200 Is niacin (vitamin B_3) a modulator of the effect of supplementary tryptophan on tryptophan metabolism and growth responses in early-weaned pigs? J. J. Matte*[1], A. Giguère[1], D. Melchior[3], and N. LeFloch[2], [1]*Agriculture and Agri-Food Canada*, *Sherbrooke (STN-Lennoxville), QC, Canada*, [2]*INRA-SENAH*, *St-Gilles, France*, [3]*Ajinomoto-Eurolysine SAS*, *Paris, France*.

The present experiment aimed to determine if tryptophan (Try) metabolism and growth responses to dietary Try are modulated by dietary niacin (B_3) in weanling piglets. A group of 104 piglets (52 pens of 2 animals), weaned at 3 wk of age, were distributed, at 4 wk of age (BW:7.6 kg, SE:0.2), in 4 factorial dietary treatments: 2 additions of B_3, 15 (LB_3) vs. 45 ppm (HB_3) and 2 additions of Try, 0 (-Try) vs. 0.10% (+Try) for Try/Lys ratios of 0.16 vs. 0.23, respectively. Growth performance was recorded every wk from 4 to 10 wk of age. Fasting blood samples were taken at 4, 6, 8 and 10 wk of age. At 11 wk of age, repeated blood samples were collected after a meal on 6 piglets per treatment for measurements on Try and insulin metabolisms. No treatment effect was observed on overall ADG, ADFI or G:F (P>0.3). However, ADFI tended to be higher (P<0.10) in HB_3 than LB_3 (685 vs. 652 g, SE:21) from 4 to 6 wk of age as well as ADG (716 vs. 699 g, SE:12, P<0.06), from 6 to 10 wk of age. No treatment effect (P>0.2) was observed on plasma Try or kynurenin (Kyn), an intermediate metabolite of Try catabolism. The response of plasma nicotinamide (Nam), a product of Try catabolism and indicator of B_3 status, to dietary B_3 differed according to dietary Try (P<0.01), with overall values of 1.4, 3.3, 4.1 and 5.3 µM (SE:0.1) in -Try LB_3, -Try HB_3, +Try LB_3 and +Try HB_3, respectively. Post-meal plasma Try (96.2 vs. 72.3 µM, SE:0.1) and Kyn (1.7 vs. 1.3 µM, SE:0.1) were higher (P<0.01) in +Try vs. -Try. There was no treatment effect on post-meal C-peptide and glucose (P>0.12) but insulin (280.5 vs. 343.7 pM, SE:25.2) and the ratio insulin:C-peptide (0.39 vs. 0.43, SE:0.02) were lower (P<0.05) in +Try vs. -Try. The treatment effects on both growth and plasma Nam suggest that the LB_3 level was suboptimal. Dietary treatment effects on plasma Nam and on post-meal plasma Try and Kyn suggest a lack of sparing effect of dietary B_3 on Try, part of supplemental Try being directed through catabolism whatever the dietary B_3. Supplemental Try also accelerated insulin clearance after a meal without apparent consequence on glucose utilisation.

Key Words: Tryptophan, Niacin, Piglets

201 Effect of replacing fish meal with synthetic amino acids on the growth performance of nursery pigs. C. L. Bradley*[1], C. V. Maxwell[1], Z. B. Johnson[1], J. L. Usry[2], and J. W. Frank[1], [1]*University of Arkansas*, *Fayetteville*, [2]*Ajinomoto Heartland LLC*, *Chicago, IL*.

