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Effect of Increasing L-Lysine-HCl and Amino Acid Ratios on Performance of Finishing Pigs From 240 to 285 lb

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Effect of Increasing L-Lysine-HCl and Amino Acid Ratios on Performance of Finishing Pigs From 240 to 285 lb

Abstract

A total of 1,789 pigs (337 × 1050, PIC; initial BW 240.0 ± 2.51 lb) were used to determine the effects of increasing L-Lys-HCl and AA ratios on performance of late finishing pigs fed diets without DDGS. The study used 2 groups of pigs and each study lasted 18 and 27 d, respectively. Pigs were housed in mixed gender pens with 20 to 25 pigs per pen and 19 replications per treatment (10 and 9 replications per group, respectively). Pens of pigs were blocked by BW and randomly allotted to 1 of 4 dietary treatments. Treatment diets consisted of low, medium, or high levels of feed-grade AA and moderate or high AA ratios relative to Lys. Medium and high levels of feed-grade AA treatments had increased L-Lys-HCl in replacement of soybean meal to achieve CP levels of 12.0, 11.0, and 11.1%. The AA ratios were increased in the low CP diet to achieve a minimum of 60% Ile, 128% Leu, 36% Met, 70% Thr, 21.2% Trp, 72% Val, and 33% His for the high AA ratio treatment. Overall, there was a marginally significant increase in ADFI (quadratic, $P = 0.097$), with the greatest response observed in pigs fed medium feed-grade AA and moderate AA ratios. Treatment diets had no effect on ADG or F/G. At the end of study 2, carcass data were collected and analyzed. No differences ($P > 0.10$) were observed for HCW, carcass yield, backfat depth, loin depth or percentage lean. In summary, differing levels of feed-grade AA and AA ratios did not impact growth performance or carcass characteristics with the exception of a marginally significant (quadratic, $P = 0.097$) increase in ADFI.

Keywords

lysine, amino acids, finishing pig

Cover Page Footnote

Appreciation is expressed to New Horizon Farms (Pipestone, MN) for providing research facilities.

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K-STATE Research and Extension

SWINE DAY 2021

Effect of Increasing L-Lysine-HCl and Amino Acid Ratios on Performance of Finishing Pigs From 240 to 285 lb[1]

Larissa L. Becker, Mike D. Tokach, Robert D. Goodband, Joel M. DeRouchey, Jason C. Woodworth, and Jordan T. Gebhardt[2]

Summary

A total of 1,789 pigs (337 × 1050, PIC; initial BW 240.0 ± 2.51 lb) were used to determine the effects of increasing L-Lys-HCl and AA ratios on performance of late finishing pigs fed diets without DDGS. The study used 2 groups of pigs and each study lasted 18 and 27 d, respectively. Pigs were housed in mixed gender pens with 20 to 25 pigs per pen and 19 replications per treatment (10 and 9 replications per group, respectively). Pens of pigs were blocked by BW and randomly allotted to 1 of 4 dietary treatments. Treatment diets consisted of low, medium, or high levels of feed-grade AA and moderate or high AA ratios relative to Lys. Medium and high levels of feed-grade AA treatments had increased L-Lys-HCl in replacement of soybean meal to achieve CP levels of 12.0, 11.0, and 11.1%. The AA ratios were increased in the low CP diet to achieve a minimum of 60% Ile, 128% Leu, 36% Met, 70% Thr, 21.2% Trp, 72% Val, and 33% His for the high AA ratio treatment. Overall, there was a marginally significant increase in ADFI (quadratic, $P = 0.097$), with the greatest response observed in pigs fed medium feed-grade AA and moderate AA ratios. Treatment diets had no effect on ADG or F/G. At the end of study 2, carcass data were collected and analyzed. No differences ($P > 0.10$) were observed for HCW, carcass yield, backfat depth, loin depth or percentage lean. In summary, differing levels of feed-grade AA and AA ratios did not impact growth performance or carcass characteristics with the exception of a marginally significant (quadratic, $P = 0.097$) increase in ADFI.

