Nonruminant Nutrition: Dietary Influences in Nursery Pigs

M99 Validation of the NCCC-42 vitamin-trace mineral premix in starter pigs. T. D. Crenshaw*[1], M. J. Azain[2], G. H. Hill[3], P. S. Miller[4], and NCCC-42 Swine Nutrition Committee[1], [1]*University of Wisconsin*, *Madison*, [2]*University of Georgia*, *Athens*, [3]*Michigan State University*, *East Lansing*, [4]*University of Nebraska*, *Lincoln*.

A multi-state (WI, GA, MI, and NE) experiment was conducted by the NCCC-42 Swine Nutrition Committee to evaluate a vitamin trace mineral premix (VMP). VMP was formulated to provide minimal quantities of vitamins and trace minerals needed to complement nutrients supplied by ingredients typical in US swine diets. In the current trial (18 to 23 d weaned pigs), VMP was added to a complex starter diet to supply either 0, 1X or 3X supplemental vitamin concentrations where X equals quantities of vitamins to meet minimum requirements if nutrients from other ingredients are considered. Because of limited data on bioavailability of several B vitamins (biotin, choline, folate, pyrodixine, and thiamin) in feed ingredients, a B vitamin premix (+B) was formulated to supply these vitamins at minimum concentrations. The +B was added to diets with either 1X or 3X (1X+B and 3X+3XB) VMP. A sixth treatment (St) involved standard premixes used at each respective station. Trace minerals were constant in all diets except St. Pigs were allowed continuous access to assigned meal diets and water throughout a 28-d trial. Differences among stations were detected ($P < 0.05$), but no interactions among stations and diets were detected for ADG or ADFI responses. Pigs fed diets with no VMP (0X) gained less and consumed less feed than pigs in other groups ($P < 0.05$). No advantages in ADG nor ADFI were detected in pigs fed diets with additional 3X VMP or VMP+B at 1X or 3X levels. Pigs fed St diets tended ($P < 0.10$) to gain faster and consumed more feed ($P < 0.05$) than pigs fed VMP diets at 1X or 3X. In conclusion, 1X VMP allowed adequate growth over a 4-wk nursery trial. Additions of higher quantities of VMP or supplemental B vitamins did not improve growth.

Table 1. Concentrations of Vitamin Premixes[1]

Trait	0X	1X	3X	1X+B	3X+3XB	St	SEM
ADG, kg/d	0.295[a]	0.308[b]	0.313[b]	0.314[b]	0.320[b]	0.335[c*]	0.01
ADFI, kg/d	0.484[a]	0.493[b]	0.515[b]	0.509[b]	0.513[b]	0.542[c]	0.01

[1] Means based on 18 pens/treatment. Means within a row with different superscripts differ ($P<0.05$) or * ($P<0.10$).

Key Words: Swine, Premix, Vitamins

M100 True phosphorus digestibility and the gastrointestinal endogenous P outputs associated with brown rice in weanling pigs. H. Yang[1], Y. L. Yin*[1,2], T. J. Li[1], R. L. Huang[1], and M. Z. Fan[1], [1]*The Chinese Academy of Sciences*, *Changsha, Hunan Province, China*, [2]*University of Guelph*, *Ontario, Canada*.

The objectives of this study were to determine true phosphorus (P) digestibility and the gastrointestinal endogenous P outputs associated with brown rice at the ileal and the fecal levels in weanling pigs. Six Duroc x Large White x Landrace barrows, with an average initial BW 12.5 ± 0.6 kg, were fitted with a simple T-cannula at the distal ileum and fed six diets according to a 6 x 6 Latin square design. The diets were cornstarch-based and contained six levels of P (0.80, 1.36, 1.93, 2.49, 3.04 and 3.61 g/kg DMI) from brown rice. Chromic oxide (3.5 g/kg diet, on as-fed basis) was included as a digestibility marker. Each experimental period consisted of 9 d with 6-d adaptation and 3d collection of representative ileal digesta and fecal samples. True ileal and fecal P digestibility values and the ileal and fecal endogenous P outputs associated with brown rice were determined by the regression analysis technique. There were no differences ($P > 0.05$) in true P digestibility values (ileal, 57.7 ± 5.4 vs. fecal, 58.2 ± 5.9%, n = 36) and the endogenous P outputs (ileal, 0.812 ± 0.096 vs. fecal, 0.725 ± 0.083 g/kg DMI, n = 36) between the ileal and the fecal levels. In conclusion, about 58% of the total P in conventional brown rice is digested in weanling pigs. The large intestine does not play an role in the digestion and absorption of P associated with brown rice in the weanling pig.

