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# Effects of Standardized Ileal Digestible Lysine:Crude Protein Ratio on Growth Performance of 25- to 55-lb Pigs

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## Summary

A total of 4,167 pigs (initially 28.7 ± 0.59 lb) were used in a 21-d growth study to evaluate SID Lys:CP ratios for 25- to 55-lb pigs. Pigs were weaned at approximately 21 d of age and pens of pigs were randomly allotted to one of 10 dietary treatments in a randomized complete block design. Pens of pigs were blocked based on sow farm origin, date of entry into the facility, and average pen weight. A total of 160 pens were used with 80 double-sided, 5-hole stainless steel fence-line feeders, with feeder serving as the experimental unit. For each feeder, one pen contained approximately 26 gilts, and one pen contained approximately 26 barrows. There were eight replicates per dietary treatment. A pelleted phase 1 diet was fed to all pigs with 1.25 lb/pig budgeted, followed by a phase 2 diet fed in meal form until beginning of the experiment on d 21 post-weaning. Phase 3 experimental treatments were arranged in a 2 × 5 factorial with main effects of SID Lys (1.15 or 1.30%) and SID Lys:CP ratio (6.00, 6.22, 6.46, 6.72, and 7.00). From d 0 to 7 (period 1), there was a tendency for a SID Lys:CP × SID Lys interaction (quadratic, $P = 0.077$), where feed efficiency improved at 6.22 SID Lys:CP and worsened (quadratic, $P = 0.001$) as the ratio increased in diets formulated to 1.15% SID Lys, while feed efficiency worsened (linear, $P = 0.010$) as SID Lys:CP ratio increased in diets formulated to 1.30% SID Lys. As the SID Lys:CP ratio increased, ADG increased (quadratic, $P = 0.043$) up to 6.46 SID Lys:CP ratio, and then decreased as the ratio increased thereafter. As the SID Lys:CP ratio increased, ADFI increased (linear, $P = 0.028$). From d 7 to 14 (period 2), a SID Lys:CP × SID Lys interaction was observed (linear, $P = 0.008$) for F/G where increasing SID Lys:CP ratio worsened (linear, $P < 0.0001$) F/G in diets formulated to 1.15% SID Lys while no response was observed in diets formulated to 1.30% SID Lys. Additionally, as the SID Lys:CP ratio increased, ADFI increased (linear, $P = 0.013$). From d 0 to 14 (periods 1 and 2), a SID Lys:CP × SID Lys interaction was observed (linear, $P = 0.0002$) where increasing SID Lys:CP ratio worsened feed efficiency in both SID Lys levels, but the magnitude was greater in diets formulated to 1.15% SID Lys (quadratic, $P = 0.016$) compared to 1.30% SID Lys (linear, $P = 0.0004$). Increasing SID Lys:CP ratio increased (linear, $P = 0.004$) ADFI. From d 14 to 21 (period 3), as the SID Lys:CP ratio increased, feed efficiency

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worsened (linear, $P = 0.004$). From d 0 to 21 (overall), a SID Lys:CP × SID Lys interaction was observed (linear, $P = 0.012$) where increasing the SID Lys:CP ratio reduced ($P < 0.0001$) feed efficiency at both SID Lys levels, but the magnitude was greater in diets formulated to 1.15% SID Lys compared to 1.30% SID Lys. Additionally, ADFI increased ($P = 0.013$) as the SID Lys:CP ratio increased. Increasing SID Lys increased ($P < 0.001$) ADG in phases 1, 2, and overall, but not from d 14 to 21. In conclusion, increasing SID Lys:CP ratio worsened feed efficiency, especially when the ratio increased beyond 6.46. Data suggests that diets for 25- to 55-lb pigs should be formulated to a SID Lys:CP ratio of 6.46 or lower to maintain feed efficiency.

## Introduction

The NRC (2012)[3] suggests a SID Lys to crude protein (CP) ratio of 6.5 for pigs between 25 to 55 lb. The validation of this ratio will help prevent the use of excess feed-grade amino acids (AAs) resulting in lost performance. A preliminary study (Smallfield et al., 2024)[4] examined the effect of increasing SID Lys:CP (6.0, 6.5, and 6.9) by replacing soybean meal (SBM) with feed-grade AAs. Increasing SID Lys:CP from 6.5 to 6.9 resulted in poorer feed efficiency; however, additional information is needed to understand if the response is dependent on the level of SID Lys that is formulated in the diets. Therefore, the objective of this study was to examine SID Lys:CP ratios in diets containing either 1.15 or 1.30% SID Lys on growth performance. Our hypothsis was that a high SID Lys:CP ratio might worsen pig performance and the magnitude of response might be influenced by lysine level in the diet.

