Nonruminant Nutrition: Amino Acids and Energy

T293 The National Animal Nutrition Program. G. L. Cromwell*[1], T. J. Applegate[2], D. C. Beitz[3], M. L. Galyean[4], M. B. Hall[5], M. D. Hanigan[6], J. Odle[7], W. P. Weiss[8], and C. Kirk Baer[9], *[1]University of Kentucky, Lexington, [2]Purdue University, West Lafayette, IN, [3]Iowa State University, Ames, [4]Texas Tech University, Lubbock, [5]USDA/ARS, Madison, WI, [6]Virginia Tech University, Blacksburg, [7]North Carolina State University, Raleigh, [8]The Ohio State University, Columbus, [9]U.S. Department of Agriculture, Washington, DC.*

The National Animal Nutrition Program (NANP), initiated in 2010, is supported as a National Research Support Project (NRSP-9) with Hatch funds administered by the US Department of Agriculture. Funds for NRSPs are drawn from the total federal allocation before the formula distribution to state agricultural experiment stations. The NANP focuses on addressing challenges facing researchers in animal agriculture and filling voids in the research and academic communities. An integrated and systematic approach is used to share, collect, assemble, synthesize, and disseminate science-based information, educational tools, and enabling technologies for agricultural animal nutrition, with emphasis on beef, dairy, swine, and poultry. The NANP also facilitates high-priority research across domestic agricultural species. The purpose of the NANP is to identify the current state of coordination and networking within animal nutrition; explore animal nutrition over time, across geographic locations, by topic, and by networks of collaborators in animal nutrition research; define high-priority animal nutrition issues; and address existing collaborations to facilitate solutions to these issues. The committee will interact with the National Research Council on critical national priorities in animal nutrition and provide a forum to address research support needs. The NANP consists of a coordinating committee (listed as authors) appointed by NRSP-9's Administrative Advisors (N. M. Cox, KY; B. W. Hess, WY; D. A. Benfield, OH; C. Faustman, CN). The coordinating committee oversees 2 additional committees: (1) a modeling committee that will improve the use of predictive technologies and tools, enable use of common software platforms, and work with researchers to develop and share models and modeling information; and (2) a feed composition committee that will assemble data and research resources on feed composition, foster communication among those collecting feed composition information, and improve efficiency and consistency in data collection and maintenance. Ongoing details regarding the activities and accomplishments of the 3 committees are posted on the NANP website: http://www.ca.uky.edu/nrsp-9/index.htm.

Key Words: animal nutrition, NANP, NRSP

T294 The National Animal Nutrition Program: Feed composition committee. P. S. Miller*[1], R. N. Dilger[2], W. P. Dozier[3], M. B. Hall[4], A. N. Hristov[5], V. R. Moreira[6], M. L. Nelson[7], N. R. St-Pierre[8], and W. P. Weiss[9], *[1]University of Nebraska, Lincoln, [2]University of Illinois, Urbana-Champaign, [3]Auburn University, Auburn, AL, [4]USDA/ARS, Madison, WI, [5]Pennsylvania State University, University Park, [6]Louisiana State University, Baton Rouge, [7]Washington State University, Pullman, [8]The Ohio State University, Columbus, [9]The Ohio State University, Wooster.*

A feed composition committee has been developed in conjunction with the National Animal Nutrition Program (NANP). This committee is supported and funded as a National Research Support Project (NRSP-9). The NRSPs are initiated by the use of Hatch funds administered by US Department of Agriculture and are drawn from the total federal allocation before the formula distribution to state agricultural experiment stations. The committee is moving forward with the following objectives: (1) Collect information on feed composition from the published literature and other critically evaluated sources and maintain a current collection of that information as a resource to the research community; (2) Develop a forum to exchange and collate information on methods of analysis, with links to sources and critiques to provide a resource to the research community and identify gaps in our ability to analyze feeds to stimulate development of new techniques; (3) Identify assays or methods that have or proven to have potential benefits to diet formulation. Thus, the overall approach of the committee is to gather data and information critical to the development of feed ingredient composition repositories for the major livestock species (beef, dairy, poultry, and swine). A major focus of the committee is to work with current and future National Research Council (NRC) committees to facilitate development and revision of ingredient databases for NRC nutrient requirement reports and to bring consistency to the databases used for the reports. Also, the committee is working closely with the NRSP-9 committee on modeling to support needs regarding ingredient composition data as model inputs. Presently, the committees' activities are posted on the NANP website: http://www.ca.uky.edu/nrsp-9/index.htm. The feed composition committee has initiated its work with data sets used by previous NRC species committees. Design of an overall database structure is currently underway. Input templates for the database have been developed for beef, dairy, poultry, and swine. The committee will solicit data from the scientific literature and industry sources focusing primarily on information derived from North America.

