the median intercept was identified using the pooled slopes and compared to all other ST intercepts. Seven ST were not different (P>.05) from the median intercept with an average geometric intercept (GI) of 0.20 (AZ, CA, KA, MN, OR, PA, WA). Three ST had a higher average GI of 1.00 (UT, ID, NE), two ST had a lower GI of 0.95 (IL, NY) and two ST had the lowest GI of 3.08. Average GI weighted for the observations in each group was -.19. The slope of ADF versus NDF appears constant throughout the US and variation in intercepts is more likely related to laboratory differences rather than to regional differences in alfalfa. In conclusion, it is possible to identify a geometric relationship between ADF and NDF that can be used to develop uniform alfalfa hay quality guidelines for the US: ADF = -.19 + .80*NDF; n=605, R^2=.90, and RMSE=1.7.

Key Words: Fiber, Forage Quality, Alfalfa

569 Effects of purified fiber energy supplementation on digestion and ruminal parameters of steers fed cool season grass hay. H. M. Blalock* and C. J. Richards, *The University of Tennessee, Knoxville*.

Six ruminally and duodenally cannulated steers were arranged in a replicated 3 x 3 Latin square. Steers had free choice access to cool season grass hay and were supplemented with 0 (NO), 0.25 (LO) or 0.50% (HI) BW of purified fiber (60% solka floc, 40% oat fiber) prior to AM hay feeding. Periods were 18 d. On d 7 to 17, steers were intra-ruminally dosed with Cr_2O_3 followed by total fecal collection from d 12 to 17 and duodenal digesta sampling at 10 hr intervals on d 13 to 17. On d 17, Co-EDTA was ruminally dosed and rumen fluid collected at 0, 3, 6, 9, 12 and 24 hr post-dosing. On d 18, ruminal contents were evacuated, weighed and subsamples retained for bacterial separation. Forage intake and total N intake were not affected by supplementation. Total intake of DM, NDF, ADF and OM were increased ($P < 0.05$) with increased supplementation. Quantities and percentages of total tract DM, NDF, ADF and OM digestion were increased ($P < 0.05$) by supplementation. Ruminal and total tract nitrogen digestion were not affected by supplementation. Ruminal acetate and propionate concentrations were not affected ($P > 0.10$) while butyrate concentrations increased ($P < 0.01$) with supplementation. Isobutyrate, valerate and isovalerate concentrations decreased ($P < 0.01$) with supplementation. However, isobutyrate was not different between HI and LO. Ruminal pH was greatest ($P < 0.01$) for HI. Ruminal NH_3-N concentrations were decreased ($P < 0.01$) by supplementation. A TRT x Time interaction existed ($P < 0.01$) for NH_3-N due to the concentration of NO remaining relatively constant throughout the 24 hr period. Total N flow at the duodenum was not affected by supplementation. This data indicates that supplementing steers consuming cool season grass hay with fibrous energy can increase ruminal and total tract fiber digestion without affecting forage intake.

Key Words: Fiber, Digestion, Ruminant

Nonruminant Nutrition: Amino Acids

570 The optimal true ileal digestible lysine and total sulfur amino acid requirement for nursery pigs between 10 and 20 kg. J. D. Schneider*, M. D. Tokach, S. S. Dritz, R. D. Goodband, J. L. Nelssen, J. M. DeRouchey, C. W. Hastad, N. A. Lenehan, N. Z. Frantz, B. W. James, K. R. Lawrence, C. N. Groesbeck, R. O. Gottlob, and M. G. Young, *Kansas State University, Manhattan*.

An experiment involving 360 pigs (avg BW = 10.3 kg) was conducted to determine the appropriate true ileal digestible (TID) lysine and total sulfur amino acid (TSAA) requirement of nursery pigs, and consequently to determine the optimal TSAA:lysine ratio. This trial was organized as a combination of two separate experiments with one set of diets consisting of five treatments with increasing TID lysine (0.9, 1.0, 1.1, 1.2, and 1.3%) and the second set of diets consisting of five treatments with increasing TID TSAA (0.56, 0.62, 0.68, 0.74, and 0.81%). The highest level of both lysine and TSAA (1.3 and 0.81%, respectively) served as a positive control and this diet was combined as one treatment to give a total of nine treatments. Pigs were randomly allotted to 8 replications with 5 pigs per pen based on BW. Average daily gain increased (linear, P < 0.01), while ADFI decreased (linear, P < 0.06) to 1.3% TID lysine. Increasing TID lysine from 0.9 to 1.3% also improved (linear, P < 0.01; and quadratic P < 0.05, respectively) gain:feed. Increasing TID TSAA from 0.56 to 0.81% increased (linear, P < 0.02) ADG and improved (linear, P < 0.01) gain:feed. Regression analysis of the response surface resulted in an estimated TID TSAA to lysine ratio ranging from 55 to 61% for ADG and 57 to 61% for gain/feed.