## Materials and Methods

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in this study. This study was conducted at a commercial research facility located in north central Ohio (Bucyrus, OH). A total of 160 pens were used with 80 double-sided, 5-hole stainless steel fence-line feeders each feeding two adjacent pens with feeder serving as the experimental unit. For each feeder, one pen contained 26 gilts, and one pen contained 26 barrows. Each pen was also equipped with a cup waterer to provide ad libitum access to feed and water.

### *Animals and diets*

Weaned pigs (approximately 21 d of age) originating from three sow farms were placed into the research facility over a 6-d period. At the time of placement in the nursery facility, pens of pigs were weighed and allotted to one of 10 dietary treatments in a randomized complete block design with blocking structure including sow farm origin, date of entry into the nursery facility, and average pen BW. A total of 4,167 pigs (337 × 1050, PIC; initially 28.7 ± 0.59 lb) were used in a 21-d growth study with eight replications per dietary treatment.

A common phase 1 and phase 2 were fed to all pigs in pelleted form and meal form, respectively, prior to treatment diets. Phase 1 was provided at 1.25 lb/pig and phase

[3] National Research Council. 2012. Nutrient Requirements of Swine: Eleventh Revised Edition. Washington, DC: The National Academies Press. https://doi.org/10.17226/13298.

[4] Smallfield, J. L.; Tokach, M. D.; Woodworth, J. C.; Goodband, R. D.; DeRouchey, J. M.; Gaffield, K. N.; Gebhardt, J. T.; Haydon, K. D.; Warner, A. J.; and Hastad, C. W. (2024) "Is Nitrogen the Limiting Factor to Maintain Feed Efficiency when Feeding Low Protein, Amino Acid Fortified Diets?" Kansas Agricultural Experiment Station Research Reports 2024.

2 was then fed until beginning experimental treatment diets at 21 d post-weaning. Experimental treatments were arranged in a 2 × 5 factorial with main effects of SID Lys (1.15 or 1.30% SID Lys) and SID Lys:CP ratios (6.00, 6.22, 6.46, 6.72, and 7.00). Prior to manufacturing, SBM and corn samples were analyzed for proximate analysis and complete AA profile (University of Missouri Agricultural Experiment Station Chemical Laboratory). Composite SBM and corn samples used in manufacturing were collected and analyzed for proximate and complete AA profile (Table 1). Treatment diets were manufactured at the Hord Elevator (Bucyrus, OH). Dietary additions of feed-grade AA were adjusted to meet or exceed AA NRC requirement estimates in relation to Lys for Met and Cys, Thr, Trp, Val, Ile, and His (Table 2). Feed samples were collected from at least six feeders per treatment per feed delivery to the research facility and subsampled to be analyzed for proximate analysis and complete AA profile.

Feed additions to each individual feeder were made and recorded by an electronic feeding system (Dry Extract; Big Dutchman, Inc., Holland, MI). Pens of pigs were weighed, and feed disappearance was calculated every 7 d until the conclusion of the trial to calculate ADG, ADFI, and feed efficiency. Feed disappearance was measured by using a volumetric regression equation that estimates the quantity of feed remaining in the feeder subtracted by the quantity of feed added to the feeder.

### *Statistical analysis*

Data were analyzed as a randomized complete block design for one-way ANOVA using the lmer function from the lme4 package in R Studio (Version 3.5.2, R Core Team. Vienna, Austria). Feeder (two pens of pigs) was considered the experimental unit. Treatment was included in the model as a fixed effect, and block was included in the model as a random intercept, which incorporated initial pen BW, sow farm origin, and date of entry into the nursery facility. Contrast statements were used to evaluate the interactive effect of SID Lys × CP, as well as the main effects of SID Lys and SID Lys:CP. Results were considered significant with $P \leq 0.05$ and were considered marginally significant with $P \leq 0.10$.

