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Evaluation of Phase Feeding and Complete Diet Blending at Different Standardized Ileal Digestible Lysine Levels on Growing-Finishing Pigs' Growth Performance, Carcass Characteristics, and Diet Economics[1]

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Summary

A total of 2,160 mixed-gender pigs (PIC 337 × 1050; initially 54.8 ± 9.4 lb) were used in the 120-d study to compare feeding strategies (phase feeding vs. complete diet blending) at different SID Lys levels (90 vs. 100% of requirement estimates) on finishing pig growth performance, carcass characteristics, and economics. Pens of pigs were randomly assigned to 1 of 4 treatments following a completely randomized block design with barn and initial body weight as blocking factors. The treatments included two feeding programs, a 5-phase feeding strategy at either 90% (Phase-90) or 100% of SID Lys requirement estimates (Phase-100); or two programs with complete diet blending, with pre-defined mixing proportions of a low and high SID Lys diet to meet 90 (Blend-90) or 100% (Blend-100) of the SID Lys curve requirement estimates for 50- to 280-lb pigs. Pigs in the phase-feeding strategies were fed on a feed budget with 47, 144, 147, 138, and 136 lb of feed per pig for phases 1 to 5, respectively. Body weights at any period of the trial and overall ADG (d 0 to 120) were not affected by the feeding strategy nor by diet SID Lys levels. In contrast, the overall ADFI of pigs fed by diet blending was lower than the ADFI of those fed by phase feeding ($P = 0.002$), resulting in improved F/G ($P < 0.001$). The SID Lys levels did not influence overall ADFI or F/G. Hot carcass weight, carcass yield, lean percentage, fat depth, and loin depth were not affected by the feeding program. Despite the lower overall ADFI of pigs fed by diet blending, the feeding strategy resulted in no significant differences in economic criteria except for feed cost per lb of gain at the high price scenario ($P = 0.049$). With low diet cost, the 90% SID Lys level resulted in lower feed cost per pig and feed cost per lb of gain than 100% SID Lys, but this was not reflected in income over feed cost (IOFC).

[1] Appreciation is expressed to ComDel Innovation (Wahpeton, ND) for partial financial support of this trial.

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In conclusion, diet blending at either 90 or 100% of the SID Lys requirement estimate improved F/G by reducing ADFI without impacting ADG or carcass characteristics. At current prices used in this study, feeding strategies at either 90 or 100% SID Lys did not significantly affect IOFC, but feeding 90% of the SID Lys recommendation reduced the feed cost.

Introduction

Modern pig production aims to maximize animal performance while reducing nutrient excretion. An efficient way to reduce the excretion of excess nutrients is to adjust nutrients in feed based on the pig's requirements, which progressively decrease over time.[4] Traditionally, pigs are fed in 2 to 5 dietary phases with varying SID Lys to calorie ratios. The ratios are oftentimes calculated at the middle of the weight range for each phase, and this consequently results in underfeeding the pigs at the first half of the phase and over-feeding them at the second half of the phase. While increasing the number of phases has shown economic and environmental advantages, it also complicates feeding management and may increase facility cost.[5]

Curve or blend feeding strategies offer the opportunity to match the daily requirements of the pigs by blending 2 basal diets at calculated proportions. This strategy is more feasible with the availability of an automatic feeding system. While studies have been conducted in this area, results on performance and economics are conflicting. Therefore, the objective of this study was to compare feeding strategies: phase feeding vs. complete diet blending at different SID Lys levels on growing-finishing pigs' growth performance, carcass characteristics, and diet economics.

Procedures

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in this experiment. The study was conducted at a commercial research-finishing site in southwest Minnesota. The barns were naturally ventilated and double-curtain-sided. Each pen was equipped with a 5-hole stainless steel dry self-feeder and a bowl waterer for *ad libitum* access to feed and water. Daily feed additions to each pen were accomplished using a robotic feeding system (FeedPro, FeedLogic by ComDel Innovation, Wahpeton, ND) able to record feed amounts for individual pens.

