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Modeling Standardized Ileal Digestible Lysine to Calorie Ratio in 27- to 260-lb Genesus Finishing Pigs

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SWINE DAY 2022

KANSAS STATE UNIVERSITY SWINE INDUSTRY DAY 2022

Modeling Standardized Ileal Digestible Lysine to Calorie Ratio in 27- to 260-lb Genesus Finishing Pigs[1]

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Summary

The first of two objectives of this study was to determine standardized ileal digestible (SID) Lys to calorie ratio (SID Lys:NE) for optimal performance of Genesus (Oakville, Manitoba, Canada) pigs from 27 to 260 lb. A second objective was to build a calculator tool to help nutritionists and producers when formulating diets with Genesus pigs. A total of 4,485 late nursery and 5,200 grow-finishing mixed-gender pigs were used in 4 and 5 studies, respectively. Studies were conducted by Genesus and results of these experiments were provided to the Kansas State University Applied Swine Nutrition Team for analysis and modeling. Diets from each trial were reformulated to obtain the dietary nutrient content using the NRC 2012[3] ingredient library. Growth performance and diet nutrient content were used in a Microsoft Excel spreadsheet to determine grams of SID Lys intake per kilogram of gain, SID Lys:NE, and NE intake. To select the optimum Lys level from each phase of the trials, ADG and F/G were evaluated. Regression equations for SID Lys per kilogram of gain, SID Lys:NE, and NE intake were generated by using the performance at the optimum Lys values in each phase. The equation for the optimal Lys:calorie ratio is: SID Lys:NE (g/Mcal) = -0.0112195247 × Average BW (lb) + 5.3408676477. The developed equations were then used to build the calculator tool available at www.KSUswine.org. In conclusion, the results showed a quadratic response when calculating Lys intake per kilogram of gain and NE intake (kcal/d), and a linear response in the SID Lys:NE for pigs between 27 to 260 lb of BW. The calculator tool provides information about SID Lys requirements to formulate diets for maximum performance for Genesus pigs from 27 to 260 lb. Further research is needed to accurately estimate the SID Lys requirements of pigs beyond 260 lb.

Introduction

Lysine is the first limiting amino acid in swine diets. Recently, studies on swine with different genetic lines with high lean tissue deposition have shown that Lys and other essential amino acid requirements have increased over time. Therefore, prediction

[1] The authors appreciate Genesus, Inc., for partial financial support of this project.

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

equations have been useful to estimate the standardized ileal digestible (SID) Lys requirements for optimal growth performance and economic results for modern finishing pigs.[4] In addition, the optimal SID Lys to energy ratio (SID Lys:NE) can be estimated based on the SID Lys requirements and dietary energy content. Genesus, Inc., specializes in swine genetics and is the world's largest independent producer of purebred swine. However, feeding guidelines have not previously been established by an independent third party to help formulate diets to support optimum performance. Thus, the objective of this project was to determine the optimal SID Lys:NE ratio for Genesus pigs from 27 to 260 lb and to build a calculator tool to help formulate diets for this specific line.

Procedures

Animals and diets

A total of 4,485 late nursery and 5,200 grow-finishing mixed-gender pigs were used in 4 and 5 growth trials, respectively. Trials were conducted by Genesus Inc. (Oakville, Manitoba, Canada) and results were provided to the Kansas State University Applied Swine Nutrition Team for analysis. In the nursery experiments, pigs with an initial BW of 24 to 28 lb were housed for 28 d in a nursery barn containing 48 pens and 24 pigs per pen. Pigs and feeders were weighed and recorded each 7 days to determine ADG, ADFI, and F/G. Pigs were fed 4 corn-soybean meal-based dietary treatments ranging from 1.21 to 1.42% or 1.15 to 1.45% SID Lys, depending on the experiment. Diets containing the lowest and highest percentage of SID Lys were manufactured and blended via a robotic feeding system to create the other diets in each experiment.

