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Rafe Q. Royall
Kansas State University, rroyall@ksu.edu

Mike D. Tokach
Kansas State University, mtokach@k-state.edu

Jason C. Woodworth
Kansas State University, jwoodworth@k-state.edu

See next page for additional authors

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Rafe Q. Royall, Mike D. Tokach, Jason C. Woodworth, Joel M. DeRouchey, Robert D. Goodband, Jordan T. Gebhardt, Carine M. Vier, Matthew Spindler, Uislei Orlando, Luis Zaragoza, Ning Lu, Wayne Cast, Danielle F. Wilson-Wells, Julia P. Holen, and Alyssa M. Betlach

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Summary

This study was conducted to evaluate the effect of dietary net energy (NE) on growth performance, carcass characteristics, and removal and mortality rates of grow-finish pigs and compare different net energy (NE) systems by using caloric efficiency. A total of 1,927 pigs (initially 51.5 ± 0.52 lb) were used in a 125-d study. Pens of pigs were blocked by BW and randomly allotted to one of five dietary treatments of decreasing NE. There were 23 to 26 pigs per pen and 15 replications per treatment in a randomized complete block design. The highest NE diet (control) was a corn-soybean meal-based diet. Based on NRC (2012)[4] ingredient NE values, the lowest energy diet contained 8% less NE than the control through inclusion of 25% wheat middlings and 15% DDGS (6% oil). These diets were blended to achieve intermediate NE levels (2, 4, and 6% less NE than the control). Dietary phases were fed from approximately 50 to 90, 90 to 130, 130 to 180, 180 to 230, and 230 to 300 lb, respectively. Overall, reducing NE decreased (linear, $P < 0.001$) ADG and final BW, but increased (linear, $P < 0.001$) ADFI, resulting in poorer (linear, $P < 0.001$) feed efficiency. Reducing NE worsened (linear, $P < 0.001$) caloric efficiency (CE) based on NRC ingredient loading values, improved (linear, $P \leq 0.003$) CE based on INRA (2008)[5] or Brazilian Tables for Poultry and Swine (2017)[6] ingredient loading values. However, when formulating diets using CVB (2020)[7] ingredient loading values, reducing NE resulted in no evidence of difference ($P > 0.10$) in CE. For carcass characteristics, reducing NE decreased (linear, $P < 0.001$) HCW, backfat depth, and carcass yield. However, reducing NE increased

[1] Department of Diagnostic Medicine/Pathology, Kansas State University, Manhattan, KS.
[2] Genus PIC, Hendersonville, TN.
[3] Swine Vet Center, St. Peter, MN.
[4] National Research Council. 2012. Nutrient Requirements of Swine: Eleventh Revised Edition. Washington, DC: The National Academies Press. https://doi.org/10.17226/13298
[5] EvaPig (2008). Evaluation of pig feeds equations and coefficients. INRA, AFX, Ajinomoto Eurolysine S.A.S.
[6] Brazilian Tables for Poultry and Swine (2017). Feedstuff composition and nutritional requirements. 4th ed. H. S. Rostagno (ed). Department of Animal Science, UFV, Viçosa, MG, Brazil.
[7] CVB (2020). Booklet of Feeding Tables for Pigs. CVB Foundation, Wageningen Livestock Research and Flemish Institute for Agricultural, Fisheries, and Food Research.

(linear, $P < 0.001$) percentage lean. Moreover, reducing NE tended to increase (linear, $P = 0.073$) percent removals, with no evidence of difference ($P > 0.10$) on percent mortality. When considering CE on a carcass gain basis, reducing NE worsened (linear, $P \leq 0.004$) CE based on NRC or CVB ingredient loading values, while reducing NE improved (linear, $P < 0.001$) CE based on INRA ingredient loading values. However, reducing NE resulted in no evidence of difference ($P > 0.010$) in CE based on Brazilian Tables ingredient loading values. These results would suggest that the NRC database overestimates NE contributions of fibrous ingredients such as wheat middlings and corn DDGS, while the INRA database underestimates their contributions to NE, whether CE is calculated based on live or carcass gain. Meanwhile, NE values in the CVB database appear to value NE more accurately in these diets based on live gain but underestimate their value on a carcass basis. The Brazilian tables appear to underestimate the contributions of fibrous ingredients to dietary NE on a live basis, but more accurately value their contributions on a carcass basis. Thus, this study reinforces establishing and utilizing accurate energy values of ingredients to economically value them appropriately.