Introduction

Swine diets can be supplemented with high levels of feed-grade AA to reduce diet cost. Feed-grade AA can be used to partially replace soybean meal while still achieving specific AA requirements needed for optimal growth and carcass traits. When high levels of feed-grade AA are used to replace a portion of soybean meal, diet CP is typically reduced. In particular, the reduction in CP can be associated with lower pig performance in late finishing.

As a result of lower soybean meal levels, one reason that growth performance may be reduced is the imbalance of branched-chain amino acids (BCAA) combined with a

[1] Appreciation is expressed to New Horizon Farms (Pipestone, MN) for providing research facilities.

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less than ideal relationship between BCAA and large neutral amino acids (LNAA).[3] A meta-analysis was conducted to predict the influence of BCAA and LNAA on growth performance of pigs.[4] The model suggests the loss in performance commonly observed when high levels of feed-grade AA are included in diets can be prevented with higher than normal inclusion of Ile, Val, and/or Trp. This model has been validated with diets containing DDGS and high Leu:Lys ratios; however, it has not been verified in lower Leu:Lys diets that do not contain DDGS. Therefore, the objective of this study was to evaluate the effect of increasing L-Lys-HCl and AA ratios on performance of late finishing pigs fed diets without DDGS.

Materials and Methods

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in this experiment. This study was conducted at a commercial finishing research facility located in southwest Minnesota (New Horizon Farms; Pipestone, MN). Each pen contained a 5-hole stainless steel dry self-feeder and a bowl waterer for *ad libitum* access to feed and water.

A total of 1,789 pigs (337 × 1050, PIC; initial BW 240.0 ± 2.51 lb) were used with 2 groups of pigs and each study lasted 18 and 27 d, respectively. Pigs were housed in mixed gender pens with 20 to 25 pigs per pen and 19 replications per treatment (10 and 9 replications per study, respectively). Pens of pigs were blocked by BW and randomly allotted to 1 of 4 dietary treatments. Experimental diets were fed in 1 phase (Table 1) and were corn-soybean meal-based. Treatment diets consisted of low, medium, or high levels of feed-grade AA and moderate or high AA ratios relative to Lys. Medium and high levels of feed-grade AA treatments had increased L-Lys-HCl in replacement of soybean meal to achieve CP levels of 12.0, 11.0, and 11.1%, respectively. The AA ratios were increased in the low CP diet to achieve a minimum of 60% Ile, 128% Leu, 36% Met, 70% Thr, 21.2% Trp, 72% Val, and 33% His for the high AA ratio treatment. During the trial, pens of pigs were weighed, and feed disappearance was recorded on d 0 and 18 (study 1), and d 0, 14, and 27 (study 2) to determine ADG, ADFI, and F/G.

At the end of study 2, final pen weights were collected, and the pigs were tattooed with a pen identification number and transported to a U.S. Department of Agriculture-inspected packing plant (JBS Swift, Worthington, MN) for carcass data collection. Carcass measurements included HCW, loin depth, backfat, and percentage lean. Percentage lean was calculated from a plant proprietary equation. Carcass yield was calculated by dividing the pen average HCW by the pen average final live weight obtained at the farm.

Data were analyzed using the GLIMMIX procedure of SAS OnDemand for Academics (SAS Institute, Inc., Cary, NC) in a randomized complete block design with pen as the experimental unit and BW as the blocking factor. Treatments were considered a fixed effect and block as the random effect. Contrast coefficients were adjusted to account for

[3] Duan, Y. H., L. M. Zeng, F. N. Li, Y. H. Li, B. E. Tan, Y. J. Ji, X. F. Kong, Y. L. Tang, Y. Z. Zhang, and Y. L. Yin. 2016. Effects of dietary branched-chain amino acid ratio on growth performance and serum amino acid pool of growing pigs. J. Anim. Sci. 94:129-134. doi:10.2527/jas2015-9527.

