 153 lb, 121 to 172 lb, and 228 to 275 lb were 5.55%, 5.43%, and 5.23%, respectively. For pigs weighing 187 to 238 lb, the requirement was estimated to be below 5.13% based on the linear model. These SID Lys:CP ratios are lower than the NRC (2012) estimates (Figure 5), suggesting higher CP levels are required compared to those recommended by NRC (2012, Figure 6) if diets are formulated to the SID Lys levels utilized in these studies.

**Table 1. Calculated SID Lys, SID Lys to CP ratio, and CP levels of dietary treatments by phase**

| Phase[1] | SID Lys,[2] % | SID Lys to CP ratio, % of NRC, 2012 | | | | |
|---|---|---|---|---|---|---|
| | | 85.0 | 92.5 | 100.0 | 107.5 | 115.0 |
| 1 | 0.94 | 5.27 (17.8)[3] | 5.74 (16.4) | 6.20 (15.2) | 6.67 (14.1) | 7.13 (13.2) |
| 2 | 0.83 | 5.22 (15.9) | 5.68 (14.6) | 6.14 (13.5) | 6.60 (12.6) | 7.06 (11.8) |
| 3 | 0.71 | 5.13 (13.9) | 5.58 (12.7) | 6.03 (11.8) | 6.48 (11.0) | 6.93 (10.2) |
| 4 | 0.63 | 4.98 (12.7) | 5.42 (11.6) | 5.86 (10.8) | 6.30 (10.0) | 6.74 (9.4) |

[1] Diets were formulated based on the requirements of 95 to 142 lb (Phase 1), 126 to 172 lb (Phase 2), 172 to 223 lb (Phase 3), and 223 to 282 lb (Phase 4).
[2] Standardized ileal digestible Lys levels in each phase were determined using the prediction models developed by Royall et al. (2022), applying the requirement estimated at the end of each phase. These levels corresponded to at least 80% of the requirement at the beginning and up to 100% at the end of each phase.
[3] Numbers in the parentheses represent dietary CP.

**Table 2. Diet composition of the low and high SID Lys:CP ratio diets in each phase (as-fed basis)[1,2]**

| | Phase 1 | | Phase 2 | | Phase 3 | | Phase 4 | |
|---|---|---|---|---|---|---|---|---|
| Ingredient, % | Low SID Lys:CP | High SID Lys:CP | Low SID Lys:CP | High SID Lys:CP | Low SID Lys:CP | High SID Lys:CP | Low SID Lys:CP | High SID Lys:CP |
| Corn[3] | 70.1 – 71.3 | 82.9 – 84.2 | 75.3 – 76.7 | 86.7 – 88.1 | 80.8 – 82.2 | 90.7 – 92.1 | 84.1 – 85.5 | 93.2 – 94.6 |
| Soybean meal[4] | 26.2 – 27.3 | 11.9 – 13.2 | 21.1 – 22.3 | 8.4 – 9.7 | 15.7 – 17.0 | 4.7 – 6.0 | 12.6 – 13.9 | 2.5 – 3.8 |
| Limestone | 0.85 | 0.79 | 0.79 | 0.74 | 0.78 | 0.73 | 0.73 | 0.69 |
| Monocalcium phosphate (21% P) | 0.55 | 0.74 | 0.40 | 0.58 | 0.31 | 0.50 | 0.20 | 0.34 |
| Salt | 0.55 | 0.55 | 0.55 | 0.56 | 0.55 | 0.56 | 0.55 | 0.57 |
| L-Lys-HCl | 0.09 – 0.12 | 0.55 – 0.56 | 0.11 – 0.13 | 0.52 | 0.13 – 0.14 | 0.48 – 0.49 | 0.13 – 0.14 | 0.45 – 0.46 |
| DL-Met | 0.03 – 0.08 | 0.17 – 0.21 | 0.01 – 0.06 | 0.13 – 0.17 | 0.00 – 0.04 | 0.10 – 0.14 | 0.00 – 0.02 | 0.07 – 0.11 |
| L-Thr | 0.06 – 0.08 | 0.25 – 0.27 | 0.05 – 0.07 | 0.23 – 0.24 | 0.05 – 0.06 | 0.20 – 0.21 | 0.05 | 0.17 – 0.19 |
| L-Trp | 0.02 – 0.03 | 0.09 | 0.02 | 0.09 | 0.02 – 0.03 | 0.08 | 0.02 – 0.03 | 0.08 |
| L-Val | --- | 0.18 – 0.20 | --- | 0.16 – 0.18 | --- | 0.14 – 0.16 | --- | 0.11 – 0.14 |
| L-Ile | --- | 0.15 | --- | 0.14 – 0.15 | --- | 0.13 – 0.14 | --- | 0.12 – 0.13 |
| L-His HCl | --- | 0.05 – 0.06 | --- | 0.04 – 0.05 | --- | 0.03 – 0.05 | --- | 0.02 – 0.04 |
| Mineral premix | 0.15 | 0.15 | 0.15 | 0.15 | 0.13 | 0.13 | 0.13 | 0.13 |
| Vitamin premix | 0.15 | 0.15 | 0.15 | 0.15 | 0.13 | 0.13 | 0.13 | 0.13 |
| Phytase[5] | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