Animals and diets

A total of 2,160 pigs (PIC 337 × 1050, Hendersonville, TN) initially 54.8 ± 9.4 lb were used. Pigs were housed in mixed gender pens with 27 pigs per pen and 20 pens per treatment. Pens of pigs were allotted to 1 of 4 feeding strategies following a completely randomized block design, with barn and initial BW as blocking factors. The four treatments followed a 2 × 2 factorial comparing 2 feeding strategies (phase feeding vs. complete diet blending) and 2 SID Lys levels (90 or 100% of PIC 2021[6] requirement estimates). Diets in phase feeding strategies were provided from 50 to 75, 75 to 140, 140 to 195, 195 to 240, and 240 to 280 lb. Pigs were fed on a feed budget set at 47, 144,

[4] Nutrient Requirements of Swine: Eleventh Revised Edition. 2012. National Academies Press, Washington, D.C.

[5] Pomar, C., I. Andretta, and A. Remus. 2021. Feeding Strategies to Reduce Nutrient Losses and Improve the Sustainability of Growing Pigs. Front. Vet. Sci. 8:742220. doi:10.3389/fvets.2021.742220.

[6] Pig Improvement Company. 2021. PIC Nutrition and Feeding Guidelines. Available at: https://www.pic.com/resources/pic-nutrition-and-feeding-guidelines-imperial/

147, 138, and 136 lb of feed per pig for phases 1 to 5, respectively. Diets were formulated to contain 4.38, 3.73, 3.06, 2.66, and 2.44 g SID Lys per Mcal NE for phases 1 to 5, respectively, for 90% SID Lys (Phase-90), and 4.86, 4.15, 3.40, 2.96, and 2.71 g SID Lys per Mcal NE for phases 1 to 5, respectively, for 100% SID Lys (Phase-100). Phase changes took place when the allotted feed budgets were consumed on a barn basis. For the diet blending, low and high SID Lys diets were formulated to contain 2.37 and 5.09 g SID Lys per Mcal NE. These diets were blended daily at different proportions until the pigs reached 255 lb to meet the targeted 90 and 100% of the SID Lys curve (Blend-90 and Blend-100), respectively. When pigs reached 255 lb, pigs in Blend-90 and Blend-100 were fed the phase 5 diet of Phase-90 and Phase-100, respectively. The diet blends for Blend-90 and Blend-100 are presented in Figure 1. The ratios of other essential SID AA to SID Lys were set to meet PIC (2021)[6] recommendations (Tables 1 and 2).

The number of pigs per pen, pen weight, and feed delivery were determined approximately every 14 d to calculate ADG, ADFI, and F/G. Four weeks prior to the termination of the trial, the 3 heaviest pigs in each pen were selected and marketed. The remaining pigs at the end of the trial were tattooed with the specific pen identification number and marketed at a commercial abattoir (JBS Swift, Worthington, MN) for collection of standard carcass measurements. Standard carcass measurements (carcass yield, backfat, loin depth, percentage lean, and hot carcass weight) were collected for each individual carcass.

Diet costs were calculated as the sum of the formula cost, grinding, mixing, and delivery costs. Total feed costs per pig were calculated as the product of treatment-associated diet costs and the total feed intake. Feed cost per pig and feed cost per pound of gain were calculated following high and low diet cost scenarios. Total revenue and income over feed cost were also calculated under high and low carcass-based price scenarios.

Statistical analysis

Data on a 2 × 2 factorial were analyzed as a randomized complete block using R (Version 4.3.1, R Core Team, Vienna, Austria), with pen serving as the experimental unit and barn and initial body weight as the blocking factors included as random effects. During the trial, one pen of pigs fed Blend-90 was removed due to an error in feed delivery. For HCW, pigs served as the experimental unit, and pen was included as random effect. For the carcass characteristics, the HCW was used as a covariate. Results were considered significant at $P \leq 0.05$, and marginally significant (tendency) at $P \leq 0.10$.

Results and Discussion

There were no interactive and main effects of feeding strategy and SID Lys observed for BW at any period of the study. Similarly, overall ADG was not influenced by feeding strategy or SID Lys level. Phase feeding strategy tended to improve ($P = 0.054$ and $P = 0.090$) ADG from d 0 to 16 and d 94 to 108 of the feeding trial. Also, 90% dietary SID Lys level improved ($P = 0.030$) ADG from d 58 to 72 of the feeding trial but did not influence overall ADG. For ADFI, no interactions between feeding strategy and SID Lys level were observed for many periods of the trial. However, pigs fed by diet blending had lower ADFI than those fed by phase feeding ($P < 0.05$) in many feeding periods and overall. In contrast, no difference in ADFI was observed between pigs fed

90 or 100% SID Lys except from d 0 to 16 ($P = 0.05$). The lower ADFI at d 16 to 29, d 58 to 72, d 72 to 94, and d 0 to 120 (overall) drove an improvement in F/G observed for pigs fed the diet blending feeding strategy ($P < 0.002$). The similar ADFI observed in pigs fed 90 or 100% of the SID Lys recommendation resulted in no significant differences in F/G except from d 0 to 16 ($P < 0.001$). The impact of feeding strategy on BW and overall ADG agrees with the study of Frobose et al.[7] where they also observed a reduction in ADFI and improvement in F/G in pigs fed with diet blending. However, a subsequent study by Frobose et al.[8] did not find differences in ADG, ADFI, or F/G.

