Diet Formulation Method Influences the Response to Increasing Net Energy for Growing-Finishing Pigs

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Summary
The objective of this study was to compare the effects of increasing dietary net energy (NE) in growing-finishing diets with maintaining a standardized ileal digestible (SID) Lys:NE ratio or not adjusting this ratio and keeping SID Lysine (Lys) constant across increasing NE density. A total of 150 pigs (Line 600 Duroc × Line 241, DNA, Columbus, NE) were used in a 91-d trial. Pens of pigs were blocked by gender and BW before being randomly assigned to treatments with 2 pigs per pen and 15 pens per treatment. Treatment diets included a low-energy negative control diet and a 2 × 2 factorial arrangement of treatments with main effects of increasing dietary NE (medium vs. high) and formulation method (constant SID Lys:NE ratio vs. constant percentage SID Lys). Increasing NE increased (linear, $P = 0.001$) daily NE intake and improved (linear, $P < 0.02$) F/G with both formulation methods; however, ADG and HCW only increased (linear, $P < 0.03$) when a constant SID Lys:NE ratio was maintained as dietary NE increased. These results demonstrate the importance of maintaining a constant Lys:NE ratio when changing the NE of the diet for growing pigs.

Key words: calorie:lysine ratio, growing-finishing pig, lysine, net energy

Introduction
Increasing dietary NE can improve growth rate and feed efficiency in growing-finishing pigs. Because increasing energy density usually decreases ADFI, pigs might not consume enough nutrients other than energy, such as AA. Therefore, to increase energy concentration and prevent a limited response in growth performance, diets could be adequate in other nutrients (Nitikanchana et al., 2015[3]). A previous trial[4] investigated the ef-

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[3] Nitikanchana, S., S. S. Dritz, M. D. Tokach, J. M. DeRouchey, R. D. Goodband, and B. J. White. 2015. Regression analysis to predict growth performance from dietary energy in growing-finishing pigs. J. Anim. Sic. 93:2826-2839.
[4] Marcal, D. The effects of increasing energy content in diets for barrows, Ph.D. Dissertation, Federal University of Mato Grosso do Sul, Campo Grande, MS, Brazil. Not yet published.

fects of increasing dietary NE without maintaining a SID Lys:NE ratio. In that study, increasing NE improved F/G, but there was no change in growth rate of growing-finishing pigs. Thus, the present study was conducted with the objective to compare the effects of increasing dietary NE with a constant SID Lys:NE ratio or a constant percentage SID Lys (no Lys:NE ratio) on growth performance and carcass characteristics of growing-finishing pigs.

Procedures

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in this experiment. The study was conducted at the Kansas State University Swine Teaching and Research Center in Manhattan, KS. Pigs were housed in an environmentally controlled barn with completely slatted concrete floor. Each pen was equipped with a single-hole stainless steel feeder and a nipple drinker for ad libitum access to feed and water.

A total of 150 pigs, 70 barrows and 80 gilts (Line 600 Duroc × Line 241; DNA, Columbus, NE) were used in a 91-d trial. Pens of pigs were blocked by gender and BW and randomly assigned to diets with 2 pigs per pen and 15 pen per treatments (7 pens with barrows and 8 pens with gilts).

Treatments were arranged in a 2 × 2 + 1 factorial including a low-energy control diet or diets with increasing NE (medium or high) and 2 formulation methods (constant SID Lys:NE ratio vs. constant percentage SID Lys).

All experimental diets were fed in meal form. Diets were formulated to be fed in 4 phases (65 to 110, 110 to 155, 155 to 220, and 220 to 280 lb)[5] and were prepared at the Kansas State University O.H. Kruse Feed Technology Innovation Center in Manhattan, KS.