	TID	Lysine, %					
Item	0.9	1.0	1.1	1.2	1.3	SED	Linear	Quadratic
ADG, g	494	524	525	519	549	17.306	0.01	0.51
ADFI, g	901	881	872	842	865	36.733	0.06	0.34
Gain/ Feed	0.55	0.59	0.61	0.62	0.63	0.012	0.01	0.05

	TID	TSAA, %					
Item	0.56	0.62	0.68	0.74	0.81	SED	Linear	Quadratic
ADG, g	514	528	545	540	549	17.306	0.02	0.40
ADFI, g	878	868	881	867	865	36.733	0.66	0.88
Gain/ Feed	0.59	0.61	0.62	0.62	0.63	0.012	0.01	0.34

Key Words: Total Sulfur Amino Acids, Lysine, Nursery Pigs

571 The optimal true ileal digestible lysine and threonine requirement for nursery pigs between 10 and 20 kg. N. A. Lenehan[1], M. D. Tokach[1], S. S. Dritz[1], R. D. Goodband[1], J. L. Nelssen[1], J. L. Usry[2], J. M. DeRouchey[1], and N. Z. Frantz*[1], [1]*Kansas State University, Manhattan,* [2]*Ajinomoto Heartland LLC, Chicago, IL*.

A total of 360 pigs (Genetiporc; initially 10.7 kg and 34 d of age) were used in a 17-d growth assay. This trial was conducted as a combination of two separate trials in order to simultaneously examine both the true ileal digestible (TID) lysine and threonine requirements, and determine the appropriate threonine to lysine ratio. The first part of the trial consisted of five treatments with increasing TID lysine (0.9 1.0, 1.1, 1.2, and 1.3%). The second part consisted of five treatments with increasing TID threonine (0.60, 0.66, 0.73, 0.79, and 0.85%). The highest level of both lysine and threonine (1.3 and 0.85%, respectively) served as a positive control and this diet was combined as one treatment to give a total of nine treatments. There were 8 replications with 5 pigs per pen. Both ADG and gain/feed (G/F) increased (quadratic, P < 0.02) to 1.2% TID lysine. For threonine, ADG (linear, P < 0.03) and G/F (quadratic, P < 0.04) increased to 0.79% TID threonine. Using 0.79% TID threonine and 1.2% TID lysine as the requirements yields a TID threonine to lysine ratio of 66% for both ADG and G/F. In summary, these results suggest a TID threonine to lysine ratio of approximately 66% for 10 to 20 kg pigs.

	TID	Lysine,	%				
Item	0.9	1.0	1.1	1.2	1.3	SED	Linear	Quadratic
ADG, g	532	541	587	599	582	19	< 0.01	0.02
ADFI, g	918	870	917	923	896	35	0.81	1.00
Gain/ feed	0.58	0.62	0.64	0.65	0.65	0.01	< 0.01	< 0.01

	TID	Threonine,	%				
Item	0.60	0.66	0.73	0.79	0.85	SED	Linear	Quadratic
ADG, g	563	573	577	603	582	19	0.03	0.26
ADFI, g	924	900	897	923	896	35	0.45	0.64
Gain/ feed	0.61	0.64	0.64	0.65	0.65	0.01	< 0.01	0.04

Key Words: Threonine, Lysine, Nursery Pigs

572 Assessment of the methionine requirement of pigs in the weight range 11 to 20 kg. Patrick B. Lynch*[1], Meike Rademacher[2], and Peadar G. Lawlor[1], [1]*Teagasc, Moorepark, Fermoy, Co. Cork, Ireland,* [2]*Degussa AG., Feed Additives, Hanau, Germany.*