Key Words: feed composition, database

T295 Accuracy of predicting digestible energy of corn for growing pigs from various data sources. R. Allen, A. Hassen*, B. Smith, M. Hinds, C. Iiams, D. Rice, D. Sevenich, F. Owens, D. Jones, and T. Sauber, *DuPont Pioneer, Johnston, IA.*

The objective of the current study was to evaluate accuracy of predicting swine digestible energy (DE) of corn based on Near-Infrared Transmittance Spectroscopy (NIT) scans and models, cross-species relationships, and literature equations. DE content of 83 corn grain samples was determined from total collection of feces using uniform sets of barrows (16 to 18 kg initial BW) of similar genetic background. Diets contained 89.5% ground corn supplemented with casein, minerals and vitamins. Nitrogen-corrected apparent metabolizable energy (AME_N) for these 83 corn grain samples was determined with 3-wk old broiler chicks. DE and AME_N data were initially analyzed using mixed models. The model for AME_N analysis included fixed effects of study, corn source within study and random effects of block and error; the DE model included the same fixed effects as AME_N and random effects of run within study, room within study and run, pig within study and room and error. Check means were used as a covariate in each model. Data from 66 corn samples were used for model development; the remaining 17 were used for cross-validation based on stratified random sampling procedure. NIT spectra data from each whole grain sample were used to develop NIT based predictions of swine DE (NIT-DE) and poultry AME_N (NIT-AME_N). Models were then developed to predict swine DE from AME_N and NIT-AME_N. Simple linear equations proved adequate to predict swine DE from either AME_N or NIT-AME_N (R^2 and root mean square error (RMSE) ranged from 0.71 to 0.73 and 53 to 54 kcal/kg, respectively). Validation test showed a similar prediction capability from either AME_N or NIT-AME_N with correlation (r) between observed and predicted values ranging from 0.88 to 0.92, and RMSE from 43 to 52 kcal/kg. Direct NIT prediction of DE from spectra data (NIT-DE) showed a comparable fit (r = 0.91 and RMSE = 48 kcal/kg). Published literature equations when combined with wet chemistry analyses showed

the weakest fit to measured DE (r = 0.51; RMSE of 112 kcal/kg). Relative DE of corn grain samples for growing pigs can be calculated reliably from measurements of poultry AME_N, NIT-AME_N or direct NIT scans.

Key Words: swine, poultry, corn

T296 Energy and amino acid digestibility of camelina meal fed to finishing pigs. R. K. Kahindi*[1], T. A. Woyengo[2], P. A. Thacker[3], and C. M. Nyachoti[1], *[1]University of Manitoba, Winnipeg, MB, Canada, [2]University of Alberta, Edmonton, AB, Canada, [3]University of Saskatchewan, Saskatoon, SK, Canada.*

This experiment was conducted to determine the apparent ileal (AID) and standardized ileal (SID) AA digestibility as well as the DE and ME content of camelina meal fed to finishing pigs. Six ileal cannulated barrows (80.2 ± 7.5 kg BW) were fed 2 diets in a 2-period cross over design to give 6 replicates per diet. The diets were a corn-soybean meal-based basal diet formulated to meet NRC (1998) nutrient requirements for 50 to 80 kg pig as well as the basal diet with a portion of the AA-yielding ingredients (corn and soybean meal) replaced with 20% camelina meal. The basal diet was fed to determine nutrient digestibility and retention by the difference method. The SID of N and AA was calculated using published values for ileal basal endogenous AA losses from our laboratory and NE was calculated using values from proximate analysis. Titanium dioxide (0.3%) was included in the diets as an indigestible marker. The GE, CP, Lys, Met, Thr, EE, NDF, ADF and glucosinolate content of camelina meal (on a DM basis) were 5,130 kcal/kg, 38.08, 1.80, 0.68, 1.68, 11.90, 31.46, 20.30% and 36.30 µmol/g, respectively. The AID and SID of N for camelina meal were 58.30 and 65.20%, respectively. The SID values of Lys, Met and Thr for camelina meal were 57.89, 53.39 and 52.48%, respectively whereas the corresponding standardized ileal digestible contents on a DM basis for the same AA were 1.04, 0.36 and 0.84%, respectively. The DE, ME, and NE values for camelina meal were 4185, 3,857, and 1,951 kcal/kg, respectively. In conclusion, camelina meal can be used as an energy and AA source in swine diets and the SID AA and DE and ME values of camelina meal from the current study could be used when formulating diets to minimize N excretion and feed costs.

Key Words: camelina meal, digestibility, pig

T297 Effect of levels of digestible lysine and ractopamine on the performace of castrated pigs from 70 to 97 kg. D. O. Fontes*[1], I. S. Fernandes[1], D. M. S. Junior[1], L. P. O. Souza[1], B. O. Rosa[1], I. J. Silva[1], A. P. L. Brustolini[1], V. S. Cantarelli[1,2], and G. M. Salum[1], *[1]Federal University of Minas Gerais, Belo Horizonte, Minas Gerais, Brazil, [2]Federal University of Lavras, Lavras, Minas Gerais, Brazil.*