For carcass characteristics, no treatment effects were observed in HCW, carcass yield, lean percentage, fat depth and loin depth. Moore et al.[9] also observed no difference in carcass characteristics among phase feeding, diet blending, or a single diet fed throughout the entire trial. Numerically, percentage lean was higher and fat depth was lowest in pigs fed 100% versus 90% SID Lys.

For economics, no interactive effect of feeding strategy and SID Lys was observed for any diet economics criteria using either the low or high price scenario. At the low price scenario, feed cost per pig and pig cost per lb of gain were lower ($P < 0.001$) for pigs fed 90% than 100% SID Lys levels. Revenue was not affected by feeding strategy or SID Lys level. Feeding 100% SID Lys resulted in numerically higher revenue, which resulted in similar IOFC between the two Lys levels. On the other hand, while ADFI was lower in pigs fed via diet blending, the cost of the blended diets was higher than the weighted cost of the 5-phase diets in phase feeding, resulting in a tendency of higher IOFC in phase feeding strategy ($P = 0.066$). At the high price scenario, feed cost per pig and feed cost per lb of gain were lower in pigs fed 90% than 100% SID Lys levels, which can be attributed to lower diet cost. Additionally, feed cost per lb of gain was lower for pigs fed via diet blending and this followed the trend of F/G. Congruent to the low price scenario, revenue and IOFC at the high price scenario were neither affected by feeding strategy nor SID Lys levels.

In conclusion, diet blending improved F/G by reducing ADFI without affecting ADG and carcass traits. The improvement in F/G with diet blending was not reflected in diet economics at low price scenario due to the higher formulation costs of the diets used for blending than the diets used in phase feeding. In contrast, at the high price scenario, diet blending resulted in lower feed cost per lb of gain due to the high economic value of F/G at high feed costs. No differences in growth performance and carcass characteristics were observed with 100 and 90% SID Lys; but feeding 90% SID Lys resulted in lower feed cost per pig and per lb of gain. Notably, the diet economics in the current study does not account for the potential savings related to feed mill logistics and improved mill efficiency when 2 diets are used instead of 5 diets for growing-finishing

[7] Frobose, H.L., J.M. DeRouchey, D. Ryder, M.D. Tokach, S.S. Dritz, R.D. Goodband, and J.L. Nelssen. 2010. The effects of feed budgeting, complete diet blending, and corn-supplement blending on finishing pig growth performance in a commercial environment. Kansas Swine Industry Day Report of Progress 1038, pp 242-252. https://newprairiepress.org/kaesrr/vol0/iss10/17/

[8] Frobose, H.L., J.M. DeRouchey, D. Ryder, M.D. Tokach, S.S. Dritz, R.D. Goodband, and J.L. Nelssen. 2012. Evaluation of feeding budgeting strategy or complete diet blending on finishing pig growth performance and carcass characteristics. Kansas Swine Industry Day Report of Progress 1074, pp. 365-375. https://newprairiepress.org/kaesrr/vol0/iss10/1237/

[9] Moore, K.L., B.P. Mullan, and J.C. Kim. 2013. Blend-feed or feeding a single diet to pig has no impact on growth performance or carcass quality. Animal Production Science. 53(1):52-56.

pigs. Further research is warranted to assess the economic benefits of diet blending when used in different blending strategies.