The objective of this trial was to determine the optimum ratio of Methionine (Met) to Lysine (Lys) for nursery pigs in the weight range 11 to 23 kg. A total of 192 pigs were used, with a pair of pigs of the same sex penned together (n = 96 pairs) as the experimental unit in a randomized complete block design. Pigs were fed a commercial starter diet for 11 d after weaning at 26 to 28 d of age and fed the test diets for 24 d. The basal diet contained (g/kg): wheat, 231; barley, 120; heated full fat soybeans, 200; field peas, 240; corn starch, 120; soy oil, 25; L-Lys HCl, 3.5; L-threonine, 2.0; L-tryptophan, 0.5; L-valine, 0.5; L-isoleucine, 0.5; minerals and vitamins, 57. The digestible energy content of the diet was 14.9 MJ/kg, crude protein was 166 g/kg, total Lys was 12.0 g/kg, and true ileal digestible (TID) Lys was 10.0 g/kg. The basal diet (2.2 g/kg total Met) was supplemented with DL-Met in increments of 0.4 g/kg to give seven diets ranging from 2.2 to 4.6 g/kg total Met. The ratio of total Met:total Lys varied from 0.183 to 0.383 and TID Met:TID Lys from 0.17 to 0.37. Total sulphur amino acids:Lys ranged from 0.41 to 0.61. Met supplementation increased the average daily feed intake (748, 734, 775, 840, 775, 829, and 707 g/d; quadratic, $P < 0.01$) and average daily gain (297, 372, 453, 457, 507, 515, and 459 g/d; linear, $P < 0.01$; quadratic, $P < 0.01$) and improved feed to gain ratio (2.55, 2.00, 1.74, 1.75, 1.54, 1.60, and 1.55; linear, $P < 0.01$; quadratic, $P < 0.01$). Exponential response curves were fitted and showed the optimum level of Met (95% of the asymptote) to be 4.1 g/kg for daily gain and 3.7 g/kg for feed:gain. It is concluded that the optimum ratio of Met:Lys is 0.31 for feed:gain and 0.34 for average daily gain.

Key Words: Nursery Pig, Methionine, Lysine

573 Evaluation of the true ileal digestible (TID) lysine requirement for 11 to 29 kg pigs. S. X. Fu*[1], A. M. Gaines[1], B. W. Ratliff[1], P. Srichana[1], G. L. Allee[1], and J. L. Usry[2], [1]*University of Missouri, Columbia,* [2]*Ajinomoto Heartland LLC, Chicago, IL.*

The objective of this research was to evaluate the true ileal digestible (TID) lysine requirement for 11 to 29 kg pigs. For this experiment, a total of 769 pigs (TR-4 × C22; 11.1 ± 0.2 kg) were allotted to one of six dietary treatments in a completely randomized design with 6 replicate pens/treatment. Dietary treatments included six TID lysine concentrations of 1.05, 1.14, 1.23, 1.32, 1.41, and 1.50%. Diets were formulated to be isocaloric and contained the same amount of soybean meal (34.25%). The dietary lysine content was increased by adding L-lysine·HCl with additional synthetic amino acids supplied as necessary to meet the minimum amino acid profile. Growth performance data were collected for 28 d. Body weights and feed intakes were recorded on d 0, 14, and 28. From d 0 to 14, increasing dietary lysine increased (linear, $P < 0.01$) ADG (505, 523, 546, 556, 554, and 550 g/d) and improved (linear, $P < 0.001$; quadratic, $P = 0.01$) G/F (0.631, 0.674, 0.691, 0.705, 0.710, and 0.711). At d 14, pigs were weighing an average of 19 kg. From d 0 to 28, increasing dietary lysine improved (linear, $P = 0.03$) ADG (614, 624, 633, 646, 639, and 646 g/d) and improved (linear, $P < 0.001$; quadratic, $P = 0.01$) G/F (0.621, 0.651, 0.657, 0.676, 0.670, and 0.669). At d 28, pigs were weighing an average of 29.0 kg. Based on the biological and economic data, the TID lysine level that maximized return over feed cost was 1.32%, regardless of weight range (11 to 19 or 11 to 29 kg). Results from this experiment indicate that the late nursery pig diet should contain at least 1.32% TID lysine.

Key Words: Lysine, Pigs, Growth

574 Estimation of the true ileal digestible sulfur amino acid requirement for nursery pigs weighing 13 to 25 kilograms by using Alimet® feed supplement. A. M. Gaines[1], G. F. Yi*[2], B. W. Ratliff[1], P. Srichana[1], G. L. Allee[1], C. D. Knight[2], and K. R. Perryman[2], [1]*University of Missouri, Columbia,* [2]*Novus International, Inc., St. Louis, MO.*

The objective of this research was to estimate the true ileal digestible (TID) sulfur amino acid (SAA) requirement of 13 to 25 kg pigs reared under commercial conditions. A total of 1,303 pigs (TR-4 × C22; 12.7 ± 0.1 kg) were allotted to one of five dietary treatments in a randomized complete block design with twelve replicate pens (22 pigs/pen) per treatment. Dietary treatments included five TID SAA levels that corresponded to concentrations of 0.63, 0.70, 0.77, 0.83, and 0.90%, respectively. Experimental diets were corn-soybean meal based and formulated to contain 1.40% TID lysine. Dietary SAA content was increased by adding Alimet® feed supplement (88% L-methionine activity) at concentrations of 0.00, 0.08, 0.15, 0.23, and 0.31%, respectively. Increasing dietary TID SAA increased (linear, $P < 0.07$; quadratic, $P < 0.01$) ADG (586, 611, 620, 604, and 608 g/d) and improved (linear, $P < 0.001$; quadratic, $P < 0.01$) G/F (0.638, 0.667, 0.676, 0.688, and 0.687). Based on the biological and economic data, the TID SAA that maximized return over feed cost was 0.77%. Using the relatively conservative two-slope broken line method, the TID SAA requirement was estimated to be 0.73 and 0.80% for ADG and G/F, respectively. These values were then used to determine the point at which the quadratic curve intersected the plateau of the broken line, which provided another objective estimate of the SAA requirement. The point at which the quadratic curve first intersected the plateau of the broken line occurred at 0.77 and 0.83% for ADG and G/F, respectively. Based on the current study, it can be concluded that the TID SAA requirement for 13-25 kg pigs are 0.73-0.77% for maximal ADG and 0.80-0.83% for optimal feed efficiency. (®ALIMET is a trademark of Novus International, Inc., and is registered in the United States and other countries.)

