

144 Evaluation of high synthetic lysine diets for 30-52 kg growing gilts reared under commercial conditions. A. M. Gaines^{*1}, B. W. Ratliff¹, P. Srichana¹, G. L. Allee¹, J. L. Usry², G. F. Yi³, C. D. Knight³, and K. R. Perryman³, ¹University of Missouri, ²Ajinimoto Heartland, LLC, ³Novus International, Inc.

Two experiments were conducted at a commercial research site in order to evaluate the effects of high synthetic lysine inclusion on the growth performance of growing gilts. In Exp.1, a total of 735 gilts (TR-4 × C22; 32.1 ± 0.15 kg) were used in a RCBD with 7 replicate pens/treatment and 21 pigs/pen (on test 21 d). Pigs were allotted to one of five dietary treatments containing 0.10, 0.20, 0.30, 0.40, and 0.50% added L-Lysine-HCl, respectively. Diets were formulated at a 1.00% true ileal digestible (TID) lysine with supplementation of only L-Thr and Alimet[®] feed supplement. For Exp.1, diets supplemented with 0.50% L-Lysine-HCl resulted in decreased (Treatment, P < 0.06; Quadratic, P < 0.05) ADG (942, 951, 942, 966, and 907 g/d) and decreased (Treatment, P < 0.01; Linear, P < 0.001) G:F (0.484, 0.476, 0.478, 0.480, and 0.463) compared to diets with 0.10-0.40% L-Lysine-HCl inclusion. In Exp.2, a total of 1,029 gilts (TR-4 × C22; 29.5 ± 0.20 kg) were used in a RCBD with 7 replicate pens/treatment and 21 pigs/pen (on test 23-d). Pigs were allotted to one of six dietary treatments containing 0.10, 0.20, 0.30, 0.40, 0.50, and 0.60% added L-Lysine-HCl, respectively. Diets were formulated at a 1.00% TID lysine and additional L-Thr, Alimet[®], L-Trp, L-Ile, and L-Val were supplied as necessary to meet minimum amino acid ratios. For Exp.2, there were no differences in ADG (P=0.21) with increasing L-Lysine-HCl inclusion (935, 948, 922, 929, 942, and 926 g/d). However, diets supplemented with 0.60% L-Lysine-HCl resulted in decreased (Treatment, P < 0.01; Linear, P < 0.01) G:F (0.481, 0.481, 0.481, 0.476, 0.475, and 0.468) compared to diets with 0.10-0.40% L-Lysine-HCl inclusion. Collectively, these two experiments indicate that in practical diet formulations, up to 0.40% L-Lysine-HCl can be added with only L-threonine and Alimet[®] supplementation, whereas up to 0.50% L-Lysine-HCl can be added in diets if supplemented with additional synthetic amino acids. (ALIMET[®] is a trademark of Novus International, Inc., and is registered in the United States and other countries)

Key Words: Gilts, Lysine-HCl, growth

145 Efficacy of liquid DL-methionine hydroxy analog free acid and DL-methionine as methionine sources for pigs. B. G. Kim¹, M. D. Lindemann^{*1}, G. L. Cromwell¹, and M. Rademacher², ¹University of Kentucky, ²Degussa AG.