Introduction

The energy concentration of swine diets is often changed to balance pig growth performance and feed cost. The effects of increasing dietary energy content on performance have been extensively studied. However, dramatic increases in ingredient costs, especially the cost of energy-dense ingredients, in recent years have led the swine industry to shift toward using more high-fiber, low-energy, diets.[8] In addition, producers often use a variety of databases or systems of equations to estimate NE of diets, and thus estimate the effect of changing dietary NE on growth performance. However, these databases and equations are extremely variable in the valuation of NE in fibrous ingredients, thus it is difficult to determine which most accurately represents the true NE of high-fiber diets. The objective of this study was to evaluate the effect of dietary NE level on growth performance, carcass characteristics, and removal and mortality rates of grow-finish pigs and to compare caloric efficiency using different NE systems.

Materials and Method

The protocol for this experiment was approved by the Kansas State University Institutional Animal Care and Use Committee. A commercial research barn located in south-central Minnesota was used for the study. The barn had slatted concrete flooring, deep pits for manure storage, and was naturally ventilated. Pens contained a 3-hole stainless steel dry self-feeder (Thorp Equipment, Thorp, WI) and a 1-cup waterer to provide *ad libitum* access to feed and water. This experiment was conducted from May to September 2023.

Animals and diets

A total of 1,927 pigs (PIC 337 × 1050; initially 51.5 ± 0.52 lb) were used. Pens of pigs were blocked by BW and randomly allotted to one of five dietary treatments in a randomized complete block design. There were 23 to 26 pigs per pen with 15 replicates per treatment. The highest energy diet (control) was a corn-soybean meal-based diet.

[8] 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 net energy in growing-finishing pigs. J. Anim. Sci. 93.2826-2839. doi:10.2527/jas2015-9005.

Based on NRC (2012) ingredient NE values, the lowest energy diet contained 8% less NE than the control through inclusion of 25% wheat middlings and 15% DDGS (6% oil). These diets were blended to achieve intermediate NE levels (2, 4, and 6% less NE than the control). Dietary NE was calculated based on NE loading values for corn, soybean meal, corn DDGS, and wheat middlings derived from the following ingredient databases; 1) NRC; 2) EvaPig (2008; INRA); 3) CVB (2020); and 4) the Brazilian Tables for Poultry and Swine (2017; Brazilian Tables). Additionally, representative samples of corn, soybean meal, corn DDGS, and wheat middlings were submitted to Midwest Labs (Omaha, NE) for proximate analysis prior to diet formulation (Table 1). These ingredient loading values were then utilized to determine dietary NE based on the following sets of equations; 1) an average of NRC (2012) Eq. 1-7 and 1-8; 2) NRC Eq. 1-8, utilizing DE values from the NRC ingredient database (NRC DE); 3) EvaPig software (2008; INRA); 4) CVB feedstuff database webapp (2020; CVB). The approximate weight of pigs for each phase was 50 to 90, 90 to 130, 130 to 180, 180 to 230, and 230 to 300 lb, respectively. The highest and lowest NE diets were blended to meet the target NE values for each treatment diet in phase 1, while three base diets containing the highest, middle, and lowest NE values were blended to meet target NE values for each treatment diet in all other phases (Tables 2 and 3). All diets were formulated to meet or exceed NRC (2012) requirement estimates. To determine ADG, ADFI, F/G, and CE, pens of pigs were weighed, and feed disappearance was recorded throughout the trial. On d 99, the heaviest 0 to 5 pigs/pen were marketed to equalize pens to 21 pigs per pen. On d 111, the heaviest 3 to 4 pigs/pen were marketed. The remaining pigs were marketed 14 d later at the conclusion of the study.