A total of 180 hybrid barrows (initial and final body weight of 70.8 ± 3.78 and 97 ± 7.3 kg) were used to evaluate the effects of ractopamine (RAC) and digestible lysine (Lys) levels on late finishing pig performance. Pigs were blocked by weight and time and randomly allotted to one of 15 dietary treatments in a 27d experiment. There were 2 pigs per pen and 6 pens per treatment. Pigs were fed corn and soybean meal based diets formulated to meet the NRC (1998) requirements, with the exception of digestible lysine which were adjusted to satisfy the level of treatments. Treatments were arranged as a 3 × 5 factorial with main effects of RAC (0, 5 and 10ppm) and digestible lysine (0.50, 0.65, 0.80, 0.95, and 1.1%). The diets were isocaloric (3,23 Mcal/kg) and isoproteic (12,6%). The levels of lysine were obtained by the addition of L-lysine-HCl and to meet the ideal protein concept, where necessary, supplementing the diets were the other essential amino acids. The parameters evaluated were BW, ADG, ADFI and G:F. Significant effect of digestible Lys was evaluated by the regression of the observed variable on digestible Lys level of diet while means of ractopamine supplemented animals were compared by SNK test at 10% probability level. Interaction was observed between lysine and ractopamine for BW, ADG and G:F ($P < 0.05$). No interactions were observed ($P > 0.05$) for ADFI and digestible lysine intake. The recommended level of digestible Lys was 0.8, 0.91 and 1.1% for diets without and with 5 and 10 ppm RAC respectively for best values of final BW and ADG. For G:F the values were 0.53, 0.96 and 0.98% of digestible Lys, respectively. Thus, considering the values obtained and the best data adjustment, it can be concluded that for the better performance of finishing barrows the digestible lysine requirement was 0.8, 0.96 and 1.1%, which corresponds to an intake of digestible lysine of 23.51, 28.04 and 32.57 g/day for diets without and with 5 and 10 ppm RAC, respectively.

Key Words: swine, amino acid, requirement

T298 Determination of digestible and metabolizable energy concentrations in oilseed meals fed to growing pigs. A. R. Son* and B. G. Kim, *Konkuk University, Seoul, Republic of Korea.*

An experiment was conducted to determine digestible energy (DE) and metabolizable energy (ME) concentrations in feed ingredients including sesame meal (SM), 3 sources of soybean meal (SBM), high-protein distillers dried grains (HPDDG), perilla meal (PM), cannola meal (CNM), copra meal (CM), corn germ meal (CGM), palm kernel expeller (PKE), and tapioca distillers dried grains (TDDG). Twelve barrows with an initial BW of 31.8 ± 2.7 kg were individually housed in metabolism crates equipped with a feeder and a nipple drinker. A 12 × 10 Youden square design was employed with 12 dietary treatments, 10 periods, and 12 animals. A basal diet mainly consisted of corn and SBM was prepared to contain 15.6% CP, 0.68% standardized ileal digestible Lys, 0.47% Ca, and 0.21% available P. Eleven additional diets were formulated to contain 30% of each test ingredient. The quantitative feed and feces method using Cr2O3 as an indigestible marker was used for fecal collection with 4-d adaptation and 4-d collection periods. The statistical model for the mixed procedure of SAS included dietary treatment as fixed variable, and animal and period as random variable. Values for the DE and ME in the 3 sources of SBM were greater ($P < 0.05$) than other test ingredients except HPDDG (Table 1). Values for DE:GE in the 3 sources of SBM were greater ($P < 0.05$) than all other test ingredients. In conclusion, SBM has greater energy concentrations than most oilseed meals and has greater energy digestibility than other oilseed meals fed to growing pigs.

Table 1. Nutrient composition (%) and energy values (cal/g) of test ingredients fed to growing pigs, as-fed basis

Ingredient	DM	CP	GE	DE	ME
SM	97.0	50.0	4,688	2,592^{e}	2,269^{ef}
SBM 1, dehulled, Korea	90.2	47.1	4,299	3,925^{a}	3,782^{a}
SBM 2, India	90.1	39.6	4,221	3,610^{ab}	3,445^{ab}
SBM 3, Korea	90.2	47.4	4,332	3,725^{ab}	3,552^{ab}
HPDDG	91.5	38.0	4,924	3,544^{bc}	3,271^{bc}
PM	90.3	43.2	4,240	1,907^{f}	1,672^{g}
CNM	91.5	37.5	4,235	3,096^{d}	2,832^{cd}
CM	90.2	21.7	4,095	2,219^{f}	2,122^{f}
CGM	94.1	21.4	4,699	3,247^{cd}	3,071^{c}
PKE	89.6	15.3	4,407	2,586^{e}	2,506^{de}
TDDG	93.3	18.4	3,875	1,202^{g}	1,157^{h}
SEM				97	96
P-value				<0.001	<0.001

Key Words: energy concentration, protein supplement, swine

T299 Energy value of dried distillers grains with solubles and oilseed meals for pigs. C. Kong* and O. Adeola, *Purdue University, West Lafayette, IN.*