The control low-NE diet was formulated to a 4.08, 3.50, 3.02, and 2.61 SID Lys:NE ratio and 0.91, 0.78, 0.66, and 0.57% SID Lys in Phases 1, 2, 3 and 4, respectively (Table 1). Two high-NE diets were formulated to achieve either the same SID Lys:NE ratios as the low-NE diet or same percentage SID Lys as the low-NE diet. The low-NE diet was blended with each of the high-NE diets in a 50:50 ratio to obtain the 2 medium-NE diets. Soybean hulls were used in the low-NE diet and choice white grease was used in the high-NE diets. Crystalline AA also were used to achieve the constant SID Lys:NE ratio vs. constant percentage SID Lys diets. Thus, this study was composed of 5 dietary treatments (low-NE; medium-NE with constant SID Lys:NE ratio; high-NE with constant SID Lys:NE ratio; medium-NE with constant percentage SID Lys; and high-NE with constant percentage SID Lys. For diet formulation, feed ingredients were assigned an NE value taken from INRA (2004).[6]

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[5] NRC. 2012. Nutrient Requirements of Swine. 11th ed. Natl. Acad. Press, Washington, DC.

[6] INRA (Institut National de la Recherche Agronomique). 2004. Tables of composition and nutritional value of feed materials, Sauvant, D., J-M. Perez, and G. Tran, Eds. Wageningen Academic Publishers, The Netherlands and INRA, Paris, France.

Pigs were weighed and feed disappearance was recorded on d 0, 19, 34, 61, and 91 to determine ADG, ADFI, and F/G. To analyze the data the study was divided in three phases of approximate equal time (Phase 1, d 0 to 34; Phase 2, d 34 to d 61; and Phase 3, d 61 to 91).

The NE intake and SID Lys intake were determined by multiplying the total feed intake × NE or SID Lys content in the diet and divided by days in the period. Caloric and SID Lys efficiencies were determined by dividing total NE intake or total SID Lys intake by the total gain in each period.

On d 91, all pigs were individually weighed and tattooed with a unique identifier. Pigs were transported to a commercial harvesting facility (Triumph Foods LLC, St. Joseph, MO) and held in lairage overnight prior to processing and carcass data collection. At the plant, HCW, backfat depth, loin depth and jowl IV value were collected. Percentage carcass yield was calculated by dividing individual HCW obtained at the packing plant by the individual final live weight obtained at the farm.

Data were analyzed as a randomized complete block design using PROC GLIMMIX in SAS (SAS Institute, Inc., Cary, NC) with dietary treatment as fixed effect. Block was included in the model as a random effect. Pen was the experimental unit for all data analysis. For analysis of backfat depth, loin depth, and percentage lean, HCW was used as a covariate. The main effect of formulation method was tested and contrast coefficients were used to evaluate linear and quadratic responses to dietary NE level within SID Lys formulation. Significance were set at $P < 0.05$ and tendencies were set at $P \leq 0.10$.

Results and Discussion

From d 0 to 34, increasing dietary NE increased daily NE intake (linear, $P < 0.001$) with both formulation methods (Table 5); however, daily SID Lys intake increased (linear, $P < 0.001$) only when SID Lys:NE ratio was kept constant as dietary NE increased. Average daily gain increased (linear, $P = 0.037$) as did BW (linear, $P = 0.005$) as energy concentration was increased with constant SID Lys:NE ratio. Pigs fed constant SID Lys:NE ratio diets had improved (linear, $P = 0.009$) F/G with increasing dietary NE. Moreover, F/G was better ($P = 0.026$) in pigs fed diets in which the SID Lys:NE ratio remained constant compared those fed a constant percentage SID Lys as NE increased. The efficiency of NE utilization worsened (linear, $P < 0.001$) with both formulation methods as dietary NE increased suggesting the NE level of soybean hulls may have been underestimated or NE level of fat may have been overestimated in diet formulation. As a result, efficiency of Lys utilization also worsened (linear, $P < 0.001$) as dietary NE increased when a constant Lys:NE ratio was maintained.

The responses from d 34 to 61 were similar to those from d 0 to 34. Daily NE intake increased (linear, $P < 0.02$) with increasing dietary NE for both formulation methods; however, SID Lys intake only increased (linear, $P < 0.001$) when SID Lys:NE ratio was kept constant as dietary NE increased. As a result, ADG and BW increased (linear, $P < 0.006$) as dietary NE increased when maintaining constant SID Lys:NE ratio. In this phase, F/G improved (linear, $P < 0.03$) by increasing dietary NE with both formulation methods. However, NE efficiency tended to be poorer (linear, $P = 0.055$) by increasing dietary NE with a constant percentage SID Lys, but was not affected when a constant SID Lys:NE was maintained.