At each marketing event, individual pigs were weighed and tattooed with a pen identification number prior to transportation to a commercial abattoir for carcass data collection. Measurements including HCW, loin depth, backfat depth, and percentage lean were collected. The calculation for carcass yield was individual pig HCW at the plant divided by individual final pig weight on the farm. Individual carcass data were used in the analysis with pen serving as the experimental unit. Hot carcass weight served as a covariate for loin depth, backfat depth, and percentage lean in the statistical analysis. Dietary NE values were used to calculate CE throughout the entire trial period, on a live and carcass basis.

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). Pen was considered the experimental unit, initial bodyweight served as a blocking factor, and treatment served as the fixed effect in the statistical model. Linear and quadratic contrast coefficients were constructed within decreasing dietary NE values to account for unequal spacing in treatments. Results were considered significant with $P \le 0.05$ and marginally significant with $P \le 0.10$.

Results and Discussion

For the overall experiment (d 0 to 125), reducing NE decreased (linear, $P < 0.001$) final BW (Table 4). Reducing the NE content of the diet decreased (linear, $P < 0.001$) ADG on a live and carcass basis and increased (linear, $P < 0.015$) ADFI, resulting in poorer (linear, $P < 0.001$) F/G on a live and carcass basis. Reducing NE decreased (linear, $P < 0.001$) g/d SID Lys intake while increasing (linear, $P < 0.001$) SID Lys intake, g/kg of gain. Reducing NE tended to increase (linear, $P = 0.073$) percent removals, with no evidence of difference ($P > 0.10$) on percent mortality, or total removals and mortality.

For carcass characteristics, reducing NE decreased (linear, $P \leq 0.002$) HCW, backfat depth, and carcass yield, but increased (linear, $P < 0.001$) carcass lean percentage.

Caloric efficiency was calculated for using NE values derived from the NRC, INRA, CVB, and the Brazilian Tables ingredient databases (Table 5). Overall (d 0 to 125), reducing NE worsened (linear, $P < 0.001$) caloric efficiency (CE) based on NRC ingredient loading values, but improved (linear, $P \leq 0.003$) CE based on INRA or Brazilian Tables ingredient loading values. When formulating diets using CVB ingredient loading values, reducing NE resulted in no evidence of difference ($P > 0.10$) in CE. When considering CE on a carcass gain basis, reducing NE worsened (linear, $P \leq 0.004$) CE based on NRC or CVB ingredient loading values, while reducing NE improved (linear, $P < 0.001$) CE based on INRA ingredient loading values. However, reducing NE resulted in no evidence of difference ($P > 0.10$) in CE based on ingredient loading values from the Brazilian Tables.

From proximate analysis of corn, soybean meal, corn DDGS, and wheat middlings, net energy values were calculated for each diet from equations in the NRC, NRC DE, INRA, and CVB. These NE values were then utilized to calculate CE (Table 6). Overall (d 0 to 125), reducing NE improved (linear, $P < 0.001$) CE when NE was calculated with NRC or INRA equations, but reducing NE worsened (linear, $P \leq 0.008$) CE when NE was calculated utilizing NRC DE values. However, when NE was calculated utilizing CVB equations, reducing NE showed no evidence of difference ($P > 0.10$) in caloric efficiency. When considering CE on a carcass gain basis, reducing NE improved (linear, $P < 0.001$) CE when NE is calculated using NRC and INRA equations. However, when NE values are calculated utilizing NRC DE values or CVB equations, reducing NE worsened (linear, $P \leq 0.002$) CE when calculated on a carcass gain basis.

In summary, reducing NE decreased ADG and increased ADFI, resulting in poorer feed efficiency throughout the trial. Additionally, reducing NE decreased HCW, backfat depth, and carcass yield, but increased carcass lean percentage. Caloric efficiency estimates (live and carcass gain basis) suggest that the NRC database overestimates NE contributions of fibrous ingredients such as wheat middlings and corn DDGS, while the INRA database underestimates their contributions to NE. Meanwhile, NE values in the CVB database appear to value NE more accurately in these diets based on live gain but underestimate their value on a carcass basis. Alternatively, the Brazilian tables appear to underestimate the contributions of fibrous ingredients to dietary NE on a live basis, but more accurately value their contributions on a carcass basis. Overall, the results of this study reinforce the importance of establishing and utilizing accurate energy values of ingredients to economically value them appropriately.