The energy values of 3 dried distillers grains with solubles (DDGS) derived from corn, triticale and sorghum, and 3 oil seed meals including canola meal (CM), cotton seed meal (CSM), and sunflower seed meal (SSM) were determined in 2 studies. Twenty-four crossbred barrows with average initial BW of 28.0 kg were grouped by weight into 6 blocks with 1 pig per metabolism crate in each study. There were 4 diets in each experiment consisting of a corn-soybean meal reference (RD) diet and 3 test diets (TD). The TD consisted of each of 3 DDGS (Exp. 1), or 3 oil seed meals (Exp. 2) that partly replaced the energy yielding sources in the RD at 300 g/kg (Exp.1) or 200 g/kg (Exp. 2) such that same ratios were maintained for all energy ingredients across all experimental diets. The DE, apparent metabolizable energy (AME), and nitrogen-corrected AME (AME_n) of the test ingredients were determined by the difference method in 2 studies each consisting of a 5-d adjustment and 5 d of total but separate collection of feces and urine. The respective DM or GE of corn DDGS, triticale DDGS, sorghum DDGS, CM, CSM, and SSM were 918, 927, 904, 912, 907, and 898 g/kg; or 4,985, 4,913, 4,785, 4,616, 4,829, and 4,122 kcal/kg of DM. Addition of DDGS to RD in Exp. 1 decreased dietary DE, AME and AME_n of the TD. In Exp. 2, the respective energy values of the TD were not affected by the addition of oil seed meals to RD with SSM, which decreased ($P < 0.01$) the energy values. In conclusion the DE, AME and AME_n were 3,751, 3,559, and 3,361 kcal/kg of DM, respectively, for corn DDGS; 3,720, 3,537, and 3,315 kcal/kg of DM, respectively, for triticale DDGS; and 3,520, 3,355, and 3,228 kcal/kg of DM, respectively, for sorghum DDGS. Furthermore, the DE, AME, AME_n of SSM for pigs were 2,449, 2,253, and 2,071 kcal/kg of DM, which were lower ($P < 0.01$) than the energy values evaluated for CM and CSM at 3,577, 3,428, and 3,087 kcal/kg of DM, respectively for CM; and 3,281, 3,139, and 2,892 kcal/kg of DM for CSM.

Key Words: dried distillers grains with solubles, energy, pigs

T300 Amino acid digestibility in copra expeller and palm kernel expeller by growing pigs. A. R. Son*[1], Y. Hyun[2], J. K. Htoo[3], and B. G. Kim[1], *[1]Konkuk University, Seoul, Republic of Korea, [2]Farm Story Dodram B&F, Seoul, Republic of Korea, [3]Evonik Industries AG, Hanau, Germany.*

An experiment was conducted to determine the apparent ileal digestibility (AID) and the standardized ileal digestibility (SID) of crude protein (CP) and amino acids (AA) in copra expeller (CE) and palm kernel expeller (PKE) by pigs. The CE contained 89.9% DM, 20.2% CP, 7.1% ether extract, 54.4% NDF, and 6.7% ash; and the PKE contained 91.9% DM, 17.2% CP, 7.1% ether extract, 66.7% NDF, and 4.0% ash on an as-fed basis. Six boars fitted with a T-cannula in the distal ileum with an initial BW of 65.2 kg (SD = 5.4) were individually housed in pens equipped with a feeder and a nipple drinker. A replicated 3 × 3 Latin square design was employed with 3 dietary treatments, 3 periods, and 6 animals. Two experimental diets were prepared to contain 40% of the CE or PKE as the sole source of nitrogen. A nitrogen-free diet was formulated mainly based on cornstarch and sucrose to estimate the basal endogenous losses of CP and AA. All diets contained 0.5% chromic oxide as an indigestible index. The statistical model for the mixed procedure of SAS included dietary treatment as fixed variable and replication, animal within replication, and period within replication as random variable. The values for the AID of all indispensable AA except His and Lys in the CE were greater ($P < 0.05$) than in the PKE. The values for the SID of CP (67.6 vs. 52.8%), Arg (90.0 vs. 80.4%), Leu (78.5 vs. 72.9%), Met (82.1 vs. 75.6%), Phe (81.4 vs. 76.4%), Thr (64.4 vs. 55.4%), Trp (66.3 vs. 54.9%), and Val (77.8 vs. 71.6%) in the CE were greater ($P < 0.05$) than in the PKE. The values for the SID of Lys in the CE and PKE (40.3 and 39.1%, respectively) were relatively less than those of other indispensable AA. In conclusion, the digestibility of CP and most AA in the CE was greater than in the PKE, and the values for the AID and SID of Lys were less than other indispensable AA in the CE and PKE.