The improvements in growth performance to increasing dietary NE were much less from d 61 to 91 than in earlier phases. However similar to earlier phases, pigs had greater (linear, $P < 0.048$) NE intake as dietary NE increased with both formulation methods, but SID Lys intake only increased (linear, $P = 0.001$) when SID Lys:NE ratio was maintained. In this last phase, despite the response observed in NE and Lys intake, there was no effect of dietary NE on ADG or F/G. Like previous phases, increased NE intake resulted in poor NE efficiency and increased SID Lys intake resulted in poorer SID Lys efficiency.

Overall, increasing dietary NE increased (linear, $P = 0.022$) ADG only in pigs fed with diets with a constant SID Lys:NE ratio. However, F/G was improved ($P < 0.017$) with both formulation methodologies. No effect of energy level was observed for ADFI, which resulted in an increase (linear, $P = 0.001$) in NE intake as dietary NE increased with both formulation methods. In treatments in which the SID Lys:NE ratio was kept constant, the increase observed in NE intake also resulted in increased (linear, $P < 0.001$) SID Lys intake. Thus, as pigs had more NE and SID Lys intake they were less efficient in utilization of the energy and SID Lys.

For carcass characteristics (Table 6), HCW of pigs fed with a constant SID Lys:NE ratio were heavier ($P = 0.027$) than carcass of pigs fed with constant percentage SID Lys. Furthermore, increasing dietary NE within the SID Lys:NE ratio diets increased (linear, $P = 0.002$) HCW. Carcass yield increased (linear, $P < 0.03$) by increasing dietary NE with both formulation methods. A tendency for a dietary NE × SID Lys formulation interaction was observed for backfat thickness. Maintaining a constant percentage SID Lys as dietary NE increased resulted in increased (quadratic, $P = 0.009$) backfat depth compared with maintaining a constant SID Lys:NE ratio. Loin depth tended to be less in pigs fed constant SID Lys:NE ratio than in pigs fed diets with constant percentage SID Lys ($P = 0.098$). Increasing dietary NE with constant percentage SID Lys also tended (linear, $P = 0.099$) to increase loin depth and had a mixed effect (quadratic, $P = 0.015$) on fat-free lean. Increasing dietary NE increased (linear, $P < 0.04$) jowl IV with both formulation methods as expected due to increasing added dietary fat in those diets. Sayler et al. (2012[7]) also observed increased jowl IV by increasing the amount of choice white grease in finishing pig diets.

In summary, increasing dietary NE with a constant SID Lys:NE ratio increased AA intake and resulted in improvements in ADG and F/G whereas increasing energy without keeping a constant SID Lys:NE ratio improved only F/G. Although pigs fed the low-NE diet grew slower, they were more efficient at utilizing the NE and SID Lys that they consumed. Increasing energy concentration without keeping SID Lys:NE constant also increased backfat depth.

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[7] Salyer, J.A., J.M. DeRouchey, M.D. Tokach, S.S. Dritz, R.D. Goodband, J.L. Nelssen, and D.B. Petry. 2012. Effects of dietary wheat middlings, distillers dried grains with solubles, and choice white grease on growth performance, carcass characteristics, and carcass fat quality of finishing pigs. J. Anim. Sci. 90:2620–2630.

Table 1. Diet composition of Phase 1 (as fed-basis)[1]