Rising feed costs are challenging producers to find alternative protein sources for swine rations. The objective of this study was to determine if fish meal (FM) could be replaced with synthetic amino acids (AA) in phase 1 and 2 nursery diets. Weaned pigs (n = 200; Monsanto GPK35 × EBU; 21.7 ± 0.2 d of age; initial BW 7.43 ± 0.01 kg) were used in a 34 d growth study. The pigs were blocked by weight in a randomized complete block design (5-6 pigs per pen and 7 pens per treatment). Pigs were fed one of five dietary treatments that contained decreasing levels of FM. Phase 1 (d 0-4; 1.6% Lys) diets ranged from 8 to 0% FM and 0.075 to 0.544% added L-Lys. Phase 2 (d 4-19; 1.52% Lys) diets ranged from 6 to 0% FM and 0.275 to 0.627% added L-Lys. Other AA (DL-Met, L-Thr, and L-Val) were used in the diet formulations to maintain ideal ratios of Met + Cys, Thr, and Val at minimums of 0.58, 0.60, and 0.65 to lysine, respectively. Pigs were fed a common corn-soy diet supplemented with 0.333% L-Lys, 0.154% DL-Meth, and 0.100% L-Thr in phase 3 (19-34 d; 1.47% Lys). None of the diets were supplemented with L-Trp. There were no differences ($P > 0.12$) in ADG and ADFI throughout the study. There was a linear decrease ($P < 0.01$) in G:F as FM was replaced with AA in the diet during phases 1-2 (0.768, 0.800, 0.739, 0.740, and 0.718); however, there was no effect of dietary treatment on G:F during phase 3 ($P = 0.27$) or overall ($P = 0.23$). Final BW were not different as FM was replaced with AA (23.75, 24.07, 23.08, 23.42, and 23.64 kg; respectively, $P = 0.32$). Although G:F decreased as FM was replaced with AA during phase 2, there were no effects on overall growth performance or final BW. These results suggest that synthetic amino acids may be used to replace fish meal in nursery diets without compromising overall growth performance of the pigs.

Key Words: Pigs, Fish Meal, Amino Acids

202 ASAS Early Career Achievement Award presentation: Balancing amino acids for reproductive performance of sows. S. W. Kim*, *North Carolina State University*, *Raleigh*.

Improving efficiency of protein utilization is important for pregnant sows under restricted feed allowance to support the growth of fetuses and mammary glands especially during late gestation and for lactating sows with limited feed intake to support the mammary gland growth and milk production especially for primiparous sows. Series of studies were conducted to characterize requirements and ideal ratios of amino acids for (1) fetal growth, (2) mammary gland growth, and (3) maternal tissue gain for gestating sows and for (4) mammary gland growth, and (5) maternal tissue gain for lactating sows. A total of 97 pregnant sows and their fetuses and a total of 174 lactating sows and their nursing piglets were used for these studies to collect fetal tissues, mammary tissues, and maternal tissues for amino acid analysis. Requirements and ideal ratios of amino acids for sows changed dynamically depending on stages of pregnancy. Suggested daily Lys requirements were 6.83 and 15.26 g and relative ideal ratios for Lys:Thr:Val:Leu were 100:79:65:88 and 100:71:66:95 for 0 to 70 and 70 to 114 of gestation, respectively. Requirements and ideal ratios of amino acids for lactating sows changed dynamically depending on potential amounts of protein mobilization from maternal tissues which are related to voluntary feed intake and milk production. Suggested ideal ratios for Lys:Thr:Val:Leu were 100:59:77:115 and 100:69:78:123 if body weight losses of sows during 21 d lactation are 0 and 33 to 45 kg, respectively. To optimize efficiency of dietary protein utilization by sows, the dietary amino acid content and ratios can be adjusted by stages of pregnancy and by expected feed intakes or parities of sows during lactation considering the dynamic changes in the requirements and ideal ratios of amino acids. Acknowledgements to RA Easter, IK Han, WL Hurley, DH Baker, G Wu, and F Ji.

Key Words: Amino Acid, Ideal Protein, Sow

203 Adaptation of protein metabolism to changes in lysine intake in growing pigs. J. J. G. C. Van den Borne*, S. Borgijink, J. Dijkstra, and W. J. J. Gerrits, *Wageningen University*, *Wageningen, The Netherlands*.