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Table 1. Diet composition of the phase-feeding treatments (as-fed basis)[1]

	90% SID Lys[2]					100% SID Lys[2]				
Items	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Ingredient, %										
Corn	70.47	76.33	82.41	85.80	87.33	66.52	72.80	79.59	83.71	85.87
Soybean meal, 47.7%[3]	25.93	20.45	14.76	11.82	10.45	29.81	23.96	17.49	13.83	11.78
Limestone	1.17	1.10	1.00	0.93	0.90	1.17	1.10	1.03	0.93	0.90
Monocalcium phosphate, 21%	0.83	0.63	0.48	0.23	0.15	0.78	0.56	0.45	0.20	0.15
Salt	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Liquid lysine, 55%	0.51	0.48	0.44	0.39	0.35	0.54	0.50	0.47	0.44	0.42
Thr[4]	0.19	0.16	0.13	0.10	0.08	0.22	0.18	0.14	0.12	0.12
DL-Met	0.14	0.10	0.05	0.01	0.00	0.17	0.12	0.07	0.04	0.02
L-Trp	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
L-Val	0.05	0.03	0.01	0.00	0.00	0.07	0.04	0.02	0.00	0.00
Tribasic copper chloride	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Vitamins and trace mineral	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Phytase[5]	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Total	100	100	100	100	100	100	100	100	100	100

continued

Table 1. Diet composition of the phase-feeding treatments (as-fed basis)[1]

	90% SID Lys[2]					100% SID Lys[2]				
Items	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Calculated analysis										
SID amino acids, %										
Lys	1.09	0.94	0.78	0.69	0.63	1.21	1.04	0.87	0.76	0.70
Ile:Lys	60	60	60	62	63	60	60	60	60	60
Met:Lys	36	35	33	30	31	37	35	34	32	31
Met and Cys:Lys	60	60	60	60	61	60	60	60	60	60
Thr:Lys	65	65	65	65	66	65	65	65	65	66
Trp:Lys	19	18	19	19	19	19	19	19	19	19
Val:Lys	70	70	70	72	75	70	70	70	70	71
Leu:Lys	129	137	148	159	169	125	132	141	150	156
His:Lys	40	41	43	45	47	39	40	42	43	44
Total Lys, %	1.22	1.06	0.88	0.78	0.72	1.35	1.17	0.97	0.86	0.79
NE, kcal/lb	1,133	1,146	1,159	1,168	1,171	1,127	1,140	1,154	1,164	1,169
SID Lys:NE, g/Mcal	4.38	3.73	3.06	2.66	2.44	4.86	4.15	3.40	2.96	2.71
CP, %[6]	18.78	16.57	14.27	13.06	12.49	20.39	18.01	15.39	13.92	13.09
Ca, %	0.70	0.62	0.54	0.45	0.43	0.70	0.62	0.55	0.46	0.43
P, %	0.55	0.48	0.42	0.36	0.33	0.55	0.48	0.43	0.36	0.34
STTD P (with phytase), %	0.43	0.38	0.33	0.28	0.26	0.43	0.37	0.33	0.28	0.26
Diet cost/ton (low), US $[7]	194.20	179.25	163.94	154.32	150.13	204.86	188.36	171.56	160.63	155.31
Diet cost/ton (high), US $[8]	316.60	301.13	285.38	274.97	270.46	328.11	310.79	293.62	282.13	276.75

[1] Diets in phase feeding strategies were provided from 50 to 75 lb, 75 to 140 lb, 140 to 195 lb, 195 to 240 lb, and 240 to 280 lb. Pigs in phase feeding strategies were set to receive feed budgets of 47, 144, 147, 138, and 136 lb of feed per pig for phases 1 to 5, respectively.

[2] SID Lys levels represent 90 or 100% of the PIC (2021) SID Lys to calorie ratio recommended for growing-finishing pigs.

[3] Net energy of soybean meal is 85% of the NE of corn.

[4] Thr Pro (CJ America) with SID Thr of 80%.

[5] Optiphos Plus 2500 G (Huvepharma, St. Joseph, MO) provided 567.5 FTU/lb diet with an assumed release of 0.13% available P.

[6] CP = crude protein.

[7] Low price scenario ($/lb) - corn: 0.05, SBM: 0.15, monocalcium phosphate: 0.23, DL-methionine: 1.70, L-Trp: 3.00, L-Val: 2.50, liquid Lys: 0.85, Thr Pro: 0.80, carcass: 59 $/cwt. Grind, mix and deliver (GMD) = $15/ton.

[8] High price scenario ($/lb) - corn: 0.11, SBM: 0.20, monocalcium phosphate: 0.28, DL-methionine: 2.50, L-Trp: 5.00, L-Val: 4.00, liquid Lys: 1.36, Thr Pro: 1.28, carcass: 88 $/cwt. Grind, mix and deliver (GMD) = $15/ton.