Key Words: Sulfur Amino Acids, Growth, Nursery Pigs

575 Effect of L-lysine-HCl level and true digestible lysine:crude protein ratio on late nursery pig performance. B. W. Ratliff*[1], A. M. Gaines[1], P. Srichana[1], R. W. Fent[1], G. L. Allee[1], J. L. Usry[2], and R. D. Boyd[3], [1]*University of Missouri, Columbia,* [2]*Ajinomoto Heartland LLC, Chicago, IL,* [3]*The Hanor Company, Franklin, KY.*

At a commercial research site, 792 pigs (TR-4 × C22; 13.0 kg) were used to evaluate the effect of L-lysineHCl level and true digestible (TID) lysine:crude protein (Lys:CP) ratio on nursery pig performance from 13 to 26 kg BW. Pigs were allotted to one of six dietary treatments with 6 replicate pens/treatment and 22 pigs/pen. Dietary treatments included five levels of L-lysineHCl that corresponded to concentrations of 0.30, 0.40, 0.50, 0.60, and 0.70% lysine, respectively. With increasing L-lysineHCl inclusion, the CP concentration decreased (21.8, 20.7, 19.6, 18.5 and 17.5%, respectively) and the TID Lys:CP ratio increased (5.96, 6.28, 6.62, 7.00 and 7.45%, respectively). To evaluate the effect of Lys:CP ratio, a 0.70% L-lysineHCl diet was formulated to contain 18.5% CP and a Lys:CP ratio of 7.00% using a 50:50 blend of L-glutamine and L-glycine. All diets were formulated at a 1.30% TID lysine and minimum ideal protein ratios were maintained (Thr, 65%; Met+Cys, 60%; Trp, 16.7%; Iso, 58%; and Val, 65%). Growth performance data were collected for 21 d. Results indicated a decrease (Linear, $P < 0.01$; Quadratic, $P = 0.10$) in ADG (631, 634, 639, 611 and 598 g, respectively) and reduced (Linear, $P < 0.01$; Quadratic, $P = 0.06$) G/F (0.684, 0.680, 0.679, 0.666 and 0.643, respectively) with increasing levels of L-lysineHCl inclusion. Feed intake was not affected ($P > 0.73$). Furthermore, for diets containing 0.70% L-lysineHCl, lowering the Lys:CP ratio to 7.00% increased ($P < 0.03$) ADG (630 vs. 598 g) and improved ($P < 0.03$) G:F (0.667 vs. 0.643). Two slope broken line analysis indicated a maximum L-lysineHCl inclusion of 0.50% for ADG and 0.55% for G:F. Collectively, these data indicate that up to 0.50% inclusion of L-lysineHCl has no negative effect on nursery pig performance and inclusion of 0.70% L-lysineHCl addition is possible when the Lys:CP is kept at or below 7.00%.

Key Words: Lysine, Crude Protein, Pigs

576 Estimation of the true ileal digestible sulfur amino acid:lysine ratio for growing pigs weighing 29 to 45 kilograms. A. M. Gaines*[1], G. F. Yi[2], B. W. Ratliff[1], P. Srichana[1], G. L. Allee[1], C. D. Knight[2], and K. R. Perryman[2], [1]*University of Missouri, Columbia,* [2]*Novus International, Inc., St. Louis, MO.*