Table 1. Proximate analysis and total amino acid content of corn, soybean mean, corn DDGS, and wheat middlings (as-is basis)[1]

Item, %	Corn	Soybean meal	DDGS	Wheat middlings
Dry matter	85.2	87.6	89.2	86.6
Crude protein	7.4	46.3	30.6	18.0
Starch	61.7	1.1	1.8	13.5
Ether extract	3.1	1.8	6.0	3.6
Acid detergent fiber	2.7	4.8	11.2	12.3
Neutral detergent fiber	7.0	5.5	27.8	39.2
Ash	1.2	5.8	5.0	5.4
Amino acids				
Alanine	0.43	1.61	1.86	0.60
Arginine	0.30	3.18	1.29	1.10
Aspartic acid	0.48	5.15	1.96	1.04
Cysteine	0.15	0.61	0.57	0.35
Glutamic acid	1.24	8.09	5.29	3.10
Glycine	0.42	2.96	1.88	0.69
Histidine	0.18	1.15	0.80	0.44
Isoleucine	0.23	1.97	1.14	0.51
Leucine	0.80	3.38	3.58	1.03
Lysine	0.34	2.77	0.94	0.65
Methionine	0.14	0.66	0.62	0.25
Phenylalanine	0.22	2.28	1.49	0.53
Proline	0.63	2.31	2.68	1.72
Serine	0.33	2.32	1.49	0.81
Threonine	0.25	1.79	1.15	0.53
Tryptophan	0.05	0.61	0.24	0.19
Tyrosine	0.01	1.29	1.03	0.29
Valine	0.32	2.02	1.42	0.72

[1] A representative sample of each ingredient was obtained, homogenized, and submitted to Midwest Laboratories (Omaha, NE, USA) for amino acid and proximate analysis prior to diet formulation.

Table 2. Composition of Phase 1, 2, and 3 diets (as-fed basis)[1,2,3]

	Dietary phase							
	1		2			3		
NE reduction, %:	**0**	**8**	**0**	**4**	**8**	**0**	**4**	**8**
Ingredient, %								
Corn	64.32	31.77	69.48	52.98	36.92	74.70	58.32	41.94
Soybean meal	32.04	25.34	27.26	24.01	20.33	22.47	18.97	15.47
Wheat middlings	---	25.00	---	12.50	25.00	---	12.50	25.00
Corn DDGS	---	15.00	---	7.50	15.00	---	7.50	15.00
Monocalcium P, 21% P	0.60	---	0.45	0.23	---	0.30	0.15	---
Limestone	1.05	1.55	0.98	1.25	1.52	0.94	1.22	1.51
Sodium chloride	0.53	0.45	0.55	0.49	0.43	0.55	0.49	0.43
L-Lys-HCl	0.45	0.34	0.40	0.36	0.31	0.35	0.31	0.28
DL-Met	0.24	0.08	0.19	0.12	0.04	0.14	0.07	0.01
Thr biomass[4]	0.28	0.14	0.23	0.17	0.10	0.19	0.14	0.09
L-Trp	0.04	0.01	0.04	0.03	0.02	0.04	0.03	0.02
L-Val	0.11	---	0.08	0.04	---	0.06	0.03	---
Vitamin premix with phytase[5]	0.20	0.20	0.20	0.20	0.20	0.15	0.15	0.15
Trace mineral premix	0.15	0.15	0.15	0.15	0.15	0.13	0.13	0.13
Total	100	100	100	100	100	100	100	100
Calculated analysis[1]								
SID AA, %								
Lys	1.27	1.17	1.12	1.08	1.03	0.97	0.93	0.89
Ile:Lys	58	66	58	63	67	59	63	68
Leu:Lys	113	142	118	133	150	125	142	160
Met:Lys	38	32	37	34	31	36	33	30
Met and Cys:Lys	59	59	59	59	59	59	59	60
Thr:Lys	66	66	66	66	66	66	67	68
Trp:Lys	20.0	20.1	20.3	20.5	20.7	20.3	20.7	21.0
Val:Lys	70	75	70	73	77	70	75	80
His:Lys	35	43	35	40	45	36	41	47
NE, kcal/lb, ingredient databases								
NRC	1,103	1,010	1,115	1,068	1,023	1,130	1,083	1,037
INRA	1,073	907	1,089	1,005	922	1,106	1,021	937
CVB	1,076	954	1,092	1,030	969	1,109	1,047	984
Brazilian Tables	1,097	960	1,112	1,042	974	1,127	1,057	988