*continued*

**Table 2. Diet composition of the low and high SID Lys:CP ratio diets in each phase (as-fed basis)[1,2]**

| | Phase 1 | | Phase 2 | | Phase 3 | | Phase 4 | |
|---|---|---|---|---|---|---|---|---|
| Ingredient, % | Low SID Lys:CP | High SID Lys:CP | Low SID Lys:CP | High SID Lys:CP | Low SID Lys:CP | High SID Lys:CP | Low SID Lys:CP | High SID Lys:CP |
| Calculated analysis | | | | | | | | |
| Net energy, kcal/lb | 1,185 | 1,189 | 1,188 | 1,191 | 1,190 | 1,192 | 1,191 | 1,194 |
| CP, % | 17.8 | 13.2 | 15.9 | 11.8 | 13.9 | 10.2 | 12.7 | 9.4 |
| SID Lys, % | 0.94 | 0.94 | 0.83 | 0.83 | 0.71 | 0.71 | 0.63 | 0.63 |
| SID Lys:CP | 5.27 | 7.13 | 5.22 | 7.06 | 5.13 | 6.93 | 4.98 | 6.74 |
| SID AA:SID Lys | | | | | | | | |
| Ile | 72 | 61 | 71 | 61 | 70 | 61 | 70 | 61 |
| Leu | 143 | 106 | 148 | 111 | 155 | 117 | 164 | 125 |
| Met | 32 | 39 | 32 | 38 | 31 | 37 | 31 | 36 |
| Met+Cys | 58 | 58 | 58 | 58 | 59 | 58 | 60 | 58 |
| Thr | 65 | 65 | 65 | 65 | 65 | 65 | 66 | 65 |
| Trp | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 |
| Val | 80 | 72 | 80 | 72 | 80 | 72 | 82 | 72 |
| His | 44 | 34 | 44 | 34 | 45 | 34 | 46 | 34 |
| Arg | 112 | 70 | 110 | 67 | 108 | 64 | 108 | 62 |
| Phe | 82 | 55 | 82 | 55 | 83 | 55 | 84 | 56 |
| Phe+Tyr | 137 | 90 | 137 | 89 | 137 | 88 | 139 | 89 |
| Ala | 81 | 61 | 84 | 64 | 89 | 68 | 94 | 73 |
| Asp | 158 | 95 | 154 | 91 | 149 | 85 | 148 | 81 |
| Glu | 300 | 202 | 301 | 202 | 304 | 203 | 311 | 208 |
| Gly | 66 | 45 | 66 | 45 | 67 | 45 | 69 | 46 |
| Pro | 119 | 87 | 123 | 90 | 128 | 95 | 134 | 100 |
| Ser | 71 | 48 | 71 | 48 | 72 | 48 | 74 | 50 |
| Ca, % | 0.59 | 0.56 | 0.52 | 0.50 | 0.48 | 0.46 | 0.43 | 0.41 |
| STTD P, % | 0.38 | 0.38 | 0.34 | 0.34 | 0.31 | 0.31 | 0.28 | 0.28 |
| Analyzed CP, %[6] | 16.8 – 17.9 | 12.4 – 13.3 | 15.7 – 15.8 | 11.2 – 11.5 | 12.8 – 13.8 | 9.4 – 10.4 | 12.3 – 12.8 | 8.7 – 9.8 |

[1] Two sets of diets for each phase were formulated. The first set was used for the first group of pigs in Exp. 1 to 4, and the second set was used for the second group of pigs in Exp. 1 to 4. Diets were formulated based on the requirements of 95 to 142 lb (Phase 1), 126 to 172 lb (Phase 2), 172 to 223 lb (Phase 3), and 223 to 282 lb (Phase 4).