The replacement rate of liquid DL-methionine hydroxy analog free acid (MHA-FA, 88%) to DL-methionine (DLM, 99%) is a subject of debate. Most of the studies that have been conducted with pigs have involved diets based on cereals other than corn. Thus, the objective of the present study was to evaluate the efficacy of MHA-FA compared with DLM to support N-retention in pigs fed diets based on corn and soybean meal. A total of 30 weanling barrows (mean initial BW of 16.83 ± 0.51 kg) were used in a metabolism study. There were two periods: a 7-d adaptation period and a 5-d collection period for total collection of feces and urine; feed intake was standardized within replicates. The basal diet was formulated to contain 16.85% CP and 0.212% methionine. Dietary treatments included: 1) basal diet, 2) basal plus 0.03% DLM, 3) basal plus 0.06% DLM, 4) basal plus 0.046% MHA-FA, and 5) basal plus 0.092% MHA-FA. The levels of DLM and MHA-FA used were approximated to provide similar methionine equivalents based upon the commercial products used and literature estimates that MHA-FA would have a relative bioequivalence of about 65% on average compared to the DLM. Analysis of the diets for inclusion of the two products demonstrated actual inclusion rates of 0.027 and 0.058% DLM and 0.044 and 0.088% MHA-FA. There was no difference in fecal N output among the treatments (P>0.05). However, urinary N (g) linearly declined (P=0.03 for DLM and P=0.01 for MHA-FA) with increasing amounts of both products. This resulted in a linear increase (P=0.01) in retained N (g/d) for both DLM and MHA-FA (10.96, 11.34, 12.11, 11.35, and 12.12, respectively). Also, N retention rate (%) increased linearly (P=0.01) with increasing levels of DLM and MHA-FA (63.5, 65.8, 69.9, 65.4, and 69.9, respectively). A slope-ratio procedure for comparison of the responses indicated a relative effectiveness on a weight for weight basis for the

MHA-FA to DLM of 65.9% for grams of N retained per day and 63.9% for N retention rate.

Key Words: Methionine, Methionine hydroxy analog, Pigs

146 The optimal true ileal digestible (TID) lysine and total sulfur amino acid (TSAA) requirement for finishing pigs fed Paylean[®]. N. Z. Frantz^{*}, M. D. Tokach, R. D. Goodband, S. S. Dritz, J. M. DeRouche, J. L. Nelssen, and C. L. Jones, *Kansas State University*.

A total of 1,887 pigs (PIC 337 C22; 97 kg initial BW) were used in a 28-d growth assay to simultaneously examine both the TID lysine and TID TSAA requirements and to determine the appropriate TID TSAA:lysine ratio in finishing pigs fed Paylean (5 ppm). Four TID lysine (0.66, 0.79, 0.92, and 1.05%) and four TID TSAA (0.47, 0.52, 0.57, and 0.63%) concentrations were evaluated. Lysine treatments were formulated with a minimum TID TSAA:lysine ratio of 60%, and TSAA diets were formulated with 1.05% TID lysine. The highest lysine and TSAA concentrations were combined in the same diet, which gave a total of 7 diets. There were eleven or twelve replications per treatment. No gender treatment or treatment week interactions were observed (P > 0.13). Increasing TID lysine improved (linear, P < 0.01) ADG (0.94, 0.97, 1.01, and 1.02) with the greatest response at 0.92% TID lysine. Increasing TID TSAA did not influence (P > 0.76) ADG (1.02, 1.02, 1.02, and 1.02 kg/d) resulting in a TID TSAA:lysine ratio of not more than 51% for ADG. Increasing TID lysine did not affect ADFI (P > 0.60), but ADFI decreased (linear, P < 0.04) with increasing TID TSAA. Increasing TID lysine and TSAA linearly (P < 0.01 and P < 0.09, respectively) improved G:F (0.332, 0.341, 0.354, and 0.359 for lysine and 0.346, 0.355, 0.357, and 0.359 for TSAA). The greatest improvement in G:F was observed as TID lysine increased to 0.92% and TID TSAA increased from 0.47% to 0.52%, resulting in an optimum TID TSAA:lysine ratio of 57%. Regression analysis indicates that the maximum G:F response was obtained with a TID TSAA:lysine ratio of 58%. Increasing TID lysine had no effect on any carcass criteria (P > 0.11), but increasing TID TSAA from 0.47 to 0.52% tended to improve fat free lean (quadratic, P < 0.10). In summary, a TID TSAA:lysine ratio of 58% optimized growth performance of finishing pigs fed Paylean[®].

Key Words: Lysine, Methionine, Paylean

147 Evaluation of the true ileal digestible (TID) total sulfur amino acid (TSAA) to lysine ratio for finishing pigs weighing 33 to 60 kg. K. R. Lawrence^{*}, C. N. Groesbeck, R. D. Goodband, M. D. Tokach, S. S. Dritz, J. M. DeRouche, J. L. Nelssen, and C. R. Neill, *Kansas State University*.