The objective of this research was to evaluate the optimum true ileal digestible (TID) sulfur amino acid:lysine (SAA:LYS) ratio for growing pigs weighing 29 to 45 kg reared under commercial conditions. A total of 2,208 growing pigs (TR4 × C22; 29.0 ± 0.1 kg) were allotted within sex (barrows and gilts) to one of six dietary treatments in a randomized complete block design with eight replicate pens (23 pigs/pen) per treatment/sex. Dietary treatments included five levels of TID SAA:LYS

ratios (49.5, 54.5, 59.5, 64.5, and 69.5%, respectively). Diets were formulated at a 0.90% TID lysine and contained 0.40% L-lysine·HCl. Dietary SAA content was increased by adding Alimet® feed supplement (88% L-methionine activity) with additional synthetic amino acids to meet the minimum amino acid profile. To evaluate the effect of 0.40% L-lysine·HCl supplemented low-protein amino acid fortified (LPAA) diets, a 0.15% L-lysine·HCl supplemented corn-soybean meal diet (high protein control) was also formulated (64.5% TID SAA:LYS ratio). Growth performance data were collected for 17 d. Increasing the TID SAA:LYS ratio increased (linear, $P < 0.001$; quadratic, $P < 0.01$) ADG (916, 951, 953, 958, and 956 g/d) and improved (linear, $P < 0.001$; quadratic, $P < 0.001$) gain:feed (0.459, 0.470, 0.477, 0.479, and 0.475). There were no differences in feed intake with increasing TID SAA:LYS ratios. However, feed intake was higher ($P < 0.01$) in pigs fed the LPAA diet compared to pigs fed the high protein control diet at 64.5% TID SAA:lysine ratio, which resulted in decreased ($P < 0.01$) gain:feed. Based on biological and economic data, the optimum TID SAA:LYS ratio that maximized return over feed cost was a 59.5%. This is in good agreement with estimates using the two slope broken line model, which indicated the optimum TID SAA:LYS ratio to be 59.7 and 61.1% for ADG and gain:feed, respectively. (®ALIMET is a trademark of Novus International, Inc., and is registered in the United States and other countries.)

Key Words: Sulfur Amino Acid, Growth, Growing Pigs

577 Estimation of the true ileal digestible sulfur amino acid:lysine ratio for early finishing gilts weighing 45 to 68 kilograms. A. M. Gaines*[1], G. F. Yi[2], B. W. Ratliff[1], P. Srichana[1], G. L. Allee[1], C. D. Knight[2], and K. R. Perryman[2], [1]*University of Missouri, Columbia,* [2]*Novus International, Inc., St. Louis, MO.*

The objective of this research was to evaluate the optimum true ileal digestible (TID) sulfur amino acid:lysine (SAA:LYS) ratio for early finishing gilts weighing 45 to 68 kg reared under commercial conditions. A total of 827 finisher gilts (TR4 × C22; 44.7 ± 0.3 kg) were allotted to one of six dietary treatments in a randomized complete block design with six replicate pens (23 pigs/pen) per treatment. Dietary treatments included five levels of TID SAA:LYS ratios (50.2, 55.2, 60.2, 65.2, and 70.2%, respectively). Diets were formulated at a 0.85% TID lysine and contained 0.40% L-lysine·HCl. Dietary sulfur amino acid content was increased by adding Alimet® feed supplement (88% L-methionine activity) with additional synthetic amino acids supplied to meet the minimum amino acid profile. To evaluate the effect of 0.40% L-lysine·HCl supplemented low-protein amino acid fortified (LPAA) diets, a 0.15% L-lysine·HCl supplemented corn-soybean meal diet (high protein control) was also formulated (65.2% SAA:LYS ratio). Growth performance data were collected for 21 d. Increasing the TID SAA:LYS ratio increased (linear, $P < 0.09$; quadratic, $P < 0.09$) ADG (1,044, 1,056, 1,089, 1,084, and 1,069 g/d) and improved (quadratic, $P < 0.02$) gain:feed (0.416, 0.428, 0.429, 0.427, and 0.424). There were no differences in feed intake with increasing TID SAA:LYS ratios. However, feed intake tended to be higher ($P < 0.10$) in pigs fed the LPAA diet compared to pigs fed the high protein control diet, which resulted in lower ($P < 0.10$) gain:feed. Based on biological and economic data, the optimum TID SAA:LYS ratio that maximized return over feed cost was a 60.2%. This is in good agreement with estimates using the two slope broken line model, which indicated the optimum TID SAA:LYS ratio to be 62.0% for maximal ADG. (®ALIMET is a trademark of Novus International, Inc., and is registered in the United States and other countries.)

Key Words: Sulfur Amino Acids, Growth, Early Finishing Gilts

578 Evaluation of the true ileal digestible (TID) lysine requirement for 80-100 kg barrows and gilts. P. Srichana*[1], A. M. Gaines[1], B. W. Ratliff[1], G. L. Allee[1], and J. L. Usry[2], [1]*University of Missouri, Columbia,* [2]*Ajinomoto Heartland LLC, Chicago, IL.*