## Results and Discussion

### *Growth performance*

From d 0 to 7 (period 1), there was a tendency for a SID Lys:CP × SID Lys interaction (quadratic, $P = 0.077$) where in pigs fed diets formulated to 1.15% SID Lys, feed efficiency was improved to 6.22 SID Lys:CP (quadratic, $P = 0.001$) and worsened as the ratio increased, while feed efficiency worsened (linear, $P = 0.010$) as the SID Lys:CP ratio increased in diets formulated to 1.30% SID Lys (Table 3). Pigs fed 1.30% SID Lys had increased ($P \leq 0.003$) ADG and d 7 BW compared to the pigs fed 1.15% SID Lys. As the SID Lys:CP ratio increased, ADG increased (quadratic, $P = 0.043$) up to 6.46 SID Lys:CP and then decreased as the ratio increased further. Increasing SID Lys:CP ratio increased (linear, $P = 0.028$) ADFI.

From d 7 to 14 (period 2), a SID Lys:CP × SID Lys interaction was observed (linear, $P = 0.008$) where feed efficiency worsened (linear, $P < 0.0001$) in diets formulated to 1.15% SID Lys as the SID Lys:CP ratio increased, while no response was observed in pigs fed diets formulated to 1.30% SID Lys. Pigs fed 1.30% SID Lys had increased ($P \leq 0.038$) ADG and d 14 BW compared to the pigs fed 1.15% SID Lys. Increasing SID Lys:CP ratio increased (linear, $P = 0.013$) ADFI.

From d 0 to 14 (periods 1 and 2), a SID Lys:CP × SID Lys interaction was observed (linear, $P = 0.0002$) where increasing the SID Lys:CP ratio worsened feed efficiency in both SID Lys levels, with a greater magnitude observed in pigs fed diets formulated to 1.15% SID Lys (quadratic, $P = 0.016$) than in diets formulated to 1.30% SID Lys (linear, $P = 0.0004$). An improvement in ADG was observed ($P \leq 0.0001$) in pigs fed 1.30% SID Lys compared to those fed 1.15% SID Lys. Additionally, as the SID Lys:CP ratio increased, ADFI increased ($P = 0.004$).

From d 14 to 21 (period 3), no SID Lys:CP ratio interactions were observed. Day 21 BW and feed efficiency were improved ($P \leq 0.012$) in pigs fed 1.30% SID Lys compared to the pigs fed 1.15% SID Lys. Additionally, as the SID Lys:CP ratio increased, feed efficiency worsened (linear, $P = 0.004$).

From d 0 to 21 (overall), a SID Lys:CP × SID Lys interaction was observed (linear, $P = 0.012$) where increasing the SID Lys:CP ratio worsened (linear, $P < 0.0001$) feed efficiency at both SID Lys levels with a more pronounced effect in diets formulated to 1.15% SID Lys than in diets formulated to 1.30% SID Lys. Additionally, an improvement in ADG was observed ($P < 0.001$) in pigs fed 1.30% SID Lys compared to the pigs fed 1.15% SID Lys. ADFI increased ($P = 0.013$) as the SID Lys:CP ratio increased through the highest ratio tested of 7.0.

In summary, results indicate that pigs fed diets formulated to 1.30% SID Lys had improved growth performance compared to pigs fed 1.15% SID Lys. Results also indicate that feed efficiency worsens as the SID Lys:CP ratio increases, potentially due to limited nitrogen availability needed to synthesize non-essential amino acids suggesting that diets for 25- to 55-lb pigs should be formulated to a SID Lys:CP ratio of 6.46 or lower to maintain growth performance and feed efficiency. Overall, a balance of intact protein and feed-grade amino acids needs to be used to maintain an appropriate SID Lys:CP ratio.

## Acknowledgments

Appreciation is expressed to the United Soybean Board for partial financial support and to Hord Family Farms (Bucyrus, OH) for providing the animals and research facilities.

**Table 1. Analyzed composition of corn and soybean meal (as-fed basis)[1]**

| Nutrient, % | SBM[2] | Corn |
|---|---|---|
| CP | 46.31 | 6.79 |
| Dry matter | 88.83 | 86.44 |
| Crude fat | 1.71 | 2.70 |
| Crude fiber | 3.41 | 1.68 |
| Ash | 6.04 | 1.16 |
| Essential AAs | | |
| Arg | 3.44 | 0.34 |
| His | 1.27 | 0.20 |
| Ile | 2.31 | 0.26 |
| Leu | 3.71 | 0.80 |
| Lys | 3.11 | 0.25 |
| Met | 0.64 | 0.14 |
| Phe | 2.47 | 0.33 |
| Thr | 1.82 | 0.25 |
| Trp | 0.53 | 0.06 |
| Val | 2.43 | 0.35 |
| Non-essential AAs | | |
| Ala | 2.06 | 0.50 |
| Asp | 5.36 | 0.47 |
| Cys | 0.67 | 0.17 |
| Glu | 8.68 | 1.28 |
| Gly | 1.99 | 0.27 |
| Pro | 2.35 | 0.60 |
| Ser | 1.82 | 0.31 |
| Tyr | 1.65 | 0.26 |

[1] Samples were analyzed for proximate analysis and complete AA profile (University of Missouri Agricultural Experiment Station Chemical Laboratory).
[2] Table reports the average of the two SBM sources used.