[2] Standardized ileal digestible Lys levels in each phase were determined using the prediction models developed by Royall et al. (2022), applying the requirement estimated at the end of each phase. These levels corresponded to at least 80% of the requirement at the beginning and up to 100% at the end of each phase. Intermediate SID Lys:CP treatments were created by blending the diets containing the lowest and highest SID Lys:CP ratios.

[3] Diets were formulated using two sets of analyzed values: 7.22% CP and 0.26% total Lys for the first group, and 7.79% CP and 0.29% total Lys for the second group of pigs in each phase.

[4] Diets were formulated using two sets of analyzed values: 45.91% CP and 2.93% total Lys for the first group, and 46.29% CP and 3.08% total Lys for the second group of pigs in each phase.

[5] HiPhorius 2,400 (DSM-Firmenich, Exton, PA). Phytase provided 408 FYT/lb with a release of 0.12% STTD P.

[6] Analyzed in duplicate using Leco TruMac N with TruMac operating software (Leco Corporation, St. Joseph, MI) at Kansas State University Swine Laboratory.

**Table 3. Effect of SID Lys to CP ratio on growth performance, N intake and BUN of 100 to 153 lb pigs, Exp. 1[1]**

| | SID Lys to CP ratio, % of NRC | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SID Lys to CP | 85.0 | 92.5 | 100.0 | 107.5 | 115.0 | | | |
| ratio: | 5.27 | 5.74 | 6.20 | 6.67 | 7.13 | | *P* = | |
| CP, %: | 17.8 | 16.4 | 15.2 | 14.1 | 13.2 | SEM | Linear | Quadratic |
| BW, lb | | | | | | | | |
| Initial | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 1.17 | 0.912 | 0.899 |
| Final | 152.9 | 152.6 | 153.6 | 152.6 | 152.8 | 1.54 | 0.926 | 0.686 |
| Growth performance | | | | | | | | |
| ADG, lb | 2.46 | 2.43 | 2.48 | 2.43 | 2.43 | 0.030 | 0.552 | 0.750 |
| ADFI, lb | 5.14 | 5.06 | 5.28 | 5.41 | 5.22 | 0.080 | < 0.001 | 0.107 |
| F/G | 2.09 | 2.09 | 2.13 | 2.23 | 2.15 | 0.028 | < 0.001 | 0.171 |
| N intake, g/d | 66.3 | 60.2 | 58.2 | 55.3 | 50.0 | 0.90 | < 0.001 | 0.708 |
| N intake, g/kg gain | 59.5 | 54.7 | 51.9 | 50.3 | 45.4 | 0.70 | < 0.001 | 0.526 |
| BUN, mg/dL[2] | 11.60 | 9.95 | 8.07 | 7.30 | 4.90 | 0.488 | < 0.001 | 0.800 |

[1] A total of 621 pigs were used with nine pigs per pen and 13 or 14 pens per treatment.
[2] Blood samples were taken on d 14 from three pigs per pen (two barrows and one gilt) to measure serum urea N.

**Table 4. Effect of SID Lys to CP ratio on growth performance, N intake and BUN of 121 to 172 lb pigs, Exp. 2[1]**

| | SID Lys to CP ratio, % of NRC | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SID Lys to CP | 85.0 | 92.5 | 100.0 | 107.5 | 115.0 | | | |
| ratio: | 5.22 | 5.68 | 6.14 | 6.60 | 7.06 | | *P* = | |
| CP, %: | 15.9 | 14.6 | 13.5 | 12.6 | 11.8 | SEM | Linear | Quadratic |
| BW, lb | | | | | | | | |
| Initial | 121.6 | 121.5 | 121.5 | 121.5 | 121.5 | 1.08 | 0.948 | 0.932 |
| Final | 171.9 | 171.8 | 171.8 | 170.8 | 170.7 | 1.34 | 0.149 | 0.746 |
| Growth performance | | | | | | | | |
| ADG, lb | 2.51 | 2.51 | 2.51 | 2.47 | 2.43 | 0.031 | 0.053 | 0.277 |
| ADFI, lb | 5.72 | 5.76 | 5.86 | 6.00 | 5.79 | 0.068 | 0.039 | 0.025 |
| F/G | 2.29 | 2.30 | 2.34 | 2.43 | 2.38 | 0.024 | < 0.001 | 0.376 |
| N intake, g/d | 66.0 | 61.0 | 57.5 | 54.8 | 49.6 | 0.65 | < 0.001 | 0.825 |
| N intake, g/kg gain | 58.2 | 53.6 | 50.5 | 49.0 | 45.0 | 0.53 | < 0.001 | 0.080 |
| BUN, mg/dL[2] | 9.05 | 7.93 | 6.12 | 5.10 | 4.31 | 0.404 | < 0.001 | 0.155 |