In the grow-finish pig experiments, pigs with an initial BW of approximately 70 lb were housed for approximately 100 d in a finisher barn containing 40 pens, each with 25 pigs per pen. Weights of pens of pigs and feeders were recorded approximately every 21 days to determine ADG, ADFI, and F/G. Pigs were fed 1 of 5 corn-soybean meal-DDGS-based dietary treatments containing 80%, 90%, 100%, 110%, and 120% of current Genesus SID Lys requirements during each phase. Diets containing the lowest and highest SID Lys content were manufactured and blended via a robotic feeding system to create the 90%, 100%, and 110% SID Lys diets.

For all studies, experimental diets were reformulated using a spreadsheet-based software program (Kansas State University Diet Formulation Program V.8.3) to obtain dietary nutrient content utilizing the NRC[3] ingredient library. Compositions of experimental diets were used to calculate SID Lys and NE (kcal/lb) concentrations on an as-fed basis and were recorded in the template for each dietary treatment.

Data setup and parameter calculations

Growth performance criteria and dietary nutrient composition from all studies were set up in an Excel spreadsheet to organize the data. Next, the parameters were calculated using the growth data provided and nutrient concentrations obtained by reformulation. Lysine consumption in grams per day was calculated using the ADFI converted to metric units and multiplied by the SID Lys content of the diet in grams per kilogram.

[4] Gonçalves, M., U. Orlando, W. Cast and, M. Culbertson. 2017. Standardized ileal digestible lysine requirements for finishing PIC pigs under commercial conditions: A meta-analysis. J. Anim. Sci. doi: 10.2527/asasmw.2017.273.

Grams of Lys per kilogram of gain were calculated by dividing the Lys intake in grams per day by the ADG converted to metric units. Net energy intake per day was calculated by multiplying the NE content of the diet and ADFI. Finally, SID Lys:NE was calculated by dividing SID Lys consumed in grams per day by NE intake (Mcal) per day.

Selection for inclusion criteria

For each dietary phase within a trial, the best performance result was selected considering ADG and F/G. When similar performance was found between treatments, margin over the feed cost was calculated and the selection was done by the best margin observed. Then, grams of Lys per kilogram of gain, SID Lys:NE and NE intake per day values were selected in each phase within trial based on the previously selected treatment (best performance results).

Building the model and a calculator tool

For each study, the average weight was calculated for the feeding period for each phase and linked to the SID Lys in grams per kilograms of gain, SID Lys:NE, and NE intake per day previously selected for that feeding period in each study. Once the dataset was calculated, a scatterplot graph was used to determine the prediction regression equation for mixed-gender pigs for SID Lys in grams per kilogram of gain, SID Lys:NE, and NE intake per day. Lastly, a Lys requirement calculator was built using the regression equations. The SID Lys:NE, SID Lys (%) and NE intake could be calculated for different weight ranges by using the fixed dietary energy content and the initial and final weight of the pigs during the feeding period for each phase.

Results and Discussion

Prediction equations

The regression revealed that grams of Lys per kg of gain, SID Lys:NE, and NE intake for pigs weighing between 27 to 260 lb could be calculated by the equations:

$$\text{SID Lys/gain (g/kg)} = -0.0005415356 \times [\text{Average BW}^2\text{ (lb)}] + 0.1711738275 \times \text{Average BW (lb)} + 12.54.\ R^2 = 0.53$$

$$\text{SID Lys:NE (g/Mcal)} = -0.0112195247 \times [\text{Average BW (lb)}] + 5.3408.\ R^2 = 0.85$$

$$\text{NE intake (Kcal/d)} = -0.0888908317 \times [\text{Average BW}^2\text{ (lb)}] + 55.0608060611 \times \text{Average BW (lb)} + 105.11.\ R^2 = 0.96$$

Using these formulas, the SID Lys:NE in grams per Mcal for a 50- and 250-lb pig were 5.04 and 2.42, respectively (Figure 1). In addition, by using a fixed energy level in the calculator tool and an established number of phase feeding periods for pigs from 27 to 260 lb, the values of SID Lys, SID Lys:NE, and NE intake can be predicted. Moreover, using the predicted values, ADFI and Lys intake per day can be calculated (Figure 2). The data provided by Genesus and considered in the analysis covered pigs weighing from 27 to 260 lb (Table 1). Therefore, using the equations for pigs weighing outside of this range could result in biased estimates. Consequently, further research will be necessary in pigs weighing more than 260 lb to assess a correct estimation of Lys requirements for Genesus pigs at heavy weights.