Key Words: protein supplement, standardized ileal digestibility, swine

T301 Digestible tryptophan:lysine ratios and different protein sources in diets for barrows from 70 to 95 kg. C. Pereira[1], M. Hannas*[1], H. Rostagno[1], L. Albino[1], R. Rodrigueiro[2], J. Htoo[3], and J. Barrera[4], *[1]Federal University of Viçosa, Viçosa, Minas Gerais, Brazil, [2]Evonik Industries, Health & Nutrition, Animal Nutrition Services, São Paulo, São Paulo, Brazil, [3]Evonik Industries AG, Health & Nutrition, Animal Nutrition Services, Hanau-Wolfgang, Germany, [4]University of Tolima, Tolima, Peru.*

The objective of this trial was to evaluate the performance of barrows fed with 2 digestible tryptophan:lysine (Trp:Lys) ratios (18% or 21%) and 2 diets with different protein sources (soybean meal – SBM or soybean meal, meat and bone meal and feather meal – SBM-MBM-FM) during the finishing phase (70 to 95 kg). A total of 96 barrows (69.26 ± 4.97 kg) were distributed in a completely randomized block design. The treatments were arranged as 2 × 2 factorial (2 diets with different protein sources × 2 digestible Trp:Lys ratios) with 12 replicates and 2 animals per pen. The diets were formulated to meet or exceed the nutritional recommendations. The experimental period lasted 24 d and the parameters evaluated were final BW, ADFI, ADG and G:F. The results were analyzed using ANOVA procedure. The test used was F at the 5% significance level. No interaction ($P > 0.05$) was found between diets with different protein sources and Trp:Lys ratios on animal performance. The diets with different protein sources had no effect ($P > 0.05$) on final BW, ADFI, ADG and G:F. There was no significant ($P > 0.05$) effect of digestible Trp:Lys ratio on G:F, however, barrows fed diets with 21% digestible Trp:Lys ratio had better final BW ($P < 0.02$), ADFI ($P < 0.01$) and ADG ($P < 0.01$) than those fed with 18% digestible Trp:Lys ratio. The use of 21% of digestible Trp:Lys in diets resulted in better performance of pigs from 70 to 95 kg. For pigs from 70 to 95 kg the Trp:Lys requirement is greater than 18%. Also, barrows fed diets with SBM or SBM-MBM-FM, formulated on digestible amino basis, showed similar performance during the finishing phase.

Table 1. Growth performance of barrows from 70 to 95 kg

	Ingredient			Dig. Trp:Lys, %			
Item	SBM	SBM-MBM-FM	$P <$ [1]	18	21	$P <$ [1]	CV, %
Final BW, kg	92.62	93.24	NS	91.71	94.20	0.02	3.09
ADFI, g	2732	2724	NS	2650	2810	0.01	5.90
ADG, g	983	989	NS	946	1028	0.01	7.99
G:F, g/g	0.360	0.363	NS	0.357	0.366	NS	5.00

[1]ANOVA, F-test.

Key Words: digestible Trp:Lys ratio, barrow, protein source

T302 Digestible lysine and methionine + cystine levels on breast meat quality of broilers at 21 days old. C. H. F. Domingues*[1,3], K. F. Duarte[2,3], E. T. Santos[3], D. M. C. Castiblanco[3], T. C. O. Quadros[3], S. Sgavioli[3], J. C. R. Alva[3], T. G. Petrolli[3], O. M. Junqueira[4], and J. D. Messana[2,3], *[1]Fundacao de Amparo a Pesquisa do Estado de Sao Paulo FAPESP, Sao Paulo, SP, Brazil, [2]Coordenacao e Aperfeicoamento de Pessoal de Nivel Superior CAPES/PNPD, Brasilia, DF, Brazil, [3]Universidade Estadual Paulista Julio de Mesquita Filho, Jaboticabal, SP, Brazil, [4]Universidade Federal de Goias, Jatai, GO, Brazil.*

The aim of this study was evaluate different levels of digestible lysine and methionine + cystine on meat quality of pectoral muscle (Pectoralis major) of broilers at 21 d old. A total of 3,200 one-day-old male Cobb x Cobb 500 chicks were used, distributed in a completely randomized design in a factorial arrangement 2 × 5 (2 digestible lysine levels: 1.253 and 1.378% × 5 digestible methionine + cystine levels: 0.812, 0.860, 0.902, 0.947, and 0.992%) and 8 replicates of 40 birds each. At 21 d of age, 480 birds were culled to the achievement of sampling pectoral muscle, which were submitted to analysis of the following parameters of meat quality: Color (L* = lightness, a* = redness, and b* = yellowness), cook loss, shear force and pH values. There was no interaction ($P > 0.05$) of digestible lysine and methionine + cystine levels for any of the variables. There was an effect ($P < 0.05$) of digestible lysine levels on the meat color and shear force occurring highest rate of redness for birds that received the level of 1.253% digestible lysine when compared with those fed with diets containing 1.378% digestible lysine, while the opposite occurred with the shear force. The levels of digestible methionine + cystine did not influence ($P > 0.05$) the redness, yellowness, pH and cook loss of breast meat, however, there was a quadratic effect ($P < 0.05$) for lightness ($Y = 291.39 - 520.82x + 280.54x^2$, $R^2 = 0.94$), indicating 0.928% as the highest level of digestible methionine + cystine for this variable. It was observed a decreasing linear effect ($P < 0.05$) for shear force ($Y = 11.786 - 9.7403x$, $R^2 = 0.88$), with increased levels of digestible methionine + cystine feed. In conclusion, the results of this study suggest that diets with 1.253 and 1.378% digestible lysine levels improve redness and shear force respectively and 0.928% digestible methionine + cystine level improve the lightness.