Table 2. Diet composition of the low and high SID Lys diets used in diet blending treatments (as-fed basis)[1]

Item	Low Lys	High Lys
Ingredient, %		
Corn	87.31	64.50
Soybean meal, 47.7%[2]	10.52	31.82
Limestone	0.90	1.18
Monocalcium phosphate, 21%	0.15	0.78
Salt	0.56	0.53
Liquid lysine, 55%	0.32	0.55
Thr[3]	0.06	0.23
DL-Met	0.00	0.19
L-Trp	0.01	0.02
L-Val	0.00	0.07
Tribasic copper chloride	0.03	0.03
Vitamins and trace mineral	0.10	0.10
Phytase[4]	0.05	0.05
Total	100	100

continued

Table 2. Diet composition of the low and high SID Lys diets used in diet blending treatments (as-fed basis)[1]

Item	Low Lys	High Lys
Calculated analysis		
SID amino acids, %		
Lys	0.61	1.26
Ile:Lys	65	60
Met:Lys	32	37
Met and Cys:Lys	63	60
Thr:Lys	66	65
Trp:Lys	19	19
Val:Lys	78	70
Leu:Lys	174	123
His:Lys	48	39
Total lys, %	0.70	1.41
NE, kcal/lb	1,171	1,123
SID lys:NE, g/Mcal	2.37	5.09
CP, %[5]	12.48	21.20
Ca, %	0.43	0.71
P, %	0.33	0.56
STTD P (with phytase), %	0.26	0.43
Diet cost/ton (low), US $[6]	149.11	209.58
Diet cost/ton (high), US $[7]	268.74	332.80

[1] For the diet blending strategies, diets were blended at different proportions on a daily basis to meet the targeted 90 and 100% of the SID Lys curve for curve-90% and curve-100%, respectively.
[2] Net energy of soybean meal is 85% of the NE of corn.
[3] Thr Pro (CJ America) with SID Thr of 80%.
[4] Optiphos Plus 2500 G (Huvepharma, St. Joseph, MO) provided 567.5 FTU/lb diet with an assumed release of 0.13% available P.
[5] CP = crude protein.
[6] Low price scenario ($/lb) - corn: 0.05, SBM: 0.15, monocalcium phosphate: 0.23, DL-methionine: 1.70, L-Trp: 3.00, L-Val: 2.50, liquid Lys: 0.85, Thr Pro: 0.80, carcass: 59 $/cwt. Grinding, mixing and deliver (GMD) = $15/ton.
[7] High price scenario ($/lb) - corn: 0.11, SBM: 0.20, monocalcium phosphate: 0.28, DL-methionine: 2.50, L-Trp: 5.00, L-Val: 4.00, liquid Lys: 1.36, Thr Pro: 1.28, carcass: 88 $/cwt. Grinding, mixing and deliver (GMD) = $15/ton.

Table 3. Effects of phase feeding vs. complete diet blending and SID Lys on finishing pig growth performance