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

| | SID Lys, % | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1.15 | | | | | 1.30 | | | | |
| **Item** **SID Lys:CP:** | **6.00** | **6.22** | **6.46** | **6.72** | **7.00** | **6.00** | **6.22** | **6.46** | **6.72** | **7.00** |
| Ingredient, %: | | | | | | | | | | |
| Corn | 64.73 | 66.64 | 68.56 | 70.48 | 72.40 | 58.32 | 60.46 | 62.59 | 64.73 | 66.86 |
| Soybean meal (45.1% CP) | 31.44 | 29.28 | 27.13 | 24.97 | 22.81 | 37.94 | 35.53 | 33.13 | 30.72 | 28.32 |
| Calcium carbonate | 0.93 | 0.92 | 0.91 | 0.91 | 0.90 | 0.94 | 0.93 | 0.92 | 0.92 | 0.91 |
| Monocalcium P (21.5% P) | 0.95 | 0.98 | 1.00 | 1.03 | 1.05 | 0.85 | 0.88 | 0.91 | 0.94 | 0.97 |
| Salt | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| Liquid lysine (55% Lys) | 0.35 | 0.45 | 0.55 | 0.65 | 0.75 | 0.33 | 0.44 | 0.55 | 0.66 | 0.77 |
| DL-Met | 0.14 | 0.16 | 0.18 | 0.20 | 0.22 | 0.17 | 0.19 | 0.21 | 0.23 | 0.26 |
| L-Trp | 0.01 | 0.02 | 0.04 | 0.05 | 0.06 | 0.01 | 0.02 | 0.03 | 0.05 | 0.06 |
| L-Val | 0.01 | 0.05 | 0.09 | 0.12 | 0.16 | --- | 0.05 | 0.09 | 0.14 | 0.18 |
| L-Ile | --- | 0.01 | 0.03 | 0.04 | 0.05 | --- | 0.01 | 0.02 | 0.03 | 0.04 |
| L-Thr | 0.18 | 0.21 | 0.25 | 0.28 | 0.32 | 0.19 | 0.23 | 0.27 | 0.31 | 0.35 |
| L-His | --- | 0.01 | 0.01 | 0.02 | 0.03 | --- | 0.01 | 0.01 | 0.02 | 0.03 |
| Sodium metabisulfate | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Zinc oxide | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Copper sulfate | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 |
| Trace mineral premix | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Vitamin premix | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Phytase[2] | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

*continued*

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

| | | SID Lys, % | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1.15 | | | | | 1.30 | | | | |
| Item | SID Lys:CP: | 6.00 | 6.22 | 6.46 | 6.72 | 7.00 | 6.00 | 6.22 | 6.46 | 6.72 | 7.00 |
| Calculated analysis | | | | | | | | | | | |
| SID AA, % | | | | | | | | | | | |
| Lys, % | | 1.15 | 1.15 | 1.15 | 1.15 | 1.15 | 1.30 | 1.30 | 1.30 | 1.30 | 1.30 |
| Ile:Lys | | 65 | 63 | 61 | 59 | 56 | 67 | 64 | 61 | 59 | 56 |
| Leu:Lys | | 129 | 124 | 119 | 115 | 110 | 126 | 122 | 117 | 112 | 107 |
| Met:Lys | | 35 | 35 | 36 | 37 | 38 | 35 | 36 | 37 | 37 | 38 |
| Met and Cys:Lys | | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 |
| Thr:Lys | | 65 | 65 | 65 | 65 | 65 | 65 | 65 | 65 | 65 | 65 |
| Trp:Lys | | 19.0 | 19.1 | 19.1 | 19.2 | 19.2 | 19.2 | 19.2 | 19.2 | 19.3 | 19.3 |
| Val:Lys | | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 |
| His:Lys | | 39.6 | 38.2 | 36.9 | 35.5 | 34.1 | 39.8 | 38.4 | 37.0 | 35.6 | 34.2 |
| NE, kcal/lb | | 1,136 | 1,139 | 1,142 | 1,145 | 1,148 | 1,130 | 1,133 | 1,136 | 1,139 | 1,142 |
| SID Lys:NE, g/Mcal | | 4.59 | 4.58 | 4.57 | 4.56 | 4.54 | 5.22 | 5.21 | 5.19 | 5.18 | 5.16 |
| Total Lys, % | | 1.29 | 1.29 | 1.28 | 1.28 | 1.27 | 1.46 | 1.45 | 1.45 | 1.44 | 1.43 |
| CP, % | | 19.2 | 18.5 | 17.8 | 17.1 | 16.4 | 21.7 | 20.9 | 20.1 | 19.4 | 18.6 |
| Ca, % | | 0.66 | 0.65 | 0.65 | 0.64 | 0.64 | 0.66 | 0.66 | 0.65 | 0.65 | 0.65 |
| STTD P, % | | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 |
| Ca:P | | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 |
| Na, % | | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 |