The objective of this trial was to evaluate the true ileal digestible (TID) total sulfur amino acid (TSAA) to lysine requirement for early finishing pigs. A total of 126 pigs (PIC L326 × L42; initially 33.1 kg) were blocked by sex and weight and allotted to one of nine dietary treatments in a 27 d trial. There were two pigs per pen with 4 replicates of barrows (initially 33.7 kg) and 3 replicates of gilts (initially 32.3 kg). Dietary treatments included five TID lysine (0.79, 0.87, 0.94, 1.02 and 1.10%) and five TID TSAA (0.53, 0.57, 0.61, 0.66 and 0.70%) concentrations. The highest lysine (1.10%) and TSAA (0.70%) were combined in one diet and used in both the lysine and TSAA titrations. All experimental diets were corn-soybean meal-based. In diets evaluating increasing TID lysine, methionine & cysteine ratios were 64 to 66% of lysine and in diets evaluating TSAA, diets were formulated to 1.10% TID lysine. Increasing TID lysine increased ADG (linear, P<0.01) and improved G:F (quadratic, P<0.03) with the greatest response at 1.02% TID lysine. Increasing TID lysine had no effect (P>0.05) on ADFI. Increasing TID TSAA had no effect (P>0.05) on ADG or ADFI. There was a linear trend (P<0.15) for an improvement in G:F maximized at 0.61% TID TSAA. Using a TID lysine requirement of 1.02% and TID TSAA requirement of 0.61% suggests a total sulfur amino acid to lysine ratio of 60%. Using the response surface for G:F suggests a similar TID TSAA:lysine ratio of 59%.

Effect of increasing true ileal digestible (TID) lysine and TSAA in 33 to 60 kg pigs

Item	TID Lysine, %				1.10	SE	Linear	Quadratic
	0.79	0.87	0.94	1.02				
ADG, kg	0.95	0.99	1.00	1.07	1.06	0.065	0.01	0.65
G:F	0.453	0.472	0.494	0.515	0.491	0.023	0.01	0.03
Item	TID TSAA, %				0.70	SE	Linear	Quadratic
	0.53	0.57	0.61	0.66				
ADG, kg	1.00	1.02	1.02	1.02	1.06	0.065	0.22	0.73
G:F	0.471	0.478	0.498	0.492	0.491	0.023	0.15	0.32

Key Words: Sulfur amino acids, Lysine, Finishing pig

148 True ileal digestible (TID) isoleucine:lysine ratio of late-finishing barrows fed corn-blood cell or corn-amino acid diets. S. X. Fu*¹, D. C. Kendall¹, R. W. Fent¹, G. L. Allee¹, and J. L. Usry², ¹University of Missouri-Columbia, ²Ajinomoto Heartland LLC.