continued

Table 2. Composition of Phase 1, 2, and 3 diets (as-fed basis)[1,2,3]

	Dietary phase							
	1		2			3		
NE reduction, %:	0	8	0	4	8	0	4	8
NE, kcal/lb, analyzed ingredient values								
NRC[6]	1,124	927	1,136	1,037	938	1,149	1,049	949
NRC, DE[7]	1,103	1,015	1,117	1,072	1,028	1,132	1,087	1,041
INRA[8]	1,088	916	1,102	1,015	928	1,116	1,028	941
CVB[9]	1,059	940	1,074	1,013	954	1,089	1,028	968
SID Lys:NE, g/Mcal	5.22	5.23	4.55	4.57	4.54	3.89	3.88	3.88
CP, %[10]	20.5	23.1	18.5	19.9	21.0	16.5	17.8	19.1
Ca, %	0.70	0.79	0.62	0.69	0.76	0.55	0.64	0.73
STTD P, %	0.40	0.43	0.36	0.39	0.42	0.32	0.37	0.41

[1] Calculated analysis is based off nutrient profiles for ingredients listed in the NRC (National Research Council, 2012).

[2] Zero and 8% reduced NE diets were blended to create treatment diets at 2, 4, and 6% NE reductions in phase 1. In phase 2, 3, 4, and 5 the 0 and 4% reduced NE diets were blended to create the 2% reduced NE diet, and the 4 and 8% reduced NE diets were blended to create the 6% reduced NE diet.

[3] Phases 1, 2, and 3 were fed from approximately 50 to 90-lb, 90 to 130lb, and 130 to 180 lb, respectively.

[4] THR Pro; CJ America-Bio, Downers Grove, IL.

[5] Axtra PHY (Dupont, Wilmington, DE) provided 325, 195, and 236 phytase units (FTU/lb) for an estimated release of 0.13, 0.12, and 0.14% STTD P, in Exp. 1, 2, and 3, respectively.

[6] NE kcal/lb calculated as an average of Eq. 1-7 and 1-8 as explained in the NRC (2012) using values derived from proximate analysis. Eq. 1-7; NE = (0.726 × ME) + (1.33 × EE) + (0.39 × Starch) – (0.62 × CP) – (0.83 × ADF); Eq. 1-8; NE = (0.700 × DE) + (1.61 × EE) + (0.48 × Starch) – (0.91 × CP) – (0.87 × ADF); with DE and ME calculated using Eq. 1-2 through 1-6.

[7] NE kcal/lb = (0.700 × DE) + (1.61 × EE) + (0.48 × Starch) – (0.91 × CP) – (0.87 × ADF); DE values derived from NRC (2012) ingredient database.

[8] NE kcal/lb = $NE/ME_{ref} + [(5.5 \times (EE_{new} - EE_{ref}) + 1.5 \times (Starch_{new} - Starch_{ref}) - 2.8 \times (CP_{new} - CP_{ref})] / ME_{new}$. Where; ref = reference values within the EvaPig software; and new = values derived from proximate analysis.

[9] NE kcal/lb = [(11.7 × CP) + (35.74 × EE) + [14.14 × (Starch + Glucose oligosaccharides + 0.90 × fermented sugars)] + (9.74 × fermented degradable carbohydrates) + (10.61 × acetic acid) + (14.62 × propionic acid) + (19.52 × butyric acid) + (20.75 × ethanol) + (12.02 × lactic acid) + (13.83 × glycerol)] × 0.23900574 × 0.45359237

[10] CP = crude protein.