Feeding strategy:	Phase feeding[1]		Diet blending[2]			*P* =		
SID Lys level[3]:	90%	100%	90%	100%	SEM	Strategy × Lys	Strategy	SID Lys
Body weight, lb								
d 0	54.7	54.7	54.8	54.7	2.13	0.995	0.913	0.835
d 16	81.7	81.5	80.5	81.0	2.94	0.642	0.161	0.820
d 29	110.2	110.0	109.5	110.2	3.28	0.579	0.767	0.727
d 44	141.5	140.9	140.3	141.0	3.67	0.501	0.576	0.978
d 58	173.7	173.5	172.6	172.9	3.75	0.847	0.476	0.999
d 72	203.7	201.7	202.4	202.3	3.60	0.412	0.765	0.376
d 94	239.9	237.7	238.9	238.9	3.41	0.414	0.926	0.394
d 108	261.6	258.6	259.3	259.8	3.77	0.253	0.736	0.389
d 120	283.2	281.4	282.5	282.3	3.67	0.676	0.973	0.588
Day 0 to 16								
ADG, lb	1.71	1.71	1.65	1.68	0.067	0.515	0.054	0.500
ADFI, lb	3.20	3.06	3.05	3.02	0.116	0.239	0.025	0.050
F/G	1.87	1.79	1.86	1.81	0.023	0.499	0.993	<0.001
Day 16 to 29								
ADG, lb	2.03	2.04	2.05	2.09	0.043	0.515	0.139	0.427
ADFI, lb	4.14	4.13	3.95	4.02	0.117	0.348	0.001	0.522
F/G	2.03	2.02	1.93	1.93	0.042	0.700	<0.001	0.776
Day 29 to 44								
ADG, lb	2.23	2.20	2.18	2.19	0.041	0.376	0.214	0.629
ADFI, lb	4.80	4.85	4.75	4.74	0.111	0.537	0.109	0.678
F/G	2.16	2.21	2.17	2.16	0.024	0.082	0.432	0.289
Day 44 to 58								
ADG, lb	2.28	2.32	2.31	2.27	0.031	0.075	0.554	0.953
ADFI, lb	5.65[a]	5.42[b]	5.49[ab]	5.53[ab]	0.101	0.011	0.609	0.093
F/G	2.48[a]	2.34[c]	2.38[bc]	2.44[ab]	0.038	<0.001	0.908	0.054
Day 58 to 72								
ADG, lb	2.11	2.03	2.11	2.07	0.052	0.540	0.464	0.030
ADFI, lb	5.92	5.88	5.70	5.68	0.093	0.858	0.003	0.666
F/G	2.82	2.96	2.71	2.76	0.066	0.408	0.002	0.058
Day 72 to 94								
ADG, lb	1.62	1.62	1.65	1.64	0.034	0.794	0.286	0.999
ADFI, lb	5.37	5.21	5.08	5.05	0.099	0.192	<0.001	0.083
F/G	3.33	3.21	3.09	3.10	0.050	0.077	<0.001	0.104

continued

Table 3. Effects of phase feeding vs. complete diet blending and SID Lys on finishing pig growth performance

Feeding strategy:	Phase feeding[1]		Diet blending[2]			*P* =		
SID Lys level[3]:	90%	100%	90%	100%	SEM	Strategy × Lys	Strategy	SID Lys
Day 94 to 108								
ADG, lb	1.87	1.83	1.77	1.82	0.060	0.203	0.090	0.938
ADFI, lb	5.52	5.55	5.55	5.54	0.093	0.806	0.918	0.824
F/G	3.00	3.07	3.18	3.09	0.082	0.145	0.073	0.800
Day 108 to 120								
ADG, lb	1.70	1.70	1.74	1.69	0.075	0.664	0.825	0.688
ADFI, lb	5.80	5.88	5.69	5.80	0.101	0.865	0.325	0.305
F/G	3.53	3.75	3.38	3.63	0.256	0.966	0.513	0.256
Overall								
ADG, lb	1.93	1.92	1.92	1.92	0.019	0.718	0.727	0.704
ADFI, lb	5.01	4.95	4.86	4.87	0.071	0.327	0.002	0.538
F/G	2.60	2.58	2.53	2.54	0.020	0.263	<0.001	0.637

[a,b,c] Treatment means with different superscripts differ $P < 0.05$.

[1] Diets in phase feeding strategies were fed from 50 to 75, 75 to 140, 140 to 195, 195 to 240, and 240 to 280 lb. The 90% SID Lys diets were formulated to contain 4.38, 3.73, 3.06, 2.66, and 2.44 g SID Lys per Mcal NE for phases 1 to 5, respectively. The 100% SID Lys diets were formulated to contain 4.86, 4.15, 3.40, 2.96, and 2.71 g SID Lys per Mcal NE for phases 1 to 5, respectively. Pigs in phase feeding strategies were provided 47, 144, 147, 138, and 136 lb of feed per pig for phases 1 to 5, respectively.

[2] For the diet blending strategies, high and low SID Lys diets were formulated to contain 5.09 and 2.37 g SID Lys per Mcal NE. These diets were blended at different proportions on a daily basis to meet the targeted 90 and 100% of the SID Lys curve, respectively.

[3] SID Lys levels represent 90 or 100% of the PIC (2021) SID Lys to calorie ratio recommendations for growing-finishing pigs.