Two experiments were conducted to determine the TID isoleucine:lysine ratio of late-finishing barrows fed corn-RBC (red blood cell) diets or corn-AA diets. In Exp. 1, 150 barrows (TR4 x C22, BW=89.9 kg) were allotted to six dietary treatments with five replicates of five pigs per pen. Dietary treatments included a five-point titration (TID isoleucine:lysine: 47, 54, 61, 68 and 75%) containing 3.9% RBC and a corn-SBM control diet. All diets contained 0.52% TID lysine and 3.45 Mcal/kg ME. Results indicated linear ($P<0.001$) and quadratic ($P<0.001$) improvements in ADG (0.628, 0.841, 1.074, 1.120 and 1.151 kg/d, respectively) and G:F (0.242, 0.300, 0.330, 0.337 and 0.327, respectively) to increasing isoleucine:lysine ratio. A linear increase ($P<0.001$) was observed in ADFI (2.575, 2.804, 3.262, 3.325 and 3.523 kg/d, respectively). Pigs fed the corn-RBC diet with an isoleucine:lysine ratio of 75% tended to have higher ADG (1.151 vs. 1.064 kg/d, $P=0.06$) and ADFI (3.325 vs. 3.293 kg/d, $P=0.07$) than pigs fed control diet. In Exp. 2, 45 individually-penned barrows (96.9 kg) were used in a 5-point TID isoleucine:lysine titration (45, 51, 57, 63 and 69%) utilizing all-corn diets fortified with synthetic amino acids. All diets contained 0.52% TID lysine and 3.40 Mcal/kg ME. A quadratic response in ADG (0.811, 0.935, 0.892, 0.855 and 0.844 kg/d, respectively; $P=0.07$) and ADFI (3.254, 3.563, 3.574, 3.400 and 3.280 kg/d, respectively; $P<0.01$) was observed to increasing isoleucine:lysine ratio. No difference was observed in G:F (0.249, 0.262, 0.250, 0.251 and 0.256, respectively; $P>0.10$) among treatments. Based on these data, TID isoleucine:lysine ratio of late-finishing barrows was estimated to be 61.7% (ADG) and 57.9% (G:F) for pigs fed corn-RBC diets and 50.7% (ADG) and 53.0% (ADFI) for pigs fed all-corn diets fortified with synthetic amino acids.

Key Words: Isoleucine, Blood cell, Pigs

149 Effects of protein source on true ileal digestible (TID) isoleucine: lysine ratio in late-finishing barrows. S.X. Fu*¹, R.W. Fent¹, P. Srichana¹, G.L. Allee¹, and J.L. Usry², ¹University of Missouri-Columbia, ²Ajinomoto Heartland LLC.

Two 22-day experiments were conducted to determine the effects of protein source on TID isoleucine:lysine ratio of late-finishing barrows. In Exp. 1, 144 barrows (TR4 x C22, BW= 87.1 kg) were blocked by weight and allotted to one of nine dietary treatments with eight replicates of two pigs per pen. Treatment 1 was a corn-SBM control diet with an inclusion of 0.15% L-lysine HCl. Treatments 2 to 9 were a 2 x 4 factorial design. The factors included: two protein sources (3% SBM plus synthetic AA or 3.85% red blood cells (RBC)) and four levels of TID isoleucine:lysine ratio (54, 60, 66 and 72%). All diets were formulated to contain 0.52% TID lysine and 3.44 Mcal/kg ME. Exp. 2 utilized the same dietary treatments as Exp. 1 with six replicates per treatment (BW= 89.9 kg). Because there was no interaction between experiment and dietary treatment ($P>0.05$), data from the two experiments were pooled. Pigs fed corn-SBM+AA diets or the corn-RBC diets with isoleucine:lysine over 60% had similar performance as control pigs. Interactive effects ($P<0.05$) on ADG, ADFI and G:F were observed between protein source and TID isoleucine:lysine ratio. In corn-SBM+AA diets, no benefit was observed for TID isoleucine:lysine ratios above 54%. However, increasing isoleucine:lysine ratio improved performance of pigs fed corn-RBC diets in terms of ADG (linearly, $P<0.01$ and quadratically, $P<0.05$), ADFI (linearly, $P<0.01$) and G:F (linearly, $P<0.01$ and quadratically, $P<0.05$). Using breakpoint analysis, TID isoleucine:lysine ratio of late-finishing barrows fed corn-RBC diets was estimated to be

61% for ADG and 61% for G:F. In conclusion, TID isoleucine:lysine ratio of late-finishing barrows was affected by dietary protein source; pigs fed corn-RBC diets need a higher TID isoleucine:lysine ratio to maximize growth performance than pigs fed corn-SBM diets.

Key Words: isoleucine, blood cell, pigs

150 Evaluation of the true ileal digestible (TID) tryptophan requirement for late nursery pigs fed high L-lysine HCl diets. R. W. Fent*, A. M. Gaines, S. X. Fu, B. W. Ratliff, P. Srichana, and G. L. Allee, University of Missouri-Columbia.