Key Words: Brown rice, Phosphorus digestibility, Weanling pigs

M101 True phosphorus digestibility and the endogenous phosphorus outputs in diets for weaned pigs determined by the substitution method. Z. R. Wang[1], L. Liu[2], X. J. Yang[2], T. C. Rideout[2], C. Yang[2], Y. L. Yin[2,3], T. Archbold[2], and M. Z. Fan*[2], [1]*Xinjiang Agricultural University*, *Urumqi, Xinjiang, China*, [2]*Institute of Subtropical Agriculture, the Chinese Academy of Sciences*, *Changsha, Hunan, China*, [3]*University of Guelph*, *Ontario, Canada*.

The objective of this study was to determine true phosphorus (P) digestibility and the gastrointestinal endogenous P output associated with corn and soybean meal (SBM)-based diets for weanling pigs by the substitution method. Twelve Yorkshire weanling barrows, with initial BW between 10 and 12 kg, were fed two diets according to a completely randomized block design. The diets were corn and SBM-based and contained two levels of P (0.74 and 0.53% on DM basis) with the lower P diet formulated by replacing corn and SBM with 29% cornstarch. Chromic oxide (3.0 g/kg diet, on as-fed basis) was included as a digestibility marker. Each experimental period consisted of 8 d with 10-d adaptation and 4-d collection of representative fecal samples. True fecal P digestibility (61.2 ± 7.7%, n = 6) and the fecal endogenous P output (0.534 ± 0.481 g/kg DMI, n = 12) associated with the diet were determined by the substitution method. In conclusion, true fecal P digestibility and the endogenous P output associated with test dietary mixtures can be determined by the substitution method with dietary P levels meeting or close to recommended dietary P requirement levels in pigs.

Key Words: Phosphorus, Pigs, True digestibility

M102 Impact of genetics and dietary phosphorus restriction on growth performance and bone integrity in pigs. L. Alexander*, S. Cutler, M. Yu, M. F. Rothschild, and C. H. Stahl, *Iowa State University*, *Ames*.

The costs associated with dietary phosphorus (P) supplementation, as well as public concerns, have driven research towards finding ways to reduce dietary P supplementation to, as well as P excretion from, pigs. Our previous work suggests differences in the regulation of P homeostasis exist between weanling pigs of different genetic backgrounds (Hittmeier et al., 2005). In this study, we examined the impact of genetic background and mild dietary P restriction on growth and bone integrity in 48 gilts sired by two different sire lines (LB and HB). They were fed either a P adequate (PA) or a P deficient (PD)

diet over a 14 wk trial. The PD provided 20% less available P than the PA. Plasma phosphorus concentration, ADG, ADFI, and G:F were determined biweekly. At the completion of the trial, radial bones were collected for bone strength analysis and intermediate carpal bones were collected for ash content determination. Data were analyzed using a mixed model with genetic line, diet, and line x diet considered as fixed effects and litter as a random effect. Initial BW and final BW were covariates for growth performance and bone strength, respectively.