[1] A total of 663 pigs were used with nine or 10 pigs per pen and 14 pens per treatment.
[2] Blood samples were taken on d 14 from three pigs per pen (two barrows and one gilt) to measure serum urea N.

**Table 5. Effect of SID Lys to CP ratio on growth performance, N intake and BUN of 187 to 238 lb pigs, Exp. 3[1]**

| | SID Lys to CP ratio, % of NRC | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SID Lys to CP | 85.0 | 92.5 | 100.0 | 107.5 | 115.0 | | | |
| ratio: | 5.13 | 5.58 | 6.03 | 6.48 | 6.93 | | *P* = | |
| CP, %: | 13.9 | 12.7 | 11.8 | 11.0 | 10.2 | SEM | Linear | Quadratic |
| BW, lb | | | | | | | | |
| Initial | 187.0 | 187.0 | 187.0 | 187.0 | 187.0 | 1.88 | 0.978 | 0.959 |
| Final | 237.4 | 235.8 | 235.8 | 237.0 | 233.6 | 2.19 | 0.046 | 0.496 |
| Growth performance | | | | | | | | |
| ADG, lb | 2.46 | 2.38 | 2.39 | 2.37 | 2.28 | 0.044 | 0.001 | 0.690 |
| ADFI, lb | 6.65 | 6.54 | 6.71 | 6.85 | 6.59 | 0.092 | 0.462 | 0.246 |
| F/G | 2.71 | 2.76 | 2.82 | 2.89 | 2.89 | 0.034 | < 0.001 | 0.491 |
| N intake, g/d | 67.1 | 60.3 | 57.5 | 54.6 | 48.8 | 0.79 | < 0.001 | 0.419 |
| N intake, g/kg gain | 60.3 | 56.0 | 53.2 | 50.8 | 47.2 | 0.65 | < 0.001 | 0.423 |
| BUN, mg/dL[2] | 8.81 | 8.51 | 7.21 | 5.27 | 4.36 | 0.457 | < 0.001 | 0.192 |

[1] A total of 624 pigs were used with eight or nine pigs per pen and 14 pens per treatment.
[2] Blood samples were taken on d 14 from three pigs per pen (two barrows and one gilt) to measure serum urea N.

**Table 6. Effect of SID Lys to CP ratio on growth performance, N intake and BUN of 228 to 275 lb pigs, Exp. 4[1]**

| | SID Lys to CP ratio, % of NRC | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SID Lys to CP | 85.0 | 92.5 | 100.0 | 107.5 | 115.0 | | | |
| ratio: | 4.98 | 5.42 | 5.86 | 6.30 | 6.74 | | *P* = | |
| CP, %: | 12.7 | 11.6 | 10.8 | 10.0 | 9.4 | SEM | Linear | Quadratic |
| BW, lb | | | | | | | | |
| Initial | 228.7 | 228.7 | 228.7 | 228.7 | 228.7 | 1.34 | 0.974 | 0.999 |
| Final | 275.4 | 274.9 | 275.1 | 274.1 | 275.2 | 2.07 | 0.656 | 0.487 |
| Growth performance | | | | | | | | |
| ADG, lb | 2.22 | 2.20 | 2.20 | 2.15 | 2.21 | 0.059 | 0.623 | 0.456 |
| ADFI, lb | 6.85 | 6.72 | 6.89 | 7.02 | 6.95 | 0.140 | 0.069 | 0.856 |
| F/G | 3.09 | 3.07 | 3.13 | 3.28 | 3.15 | 0.042 | 0.009 | 0.389 |
| N intake, g/d | 63.1 | 57.1 | 53.9 | 50.8 | 46.7 | 1.22 | < 0.001 | 0.144 |
| N intake, g/kg gain | 63.0 | 58.3 | 54.9 | 51.8 | 47.4 | 0.85 | < 0.001 | 0.740 |
| BUN, mg/dL[2] | 9.82 | 8.10 | 7.01 | 6.83 | 5.20 | 0.750 | < 0.001 | 0.507 |

[1] A total of 609 pigs were used with eight to 10 pigs per pen and 13 pens per treatment.
[2] Blood samples were taken on d 14 from three pigs per pen (two barrows and one gilt) to measure serum urea N.