Table 3. Composition of phase 4 and 5 diets (as-fed basis)[1,2,3]

	Dietary Phase					
	4			5		
NE reduction, %:	**0**	**4**	**8**	**0**	**4**	**8**
Ingredient, %						
Corn	78.52	62.01	45.94	81.15	64.96	48.77
Soybean meal	18.99	15.50	11.58	16.79	12.80	8.82
Wheat middlings	---	12.50	25.00	---	12.50	25.00
Corn DDGS	---	7.50	15.00	---	7.50	15.00
Monocalcium P, 21% P	0.20	0.10	---	---	---	---
Limestone	0.91	1.21	1.51	0.84	1.16	1.49
Sodium chloride	0.55	0.50	0.45	0.55	0.50	0.45
L-Lys-HCl	0.30	0.28	0.25	0.25	0.24	0.23
DL-Met	0.10	0.05	---	0.07	0.03	---
Thr biomass[4]	0.15	0.10	0.04	0.12	0.07	0.02
L-Trp	0.03	0.02	0.01	0.02	0.01	0.01
L-Val	0.03	0.01	---	---	---	---
Vitamin premix with phytase[5]	0.13	0.13	0.13	0.13	0.13	0.13
Trace mineral premix	0.10	0.10	0.10	0.10	0.10	0.10
Total	100	100	100	100	100	100
Calculated analysis[1]						
SID AA, %						
Lys	0.85	0.82	0.78	0.76	0.73	0.70
Ile:Lys	60	65	69	62	66	70
Leu:Lys	133	151	171	143	161	181
Met:Lys	35	33	31	33	33	33
Met and Cys:Lys	59	61	64	59	63	67
Thr:Lys	66	66	66	66	66	66
Trp:Lys	20.4	20.3	20.1	20.0	20.1	20.2
Val:Lys	70	76	83	70	78	86
His:Lys	38	43	49	40	45	51
NE, kcal/lb, ingredient databases						
NRC	1,141	1,093	1,047	1,149	1,102	1,055
INRA	1,117	1,032	948	1,127	1,042	957
CVB	1,121	1,058	996	1,130	1,067	1,005
Brazilian Tables	1,138	1,068	998	1,147	1,076	1,006

continued

Table 3. Composition of phase 4 and 5 diets (as-fed basis)[1,2,3]

	Dietary Phase					
	4			5		
NE reduction, %:	**0**	**4**	**8**	**0**	**4**	**8**
NE, kcal/lb, analyzed ingredient values						
NRC[6]	1,158	1,057	957	1,165	1,064	964
NRC, DE[7]	1,142	1,096	1,051	1,151	1,105	1,059
INRA[8]	1,126	1,038	951	1,134	1,046	958
CVB[9]	1,099	1,038	978	1,108	1,047	986
SID Lys:NE, g/Mcal	3.38	3.39	3.37	3.00	3.00	3.00
CP, %[10]	15.1	16.4	17.5	14.1	15.3	16.4
Ca, %	0.51	0.61	0.71	0.44	0.56	0.69
STTD P, %	0.30	0.35	0.40	0.25	0.32	0.39

[1] Calculated analysis is based off nutrient profiles for ingredients listed in the NRC (National Research Council, 2012).

[2] Zero and 8% reduced NE diets were blended to create treatment diets at 2, 4, and 6% NE reductions in phase 1. In phase 2, 3, 4, and 5 the 0 and 4% reduced NE diets were blended to create the 2% reduced NE diet, and the 4 and 8% reduced NE diets were blended to create the 6% reduced NE diet.

[3] Phases 4 and 5 were fed from approximately 180 to 230 lb and 230 to 300-lb respectively.

[4] THR Pro; CJ America-Bio, Downers Grove, IL.

[5] Axtra PHY (Dupont, Wilmington, DE) provided 325, 195, and 236 phytase units (FTU/lb) for an estimated release of 0.13, 0.12, and 0.14% STTD P, in Exp. 1, 2, and 3, respectively.