Key Words: digestible amino acid, pectoral muscle, pH

T303 Determination of optimum amino acid to calorie ratio for grower and finisher pigs. A. Hassen*, B. Smith, C. Iiams, D. Rice, F. Owens, D. Jones, and T. Sauber, *DuPont Pioneer, Johnston, IA.*

Accurate diet formulation will minimize experimental error. This is critical for trials which require high sensitivity to experimental treatments. The objective of this study was to identify optimal corn-soy diet lysine:calorie ratios (LCR) for pigs reared in an environment that supports rapid growth (typically 0.9 to 1.25 kg/day from 25 to 120 kg BW). Individually-penned barrows (PIC Line 1055 females × Line 280 boars) were fed treatment diets in 3 growth phases: Grower (25 to 60 kg), Finisher1 (60 to 90 kg), and Finisher2 (90 to 120 kg). For each phase, diet ME was held constant and lysine concentration was increased in even increments of 0.11% across each of 6 treatments to achieve target ranges of 2.25 to 3.75 (grower), 1.75 to 3.25 (Finisher 1), and 1.25 to 2.75 (Finisher 2) for LCR (g lysine:Mcal ME). Twelve pigs were randomly assigned to each treatment in the Grower phase, and were fed to a constant BW before progressing to the next growth phase and dietary LCR treatment. Preceding phase dietary treatment was used as a blocking factor during re-randomization to the next set of 6 dietary treatments in each successive phase. Data within each phase were analyzed using linear and non-linear models to evaluate effects of treatment diets on gain-to-feed ratio (GF). Parameter estimates from linear models were used to estimate optimum GF and the corresponding LCR levels based on different approaches. For each phase, level of LCR produced a significant effect on GF and orthogonal contrasts of treatment effect suggested curvilinear relationships between GF and LCR. In all cases, the final prediction model included a concave-down quadratic curve; suggesting a unique maximum and a range of optimum animal performance values for the LCR used within each phase. Maximum GF (SE) for Grower, Finisher1, and Finisher2 were 0.57 (0.01), 0.44 (0.01), and 0.39 (0.01), respectively. The mean LCR at optimum performance ranged from 3.17 to 3.3, 2.41 to 2.80, and 2.11 to 2.45 for the respective phases. The estimates derived from the experiment will be used for formulation of diets for future trials in our facility.

Key Words: amino acid, energy, swine

T304 Digestible tryptophan:lysine ratios and different protein sources in diets for barrows from 30 to 65 kg. C. Pereira[1], M. Hannas*[1], H. Rostagno[1], L. Albino[1], R. Rodrigueiro[2], J. Htoo[3], and G. Viana[1], *[1]Federal University of Viçosa, Viçosa, Minas Gerais, Brazil, [2]Evonik Industries, Health & Nutrition, Animal Nutrition Services, São Paulo, São Paulo, Brazil, [3]Evonik Industries AG, Health & Nutrition, Animal Nutrition Services, Hanau-Wolfgang, Germany.*

A total of 96 barrows (30.14 ± 2.27 kg) were used to investigate the effects of 2 digestible tryptophan:lysine (Trp:Lys) ratios (18 or 21%) and 2 diets with different protein sources (soybean meal – SBM or soybean meal, meat and bone meal and feather meal – SBM-MBM-FM) on growth performance of barrows from 30 to 65 kg. Animals were distributed in a complete randomized block design and the treatments were arranged as 2 × 2 factorial (2 diets with different protein sources × 2 digestible Trp:Lys ratios) with 12 replicates and 2 animals per pen. The diets were formulated to meet or exceed the nutritional recommendations of Rostagno et al., 2011. The experimental period lasted 32 d and the parameters evaluated were final body weight (FBW), average daily feed intake (ADFI), average daily gain (ADG) and feed:gain ratio (F:G). There was no interaction ($P > 0.05$) between Trp:Lys ratios and the diets with different protein sources on pig performance. The SBM diet increased ADFI ($P < 0.03$), however, there was no effect ($P > 0.05$) of the experimental diets on FBW, ADG and F:G. Barrows fed 21% digestible Trp:Lys ratio had better ($P < 0.01$) FBW, ADG and F:G than those fed 18% Trp:Lys ratio. ADFI was not affected by Trp:Lys ratio ($P > 0.05$). Considering the performance of barrow from 30 to 65 kg, it is recommended the utilization 21% of digestible Trp:Lys ratio. Also, barrows fed diets with SBM or SBM-MBM-FM, formulated on digestible amino basis, showed similar performance during the growing phase.

Table 1. Growth performance of barrows from 30 to 65 kg

	Ingredient			Dig Trp:Lys, %			
Item	SBM	SBM-MBM-FM	$P <$ [1]	18	21	$P <$ [1]	CV
FBW, kg	64.13	63.55	NS	62.97	64.70	0.01	3.51
ADFI, g	2128	2045	0.03	2064	2109	NS	5.83
ADG, g	1064	1046	NS	1029	1081	0.01	6.56
F:G, g/g	2.002	1.957	NS	2.009	1.950	0.01	3.96

[1]ANOVA, F-test.