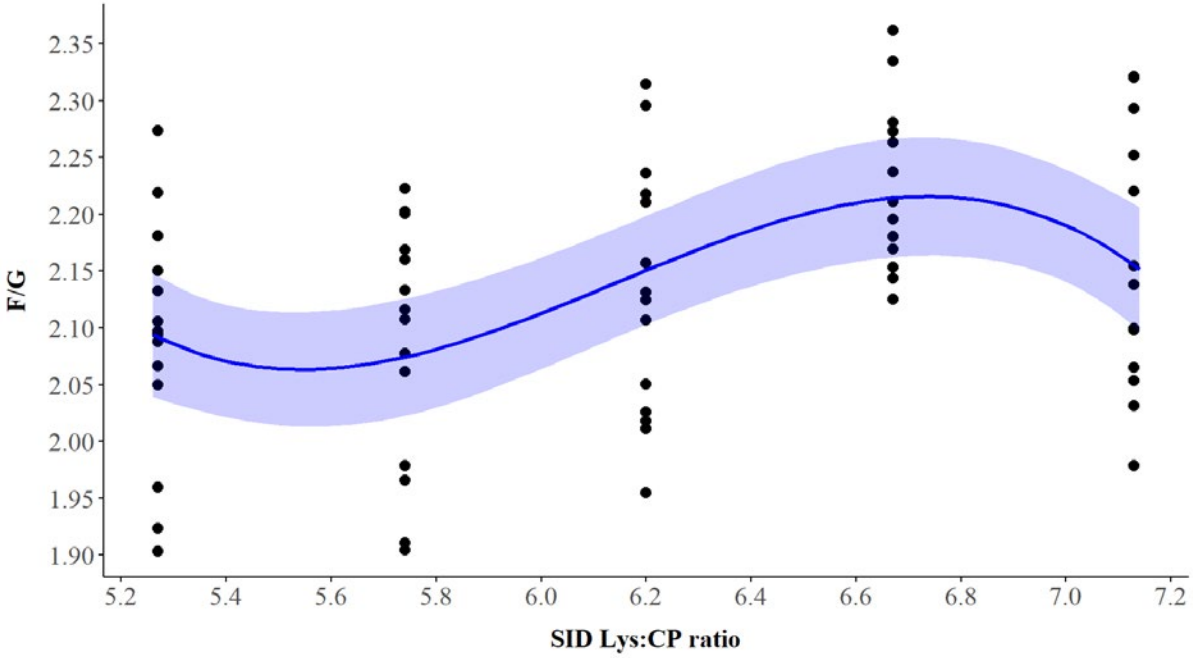


**Figure 1. Estimation of SID Lys:CP ratio requirements to minimize F/G for 100 to 153 lb pigs (Exp. 1) using a cubic model (• Pen — linear predictor). Linear, quadratic, cubic and broken line linear models were fit to estimate SID Lys:CP required to minimize F/G. The cubic model resulted in the lowest BIC, with the local minimum at 5.55 SID Lys:CP ratio.**