Two experiments were conducted at a commercial research site in order to evaluate the true ileal digestible (TID) lysine requirement for 80 to 100 kg barrows and gilts. In Exp.1, a total of 865 barrows (TR-4 × C22; 83.0 ± 0.3 kg) were used in a completely randomized design with 7 replicate pens/treatment. In Exp. 2, a total of 884 gilts (TR-4 × C22; 79.6 ± 0.4 kg) were used in a completely randomized design with 7 replicate pens/treatment. Pigs used in both experiments were allotted to one of six dietary treatments containing 0.50, 0.60, 0.70, 0.80, 0.90, and 1.00% TID lysine. Diets used in the experiments were corn-soybean meal based diets and contained 0.15% L-lysine HCl. Dietary lysine content was increased by altering the corn:soybean meal ratio. Growth performance data were collected for 14 and 21 d, respectively, for Exp.1 and 2. For Exp. 1, increasing dietary lysine increased (quadratic, $P < 0.01$) ADG (907, 985, 983, 982, 961, and 957 g/d) and improved (linear, $P = 0.07$; quadratic, $P = 0.06$) G/F (0.294, 0.303, 0.314, 0.309, 0.310, and 0.308). For Exp. 2, increasing dietary lysine increased (linear, $P < 0.001$; quadratic, $P < 0.001$) ADG (898, 986, 1,000, 1,000, 969, and 1,004 g/d) and improved (linear, $P < 0.001$; quadratic, $P < 0.001$) G:F (0.317, 0.348, 0.346, 0.374, 0.354, and 0.358). Furthermore, increasing dietary lysine resulted in a linear decrease ($P = 0.05$) in ADFI (2,834, 2,830, 2,890, 2,807, 2,732, and 2,802 g/d). Using segmented regression procedures, the TID lysine requirement was estimated to be 0.61 and 0.68% for ADG and G/F, respectively, in barrows. The TID lysine requirement was estimated to be 0.61 and 0.77% for ADG and G/F, respectively, in gilts. These data indicate that from 80 to 100 kg BW, the optimum TID lysine requirement for barrows and gilts of this genotype is at least 0.60%.

Key Words: Lysine, Pigs, Growth

579 Effect of low-protein amino acid supplemented diets on performance and indicators of enteric health in early-weaned pigs. C. M. Nyachoti*[1], O. F. Omogbenigun[1], M. Rademacher[2], and G. Blank[1], [1]*University of Manitoba, Winnipeg, MB, Canada,* [2]*Degussa AG, Germany.*

Previous research suggests that high dietary protein may encourage proliferation of intestinal pathogenic bacteria leading to post-weaning diarrhea in pigs. We used 96 pigs weaned at 18 d to study the effect of low-protein amino acid (AA) supplemented diets on performance, and intestinal microbial population and fermentation activities in a 3-wk trial. Four corn-wheat and soybean meal-based diets were assigned at random to six pens each with 4 pigs balanced for initial body weight and sex. The diets were a control containing 23% CP or the same diet but with CP reduced to 21%, 19% and 17% and supplemented with Lys, Thr, Trp, and Ile to equal that of the control. Diets were formulated to similar nutrient levels and provided for ad libitum intake. Blood was sampled on d 0, 7, 14, and 21 for determining plasma urea nitrogen (PUN). ADFI, ADG, and gain:feed (G:F) were determined weekly. On d 21, two pigs per pen selected at random, were sacrificed to determine intestinal histology, digesta pH, ammonia levels, volatile fatty acids (VFA), and luminal microbial counts. ADFI, ADG, and G:F were not affected ($P > 0.05$) by reducing CP by 2 percentage units but a reduction of 4 or more percentage units reduced ($P < 0.05$) ADFI and ADG over the 3-wk study period. Ileal digesta pH was lower ($P = 0.01$) in pigs fed low-protein diets compared with control. Ammonia nitrogen in ileal digesta, and PUN were reduced linearly ($P < 0.01$) as CP was reduced. With the exception of valeric acid, VFA levels in ileal digesta of piglets fed low-protein diets were generally lower ($P < 0.05$) compared with control. Diet had no effect on intestinal microbial counts ($P > 0.1$). The results show that when CP is reduced by four or more percentage units other AA may become limiting and support the hypothesis that low CP AA supplemented diets may help maintain enteric health in pigs by lowering microbial metabolites with toxic effects.