The indicator amino acid technique is a well-known tool to estimate amino acid requirements within a subject. It involves measurement of responses in protein metabolism to step-wise changes in amino acid imbalance. The objective of this experiment was to compare lysine requirement estimates from increasing *vs.* decreasing titration strategies, and to study adaptive responses to changes in lysine intake. Pigs (n=14; 27.1±0.2 kg) were housed in metabolism crates and assigned to one of two treatments, with digestible lysine intake either increasing from 4.7 to 14.0 g/kg (INCR) or decreasing from 14.0 to 4.7 g/kg feed (DECR) in 7 equidistant steps, at identical intakes of other nutrients. Each step lasted 4d. Four complete 24h urine collections were performed from all pigs for each lysine level. Total urinary N and urea excretion were determined for all 24h collections. [^{15}N]glycine was provided orally at d 3 of each lysine level and enrichment was measured in urinary urea. A linear-plateau model was fitted to N efficiency (in %) data. Treatment effects on slopes and inflection point estimates of the model were then analyzed statistically. Based on the F-test, for 11 of the 14 pigs the linear-plateau model fitted data better (P<0.01) than a straight line. The slope was higher (P<0.01) for DECR than for INCR (4.7 *vs.* 3.8 %/g). The lysine requirement, estimated from the inflection point, was lower (P<0.05) for DECR (10.1 g/kg) than for INCR (11.4 g/kg). Protein turnover increased linearly with lysine intake. With increasing lysine intakes, the increase in protein turnover rates was markedly greater for DECR than for INCR (P<0.05). No consistent changes in urinary N output were observed between the 4 subsequent 24h collections, although it was lower (P<0.05) for d 1 and 3 compared with d 2 and 4. In conclusion, increasing and decreasing lysine titration strategies resulted in different estimates for lysine requirement in pigs, indicating that adaptive processes in protein metabolism interfere with requirement estimates in within-subject titration techniques.

Key Words: Pig, Lysine, Protein Metabolism

204 Effects of fortifying low crude protein diet with crystalline amino acids on ammonia and uric acid production and excretion in broilers. N. F. Namroud, M. Shivazad*, and M. Zaghari, *University of Tehran*, *Karaj, Tehran, Iran*.

A study was conducted to evaluate the effects of providing all EAA in low CP diets equal to that of higher CP diets in broilers. Also, the effects of additional mixture of Gly and Glu or supplementation of excess EAA to low CP diets on the live performance, body composition, and excreta characteristics including pH, moisture, nitrogen, uric acid, ammonia concentration, and some blood factors related to nitrogen metabolism were measured to assess the reason of decreasing performance, especially appetite in low CP diets that have adequate amount of EAA. Male broiler chickens growing from 10 to 28 days of age were fed 8 experimental diets. Reducing dietary CP below 19% affected live performance and fat deposition in whole-body and abdominal cavity significantly (P≤0.05). Adding the Gly and Glu mixtures to low CP diets improved live performance and decreased fat deposition (P≤0.05). Nitrogen content, ammonia, uric acid level, moisture, and acidity of excreta were influenced by dietary CP (P≤0.05). Blood ammonia level was increased, and plasma uric acid was decreased with reduction of CP to 17% (P≤0.05). Supplementing Gly and Glu to low CP dietary treatments increased plasma and excreta uric acid level in spite of decreasing level of ammonia production (P≤0.05). Reduction of dietary CP had no significant influence on the most free plasma amino acid levels; however, appetite was depressed (P≤0.05). The liver weight was elevated with increase in blood ammonia level (P≤0.05). This difference may be due to adaptation process of liver to high blood ammonia level. Therefore, our suggestion is that blood ammonia level, which is has fatal effects on living cells may regulate appetite, besides the aminostatic mechanism in broilers.

Key Words: Crude Protein, Ammonia, Broiler

205 The effect of the level of crude protein and dietary fiber on the productive performance and health status of piglets. R. G. Hermes*, F. Molist, M. Iwazaki, M. Nofrarías, J. Gasa, and J. F. Pérez, *Universitat Autònoma de Barcelona*, *Bellaterra, Barcelona, Spain*.