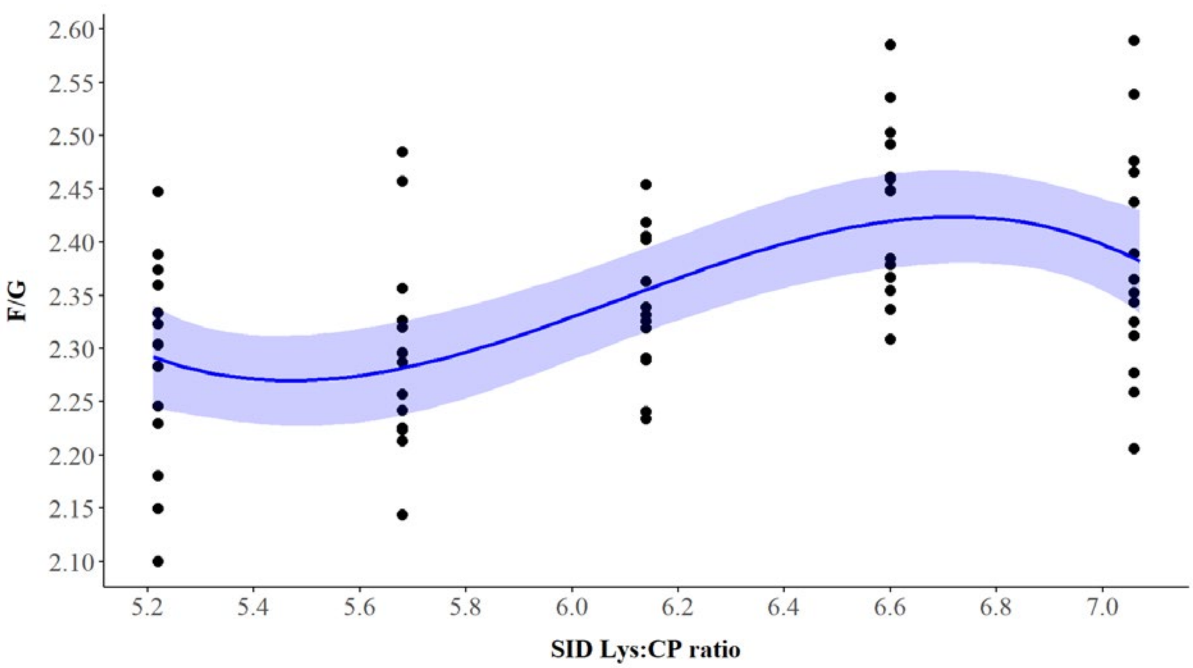


**Figure 2. Estimation of SID Lys:CP ratio requirements to minimize F/G for 121 to 172 lb pigs (Exp. 2) using a cubic model (• Pen — linear predictor). Linear, quadratic, cubic and broken line linear models were fit to estimate SID Lys:CP ratio required to minimize F/G. The cubic model resulted in the lowest BIC, with the local minimum at 5.43 SID Lys:CP ratio.**