			Formulation method			
		Control	Constant Lys:NE		Constant Lys %	
Item	NE level:	Low	Medium	High	Medium	High
Ingredient, %						
Corn		68.87	68.36	67.86	71.46	74.05
Soybean meal (45% CP)		19.51	22.72	25.93	19.96	20.41
Soybean hulls		8.67	4.33	---	4.33	---
Choice white grease		---	1.60	3.19	1.25	2.51
Monocalcium phosphate (21% P)		0.90	0.88	0.85	0.89	0.88
Limestone		0.90	0.95	1.00	0.96	1.03
Sodium chloride		0.35	0.35	0.35	0.35	0.35
L-Lys-HCl		0.30	0.30	0.30	0.30	0.30
DL-Met		0.07	0.08	0.10	0.07	0.06
L-Thr		0.09	0.09	0.09	0.09	0.08
L-Trp		0.02	0.01	0.01	0.02	0.02
L-Val		0.01	0.01	0.01	0.01	0.01
Trace mineral premix		0.15	0.15	0.15	0.15	0.15
Vitamin premix		0.15	0.15	0.15	0.15	0.15
Phytase[2]		0.02	0.02	0.02	0.02	0.02
Calculated analysis						
Standardized ileal digestible (SID) AA, %						
Lys		0.91	0.98	1.05	0.91	0.91
Ile:Lys		61	61	62	61	61
Leu:Lys		136	135	133	138	139
Met:Lys		33	33	34	33	32
Met and Cys:Lys		58	58	58	58	58
Thr:Lys		62	62	62	62	62
Trp:Lys		19	19	19	19	19
Val:Lys		69	69	69	69	69
Total Lys, %		1.04	1.11	1.17	1.03	1.03
CP, %		16.3	17.3	18.4	16.3	16.2
ME, kcal/lb		1,438	1,499	1,560	1,493	1,547
NE, kcal/lb[3]		1,013	1,087	1,162	1,088	1,163
SID Lys:ME, g/Mcal		2.87	2.96	3.04	2.77	2.67
SID Lys:NE, g/Mcal		4.08	4.08	4.08	3.80	3.55
Ca, %		0.60	0.60	0.60	0.60	0.60
P, %		0.52	0.53	0.54	0.52	0.53
Available P, %		0.34	0.34	0.34	0.34	0.34

[1] Phase 1 experimental diets were fed from d 0 to 19 (78- to 120-lb BW).
[2] Ronozyme Hiphos 2700 (DSM Nutritional Products, Inc., Parsippany, NJ), providing 184.3 phytase units (FTU)/lb and an estimated release of 0.10% available P.
[3] NE values from ingredients were obtained from INRA (2004).

Table 2. Diet composition of Phase 2 (as fed-basis)[1]

	Control	Formulation method			
		Constant Lys:NE		Constant Lys %	
Item NE level:	Low	Medium	High	Medium	High
Ingredient, %					
Corn	72.55	73.82	75.10	76.64	80.73
Soybean meal (45% CP)	13.76	16.78	19.80	14.27	14.78
Soybean hulls	10.98	5.49	---	5.49	---
Choice white grease	---	1.15	2.30	0.84	1.68
Monocalcium phosphate (21% P)	0.75	0.73	0.70	0.73	0.70
Limestone	0.85	0.91	0.98	0.94	1.03
Sodium chloride	0.35	0.35	0.35	0.35	0.35
L-Lys-HCl	0.30	0.30	0.30	0.30	0.30
DL-Met	0.04	0.05	0.06	0.04	0.03
L-Thr	0.08	0.08	0.08	0.08	0.07
L-Trp	0.02	0.02	0.02	0.02	0.02
L-Val	0.01	0.01	0.01	0.01	0.00
Trace mineral premix	0.15	0.15	0.15	0.15	0.15
Vitamin premix	0.15	0.15	0.15	0.15	0.15
Phytase[2]	0.02	0.02	0.02	0.02	0.02
Calculated analysis					
Standardized ileal digestible (SID) AA, %					
Lys	0.78	0.84	0.90	0.78	0.78
Ile:Lys	59	60	61	60	60
Leu:Lys	142	141	140	145	148
Met:Lys	32	32	32	31	31
Met and Cys:Lys	58	58	58	58	58
Thr:Lys	62	62	62	62	62
Trp:Lys	19	19	19	19	19
Val:Lys	69	69	69	69	69
Total Lys, %	0.90	0.95	1.01	0.89	0.88
CP, %	14.07	15.05	16.03	14.07	14.08
ME, kcal/lb	1,428	1,487	1,546	1,481	1,534
NE, kcal/lb[3]	1,004	1,084	1,164	1,085	1,165
SID Lys:ME, g/Mcal	2.46	2.55	2.63	2.37	2.29
SID Lys:NE, g/Mcal	3.50	3.50	3.50	3.24	3.02
Ca, %	0.55	0.55	0.55	0.55	0.55
P, %	0.46	0.47	0.49	0.46	0.47
Available P, %	0.30	0.30	0.30	0.30	0.30

[1] Phase 2 experimental diets were fed from d 20 to 34 (120- to 158-lb BW).
[2] Ronozyme Hiphos 2700 (DSM Nutritional Products, Inc., Parsippany, NJ), providing 184.3 phytase units (FTU)/lb and an estimated release of 0.10% available P.
[3] NE values from ingredients were obtained from INRA (2004).