[6] NE kcal/lb calculated as an average of Eq. 1-7 and 1-8 as explained in the NRC (2012) using values derived from proximate analysis. Eq. 1-7; NE = (0.726 × ME) + (1.33 × EE) + (0.39 × Starch) – (0.62 × CP) – (0.83 × ADF); Eq. 1-8; NE = (0.700 × DE) + (1.61 × EE) + (0.48 × Starch) – (0.91 × CP) – (0.87 × ADF); with DE and ME calculated using Eq. 1-2 through 1-6.

[7] NE kcal/lb = (0.700 × DE) + (1.61 × EE) + (0.48 × Starch) – (0.91 × CP) – (0.87 × ADF); DE values derived from NRC (2012) ingredient database.

[8] NE kcal/lb = $NE/ME_{ref} + [(5.5 \times (EE_{new} - EE_{ref}) + 1.5 \times (Starch_{new} - Starch_{ref}) - 2.8 \times (CP_{new} - CP_{ref})] / ME_{new}$. Where; ref = reference values within the EvaPig software; and new = values derived from proximate analysis.

[9] NE kcal/lb = [(11.7 × CP) + (35.74 × EE) + [14.14 × (Starch + Glucose oligosaccharides + 0.90 × fermented sugars)] + (9.74 × fermented degradable carbohydrates) + (10.61 × acetic acid) + (14.62 × propionic acid) + (19.52 × butyric acid) + (20.75 × ethanol) + (12.02 × lactic acid) + (13.83 × glycerol)] × 0.23900574 × 0.45359237

[10] CP = crude protein.

Table 4. Effects of reducing net energy on grow-finish pig performance and carcass characteristics[1]

	NE reduction, %:						*P* =	
	0	2	4	6	8	SEM	Linear	Quadratic
Body weight, lb								
Initial	51.8	51.3	51.5	51.5	51.5	0.52	0.227	0.120
Final[2]	302.9	296.2	295.5	290.5	282.9	1.80	< 0.001	0.296
d 0 to 125 (Overall)								
ADG, lb	2.09	2.05	2.03	1.99	1.92	0.012	< 0.001	0.121
ADFI, lb	4.87	4.92	5.03	5.01	5.07	0.035	< 0.001	0.346
F/G	2.33	2.40	2.48	2.52	2.64	0.011	< 0.001	0.222
Carcass ADG, lb[3]	1.53	1.49	1.47	1.44	1.38	0.009	< 0.001	0.185
Carcass F/G[4]	3.18	3.29	3.42	3.49	3.66	0.016	< 0.001	0.184
SID Lys intake, g/d	20.47	20.30	20.31	19.80	19.56	0.140	< 0.001	0.148
SID Lys intake, g/kg gain	21.62	21.84	22.04	21.91	22.34	0.098	< 0.001	0.822
Removals, %	1.82	1.30	1.83	2.58	3.37	0.918	0.073	0.355
Mortality, %	4.16	3.38	3.39	3.09	2.33	1.017	0.172	0.818
Total, %	5.97	4.68	5.22	5.67	5.70	1.208	0.877	0.551
Carcass characteristics[2]								
Count, n	327	333	307	334	300			
HCW, lb	223.4	217.2	216.0	211.5	204.9	1.37	< 0.001	0.412
Carcass yield, %	73.2	73.0	72.6	72.3	72.1	0.15	< 0.001	0.676
Backfat depth, in	0.62	0.60	0.59	0.56	0.55	0.008	< 0.001	0.823
Loin depth, in	2.67	2.69	2.67	2.70	2.68	0.015	0.612	0.746
Lean, %	57.5	57.7	57.9	58.4	58.5	0.14	< 0.001	0.943

[1] A total of 1,927 pigs (initial BW = 51.5 lb) were used in a growth performance study with 23 to 26 pigs per pen and 15 replicates per treatment from May to September 2023.
[2] Weighted average from all marketing events. Between 0 to 5 pigs/pen were marketed at the 1st cut, 3 or 4 pigs were marketed at the 2nd cut, with the remaining pigs being marketed at the dump.
[3] Carcass ADG calculated as: Carcass yield × Live ADG.
[4] Carcass F/G calculated as: ADFI ÷ Carcass ADG.