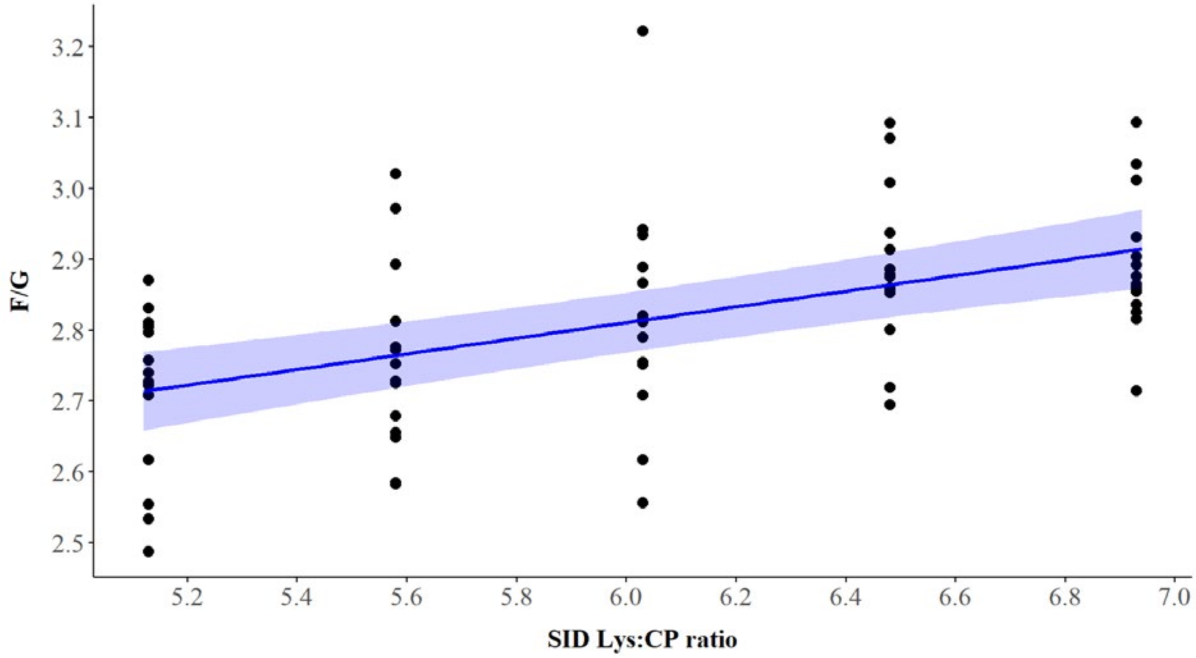


**Figure 3. Estimation of SID Lys:CP ratio requirements to minimize F/G for 187 to 238 lb pigs (Exp. 3) using a linear model (• Pen — linear predictor). Linear, quadratic, cubic and broken line linear models were fit to estimate SID Lys:CP ratio required to minimize F/G. The linear model resulted in the lowest BIC indicating a requirement below 5.13 SID Lys:CP ratio.**

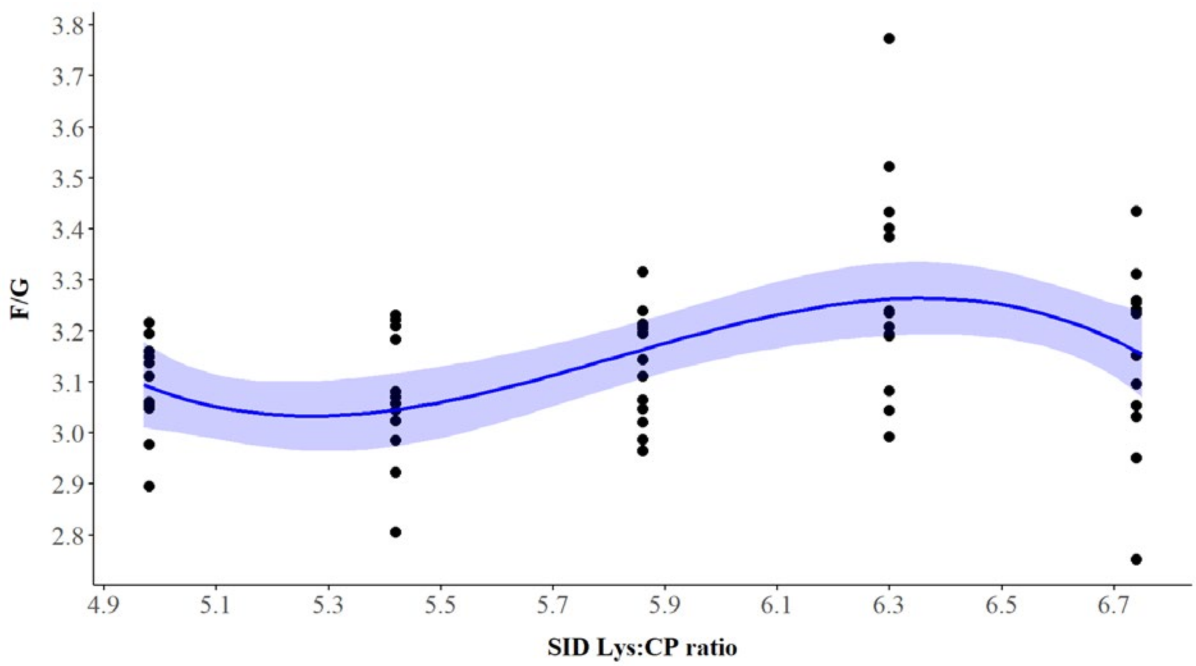


**Figure 4. Estimation of SID Lys:CP ratio requirements to minimize F/G for 228 to 275 lb pigs (Exp. 4) using a cubic model (• Pen — linear predictor). Linear, quadratic, cubic and broken line linear models were fit to estimate SID Lys:CP ratio required to minimize F/G. The cubic model resulted in the lowest BIC, with the local minimum at 5.23 SID Lys:CP ratio.**