[4] Cemin, H. S., M. D. Tokach, S. S. Dritz, J. C. Woodworth, J. M. DeRouchey, and R. D. Goodband. 2019. Meta-regression analysis to predict the influence of branched-chain and large neutral amino acids on growth performance of pigs. J. Anim. Sci. 97:2505-2514. doi:10.1093/jas/skz118.

unequal spacing of diet crude protein for the following treatments: low feed-grade AA and moderate AA ratio, medium feed-grade AA and moderate AA ratio, and high feed-grade AA and moderate AA ratio. A pairwise comparison was used for high feed-grade AA and moderate AA ratio treatment, and high feed-grade AA and high AA ratio treatment. Results were considered significant with $P \leq 0.05$ and were considered marginally significant with $P \leq 0.10$.

Results and Discussion

Overall, there was a marginally significant increase in ADFI (quadratic, $P = 0.097$), with the greatest response observed in pigs fed medium feed-grade AA and moderate AA ratios (Table 2). Treatment diets had no effect on ADG or F/G.

For carcass traits, no differences ($P > 0.10$) were observed for HCW, carcass yield, backfat depth, loin depth or percentage lean (Table 2).

To assess the accuracy of performance predicted from the model of Cemin et al.[5] to the actual performance, we first adjusted the intercept of the predicted low feed-grade AA inclusion and moderate AA ratios treatment to match the actual ADG. When comparing the predicted ADG from the model to the actual ADG of the other treatments (Table 2), the model underpredicted ADG for pigs fed medium and high feed-grade AA diets that had moderate AA ratios. The model overpredicted the ADG for the pigs fed high feed-grade AA with high AA ratios. These results demonstrate that the model may not accurately predict growth responses when the Leu:Lys ratio is low (below 150%).

In conclusion, differing levels of feed-grade AA and AA ratios did not impact late finishing growth performance or carcass characteristics with the exception of a marginally significant (quadratic, $P = 0.097$) increase in ADFI.

Brand names appearing in this publication are for product identification purposes only. No endorsement is intended, nor is criticism implied of similar products not mentioned. Persons using such products assume responsibility for their use in accordance with current label directions of the manufacturer.

[5] Cemin, H. S., M. D. Tokach, S. S. Dritz, J. C. Woodworth, J. M. DeRouchey, and R. D. Goodband. 2019. Meta-regression analysis to predict the influence of branched-chain and large neutral amino acids on growth performance of pigs. J. Anim. Sci. 97:2505-2514. doi:10.1093/jas/skz118.

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

	Feed-grade AA/AA ratio			
	Low	Medium	High	High
Ingredient, %	Moderate	Moderate	Moderate	High
Corn	80.04	84.16	86.88	86.74
Soybean meal (46.5% CP)	16.97	12.46	9.50	9.49
Choice white grease	1.00	1.00	1.00	1.00
Limestone	0.85	0.85	0.85	0.85
Monocalcium P (21% P)	0.25	0.35	0.35	0.35
Salt	0.50	0.50	0.50	0.50
L-Lys-HCl	0.15	0.30	0.39	0.39
DL-Met	---	0.05	0.07	0.09
L-Thr	0.06	0.14	0.19	0.23
L-Trp	---	0.01	0.03	0.05
L-Val	---	0.02	0.07	0.10
L-Ile	---	---	---	0.05
Vitamin and trace mineral premix	0.15	0.15	0.15	0.15
Phytase[2]	0.03	0.03	0.03	0.03
Total	100	100	100	100
Calculated analysis[3]				
SID AA, %				
Lys	0.70	0.70	0.70	0.70
Ile:Lys	73	61	53	60
Leu:Lys	155	139	128	128
Met:Lys	28	32	34	36
Met and Cys:Lys	57	58	58	60
Thr:Lys	66	66	66	70
Trp:Lys	21.6	19.0	18.5	21.2
Val:Lys	77	68	68	72
His:Lys	44	38	34	33
Total Lys, %	0.80	0.79	0.78	0.78
ME, kcal/lb	1,527	1,529	1,531	1,533
NE, kcal/lb	1,211	1,211	1,212	1,213
SID Lys:NE, g/Mcal	2.63	2.63	2.62	2.62
CP, %	13.6	12.0	11.0	11.1
Ca, %	0.47	0.48	0.47	0.47
STTD P, %	0.29	0.30	0.29	0.29