Protein (CP) and dietary fiber (DF) are considered factors involved on the digestive maturation and health status of piglets. In the present study, ninety six 35-days-old piglets (7.66 ± 0.92kg BW) were placed in 32 pens of 3 animals each, and allotted to four dietary treatments for 21 days. The four diets were formulated based on rice, dairy products and soybean meal in a 2×2 factorial design, with 2 levels of CP (LP, 16%CP and HP, 19%CP) and 2 levels of DF (LF, 5%NDF and HF, 7% NDF). The HF diet was obtained by the supplementation of the basal diet with 4% of wheat bran and 2% of sugar beet pulp. Animal performance was weekly registered, and samples of feces collected for microbiology on days 1 and 21. On day 21, one pig from each pen was sampled for blood analyses of the acute-phase protein (PigMap) and sacrificed to register the digestive tract weight and colon histology. Animals fed on the HF diet increased the average daily gain (390 vs. 457 g/d; p ≤ 0.001), and the large intestine weight (4.4 vs. 5.4% of BW; p ≤ 0.05). It coincided with a decrease (p ≤ 0.05) on the *E. coli* counts (7.77 vs. 6.86 log of CFU/g feces), and an increase (p ≤ 0.05) on the ratio Lactobacilli:Enterobacteria (0.76 vs. 1.37). On the other hand, CP level did not modify the productive performance, but HP increased the weight (% of BW) of the small (6.5 vs. 7.7), and large intestine (3.8 vs. 4.3) (p ≤ 0.05). In the large bowel, HP diet increased the numbers of goblet cells (4.6 vs. 5.4/100µm; p ≤ 0.05), while reduced the numbers of intraepithelial lymphocytes (1.8 vs. 1.3/100µm; p ≤0.05). In relation with the health status, a significant interaction was observed, with the LP-HF treatment showing the highest incidence of diarrhea, antibiotic interventions and PigMap concentration (p ≤ 0.05). As a whole, CP has major effects on the gastrointestinal growth, while DF promotes major changes on the microbial colonization. An early increase on DF supplementation appears to promote a healthier status when this change is concomitant with a high CP level.

Key Words: Piglets, Dietary Fiber, Health Status

206 Pea protein as a substitute of soy bean protein in diets for young pigs: Effects on nutrient digestibility and digestive traits. D. G. Valencia[1], M. P. Serrano[1], C. Centeno[2], R. Lázaro[1], and G. G. Mateos*[1], [1]*Universidad Politécnica de Madrid*, *Spain*, [2]*Instituto del Frío, C.S.I.C.*, *Madrid, Spain*.

A trial was conducted to study the effects of using pea protein concentrate (PPC), soybean meal (SBM) or fullfat soybean (FFSB) as a substitute

of soy protein concentrate (SPC) on coefficient of ileal apparent digestibility (CIAD) of nutrients and digestive traits of piglets. The design was completely randomized with four treatments and six replicates of one piglet each. Four isonutritive diets (2,490 kcal NE/kg and 1.28% available Lys) were formulated and fed to pigs from 26 to 48 d of age. The main difference among these diets was the protein source used. In all cases the source tested supplied 5.5% of the dietary protein (CP). The CIAD of dietary components, the pH of the gastro intestinal tract (GIT), and the weight of digestive organs and spleen were measured at 48 d of age. Protein source had no effect on CIAD of CP or amino acids. However, the CIAD of organic matter (0.813 and 0.813 vs. 0.789 and 0.768) and gross energy (0.810 and 0.816 vs. 0.789 and 0.768) was greater for pigs fed SPC and SBM than for pigs fed PPC and FFSB ($P \leq 0.01$). The weight of the GIT was greater for pigs fed FFSB and PPC than for pigs fed SBM with pigs fed SPC being intermediate (61.0, 60.3, 52.8, and 55.9 g/kg body weight, respectively; $P \leq 0.05$). The poorer nutrient digestibility observed in pigs fed PPC and FFSB as compared to pigs fed SBM or SPC might be related to the higher TI content of these protein sources (4.9 and 4.7 vs. 2.7 and 1.6 g/kg). In summary, the inclusion of pea protein concentrate and fullfat soybean in the diet impairs ileal digestibility of organic matter and gross energy at 48 d of age. The replacement of soya bean meal by pea protein or soy protein concentrate in piglet diets, to improve nutrient digestibility, is not justified.

Key Words: Pea Protein Concentrate, Soy Bean Products, Digestibility in Piglets

207 Metabolizable energy and nitrogen-corrected metabolizable energy of meat and bone meal for pig. O. A. Olukosi* and O. Adeola, *Purdue University*, *West Lafayette, IN*.