[1] Phase 3 diets were fed from d 0 (28.7 lb) to d 21 (58.2 lb).
[2] Quantum Blue 2G (AB Vista, Marlborough, Wiltshire, UK) included at 907 FTU/lb provided an estimated release of 0.12% STTD P.

**Table 3. Analyzed composition of treatment diets (as-fed basis)[1]**

| | SID Lys, % | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1.15 | | | | | 1.30 | | | | |
| **SID Lys:CP:** | **6.00** | **6.22** | **6.46** | **6.72** | **7.00** | **6.00** | **6.22** | **6.46** | **6.72** | **7.00** |
| Nutrient, % | | | | | | | | | | |
| CP | 19.41 | 19.24 | 17.60 | 17.31 | 16.37 | 22.37 | 20.45 | 20.11 | 19.09 | 18.97 |
| Dry matter | 87.68 | 87.95 | 87.15 | 87.15 | 87.10 | 87.71 | 87.63 | 87.55 | 87.58 | 87.37 |
| Crude fat | 1.24 | 1.39 | 1.55 | 1.54 | 1.64 | 1.16 | 1.13 | 1.03 | 1.36 | 1.38 |
| Crude fiber | 2.18 | 2.07 | 2.06 | 1.87 | 1.82 | 2.04 | 1.98 | 1.90 | 1.93 | 2.02 |
| Ash | 4.78 | 4.81 | 4.68 | 4.76 | 4.53 | 5.15 | 4.97 | 5.14 | 4.64 | 4.60 |
| Essential AAs | | | | | | | | | | |
| Arg | 1.22 | 1.18 | 1.07 | 1.03 | 1.01 | 1.47 | 1.28 | 1.27 | 1.18 | 1.16 |
| His | 0.50 | 0.50 | 0.46 | 0.45 | 0.45 | 0.59 | 0.53 | 0.53 | 0.51 | 0.52 |
| Ile | 0.85 | 0.83 | 0.77 | 0.77 | 0.75 | 1.01 | 0.90 | 0.90 | 0.86 | 0.85 |
| Leu | 1.60 | 1.57 | 1.47 | 1.43 | 1.41 | 1.86 | 1.67 | 1.66 | 1.58 | 1.57 |
| Lys | 1.27 | 1.29 | 1.24 | 1.28 | 1.27 | 1.48 | 1.38 | 1.43 | 1.38 | 1.41 |
| Met | 0.42 | 0.43 | 0.42 | 0.48 | 0.50 | 0.49 | 0.49 | 0.54 | 0.51 | 0.55 |
| Phe | 0.94 | 0.91 | 0.84 | 0.82 | 0.80 | 1.12 | 0.99 | 0.98 | 0.92 | 0.90 |
| Thr | 0.85 | 0.85 | 0.84 | 0.85 | 0.86 | 0.98 | 0.94 | 0.98 | 0.91 | 0.93 |
| Trp | 0.19 | 0.21 | 0.19 | 0.20 | 0.20 | 0.24 | 0.21 | 0.23 | 0.23 | 0.21 |
| Val | 0.96 | 0.97 | 0.94 | 0.94 | 0.94 | 1.11 | 1.03 | 1.06 | 1.06 | 1.09 |
| Non-essential AAs | | | | | | | | | | |
| Ala | 0.93 | 0.92 | 0.86 | 0.83 | 0.83 | 1.07 | 0.97 | 0.95 | 0.92 | 0.91 |
| Asp | 1.90 | 1.84 | 1.68 | 1.62 | 1.57 | 2.31 | 2.00 | 1.99 | 1.84 | 1.82 |
| Cys | 0.31 | 0.30 | 0.28 | 0.27 | 0.27 | 0.35 | 0.31 | 0.31 | 0.30 | 0.30 |
| Glu | 3.45 | 3.37 | 3.12 | 3.02 | 2.94 | 4.11 | 3.64 | 3.60 | 3.39 | 3.34 |
| Gly | 0.77 | 0.75 | 0.70 | 0.67 | 0.66 | 0.91 | 0.81 | 0.80 | 0.75 | 0.74 |
| Pro | 1.08 | 1.05 | 1.00 | 0.98 | 0.97 | 1.21 | 1.11 | 1.10 | 1.07 | 1.06 |
| Ser | 0.77 | 0.75 | 0.70 | 0.67 | 0.64 | 0.89 | 0.80 | 0.79 | 0.75 | 0.72 |
| Tyr | 0.64 | 0.61 | 0.58 | 0.56 | 0.55 | 0.74 | 0.67 | 0.66 | 0.62 | 0.62 |