After 4wk on trial, reduced ADG ($P < .05$) was seen among LB pigs fed the PD, but not among the HB pigs. The depressed ADG among LB PD pigs corresponded with a lower ($P < .05$) G:F. These differences were not seen by 14wk. Lower ($P < .05$) plasma P concentrations in PD fed pigs were seen at wk14. The bones of pigs fed PA were stronger those fed PD ($P < .05$). Radial bones of HB pigs were more bendable ($P < .05$) than those of LB pigs, and this increased in both lines with the PD diet ($P < .05$). Pigs fed the PD had lower ($P < .05$) breaking strength and ash %. A line*diet effect was also seen in ash %. Among PA fed pigs, LB pigs had higher ($P < .05$) ash % than HB pigs. These differences suggest that genetic background affects bone integrity and altered regulation of mineral homeostasis between these lines may help explain these differences. Future research could lead to genotype specific dietary P requirements and/or breeding strategies to produce more ″environmentally-friendly″ pigs.

Key Words: Phosphorus, Bone, Pig

M103 Evaluation of plasma protein replacement strategies in complex and semi-complex phase 1 and 2 diets, followed by either high or low soybean meal subsequent nursery diets. G. Willis*[1], P. Wilcock[1], and B. Richert[2], [1]*Primary Nutrition*, *Dundee, IL*, [2]*Purdue University*, *West Lafayette, IN*.

Three hundred fifty pigs (BW=5.3 kg; 7 pigs/pen) were utilized to evaluate alternative plasma replacement strategies in phase 1 and 2 nursery diets. The strategies evaluated were replacement of spray-dried plasma (SDP) with milk proteins (MP) or isolated soy protein (ISP). Treatment 1 (T1) was complex phase 1 and 2 diets containing 5 and 2.5% SDP, respectively. In T2, SDP was replaced by MP primarily from whey protein concentrate. T3 was like T2, but utilized approximately 2% more MP from whey in replacement for corn. T4 was semi-complex phase 1 and 2 diets with 5 and 2.5 % SDP. T5 was like T4 but SDP was replaced with ISP. After phase 2, treatments were fed either high soybean meal (HSBM, 30%) or low soybean meal (LSBM, 15%) phase 3 diets until d 21. Pigs were fed a common phase 4 diet from d 21-35. For d 0-7, replacing SDP with MP (T1, T2, T3; ADG 187, 198, 205 g/d and G:F 1.14, 1.16, 1.18, respectively) or ISP (T4-T5, ADG 130, 132 and G:F 0.90, 1.06, respectively) had no effect on performance. Similarly, d 14 BW was unaffected by SDP replacement strategy (8.13, 8.13, 8.32 kg for T1, T2, and T3; 7.82, 7.79 kg for T4-T5, respectively). However, complex diets (T1, T2, T3) had greater ADG ($P<0.001$), ADFI ($P<0.001$) and G:F ($P<0.03$) during d 0-7 and were heavier ($P<0.001$) at d 14 than pigs fed the semi-complex diets (T4-T5). In phase 3, HSBM diets tended to improve ADG (418 vs. 404 g/d; $P<0.08$) and improved G:F (0.68 vs. 0.65; $P<0.05$) from d 14-21. For the entire study (d 0-35) both SDP replacement strategies were effective (T1, T2, T3; ADG 392, 392, 400 g/d and G/F 0.64, 0.61, 0.63; T4-T5 ADG 379, 379 g/d and G/F 0.61, 0.61, respectively) in maintaining pig growth. Level of soybean meal in phase 3 did not alter overall nursery performance (ADG, 389 vs 387 g/d; G/F, 0.62 vs 0.62; HSBM vs. LSBM, respectively). Plasma protein can be replaced in both complex and semi-complex nursery diets with milk proteins or isolated soy proteins, respectively, without impacting pig performance.

Key Words: Pig, Plasma, Milk proteins

M104 Nutrient digestibility of vegetable protein sources of different particle size in young pigs. D. G. Valencia, M. P. Serrano, R. Lázaro, and G. G. Mateos*, *Universidad Politécnica de Madrid*, *Spain*.