Apparent metabolizable energy (AME) and nitrogen-corrected AME (AMEn) of 14 meat and bone meal (MBM) samples were determined using barrows. Treatments consisted of 1 standard corn-soybean meal (SBM) diet and 14 test diets in which each of the 14 MBM samples replaced equal quantities of corn and SBM in the standard diets such that the ratio of corn:SBM was the same in all the 15 diets. Each dietary treatment had 9 barrows. The barrows were allowed 5 d of adjustment to metabolism cages and diets and 5 d of feeding and total collection of feces and urine. The diets, urine and feces were analyzed for gross energy (GE) and N. Correlation, regression, partial correlation and model development and selection analyses were used to determine relationship among proximate fractions and AME or AMEn and for choosing the optimum prediction equation. The AME values were significantly different ($P < 0.05$) among the 14 MBM samples and ranged from 2,611 to 3,890 kcal/kg, whereas AMEn ranged from 2,512 to 3,794 kcal/kg and was not significantly different among the MBM samples. Proximate components were correlated to AME and AMEn of the MBM samples. There were negative correlations between AME and Ca, P, and ash (r^2 = -0.43, -0.48 and -0.49, respectively), AMEn was also negatively correlated to the same chemical components with similar r^2 values. Both AME and AMEn were positively correlated to fat (r^2 = 0.42 and 0.43 for AME and AMEn, respectively) and protein (r^2 = 0.17 and 0.16 for AME and AMEn, respectively). The best two-model predictors were protein and fat, adding GE to these two improved the precision of the prediction equation. The best prediction equation for AME was based on 5 variables and was 7,756 - (0.84×GE) + (704×P, %) + (156×Ca, %) + (129×Fat, %) - (268×Ash, %). For AMEn, the best prediction equation was 7,664 - (0.85×GE, kcal/kg) + (707×P, %) + (154×Ca, %) + (132×Fat, %) - (268×Ash, %). In conclusion, although no single chemical component explained more than 50% of the variations in AME and AMEn of the MBM, but in combination provide information that may be used to predict the energy value of MBM.

Key Words: Energy, Meat and Bone Meal, Proximate Components

208 Amino acid and energy digestibility in soybean meal from high-protein and low-oligosaccharide varieties of soybeans fed to growing pigs. K. M. Baker* and H. H. Stein, *University of Illinois*, *Urbana*.

Two experiments were conducted using 5 sources of soybean meal (SBM) that included hexane extracted SBM produced from high-protein soybeans (SBM-HP) and from conventional soybeans, and mechanically expelled SBM produced from high-protein soybeans, low-oligosaccharide soybeans (SBM-LO), and conventional soybeans. The standardized ileal digestibility (SID) of CP and AA in the 5 sources of SBM were measured in Exp. 1. Five diets that each contained 1 source of SBM as the only AA-containing ingredient and a N-free diet were formulated. Twelve growing barrows (initial BW: 67.7 kg) were allotted to a replicated 6 × 6 Latin square design with 6 periods and 6 diets. Each period lasted 7 d and ileal digesta were collected on d 6 and 7 of each period. With the exception of Trp, no differences in SID values between the extracted SBM-HP and the extracted conventional SBM were observed. The expelled SBM-HP and SBM-LO had greater ($P \leq 0.05$) SID for His, Ile, Lys, Thr, and Val than the expelled conventional SBM. The SID for all indispensable AA in the expelled SBM-HP were greater ($P \leq 0.05$) than in the extracted SBM-HP, and for the conventional SBM, the SID for Arg, Ile, Leu, Phe, and Trp were greater ($P \leq 0.05$) in the expelled meal than in the extracted meal. Experiment 2 was conducted to measure ME in the 5 sources of SBM using 48 growing barrows (initial BW: 38.6 kg) that were placed in metabolism cages and randomly allotted to 6 diets with 8 replicates per diet. A corn-based diet and 5 diets based on a mixture of corn and each source of SBM were formulated. Urine and feces were collected during a 5-d collection period, and values for ME in each source of SBM were calculated using the difference procedure. Results showed that ME in the extracted SBM-HP was greater ($P \leq 0.05$) than in the extracted conventional SBM (4,074 vs. 3,672 kcal/kg DM). The ME in the expelled SBM-HP was also greater ($P \leq 0.05$) than in the expelled conventional SBM and in the SBM-LO (4,059 vs. 3,620 and 3,721 kcal/kg DM). It is concluded that SBM-HP has a greater feeding value than conventional SBM.

Key Words: High-Protein Soybean Meal, Low-Oligosaccharide Soybean Meal, Pigs

209 Standardized ileal amino acid digestibilities in grain legumes for pigs. D. Jezierny*[1], R. Mosenthin[1], M. Eklund[1], and M. Rademacher[2], [1]*University of Hohenheim*, *Stuttgart, Germany*, [2]*Evonik Degussa GmbH*, *Hanau-Wolfgang, Germany*.