Table 3. Diet composition of Phase 3 (as fed-basis)[1]

		Formulation method			
	Control	Constant Lys:NE		Constant Lys %	
Item NE level:	Low	Medium	High	Medium	High
Ingredient, %					
Corn	75.49	78.38	81.28	80.99	86.49
Soybean meal (45% CP)	8.98	11.86	14.74	9.55	10.12
Soybean hulls	13.14	6.57	---	6.57	---
Choice white grease	---	0.74	1.48	0.45	0.90
Monocalcium phosphate (21% P)	0.63	0.61	0.60	0.61	0.60
Limestone	0.70	0.78	0.85	0.79	0.88
Sodium chloride	0.35	0.35	0.35	0.35	0.35
L-Lys-HCl	0.30	0.30	0.30	0.30	0.30
DL-Met	0.02	0.03	0.03	0.01	0.01
L-Thr	0.09	0.09	0.09	0.08	0.08
L-Trp	0.03	0.02	0.02	0.03	0.02
L-Val	0.01	0.01	0.00	0.01	0.00
Trace mineral premix	0.13	0.13	0.13	0.13	0.13
Vitamin premix	0.13	0.13	0.13	0.13	0.13
Phytase[2]	0.02	0.02	0.02	0.02	0.02
Calculated analysis					
Standardized ileal digestible (SID) AA, %					
Lys	0.66	0.72	0.78	0.66	0.66
Ile:Lys	57	59	60	58	59
Leu:Lys	148	148	148	153	158
Met:Lys	30	31	31	30	29
Met and Cys:Lys	58	58	58	58	58
Thr:Lys	64	64	64	64	64
Trp:Lys	19	19	19	19	19
Val:Lys	69	69	70	70	70
Total Lys, %	0.78	0.83	0.88	0.76	0.75
CP, %	12.25	13.18	14.11	12.28	12.32
ME, kcal/lb	1,421	1,478	1,535	1,473	1,524
NE, kcal/lb[3]	996	1,081	1,165	1,081	1,167
SID Lys:ME, g/Mcal	2.12	2.21	2.29	2.04	1.97
SID Lys:NE, g/Mcal	3.02	3.02	3.02	2.78	2.58
Ca, %	0.47	0.47	0.47	0.47	0.47
P, %	0.41	0.43	0.45	0.42	0.43
Available P, %	0.27	0.27	0.27	0.27	0.27

[1] Phase 3 experimental diets were fed from d 35 to 61 (158- to 220-lb BW).
[2] Ronozyme Hiphos 2700 (DSM Nutritional Products, Inc., Parsippany, NJ), providing 184.3 phytase units (FTU)/lb and an estimated release of 0.10% available P.
[3] NE values from ingredients were obtained from INRA (2004).

Table 4. Diet composition of Phase 4 (as fed-basis)[1]

		Formulation method			
	Control	Constant Lys:NE		Constant Lys %	
Item NE level:	Low	Medium	High	Medium	High
Ingredient, %					
Corn	76.98	80.91	84.84	83.22	89.45
Soybean meal (45% CP)	6.68	9.34	12.00	7.28	7.88
Soybean hulls	14.30	7.15	---	7.15	---
Choice white grease	---	0.49	0.99	0.24	0.49
Monocalcium phosphate (21% P)	0.50	0.48	0.45	0.50	0.50
Limestone	0.63	0.71	0.80	0.71	0.80
Sodium chloride	0.35	0.35	0.35	0.35	0.35
L-Lys-HCl	0.25	0.25	0.25	0.25	0.25
DL-Met	0.02	0.03	0.03	0.01	0.00
L-Thr	0.07	0.07	0.07	0.06	0.06
L-Trp	0.02	0.02	0.02	0.02	0.02
L-Val	0.00	0.00	0.00	0.00	0.00
Trace mineral premix	0.10	0.10	0.10	0.10	0.10
Vitamin premix	0.10	0.10	0.10	0.10	0.10
Phytase[2]	0.02	0.02	0.02	0.02	0.02
Calculated analysis					
Standardized ileal digestible (SID) AA, %					
Lys	0.57	0.62	0.67	0.57	0.57
Ile:Lys	60	62	63	61	62
Leu:Lys	163	163	163	169	175
Met:Lys	33	34	34	32	32
Met and Cys:Lys	64	64	64	64	64
Thr:Lys	65	65	65	65	65
Trp:Lys	19	19	19	19	19
Val:Lys	73	73	74	74	76
Total Lys, %	0.68	0.72	0.76	0.67	0.65
CP, %	11.31	12.17	13.03	11.37	11.42
ME, kcal/lb	1,418	1,474	1,529	1,469	1,519
NE, kcal/lb[3]	991	1,079	1,166	1,079	1,167
SID Lys:ME, g/Mcal	1.82	1.91	1.99	1.76	1.70
SID Lys:NE, g/Mcal	2.61	2.61	2.61	2.40	2.21
Ca, %	0.42	0.42	0.42	0.42	0.42
P, %	0.37	0.39	0.40	0.38	0.40
Available P, %	0.24	0.24	0.24	0.24	0.24