In conclusion, Genesus finishing pigs' requirements for optimal performance were estimated by analyzing data and modeling the results obtained from previous trials. The results showed a quadratic response when calculating Lys intake per kilogram of gain and NE intake (kcal/d), and a linear response in the SID Lys:NE for pigs between 27 to 260 lb. The model and associated calculator tool available at *www.KSUswine.org* will help nutritionists and production companies using Genesus finishing pigs to estimate the requirements of SID Lys for optimal performance. However, considering the current market weights, further research and data are needed to accurately predict the requirements for pigs weighing over 260 lb.

Table 1. Grams of Lys per kilogram of gain, Lys:NE and NE intake estimates resulting from the developed regression equations[1]

BW, lb	Lys/gain, g/kg[2]	SID Lys:NE, g/Mcal[3]	NE intake, kcal/d[4]
27	16.8	5.04	1,527
40	18.5	4.89	2,165
60	20.9	4.67	3,089
80	22.8	4.44	3,941
100	24.2	4.22	4,722
120	25.3	3.99	5,432
140	25.9	3.77	6,071
160	26.1	3.55	6,639
180	25.8	3.32	7,136
200	25.1	3.10	7,562
220	24.0	2.87	7,916
240	22.4	2.65	8,200
260	20.4	2.42	8,412

[1]A total of 4,485 late nursery and 5,200 grow-finish mixed-gender pigs were used in 4 and 5 studies, respectively. Research trials were conducted by Genesus Inc., and data were then provided to the Kansas State University Applied Swine Nutrition Team for analysis.

[2] SID Lys/gain (g/kg) = -0.0005415356 × [Average BW^2 (lb)] + 0.1711738275 × Average BW (lb) + 12.54. R^2= 0.53.

[3] SID Lys:NE (g/Mcal) = -0.0112195247 × [Average BW (lb)] + 5.3408. R^2= 0.85.

[4] NE intake (Kcal/d) = -0.0888908317 × [Average BW^2 (lb)] + 55.0608060611 × Average BW (lb) + 105.11. R^2= 0.96.

Lysine Recommendations for Grow-Finish Pigs

Weight, lb	SID Lys:NE, g/Mcal Mix Gender
50	4.78
70	4.56
90	4.33
110	4.11
130	3.88
150	3.66
170	3.43
190	3.21
210	2.98
230	2.76
250	2.54

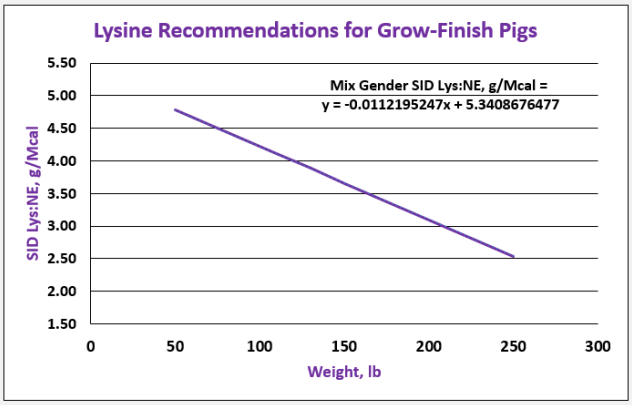

Figure 1. SID Lys:NE recommendations for 50- to 250-lb Genesus pigs.

Lysine Calculator for Grow-Finish Pigs

Dietary net Energy, kcal/lb	1150	1150	1150	1150	1150	1150	
Start weight, lb	27	40	80	130	180	230	
End weight, lb	40	80	130	180	230	290	
SID Lysine:NE ratio, g/Mcal	4.97	4.67	4.16	3.60	3.04	2.42	
SID Lysine, %	1.26	1.18	1.06	0.91	0.77	0.61	
NE intake, Kcal/d	1,850	3,089	4,906	6,504	7,657	8,412	
Expected intake, lb/d	1.61	2.69	4.27	5.66	6.66	7.31	
Lysine intake, g/d	9.2	14.4	20.4	23.4	23.3	20.4	

Figure 2. Screenshot of the calculator output using a fixed energy level and six weight ranges to estimate SID Lys:NE, SID Lys%, and NE intake.