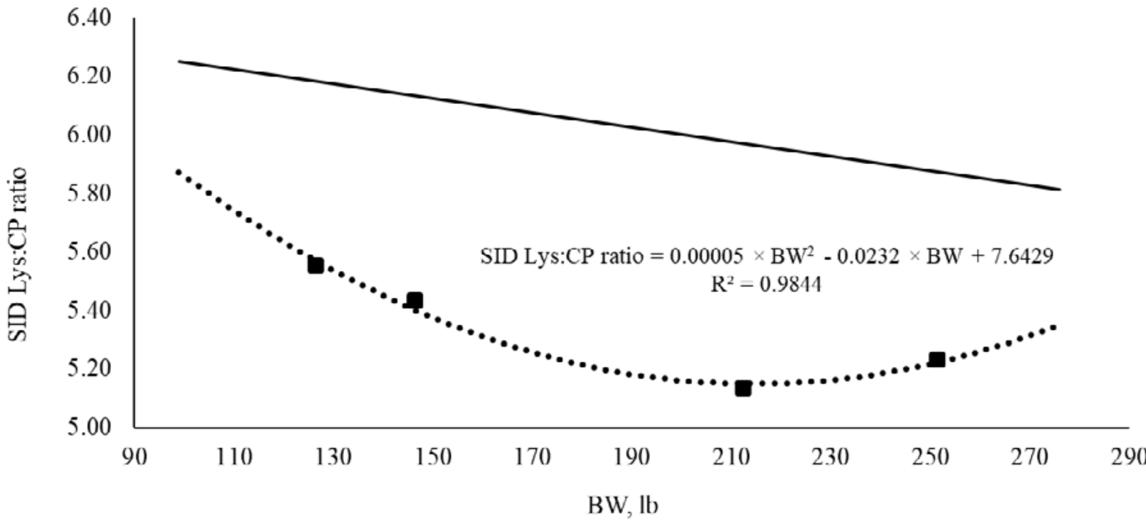


**Figure 5. Estimated SID Lys:CP ratio for pigs weighing 100 to 275 lb . The solid line (—) represents the SID Lys to CP ratio calculated using NRC (2012) estimates for SID Lys and CP (N × 6.25). Experimental SID Lys:CP ratio requirements to minimize F/G are shown as ■ [5.55, 100 to 153 lb (cubic model); 5.43, 121 to 172 lb (cubic model); <5.13, 187 to 238 lb (linear model); 5.23, 228 to 275 lb (cubic model)].**

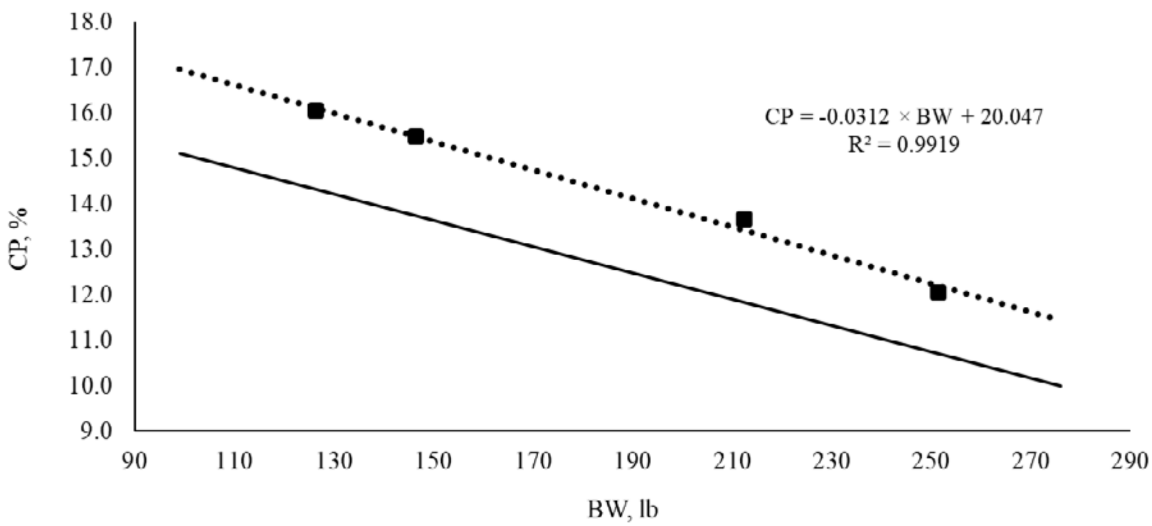


**Figure 6. Estimated CP for pigs weighing 100 to 275 lb. The solid line (—) represents the NRC (2012) estimates. Experimental CP requirements to minimize F/G are shown as ■ [16.04, 100 to 153 lb; 15.47, 121 to 172 lb, >13.65, 187 to 238 lb; 12.05, 228 to 275 lb]. These were calculated using the SID Lys to CP ratio indicated in Figure 5 and NRC (2012) SID Lys requirements.**