[1] Phase 4 experimental diets were fed from d 62 to 91 (220- to 280-lb BW).
[2] Ronozyme Hiphos 2700 (DSM Nutritional Products, Inc., Parsippany, NJ), providing 184.3 phytase units (FTU)/lb and an estimated release of 0.10% available P.
[3] NE values from ingredients were obtained from INRA (2004).

Table 5. Effects of increasing dietary NE with constant standardized ileal digestible (SID Lys:NE ratio or constant percentage SID Lys) on growth performance of growing-finishing pigs[1]

		Formulation method						Probability, $P <$				
		Control	Constant Lys:NE		Constant Lys %			Lys:NE	NE Lys:NE		NE Lys%	
Item	NE level:	Low	Medium	High	Medium	High	SEM	vs. Lys%	Linear	Quadratic	Linear	Quadratic
BW, lb												
d 0		78.6	78.6	78.7	78.6	78.7	1.98	0.959	0.884	0.933	0.884	1.000
d 34		154.2	160.2	160.9	156.3	156.9	3.03	0.018	0.005	0.191	0.242	0.698
d 61		213.9	222.9	225.6	217.0	217.0	3.41	0.003	0.001	0.280	0.362	0.598
d 91		279.8	286.7	291.8	281.2	281.9	3.88	0.023	0.013	0.821	0.654	0.938
d 0 to 34												
ADG, lb		2.16	2.28	2.32	2.22	2.23	0.058	0.163	0.037	0.506	0.323	0.741
ADFI, lb		4.81	4.95	4.87	5.00	4.87	0.134	0.835	0.673	0.381	0.716	0.191
F/G		2.23	2.18	2.10	2.26	2.18	0.036	0.026	0.009	0.885	0.262	0.240
NE intake, kcal/d		4,874	5,386	5,664	5,445	5,662	147.5	0.797	<0.001	0.394	<0.001	0.199
SID Lys intake, g/d		18.5	20.5	21.5	19.2	18.7	0.541	<0.001	<0.001	0.346	0.662	0.203
NE efficiency		2,262	2,365	2,445	2,454	2,535	39.9	0.020	0.001	0.805	<0.001	0.229
SID Lys efficiency		8.56	8.99	9.30	8.66	8.37	0.149	<0.001	<0.001	0.734	0.348	0.264
d 34 to 61												
ADG, lb		2.18	2.32	2.40	2.25	2.23	0.056	0.025	0.006	0.591	0.531	0.490
ADFI, lb		6.95	7.23	6.94	7.16	6.60	0.182	0.236	0.957	0.184	0.148	0.072
F/G		3.20	3.12	2.91	3.20	2.97	0.075	0.300	0.006	0.484	0.030	0.184
NE intake, kcal/d		7,040	7,857	8,063	7,789	7,679	199.1	0.228	<0.001	0.185	0.018	0.064
SID Lys intake, g/d		20.8	23.6	24.5	21.4	19.76	0.571	<0.001	<0.001	0.165	0.166	0.085
NE efficiency		3,240	3,389	3,381	3,487	3,458	81.5	0.269	0.211	0.420	0.055	0.159
SID Lys efficiency		9.58	10.18	10.29	9.59	8.90	0.232	<0.001	0.027	0.380	0.035	0.199

continued

Table 5. Effects of increasing dietary NE with constant standardized ileal digestible (SID Lys:NE ratio or constant percentage SID Lys) on growth performance of growing-finishing pigs[1]