Table 5. Effects of reducing net energy on grow-finish pig caloric efficiency based on ingredient NE databases[1]

	NE reduction, %						*P* =	
	0	2	4	6	8	SEM	Linear	Quadratic
d 0 to 125 (Overall)								
CE, kcal/lb gain[2]								
NRC[3]	2,646	2,669	2,699	2,680	2,741	11.7	< 0.001	0.495
INRA[4]	2,590	2,565	2,546	2,476	2,479	11.1	< 0.001	0.908
CVB[5]	2,598	2,600	2,609	2,568	2,604	11.4	0.572	0.664
Brazilian Tables[6]	2,640	2,633	2,635	2,585	2,612	11.5	0.003	0.718
CE, kcal/lb carcass gain[7]								
NRC	3,608	3,652	3,716	3,707	3,811	17.5	< 0.001	0.470
INRA	3,531	3,511	3,505	3,426	3,446	16.6	< 0.001	0.901
CVB	3,542	3,558	3,592	3,553	3,620	16.9	0.004	0.633
Brazilian Tables	3,599	3,605	3,628	3,577	3,631	17.1	0.482	0.710

[1] A total of 1,927 pigs (initial BW = 51.5 lb) were used in a growth performance study with 23 to 26 pigs per pen and 15 replicates per treatment from May to September 2023.
[2] Caloric efficiency = F/G × dietary NE (kcal/lb).
[3] NE is based off nutrient profiles for ingredients listed in the NRC (2012).
[4] NE is based off nutrient profiles for ingredients listed in EvaPig (2008).
[5] NE is based off nutrient profiles for ingredients listed in the CVB (2020).
[6] NE is based off nutrient profiles for ingredients listed in the Brazilian Tables for Poultry and Swine (2017).
[7] Caloric efficiency calculated as: Carcass F/G × dietary NE (kcal/lb)

Table 6. Effects of reducing net energy on grow-finish pig caloric efficiency based on analyzed ingredient NE values[1]

	NE reduction, %						*P* =	
	0	-2	-4	-6	-8	SEM	Linear	Quadratic
d 0 to 125 (Overall)								
CE, kcal/lb gain[2]								
NRC[3]	2689	2648	2612	2525	2508	11.4	< 0.001	0.904
NRC, DE[4]	2650	2674	2707	2689	2752	11.8	< 0.001	0.506
INRA[5]	2613	2585	2562	2489	2488	11.2	< 0.001	0.971
CVB[6]	2549	2552	2562	2523	2559	11.2	0.741	0.673
CE, kcal/lb carcass gain[7]								
NRC	3666	3625	3597	3492	3487	17.0	< 0.001	0.930
NRC, DE	3613	3660	3727	3720	3827	17.6	< 0.001	0.459
INRA	3531	3511	3505	3426	3446	16.6	< 0.001	0.901
CVB	3476	3493	3527	3491	3558	16.6	0.002	0.629

[1] A total of 1,927 pigs (initial BW = 51.5 lb) were used in a growth performance study with 23 to 26 pigs per pen and 15 replicates per treatment from May to September 2023.
[2] Caloric efficiency = F/G × dietary NE (kcal/lb).
[3] NE is based on equations 1-1 through 1-8 listed in the NRC (2012). Using chemical analysis of ingredients.
[4] NE is based on equation 1-8 listed in the NRC (2012): NE kcal/lb = (0.700 × DE) + (1.61 × EE) + (0.48 × Starch) – (0.91 × CP) – (0.87 × ADF); DE values derived from NRC (2012) ingredient database.
[5] NE is based on equations in the EvaPig software using chemical analysis of ingredients.
[6] NE is based on equations in the CVB software using chemical analysis of ingredients.
[7] Caloric efficiency calculated as: Carcass F/G × dietary NE (kcal/lb).