Two trials were conducted to test the inclusion of vegetable protein sources in the diet on coefficient of total tract apparent digestibility (CTTAD) and ileal apparent digestibility (CIAD) of nutrients in young pigs. In addition, the effect of particle size of soybean meal (SBM) and full fat soybean (FFSB) on these coefficients was also studied. Seven isonutritive diets (2,490 kcal NE/kg and 1.28% available Lys) were fed from 21 to 48 d of age. The main difference among them was the protein source used; a) SBM, 45.2% CP with an average particle size (APS) of 883, 400, or 137 μm, b) FFSB, 34.9% CP with an APS of 780 or 82 μm, c) soy protein concentrate, 56% CP (SPC) with an APS of 200 μm, and d) pea protein concentrate, 52.5% CP (PEA) with an APS of 30.0 μm. In all cases the source tested supplied 5.5% of the protein of the diet. Each treatment was replicated five times (six piglets) in trial 1 (CTTAD study) and six times (one piglet) in trial 2 (CIAD study). At 36 d of age, the CTTAD of OM (90.3 vs. 89.3 %; $P \leq 0.05$), CP (84.8 vs. 81.3 %; $P \leq 0.001$), and GE (88.8 vs. 87.3 %; $P \leq 0.01$) was higher for piglets fed soy products (SOY) containing diets than for piglets fed the PEA containing diet, but no negative effects of PEA feeding were observed at 48 d of age. Piglets fed SOY diets tended to have better CIAD of CP (76.1 vs. 73.7 %; $P \leq 0.10$) than piglets fed the PEA diet. Piglets fed SBM containing diets had better CTTAD of OM and CP ($P \leq 0.05$) and CIAD of OM ($P \leq 0.001$) than piglets fed FFSB containing diets. Piglets fed SPC diets had better CIAD of OM (81.3 vs. 80.3 %; $P \leq 0.01$) and tended to have better CIAD of CP (78.0 vs. 75.6 %; $P \leq 0.10$) than piglets fed SBM containing diets. Reducing the APS of the SBM or the FFSB used did not affect nutrient digestibility ($P \geq 0.10$). We conclude that the inclusion of pea protein reduced nutrient digestibility, specially at young ages and that reducing particle size of either soybean meal or full fat soybean below 780 μm did not affect nutrient digestibility.

Key Words: Piglet digestibility, Vegetable protein sources, Particle size

M105 The evaluation of several protein sources on amino acids digestibility in early-weaned pigs. B. J. Min*[1], J. H. Cho[1], Y. J. Chen[1], H. J. Kim[1], J. S. Yoo[1], I. H. Kim[1], S. S. Lee[2], and W. T. Cho[2], [1]*Dankook University*, *Cheonan, Chung nam, Korea*, [2]*Genebiotech Co. Ltd.*, *Gongju, Chung nam, Korea*.

Twenty early-weaned barrows (Yorkshire × Landrace × Duroc, 3.98 ± 0.38kg BW, weaned at 14 d) were used in metabolism trial to evaluate several protein sources on amino acids digestibility. Treatments included 1) SBM (soybean meal), 2) FSP (fermented soy protein), 3) RPC (rice protein concentrate), 4) FM (fish meal) and 5) DSM (dried skim milk). Diets were the protein sources preparations with only vitamins and minerals added as needed to meet or exceed NRC recommendations. Daily feed was provided following equations of $0.05 \times BW^{0.9}$. In amino acids digestibility, RPC (87.63%) has higher ($P < 0.05$) total essential amino acids (EAA) digestibility than SBM (67.57%) and FSP (64.15%). Also, there were numerical differences among DSM (75.45%), FM (78.56%) and RPC (87.63%) treatments. Total non- EAA and N digestibilities were improved which pigs

fed RPC and FM compared those fed other diets ($P < 0.05$). Also, biological value (BV) in pigs fed RPC diet was 76.30%, compared with 72.20, 66.42, 60.87 and 57.65% for those fed FM, DSM, FSP and SBM diet, respectively ($P < 0.05$). DM digestibility of DSM treatment was the highest value as 61.73% compared with other treatments ($P < 0.05$). Results were showed that RPC, FM has greater AA, N digestibilities than SBM, FSP and DSM.