Key Words: Amino Acid Supplementation, Early-Weaned Pigs, Intestinal Health

580 The tryptophan requirement of growing and finishing barrows. J. L. Shelton*[1], A. C. Guzik[1], L. L. Southern[1], B. J. Kerr[2], and T. D. Bidner, [1]*LSU Agricultural Center, Baton Rouge, LA,* [2]*USDA-ARS-SOMMRU, National Swine Research and Information Center, Ames, IA.*

Five experiments were conducted to determine the true digestible Trp (dTrp) requirement of growing and finishing barrows. Treatments were replicated with three or four replications of three or four barrows per pen. Broken line regression was used to estimate the dTrp requirement in all experiments. Experiment 1 was conducted with 27 barrows (initial and final BW of 78.3 and 109.8 kg, respectively) to validate whether a corn-feather meal (C-FM) Trp-deficient diet, with added crystalline L-Trp, would result in growth performance and carcass traits similar to a corn-soybean meal (C-SBM) diet. Barrows fed the C-FM diet without L-Trp addition had decreased growth performance and carcass traits, and an increased plasma urea N (PUN) concentration ($P < 0.01$). Adding

L-Trp to the C-FM diet resulted in similar growth performance and carcass traits as barrows fed the C-SBM diet (P > 0.10). In Exp. 2, 60 barrows (initial and final BW of 74.6 and 104.5 kg, respectively) were used to estimate the dTrp requirement. The levels of dTrp used in Exp. 2 were 0.06, 0.08, 0.10, 0.12, or 0.14%. Response variables were growth performance, PUN concentrations, carcass traits, and pork quality. The dTrp requirement was estimated to be 0.102%. In Exp. 3, 4, and 5, barrows (n = 60, 60, or 80, respectively) were allotted to five dietary treatments supplemented with crystalline L-Trp, and PUN concentration was the response variable. The levels of dTrp in Exp. 3 (BW was 30.9 kg) were 0.13, 0.15, 0.17, 0.19, or 0.21%. The dTrp requirement was estimated to be 0.167%. The levels of dTrp in Exp 4 (BW was 51.3 kg) were 0.09, 0.11, 0.13, 0.15, or 0.17%. The dTrp requirement was estimated to be 0.134%. The levels of dTrp in Exp. 5 (BW was 69.4 kg) were 0.07, 0.09, 0.11, 0.13, or 0.15%. The dTrp requirement was estimated to be 0.096%. These data indicate that the dTrp requirements of barrows weighing 30.9, 51.3, 69.4, and 74.6 to 104.5 are 0.167, 0.134, 0.096, and 0.102%, respectively.

Key Words: Barrows, Requirement, Tryptophan

581 The isoleucine requirement of 80- to 120-kilogram barrows. D. W. Dean*[1], L. L. Southern[1], B. J. Kerr[2], and T. D. Bidner[1], [1]*LSU Agricultural Center, Baton Rouge, LA,* [2]*USDA-ARS-MWA-SOMMRU, Ames, IA.*

Three experiments were conducted to validate an Ile deficient diet and then to determine the Ile requirement of 80- to 120-kg barrows. Crossbred barrows (n = 60, 80, or 80 with initial BW of 93, 82, and 85 kg, respectively) were used in each experiment. In Exp. 1, five replications with four pigs per pen were fed diets containing either a corn-soybean meal diet (C-SBM) or a corn-based diet containing 5% blood cells (BC) with or without 0.26% supplemental Ile (C-BC+Ile or C-BC) in a 28-d growth assay. On d 14, pigs receiving the C-BC diet were taken off experiment due to a severe depression in feed intake. Growth performance was not different for pigs fed C-SBM or C-BC+Ile (P = 0.36) over the 28-d experiment. In Exp. 2, four replications with four pigs per pen were fed the C-BC diet containing 0.24, 0.26, 0.28, 0.30, or 0.32% true digestible (TD) Ile. The experiment lasted 7 d and was an attempt to estimate the Ile requirement using plasma urea nitrogen (PUN) as the response variable. Because of dramatic incremental increases in ADFI as TD Ile was increased, PUN could not be used to estimate the Ile requirement. In Exp. 3, five replications with four pigs per pen were fed the C-BC diet containing 0.28, 0.30, 0.32, 0.34, or 0.36% TD Ile. Three pigs per pen were slaughtered on d 33 or 61 for determination of carcass lean and fat measurements (117.8 kg average final BW). Daily gain, ADFI, and gain:feed were increased linearly (P = 0.007) as Ile was increased in the diet. There were no effects of TD Ile level on 10th rib fat depth or loin muscle area; however, kilograms of lean was increased linearly (P < .001) as TD Ile level increased. In summary, the Ile deficiency of a C-BC diet can be corrected by the addition of supplemental Ile, and the PUN method is not suitable when assessing Ile requirement due to dramatic changes in ADFI. The TD Ile requirement for 80- to 120-kg barrows for maximizing feed intake, growth, and kilograms of lean is not less than 0.36%.