Key Words: digestible Trp:Lys ratio, barrow, protein source

T305 Oral administration of amino acids as energy sources for newborn piglets. N. E. Manzke[1], L. B. Scapini[2], W. Loyola[3], M. Kutschenko[4], J. M. Fontana[5], E. T. Nogueira[4], E. G. Xavier[1], A. Coldebella[3], and G. J. M. M. Lima*[3], *[1]Universidade Federal de Pelotas, Pelotas, RS, Brazil, [2]Universidade Federal do Parana, Palotina, PR, Brazil, [3]EMBRAPA, Concordia, SC, Brazil, [4]Ajinomoto, Sao Paulo, SP, Brazil, [5]Granja Fontana, Charrua, RS, Brazil.*

Amino acids have been supplemented in diets due to their beneficial effects on performance, health and immune status. Some of these occur because they may be readily available sources of energy, especially to young animals, which may face malnutrition after birth. This study was carried out to evaluate the effects of glutamine (Gln), glutamic acid (Glu) and AminoGut (Amg) supplementation on performance, immune response and blood parameters. Forty-seven litters, selected based on genotype and parity, were distributed according to a complete randomized block design. Within each litter, 4 piglets were chosen with body weights close to litter average. Treatments consisted of daily intragastric applications of 4-mL doses containing one of the following: Placebo: distilled water; Gln: 2 g L-glutamine; Glu: 2 g L-glutamic acid; Amg: 2 g of the commercial mixture of L-glutamine and L-glutamic acid. Animals were supplemented with treatments along the first 7 d of life with the first dose provided to piglets just after colostrum consumption. There were no treatment effects ($P > 0.10$) on individual weight and weight gain of piglets. Amino acid supplementation increased ($P = 0.06$) the diameter of the papule produced by *Phaseolus vulgaris* lectin skin test at 24 h after intradermal injection, compared with Placebo (6.12 mm). Amg (8.68 mm) and Glu (8.09 mm) showed the highest response for this variable ($P < 0.05$), at the same time as Amg promoted higher cell-mediated immunity than Gln (7.16 mm, $P < 0.05$) when compared with Placebo by *t*-test. There were no differences in plasmatic levels of glucose ($P = 0.40$) and creatinine ($P = 0.49$) among treatments. However, serum urea was significantly higher ($P < 0.0001$) in animals supplied with Gln, when compared with Glu, Amg and Placebo. Glu and Amg also increased blood urea compared with the Placebo group. Higher blood urea levels verified in amino acid supplemented piglets may suggest that the amounts supplied are above requirements. Despite there were no significant responses on piglet weight, amino acid supplementation provided better cell-mediated immunity, with a higher reaction shown by animals receiving Amg and Glu.

Key Words: glutamine, glutamic acid, AminoGut

T306 Effect of dietary lysine to energy ratio on growth performance and sensory characteristics of indigenous Venda chickens. O. J. Alabi*, J. W. Ng'ambi, and D. Norris, *University of Limpopo, Mankweng, Polokwane, South Africa.*

The study determined the effect of dietary lysine to energy ratio on optimal productivity, carcass and sensory characteristics of indigenous Venda chickens aged 8–13 weeks. A completely randomized design was used. One hundred and 60 female indigenous Venda chickens (BW 362 ± 10 g) were allocated to 4 dietary treatments. Each treatment was replicated 4 times and each replicate had 10 chickens. Four maize-soybeans based diets were formulated. Each treatment had similar dietary lysine (12 g/kg DM) but different energy levels (11, 12, 13 and 14 MJ ME/kg DM), thus, forming 4 dietary lysine to energy ratios (L:E) of 1.09, 1.00, 0.92 and 0.86, respectively. Data on chicken productivity, carcass characteristics (as percentages of live weights) and meat sensory attributes were measured. These data were analyzed using one way ANOVA. A quadratic curve estimate model was used to determine dietary lysine to energy ratio for optimum growth rate, feed intake, FCR, metabolizable energy, N-retention, relative carcass and sensory characteristic values. Results showed that dietary lysine to energy ratio of 0.88 supported optimum growth rate (17.89 g/bird/day), heart weight (0.76%) and meat flavor (4 points out of a 5-point hedonic scale). While a ratio of 0.99 g/MJ ME supported optimum feed intake (109.92 g/bird/day), FCR (6.05 g feed/g live weight gain), metabolizable energy value (11.33 MJ ME/kg), N- retention (1.63 g/bird/day), carcass (87.18%), breast meat (20.36%) and drumstick (12.00%). A higher ratio of 1.05 optimized liver (2.27%), wing (11.29%), gizzard (5.40%) and fat pad (2.84%). Meat tenderness and juiciness (3.25 points each out of a 5-point hedonic scale) were optimized at a ratio of 1.07. Thus, dietary L:E level for chicken production optimization depended on the particular parameter of interest. These findings have many implications on ration formulation for female indigenous Venda chickens.