Two experiments were conducted to determine the effect of dietary TID tryptophan concentration on the growth performance of late nursery pigs fed diets containing high levels of L-lysine HCl. In Exp. 1, 135 pigs (TR-4 C22; 13.4 ± 0.01 kg) were allotted to one of five dietary treatments in a randomized complete block design with six replicate pens per treatment. These pigs were housed in a segregated early weaning facility. In Exp. 2, a commercial nursery facility was utilized in which 922 pigs (TR-4 C22; 14.8 ± 0.15 kg) were allotted to the same dietary treatments as Exp. 1 in a randomized complete block design with six replicates per treatment. All diets contained 0.7% L-lysine HCl and were formulated to 1.30% TID lysine with a lysine:CP ratio maintained at 7.0%. Treatments consisted of a titration of dietary TID tryptophan concentration including 0.165, 0.185, 0.205, 0.225, and 0.245% achieved through the addition of L-tryptophan to the basal diet. Exp. 1 and 2 were conducted over a 17-d or 15-d growth period, respectively, with ADG, ADFI, and G:F calculated at the conclusion of the experiments. Similar growth responses were observed for the two nursery experiments. Average daily gain, ADFI, and G:F were similar ($P>0.05$) across all dietary treatments as TID tryptophan concentration increased in the diet. Average daily gain for Exp. 1 and 2 were 603, 621, 631, 621, and 626 g/d (SE=19.1) and 549, 572, 572, 576, and 576 g/d (SE=13.6), respectively for the five dietary treatments. Gain:feed for Exp. 1 and 2 were 0.711, 0.733, 0.720, 0.728, and 0.708 (SE=0.011) and 0.654, 0.671, 0.676, 0.667, 0.676 (SE=0.009). These data indicate that the TID tryptophan requirement for late nursery pigs may not be greater than 0.165% when pigs are consuming a diet containing 0.7% L-lysine HCl.

Key Words: Tryptophan, Pigs, L-Lysine HCl

151 Body weight has no effect on the threonine requirement in growing pigs. J. van Milgen*¹, J. Noblet¹, and L. Le Bellego², ¹INRA - UMR VP, ²Ajinomoto Eurolysine SAS.

Threonine is generally the second or third limiting amino acid in cereal-based diets. Relative to other amino acids, endogenous losses of threonine are quite high. Consequently, the contribution of maintenance to the total requirement is higher for threonine than for most other amino acids. Total ileal digestible threonine requirements are usually expressed relative to that of lysine (thr:lys). If the contribution of maintenance to the total amino acid requirement changes during growth, the optimum thr:lys ratio will vary. A series of experiments was conducted to determine the effect of BW on the optimum thr:lys ratio in growing pigs. In experiment 1, fifteen blocks of four pigs each (initial BW 55 kg) were fed one of four diets in which the thr:lys ratio varied between 55 to 70%. Diets were based on corn, wheat and barley and soybean meal and differed only in the added threonine content. Lysine (0.67% as-fed) was the second-limiting amino acid. Pigs were housed individually and were pair-fed within a block. Average daily gain during a 3-wk period was used as the response criterion. In experiment 2, the effect of BW on the thr:lys requirement was tested (initial BW 20, 50 or 90 kg) using a design similar to experiment 1. The thr:lys ratio varied between 55 and 75% using six pigs per diet and BW (with 0.88, 0.68 and 0.45% total lysine for the three stages). The hypothesis that lysine was the second-limiting amino acid in the experiment was confirmed in a separate experiment in which additional lysine was added to the diet with the highest thr:lys ratio. Ileal digestibility of the diets without added threonine was determined in 40-kg pigs with an ileo-rectal anastomosis. Performance was analyzed using either a linear-plateau (LP) or a curvilinear-plateau model (CLP). Average daily gain ranged from 720 g/d (BW = 20 kg) to 880 g/d (BW = 90 kg). Using model CLP, the optimum thr:lys ratio was 65% with no significant effect of BW on this ratio. The estimate when using model LP was about 3%-point lower.