[1]Treatment diets were fed for 18 and 27 d and consisted of low, medium, or high levels of feed-grade amino acids and moderate or high branched-chain amino acids (Ile, Leu, and Val) ratios relative to Lys.
[2]Optiphos 2000 (Huvepharma, Sofia, Bulgaria) provided 136.5 phytase units (FTU)/lb of diet, for an estimated release of 0.10% STTD P.
[3]National Research Council. 2012. Nutrient Requirements of Swine: Eleventh Revised Edition. Washington, DC: The National Academies Press. https://doi.org/10.17226/13298..

Table 2. Effect of increasing L-Lysine-HCl and AA ratios on performance of finishing pigs[1]

	Feed-grade AA[2] /AA ratio					*P* =		
	Low	Medium	High	High		Crude protein[3]		High, moderate vs.
Item	Moderate	Moderate	Moderate	High	SEM	Linear	Quadratic	High, high[4]
BW, lb								
Starting weight	240.1	239.4	240.3	240.1	2.51	0.874	0.124	0.809
Ending weight	283.5	283.7	283.8	283.0	1.84	0.864	0.992	0.519
Overall								
ADG, lb	1.97	2.02	1.98	1.95	0.039	0.669	0.208	0.448
ADFI, lb	6.61	6.82	6.75	6.73	0.094	0.072	0.097	0.851
F/G	3.37	3.39	3.42	3.46	0.053	0.489	0.831	0.556
Model predicted[5]								
ADG, lb	1.97	1.92	1.87	1.98	---	---	---	
ADFI, lb	6.67	6.90	6.94	7.28	---	---	---	
F/G	3.38	3.60	3.70	3.67	---	---	---	
Removals, %	0.00	0.15	0.89	0.15	0.593	0.984	0.989	0.102
Mortality, %	0.22	0.34	0.34	0.46	0.334	0.624	0.823	0.706
Total removals, %	0.35	0.71	1.58	0.87	0.670	0.072	0.714	0.295
Carcass characteristics[6]								
HCW	211.6	211.8	212.9	210.9	1.81	0.554	0.753	0.345
Carcass yield, %	74.8	75.6	75.3	75.0	0.71	0.579	0.603	0.803
Backfat depth, in.[7]	0.64	0.65	0.64	0.64	0.013	0.748	0.665	0.704
Loin depth, in.[7]	2.74	2.72	2.78	2.78	0.026	0.396	0.148	0.968
Lean, %[7]	57.3	57.1	57.5	57.4	0.21	0.561	0.315	0.733

[1]A total of 1,789 pigs (initially 240.0 ± 2.51 lb) were used with 20 to 25 pigs per pen and 19 replications per treatment.
[2]Treatment diets consisted of low, medium, or high levels of feed-grade amino acids and moderate or high AA ratios relative to Lys.
[3]Linear and quadratic contrasts of diet crude protein compared the following treatments: low feed-grade AA and moderate AA ratio, medium feed-grade AA and moderate AA ratio, and high feed-grade AA and moderate AA ratio.
[4]Contrast comparison was high feed-grade AA and moderate AA ratio treatment, and high feed-grade AA and high AA ratio treatment.
[5]Values represent predicted values using Cemin et al. model. (Cemin, H. S., M. D. Tokach, S. S. Dritz, J. C. Woodworth, J. M. DeRouchey, and R. D. Goodband. 2019. Meta-regression analysis to predict the influence of branched-chain and large neutral amino acids on growth performance of pigs. J. Anim. Sci. 97:2505-2514. doi:10.1093/jas/skz118.).
[6]Carcass data were only collected for study 2 (838 pigs total).
[7]Adjusted using HCW as covariate.