Key Words: growth performance, lysine to energy ratio, optimization

T307 Evaluation of dietary glutamic acid plus glutamine levels on the growth performance of piglets. D. Lescano[1], L. Albino[1], M. Hannas[1], S. Salguero[1], M. Kutschenko[2], E. Nogueira[2], and H. Rostagno*[1], *[1]Federal University of Viçosa, Viçosa, MG, Brazil, [2]Ajinomoto of Brazil Ajinomoto Animal Nutrition, São Paulo, SP, Brazil.*

A study was conducted to evaluate the utilization of 4 dietary levels of a commercial product containing glutamic acid plus glutamine (min 95%) in diets for weanling pigs (18 d) to 46 d old. A total of 44 piglets were randomly assigned in a completely randomized block design into 4 treatments, 5 replicates and 2 or 3 pigs per experimental unit. The treatments were: T1 = 0.0%; T2 = 0.4%; T3 = 0.8% and T4 = 1.2% glutamic acid (Glu) plus glutamine (Gln). Diets were based on corn, soybean meal, pre-cooked corn, dairy products, blood plasma, L-lysine, L-threonine and DL-methionine. The experimental period lasted 28 d and the parameters evaluated were body weight, weight gain, feed intake and feed conversion ratio. The addition of Glu plus Gln improved linearly ($P < 0.05$) daily feed intake (DFI) and feed conversion ratio (F:G) of the piglets. There were also linear ($P < 0.01$) and quadratic effects ($P < 0.04$) of dietary Glu plus Gln level on final body weight (FBW), total weight gain (TWG) and daily weight gain (DWG) of the piglets (Table 1). It is concluded that the best dietary Glu plus Gln level is 0.8% for weanling piglets from 18 to 46 days of age.

Table 1. Growth performance of weanling piglets from 18 to 46 days of age

	Glu plus Gln (%)				Regression		
Parameter	0.0	0.4	0.8	1.2	Linear	Quadratic	CV (%)
BW initial, kg	5.24	5.24	5.22	5.06	NS	NS	3.22
FBW, kg	15.41	16.55	17.33	16.95	<0.002	0.03	4.24
DFI, kg	0.48	0.55	0.52	0.54	<0.04	NS	6.13
TWG, kg	10.16	11.30	12.11	11.88	<0.001	<0.04	6.13
DWG, kg	0.36	0.40	0.43	0.42	<0.001	<0.04	6.13
F:G ratio	1.34	1.33	1.17	1.23	<0.002	NS	5.12

NS = not significant ($P > 0.05$).

Key Words: piglet, growth performance, glutamic acid plus glutamine

T308 Effect of different space allocation and energy levels on growth performance and nutrient digestibility in growing-finishing pigs. J. Li, J. P. Lee, and I. H. Kim*, *Department of Animal Resource & Science, Dankook University, Cheonan, Choognam, South Korea.*

This study was conducted to investigate the effects of different space allocation (SA) and dietary ME levels on growth performance, apparent total tract nutrient digestibility (ATTD) in growing-finishing pigs. Data were collected from 4 growing, early (1 to 5 wk) and late (6 to 10 wk) finishing pigs experiments conducted from 2010 to 2012, and each experiment lasted for 5 wk. In each experiment, growing pigs (BW = 27.10 ± 1.60 kg) and finishing pigs (BW = 67.43 ± 1.97 kg) were fed 2 ME levels of corn/soybean-meal based diets (growing phase:3400 vs. 3550 kcal/kg; finishing phase:3300 vs. 3450 kcal/kg) by addition of 3% soybean oil. Pigs were given 0.80 and 0.60 m^2/pig for growing phase, and 1.08 and 0.81 m^2/pig for finishing phase. All statistical analysis was conducted as 2 × 2 factorial arrangement using the GLM procedure of SAS (1996) with pen as the experimental unit. The probability level of $P < 0.05$ was regarded as statistically significant. In growing pig experiments, the effect of low SA decreased ($P < 0.05$) ADG, ADFI, and G:F. The high ME level decreased ($P < 0.05$) ADFI, increase ($P < 0.05$) G:F and ATTD of energy. There was an interactive effect between SA and ME on ADFI, with the pigs fed high ME diet and in greater SA had lower ($P < 0.05$) ADFI than those fed control diet in low SA. In early finishing pig experiments, pigs given low SA consumed less feed, grew slower and had lower G:F ($P < 0.05$). Feed intake were reduced with high ME diet compared with control diet ($P < 0.05$). The ADFI was lowered ($P < 0.05$) by the interaction effect of greater SA and high ME diet compared with control diet and low SA. Late finishing pigs given low SA had lower ADG, ADFI, and G:F. No effect ($P > 0.05$) of ME level and their interaction was observed to influence growth performance and nutrient digestibility. In conclusion, results indicated reduction in ADFI, ADG, and G:F for pigs given low SA; the addition of high ME diet were found to improve feed efficiency in growing and early finishing pigs. Higher ME level was able to counteract the detrimental effect of SA to a certain extent.

Key Words: energy level, growing-finishing pig, space allocation