		Formulation method						Probability, *P* <				
		Control	Constant Lys:NE		Constant Lys %				NE Lys:NE		NE Lys%	
Item	NE level:	Low	Medium	High	Medium	High	SEM	Lys:NE vs. Lys%	Linear	Quadratic	Linear	Quadratic
d 61 to 91												
ADG, lb		2.20	2.13	2.21	2.14	2.17	0.061	0.795	0.904	0.272	0.677	0.550
ADFI, lb		7.00	7.23	6.72	6.92	6.58	0.186	0.206	0.270	0.090	0.100	0.546
F/G		3.20	3.41	3.07	3.23	3.04	0.071	0.147	0.207	0.002	0.120	0.195
NE intake, kcal/d		7,086	7,865	7,804	7,528	7,651	206.4	0.220	0.013	0.088	0.048	0.511
SID Lys intake, g/d		18.1	20.4	20.4	17.9	17.0	0.512	<0.001	0.001	0.075	0.122	0.571
NE efficiency		3,240	3,711	3,567	3,519	3,537	78.5	0.161	0.005	0.002	0.010	0.178
SID Lys efficiency		8.27	9.60	9.33	8.36	7.86	0.198	<0.001	<0.001	0.002	0.145	0.225
d 0 to 91												
ADG, lb		2.17	2.24	2.30	2.20	2.21	0.039	0.108	0.022	0.967	0.487	0.817
ADFI, lb		6.13	6.31	6.06	6.26	5.93	0.138	0.491	0.672	0.161	0.270	0.144
F/G		2.82	2.82	2.64	2.84	2.68	0.041	0.412	0.002	0.060	0.017	0.070
NE intake, kcal/d		6,209	6,864	7,036	6,812	6,902	152.6	0.509	<0.001	0.161	0.001	0.137
SID Lys intake, g/d		19.0	21.3	22.0	19.4	18.46	0.446	<0.001	<0.001	0.110	0.326	0.151
NE efficiency		2,858	3,070	3,064	3,093	3,123	45.3	0.354	0.001	0.047	<0.001	0.059
SID Lys efficiency		8.75	9.52	9.59	8.83	8.35	0.134	<0.001	<0.001	0.023	0.027	0.073

[1] A total of 150 pigs (Line 600 × Line 241, DNA, Columbus, NE) were used in a 91-d growing-finishing trial with 2 pigs per pen and 15 pens per treatment.

Table 6. Effects of increasing dietary NE with constant standardized ileal digestible (SID Lys:NE ratio or constant percentage SID Lys) on carcass characteristics of growing-finishing pigs[1]

		Formulation method						Probability, $P <$				
		Control	Constant Lys:NE		Constant Lys%				NE Lys:NE		NE Lys%	
Item	NE level:	Low	Medium	High	Medium	High	SEM	Lys:NE vs. Lys%	Linear	Quadratic	Linear	Quadratic
HCW, lb		205.3	212.1	217.9	207.2	210.5	3.37	0.027	0.002	0.876	0.188	0.827
Carcass yield, %		73.4	74.0	74.7	73.6	74.6	0.40	0.664	0.024	0.925	0.027	0.466
Backfat, cm		19.0	18.6	18.8	20.7	19.0	0.58	0.041	0.872	0.687	0.952	0.009
Loin depth, cm		61.7	60.1	62.5	62.1	64.5	1.20	0.098	0.633	0.166	0.099	0.522
Fat-free lean, %		53.0	52.9	53.3	52.5	53.6	0.28	0.935	0.541	0.458	0.121	0.015
Jowl iodine value		67.5	67.8	68.6	67.1	69.3	0.38	0.979	0.034	0.526	0.001	0.006

[1] A total of 150 pigs (Line 600 × Line 241 DNA, Columbus, NE) were used in a 91-d growing-finishing trial with 2 pigs per pen and 15 pens per treatment.