[1] Samples were analyzed for proximate analysis and complete AA profile (University of Missouri Agricultural Experiment Station Chemical Laboratory).

**Table 4. Interactive effects of SID Lys:CP and SID Lys on growth performance[1]**

| | SID Lys,% | | | | | | | | | | | *P* = | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1.15 | | | | | 1.30 | | | | | | SID Lys:CP × SID Lys | | |
| SID Lys:CP: | 6.00 | 6.22 | 6.46 | 6.72 | 7.00 | 6.00 | 6.22 | 6.46 | 6.72 | 7.00 | SEM | Linear | Quadratic | SID Lys[2] |
| BW, lb | | | | | | | | | | | | | | |
| d 0 | 28.7 | 28.6 | 28.6 | 28.3 | 28.7 | 28.5 | 29.0 | 28.8 | 29.0 | 28.7 | 0.59 | 0.474 | 0.207 | 0.230 |
| d 7 | 36.8 | 36.9 | 36.8 | 36.6 | 36.6 | 37.0 | 37.8 | 37.5 | 37.4 | 37.1 | 0.68 | 0.697 | 0.418 | 0.003 |
| d 14 | 46.9 | 46.7 | 46.8 | 46.5 | 46.6 | 47.0 | 48.3 | 47.6 | 47.6 | 47.4 | 0.89 | 0.602 | 0.253 | 0.002 |
| d 21 | 58.1 | 57.7 | 57.7 | 57.5 | 57.6 | 58.1 | 59.4 | 58.7 | 58.7 | 58.4 | 0.87 | 0.654 | 0.212 | 0.004 |
| Period 1 (d 0 to 7) | | | | | | | | | | | | | | |
| ADG, lb | 1.15 | 1.18 | 1.17 | 1.18 | 1.13 | 1.22 | 1.24 | 1.25 | 1.21 | 1.20 | 0.035 | 0.696 | 0.593 | < 0.0001 |
| ADFI, lb | 1.65 | 1.64 | 1.66 | 1.72 | 1.72 | 1.63 | 1.64 | 1.67 | 1.66 | 1.66 | 0.063 | 0.236 | 0.505 | 0.184 |
| G:F | 0.70 | 0.72 | 0.71 | 0.69 | 0.66 | 0.75 | 0.76 | 0.75 | 0.73 | 0.73 | 0.019 | 0.279 | 0.077 | < 0.0001 |
| F/G[3] | 1.44 | 1.40 | 1.42 | 1.45 | 1.52 | 1.34 | 1.32 | 1.34 | 1.37 | 1.38 | 0.034 | ----- | ----- | ----- |
| Period 2 (d 7 to 14) | | | | | | | | | | | | | | |
| ADG, lb | 1.45 | 1.39 | 1.42 | 1.40 | 1.42 | 1.43 | 1.48 | 1.44 | 1.44 | 1.46 | 0.041 | 0.641 | 0.330 | 0.038 |
| ADFI, lb | 2.12 | 2.11 | 2.15 | 2.18 | 2.23 | 2.10 | 2.18 | 2.14 | 2.16 | 2.16 | 0.053 | 0.265 | 0.337 | 0.635 |
| G:F[4] | 0.68 | 0.66 | 0.66 | 0.64 | 0.64 | 0.68 | 0.68 | 0.68 | 0.67 | 0.68 | 0.009 | 0.008 | 0.885 | < 0.0001 |
| F/G[3] | 1.47 | 1.52 | 1.51 | 1.56 | 1.57 | 1.47 | 1.47 | 1.48 | 1.50 | 1.48 | 0.020 | ----- | ----- | ----- |
| Periods 1 & 2 (d 0 to 14) | | | | | | | | | | | | | | |
| ADG, lb | 1.30 | 1.28 | 1.30 | 1.29 | 1.28 | 1.32 | 1.36 | 1.34 | 1.33 | 1.33 | 0.027 | 0.917 | 0.720 | 0.0001 |