Table 4. Effects of phase feeding vs. complete diet blending and SID Lys on finishing pig carcass traits

Feeding strategy:	Phase feeding[1]		Diet blending[2]			*P* =		
SID Lys level[3]:	90%	100%	90%	100%	SEM	Strategy × Lys	Strategy	SID Lys
HCW, lb	213.13	213.54	211.31	211.93	2.337	0.930	0.178	0.685
Carcass yield, %[4]	74.61	74.83	73.99	74.32	0.351	0.867	0.074	0.384
Percentage lean, %[5]	56.99	57.07	57.16	57.36	0.201	0.658	0.094	0.303
Fat depth, in.[5]	0.65	0.64	0.64	0.62	0.013	0.849	0.111	0.145
Loin depth, in.[5]	2.67	2.64	2.66	2.67	0.015	0.135	0.598	0.495

[1] Diets in phase feeding strategies were provided from 50 to 75 lb, 75 to 140 lb, 140 to 195 lb, 195 to 240 lb, and 240 to 280 lb, and formulated to contain 4.38, 3.73, 3.06, 2.66, and 2.44 g SID Lys per Mcal NE for phases 1 to 5, respectively, for phase-90% and 4.86, 4.15, 3.40, 2.96, and 2.71 g SID Lys per Mcal NE for phases 1 to 5, respectively, for phase-100%. Pigs in phase feeding strategies were set to receive feed budgets of 47, 144, 147, 138, and 136 lb of feed per pig for phases 1 to 5, respectively.

[2] For the diet blending strategies, high and low SID Lys diets were formulated to contain 5.09 and 2.37 g SID Lys per Mcal NE. These diets were blended at different proportions on a daily basis to meet the targeted 90 and 100% of the SID Lys curve for curve-90% and curve-100%, respectively.

[3] SID Lys levels represent 90 or 100% of the PIC (2021) SID Lys to calorie ratio recommendation for growing-finishing pigs.

[4] Carcass yield was calculated based on adjusted live weight. Adjusted live weight = (pen live weight – total weight of light and junk pigs) / (pen inventory – number of light and junk pigs).

[5] Data were analyzed using HCW as a covariate.

Table 5. Diet economics of growing-finishing pigs fed using different feeding strategies at different SID Lys levels

Feeding strategy:	Phase feeding[1]		Diet blending[2]			*P* =		
SID Lys level[3]:	90%	100%	90%	100%	SEM	Strategy × Lys	Strategy	SID Lys
Low price[4]								
Feed cost per pig, $[6]	46.76	49.06	46.85	49.48	0.688	0.626	0.445	<0.001
Feed cost per lb of gain, $[7]	0.214	0.222	0.214	0.224	0.0020	0.221	0.505	<0.001
Total revenue, $[8]	98.40	100.52	96.25	97.37	1.707	0.754	0.102	0.312
IOFC, $/pig[9]	51.64	51.46	49.40	47.89	1.628	0.671	0.066	0.587
High price[5]								
Feed cost per pig, $[6]	81.18	83.85	80.41	83.53	1.196	0.703	0.352	<0.001
Feed cost per lb of gain, $[7]	0.372	0.379	0.366	0.378	0.0030	0.281	0.049	<0.001
Total revenue, $[8]	146.76	149.92	143.56	145.23	2.546	0.754	0.102	0.312
IOFC, $/pig[9]	65.59	66.07	63.11	61.70	2.452	0.683	0.144	0.842

[1] Diets in phase feeding strategies were provided from 50 to 75 lb, 75 to 140 lb, 140 to 195 lb, 195 to 240 lb, and 240 to 280 lb, and formulated to contain 4.38, 3.73, 3.06, 2.66, and 2.44 g SID Lys per Mcal NE for phases 1 to 5, respectively, for phase-90% and 4.86, 4.15, 3.40, 2.96, and 2.71 g SID Lys per Mcal NE for phases 1 to 5, respectively, for phase-100%. Pigs in phase feeding strategies were set to receive feed budgets of 47, 144, 147, 138, and 136 lb of feed per pig for phases 1 to 5, respectively.

[2] For the diet blending strategies, high and low SID Lys diets were formulated to contain 5.09 and 2.37 g SID Lys per Mcal NE. These diets were blended at different proportions on a daily basis to meet the targeted 90 and 100% of the SID Lys curve for curve-90% and curve-100%, respectively.

[3] SID Lys levels represent 90 or 100% of the PIC (2021) SID Lys to calorie ratio recommendation for growing-finishing pigs.

[4] Low price scenario ($/lb) - corn: 0.05, SBM: 0.15, monocalcium phosphate: 0.23, DL-methionine: 1.70, L-Trp: 3.00, L-Val: 2.50, liquid Lys: 0.85, Thr Pro: 0.80, carcass price: $59/cwt. Grind, mix and deliver (GMD) = $15/ton.