Key Words: Isoleucine, Pig, Plasma Urea Nitrogen

582 Determination of the optimum threonine:lysine ratio for prolific lactating sows. A. M. Gaines*[1], N. H. Williams[2], M. E. Johnston[3], C. Zier[2], G. L. Allee[1], J. L. Usry[4], and R. D. Boyd[3], [1]*University of Missouri, Columbia,* [2]*Pig Improvement Company, Franklin, KY,* [3]*The Hanor Company, Inc., Franklin, KY,* [4]*Ajinomoto Heartland LLC, Chicago, IL.*

This study was conducted to determine the optimum threonine:lysine ratio for prolific lactating sows. A total of 269 PIC product sows (parities 1-6) were allocated by parity to four dietary threonine concentrations, 0.51, 0.58, 0.64, and 0.70%. Diets were formulated to contain 0.90% total lysine which, based on expected litter growth rate (2.35 kg/d), would have been below requirement. The four concentrations of threonine corresponded to total threonine:lysine ratios of 0.57, 0.64, 0.71, and 0.78, respectively. Experimental diets were corn-soybean meal based diets and contained 0.29% L-lysine·HCl. Soybean meal was held constant and dietary threonine was increased by adding L-threonine with additional synthetic amino acids supplied as necessary to meet the minimum amino acid profile. Sows were fed ad libitum from d 112 of gestation through a 19 d lactation period. Litter size was standardized by 24 h post-farrowing (avg. 11.5 pigs/litter). There was no treatment difference (P > 0.41) in sow feed intake (avg. 6.3 kg/d). Sow weight loss during lactation ranged from 11.4-17.5 kg and was not affected by threonine:lysine ratio (P > 0.15). Increasing the threonine:lysine ratio improved litter weight gain (quadratic, P < 0.06), litter weaning weight (P < 0.05), and the number of pigs weaned (quadratic, P < 0.06). The highest threonine:lysine ratio (0.78) was detrimental to both piglet livability (88.6 vs. 91.2%) and litter growth rate (2.10 vs. 2.34 kg/d). A threonine:lysine ratio of 0.64 appears to optimize milk production and pigs weaned for high producing lactating sows nursing large litters. This estimate was the same for both younger (parity 1-2) and older sows (parity 3-6).

Key Words: Threonine, Lactation, Sows

583 The valine requirement of lactating sows. M. Etienne*[1], J. Y. Dourmad[1], J. Noblet[1], L. Le Bellego[2], and C. Relandeau[2], [1]*INRA-UMRVP, Saint-Gilles, France,* [2]*Ajinomoto Eurolysine sas, Paris, France.*

This study was undertaken to determine the effects of the valine:lysine ratio in the lactation diet on sow and piglet performance, milk and piglet compositions, and nitrogen balance of sows. A basal diet with barley, wheat, peas and soybean meal containing 135 g/kg CP was fortified with crystalline amino acids to reach an optimal balance between essential amino acids except for valine. The lysine level was limiting (7.6 g/kg), and crystalline L-valine was added so that the valine:lysine ratio was below (0.70, diet L), met (0.89, diet M) or exceeded (1.28, diet H) estimated requirements (INRA, 1991). Twelve replicates of three Landrace x Large White sows (mean parity, 2.5) were fed the experimental diets during a 25-d lactation. Litters were equalized to 13.7 piglets after farrowing. They did not have access to creep feed. Sow feed intake increased progressively up to 6 kg/d within 5 d and then remained constant. Feces and urine of sows were collected from 5 to 25 d of lactation. Body composition of two piglets/litter sacrificed at weaning was determined. Weight and backfat depth losses during lactation (26.7 kg and 2.8 mm, respectively) did not differ between groups. The mean number of piglets nursed (12.6) or weaned (12.1) was not affected by treatments. Mean piglet (6.47 kg) and litter weight at weaning (78.3 kg) and average daily gain of piglets (194 g/d) and litters (2.29 kg/d) were similar in the three groups. No significant effect of diet was found on milk composition determined at 5, 15 and 25 d of lactation. Mean dry matter, nitrogen, and energy output in milk estimated through growth rate and composition of body weight gain of the piglets were also unaffected (1.53 kg, 63.6 g, and 41.9 MJ/d, respectively). Piglets in the L group had more dry matter and fat and less nitrogen (P < 0.05) in their body than those in groups M and H. The N retention coefficient in sows did not differ between groups. It is concluded that there is no advantage to increase the valine:lysine ratio in the lactation diet of sows beyond 0.90.

Key Words: Sows, Valine, Lactation

Physiology and Endocrinology: Nutritional Regulation of Reproduction

584 Energy balance, dry matter intake, and hormone profiles of cows with ovulatory and non-ovulatory follicles during the first postpartum follicle wave. S. T. Butler* and W. R. Butler*, *Cornell University, Ithaca, NY.*

An early resumption of ovulatory activity following parturition is positively associated with subsequent measures of reproductive success. Postpartum energy balance (EB) affects ovarian follicle development and likelihood of ovulation. This study was carried out to assess whether differences in transition period EB (pre- and postpartum) also contribute to differences in postpartum follicular activity (study period = d -21 to d 30 relative to parturition). First wave follicle development was fol-