It has been agreed upon to use standardized ileal digestibilities (SID) of CP and AA in diet formulation for pigs. This study with grower pigs was conducted to determine SID values in different cultivars of faba beans, peas and lupins. Moreover, ileal digestibilities of starch in faba beans and peas were also determined. Three consecutive experiments

were conducted with 6 barrows each (initial BW 23.2 ± 1.9 kg). The pigs were fitted with a simple T-cannula at the distal ileum. In total, 18 assay feed ingredients, including 6 cultivars of faba beans (25 to 30% CP, as-fed) or peas (20 to 23% CP, as-fed), 5 cultivars of lupins (31 to 42% CP, as-fed) and 1 soybean meal (SBM) (49% CP, as-fed) as reference component were tested in a randomized row-column-design with 6 periods in each experiment (n = 6 per assay feed ingredient). The assay feed ingredients were added to a corn starch casein-based basal diet at the expense of corn starch. Each assay diet supplied approximately 50% of the total CP and AA content from the assay feed ingredient and casein, respectively. Both SID of CP and AA and ileal digestibility of starch in legume seeds were determined according to the principles of the difference method. The SID of CP differed ($P < 0.05$) between faba beans, peas and lupins, ranging between 69 to 81, 77 to 82 and 85 to 89%, respectively. The SID of Lys, Met, Trp, Ile and Phe in these grain legumes were lower compared to SBM ($P < 0.05$). The SID of most AA in faba beans and peas were lower compared to lupins or SBM ($P < 0.05$). The SID of CP and AA in faba beans was partly affected by cultivar ($P < 0.05$). The ileal digestibilities of starch in peas and faba beans were similar ($P > 0.05$), ranging between 78 to 89 and 77 to 84%, respectively. In conclusion, mean SID values for CP and AA in grain legumes are in good agreement with tabulated values, however, for individual cultivars these values may vary.

Key Words: Standardized Ileal Amino Acid Digestibility, Grain Legumes, Pig

210 True ileal amino acid digestibility in cecectomized roosters and lysine bioavailability in chicks fed distillers dried grains with solubles. A. A. Pahm*, J. E. Pettigrew, C. S. Scherer, D. H. Baker, C. M. Parsons, and H. H. Stein, *University of Illinois*, *Urbana*.

The concentration of true ileal digestible (TID) Lys and relative bioavailable Lys in 7 sources of distillers dried grains with solubles (DDGS) fed to poultry were compared. We also evaluated the use of 2 in vitro procedures, reactive Lys and color score, to predict the concentration of TID Lys and bioavailable Lys in DDGS. The TID of AA in all sources of DDGS were measured using cecectomized roosters. Relative bioavailable Lys in all sources of DDGS were measured using standard curve methodology. Initially, 9-d total gain of chicks fed increasing levels of L-Lys HCl was measured and a regression equation was derived by plotting the bioavailable Lys intake against 9-d total gain of chicks. Seven additional diets were formulated to contain each of 7 sources of DDGS, and 9-d total gain of chicks fed these diets was measured. The 9-d total gain of chicks fed diets containing DDGS was used in the regression equation to predict the relative bioavailable Lys. The 7 DDGS sources were analyzed for reactive Lys using the guanidination procedure, and Hunterlab L, a, and b scores were measured to determine the degree of lightness, redness, and yellowness in the samples. Results showed that the TID for Lys among the 7 DDGS sources varied ($P < 0.05$) from 52.7 to 70.4%. The average TID for Lys was 61.4%. Concentration of relative bioavailable Lys did not differ among the 7 sources of DDGS. The average concentration of TID Lys in DDGS was not different from the concentration of bioavailable Lys (0.47% and 0.53%, respectively). The concentration of TID Lys was correlated ($r^2=0.84$, $P < 0.05$) with the concentration of reactive Lys in the samples. Hunterlab L scores of DDGS was correlated ($r^2=0.90$, $P <0.05$) with the concentration of bioavailable Lys. In conclusion, the concentration of TID Lys in DDGS is close to the concentration of bioavailable Lys in chicks. Values for reactive Lys and Hunterlab L may be used to estimate the concentration of TID Lys and bioavailable Lys in DDGS, respectively.

Key Words: Digestibility, Bioavailability, DDGS