[5] High price scenario ($/lb) - corn: 0.11, SBM: 0.20, monocalcium phosphate: 0.28, DL-methionine: 2.50, L-Trp: 5.00, L-Val: 4.00, liquid Lys: 1.36, Thr Pro: 1.28, carcass price: $88/cwt. Grind, mix and deliver (GMD) = $15/ton.

[6] Feed cost per pig = total feed cost divided by number of pigs at placement. For phase-fed group, total feed cost was calculated using weighted feed cost of the 5 diet phases. For the diet blending group, total feed cost was calculated based on the cost of high and low Lys diets.

[7] Feed cost per lb of gain = total feed cost divided by the total gain.

[8] Total revenue = (total gain × carcass yield) × carcass price ($/cwt) divided by 100. Total gain includes the weight of marketed, topped, and light pigs.

[9] Income over feed cost (IOFC) = total revenue – total cost.

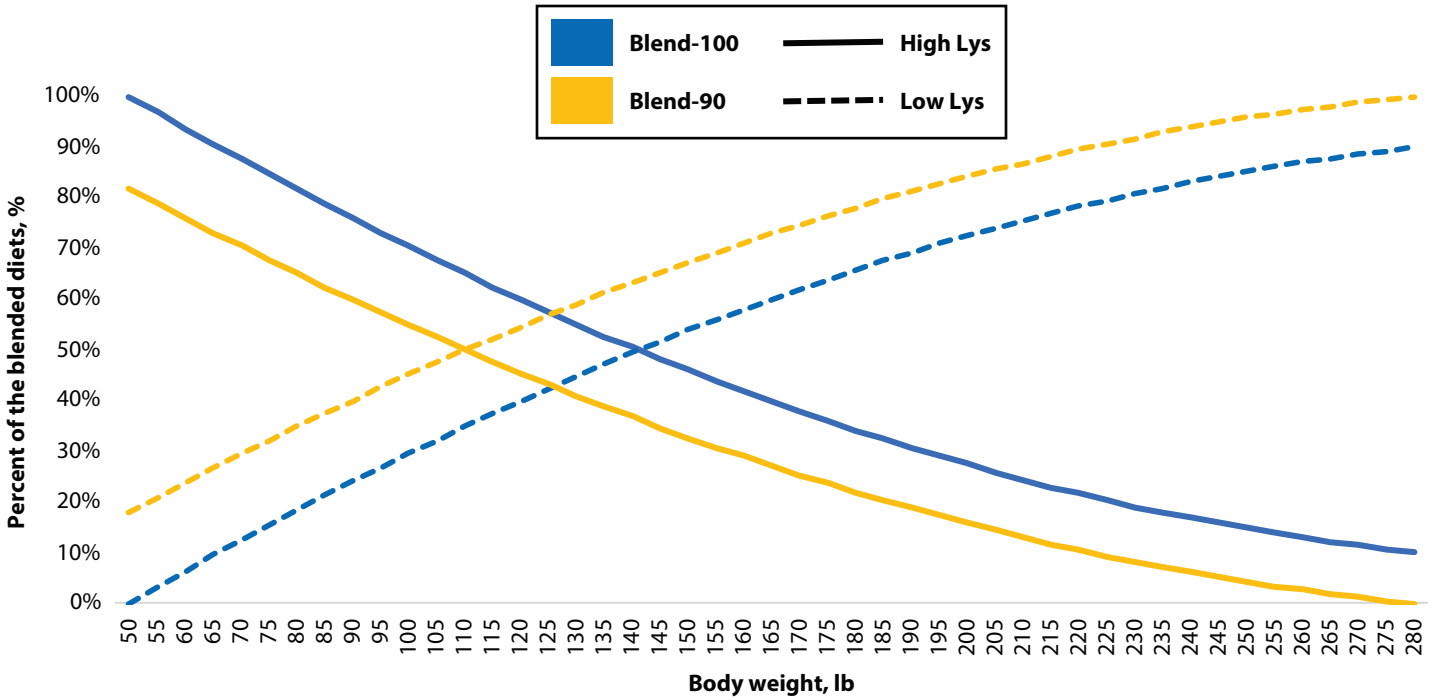

Figure 1. Blending of high Lys (solid line) and low Lys (broken line) diets for Blend-90 (yellow line) and Blend-100 (blue line). Diet blending was done daily following the feed curve from FeedPro (FeedLogic by ComDel Innovation, Wahpeton, ND).