| ADFI, lb | 1.89 | 1.88 | 1.90 | 1.95 | 1.97 | 1.87 | 1.91 | 1.90 | 1.91 | 1.91 | 0.047 | 0.165 | 0.319 | 0.291 |
| G:F[5] | 0.69 | 0.68 | 0.68 | 0.66 | 0.65 | 0.71 | 0.71 | 0.71 | 0.70 | 0.70 | 0.010 | 0.0002 | 0.133 | < 0.0001 |
| F/G[3] | 1.45 | 1.46 | 1.47 | 1.51 | 1.54 | 1.41 | 1.40 | 1.42 | 1.44 | 1.44 | 0.020 | ----- | ----- | ----- |
| Period 3 (d 14 to 21) | | | | | | | | | | | | | | |
| ADG, lb | 1.60 | 1.57 | 1.56 | 1.58 | 1.56 | 1.58 | 1.59 | 1.57 | 1.58 | 1.57 | 0.027 | 0.673 | 0.519 | 0.694 |
| ADFI, lb | 2.55 | 2.56 | 2.53 | 2.56 | 2.58 | 2.50 | 2.52 | 2.51 | 2.55 | 2.55 | 0.035 | 0.638 | 0.551 | 0.125 |
| G:F | 0.63 | 0.61 | 0.61 | 0.62 | 0.61 | 0.63 | 0.63 | 0.63 | 0.62 | 0.62 | 0.009 | 0.888 | 0.875 | 0.012 |
| F/G[3] | 1.60 | 1.63 | 1.63 | 1.62 | 1.65 | 1.59 | 1.58 | 1.60 | 1.61 | 1.62 | 0.023 | ----- | ----- | ----- |
| Overall (d 0 to 21) | | | | | | | | | | | | | | |
| ADG, lb | 1.40 | 1.38 | 1.38 | 1.39 | 1.37 | 1.41 | 1.44 | 1.42 | 1.41 | 1.41 | 0.019 | 0.785 | 0.586 | 0.001 |
| ADFI, lb | 2.11 | 2.10 | 2.11 | 2.15 | 2.17 | 2.08 | 2.11 | 2.10 | 2.12 | 2.12 | 0.038 | 0.450 | 0.369 | 0.157 |
| G:F[6] | 0.66 | 0.66 | 0.66 | 0.65 | 0.63 | 0.68 | 0.68 | 0.68 | 0.67 | 0.67 | 0.007 | 0.012 | 0.298 | < 0.0001 |
| F/G[3] | 1.51 | 1.53 | 1.53 | 1.55 | 1.59 | 1.48 | 1.47 | 1.48 | 1.51 | 1.50 | 0.015 | ----- | ----- | ----- |

[1] A total of 4,167 pigs (initially 28.7 ± 0.59 lb) were used in a 21-d growth study with 26 pigs per pen (52 pigs per feeder) and eight replications per treatment.
[2] Main effect of SID Lys.
[3] F/G was calculated taking the inverse of G:F. *P*-values are the same as reported for G:F.
[4] Linear effect of SID Lys:CP in 1.15% SID Lys, $P < 0.0001$. Linear effect of SID Lys:CP in 1.30% SID Lys, $P = 0.264$.
[5] Quadratic effect of SID Lys:CP in 1.15% SID Lys, $P = 0.016$. Quadratic effect of SID Lys:CP in 1.30% SID Lys, $P = 0.777$; Linear effect of SID Lys:CP in 1.15% SID Lys, $P < 0.0001$. Linear effect of SID Lys:CP in 1.30% SID Lys, $P = 0.0004$.
[6] Quadratic effect of SID Lys:CP in 1.15% SID Lys, $P = 0.072$. Quadratic effect of SID Lys:CP in 1.30% SID Lys, $P = 0.745$; Linear effect of SID Lys:CP in 1.15% and 1.30% SID Lys, $P < 0.0001$.