Key Words: Protein source, Early-weaned pigs, AA digestibility

M106 The effects of fermented soy protein in simple or complex diet on growth performance and amino acids digestibility in weaned pigs. B. J. Min*[1], J. H. Cho[1], Y. J. Chen[1], H. J. Kim[1], J. S. Yoo[1], I. H. Kim[1], S. S. Lee[2], and W. T. Cho[2], [1]*Dankook University*, *Cheonan, Chungnam, Korea*, [2]*GenebiotechCo. Ltd.*, *Gongju, Chungnam, Korea*.

120 weaned pigs(D×Y×L, 5.68±0.80kg average initial BW, weaned at 21 d) were used to evaluate the effect of fermented soy protein in simple or complex diet on growth performance and amino acids digestibility during 30 days. Experimental diets consisted of simple(using soybean meal as protein sources) and complex(using SBM, rice protein concentrate, potato protein concentrate and fish meal as protein sources) diet which contained 0 or 5% fermented soy protein(FSP), respectively. Pigs were provided each experimental diet for 20 days (phase 1) and then, all pigs fed same common diet for 10 days (phase 2). In 0-10 days, pigs fed complex diet gained more than those fed simple diet(P<0.05). However, in 10-30 days, ADG was not affected by treatments. In 20-30 days, G/F was higher in pigs fed 5% FSP diet than those fed 0% FSP diet(P<0.09). In whole period, growth performance of pigs fed complex diet including 5% FSP was tended to increase without significant differences. Also, including FSP in both diets improved feed efficiency of pigs(P<0.05). DM and N digestibilities of pigs fed complex diet was higher than those fed simple diet at 10 d(P<0.001). However, there was no effect on N digestibility at 20, 30d. Lysine, methionine and valine digestibilities were greater(P<0.02) in pigs fed 5% FSP diet than in those fed 0% FSP diet. Pigs fed only soybean meal as protein source was increased NH_3-N in feces compared with pigs fed 5% FSP in simple diet and 0% FSP in complex diet(P<0.05).

Key Words: Fermented soy protein, Simple/complex diet, Growth performance

M107 Optimal lysine level of fermented soy protein diet in weaned pigs. B. J. Min*[1], J. H. Cho[1], Y. J. Chen[1], H. J. Kim[1], I. H. Kim[1], S. S. Lee[2], and W. T. Cho[2], [1]*Dankook University*, *Cheonan, Chungnam, Korea*, [2]*Genebiotech Co. Ltd.*, *Gongju, Chungnam, Korea*.

Twenty weaned barrows(Y×L×D, 6.15±0.45kg BW, weaned at 21 d) were used in metabolism trial to determine optimal Lys concentration of fermented soy protein diet. Pigs were provided 1.2, 1.3, 1.4, and 1.5% Lys concentration diets using 5% fermented soy protein. Through the 14 experimental days, growth performance was not affected by Lys concentrations. In digestibility assays at 7 d and 14 d, DM digestibility was showed quadratic response(P<0.05) to the highest in pigs fed 1.4% Lys concentration diet. Total essential amino acids(EAA) digestibility was increased in pigs fed 1.5% Lys compared with other diets(linear effect, P<0.001) at 7 d. Also, Lys digestibility(85.83%) was high with 1.5% Lys than with 1.2, 1.3 or 1.4%(78.57, 80.89, and 82.43%), respectively, linear effect(P<0.001). There was linear improving in most amino acids except Ile, Leu, and Phe as increasing Lys concentration. In 14 d, Lys, Met, Thr, Arg and His digestibility were improved linearly(P<0.03) as Lys concentration was increased. However, total EAA digestibility has no statistical difference at 14 d. Biological value of pigs fed higher Lys concentration diet was increased, however, there was no significant difference. BUN concentration in blood was decreased linearly as Lys was increased(P<0.08).