**Table 5. Main effect of SID Lys:CP ratio on growth performance[1]**

| | SID Lys:CP ratio | | | | | | *P* = | |
|---|---|---|---|---|---|---|---|---|
| | 6.00 | 6.22 | 6.46 | 6.72 | 7.00 | SEM | Linear | Quadratic |
| BW, lb | | | | | | | | |
| d 0 | 28.6 | 28.8 | 28.7 | 28.7 | 28.7 | 0.56 | 0.944 | 0.704 |
| d 7 | 36.9 | 37.3 | 37.1 | 37.0 | 36.9 | 0.64 | 0.615 | 0.217 |
| d 14 | 47.0 | 47.5 | 47.2 | 47.1 | 47.0 | 0.84 | 0.731 | 0.418 |
| d 21 | 58.1 | 58.6 | 58.2 | 58.1 | 58.0 | 0.79 | 0.597 | 0.580 |
| Period 1 (d 0 to 7) | | | | | | | | |
| ADG, lb | 1.18 | 1.21 | 1.21 | 1.20 | 1.17 | 0.031 | 0.327 | 0.043 |
| ADFI, lb | 1.64 | 1.64 | 1.66 | 1.69 | 1.69 | 0.060 | 0.028 | 0.896 |
| G:F | 0.72 | 0.74 | 0.73 | 071 | 0.70 | 0.019 | < 0.0001 | 0.004 |
| F/G[2,3] | 1.39 | 1.36 | 1.38 | 1.41 | 1.45 | 0.032 | ----- | ----- |
| Period 2 (d 7 to 14) | | | | | | | | |
| ADG, lb | 1.44 | 1.44 | 1.43 | 1.42 | 1.44 | 0.037 | 0.905 | 0.593 |
| ADFI, lb | 2.11 | 2.15 | 2.14 | 2.17 | 2.20 | 0.046 | 0.013 | 0.989 |
| G:F | 0.68 | 0.67 | 0.67 | 0.65 | 0.66 | 0.008 | 0.0001 | 0.274 |
| F/G[2,3] | 1.47 | 1.50 | 1.50 | 1.53 | 1.53 | 0.017 | ----- | ----- |
| Periods 1 & 2 (d 0 to 14) | | | | | | | | |
| ADG, lb | 1.31 | 1.32 | 1.32 | 1.31 | 1.30 | 0.024 | 0.502 | 0.397 |
| ADFI, lb | 1.88 | 1.89 | 1.90 | 1.93 | 1.94 | 0.043 | 0.004 | 0.953 |
| G:F | 0.70 | 0.70 | 0.70 | 0.68 | 0.67 | 0.009 | < 0.0001 | 0.056 |
| F/G[2,3] | 1.43 | 1.43 | 1.44 | 1.48 | 1.49 | 0.019 | ----- | ----- |
| Period 3 (d 14 to 21) | | | | | | | | |
| ADG, lb | 1.59 | 1.58 | 1.56 | 1.58 | 1.57 | 0.022 | 0.424 | 0.743 |
| ADFI, lb | 2.52 | 2.54 | 2.52 | 2.55 | 2.56 | 0.026 | 0.194 | 0.685 |
| G:F | 0.63 | 0.62 | 0.62 | 0.62 | 0.61 | 0.007 | 0.004 | 0.974 |
| F/G[2] | 1.59 | 1.61 | 1.62 | 1.62 | 1.64 | 0.019 | ----- | ----- |
| Overall (d 0 to 21) | | | | | | | | |
| ADG, lb | 1.40 | 1.41 | 1.40 | 1.40 | 1.39 | 0.015 | 0.395 | 0.642 |
| ADFI, lb | 2.09 | 2.11 | 2.11 | 2.14 | 2.15 | 0.033 | 0.013 | 0.874 |
| G:F | 0.67 | 0.67 | 0.67 | 0.66 | 0.65 | 0.007 | < 0.0001 | 0.132 |
| F/G[2,3] | 1.49 | 1.50 | 1.51 | 1.53 | 1.54 | 0.015 | ----- | ----- |

[1] A total of 4,167 pigs (initially 28.7 ± 0.59 lb) were used in a 21-d growth study with approximately 26 pigs per pen (52 pigs per feeder) and 16 replicates per treatment.
[2] F/G was calculated taking the inverse of G:F. *P*-values are the same as reported for G:F
[3] SID Lys:CP × SID Lys interaction ($P < 0.05$).