Key Words: Fermented soy protein, Lysine level, AA digestibility

M108 Lysine requirement of gilts following a protein restriction from 4 to 8 weeks of age. C. L. Collins[1,3], S. X. Fu[2], R. Hinson[2], B. J. Leury[3], B. G. Tatham[1], G. L. Allee[2], and F. R. Dunshea*[1,3], [1]*Department of Primary Industries*, *Werribee, Victoria, Australia*, [2]*University of Missouri*, *Columbia*, [3]*University of Melbourne*, *Parkville, Victoria, Australia*.

Compensatory growth responses can be observed following short periods of protein restriction although the degree of compensation can be variable. One reason for this may be differences in the lysine requirement during realimentation. To examine this two hundred and sixteen TR4 x C22 gilts were weighed and allocated to 54 pens of 4 pigs per pen at approximately 30 days of age. Pigs were allocated to one of 6 treatment groups and fed either a corn/soybean diet with adequate nutrients (13.5 g total ileal digestible (TID) lysine/kg) (treatment 1), or a diet restricted in lysine content (10.8 g TID lysine/kg) (treatments 2 to 6) for a 4 week period. During the subsequent 5 weeks, treatments 1 to 6 received diets containing 10, 7, 8.5, 10, 11.5 and 13 g TID lysine/kg, respectively. All treatment groups received a common finisher diet for the final 7 weeks to 141 days of age. Daily gain of the restricted gilts was reduced compared to the controls during the weaner period (504 v's 539 g/d, respectively P<0.001). During the subsequent 5 week realimentation period restricted gilts gained faster on the higher lysine diets (ADG 889, 696, 837, 918, 946, 943 g/day, respectively for treatment 1 to 6, P<0.001). Despite this, post restriction response curves, best described by a quadratic function, estimated that the lysine requirement of the restricted gilts during the 5 week realimentation period was 9.8 g/kg. This lysine requirement was defined as the point at which 95% of the maximum ADG was reached. Final live weights at 141 days of age indicate that there were no differences between the treatments (110.4, 107.0, 108.8, 109.1, 110.8, 110.1 kg respectively P=0.307). These data suggest that although gilts gained faster on a higher lysine diet immediately post restriction, a higher nutrient diet may not be necessary to achieve similar liveweights by 141 days of age.

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Key Words: Pig, Compensatory growth, Dietary lysine

M109 Dietary lysine needs of a lean, late maturing strain of pigs. T. R. Lutz, R. C. Clayton, and T. S. Stahly*, *Iowa State University*, *Ames*.

Pigs from a lean, late maturing strain (PIC Camborough x 337) were fed one of four dietary lysine (Lys) regimens from 6 to 30 kg BW. Four littermates in each of twenty litters were weaned (15-19 d), individually penned, fed a 1.74% Lys basal diet until they reached 6-7 kg BW and then randomly allotted within litter to dietary treatment. Pig weights and feed consumption were recorded every 4 days. A fortified basal diet consisting of corn, soybean meal (soy), 15% dried whey, 3% choice white grease containing 1.32, 1.46, 1.60, or 1.74% Lys was fed. As each pig reached a BW of 14 (+/- 1.1) kg, their respective basal was modified (-whey) and dietary Lys level was

lowered by .14 percentage units. Lys concentrations were achieved by altering the ratio of soy to corn. Other amino acids were maintained to provide a minimum of 100% of their ideal ratio to Lys. Pooled over BW of 6 to 14.5 kg, ADG (468, 489, 498, 527 g; P<.01) and G:F ratios (744, 788, 830, 859 g/kg; P<.01) increased with increasing increments of dietary Lys. From 14.5 to 30 kg BW, ADG and G:F ratios (658, 690, 709, 712 g/kg; P<.01) responded quadratically to increasing dietary Lys. As the pigs matured, G:F ratios were lowered, averaging 891, 915, 891, 770, 746, 753, 753, 713, 682, 669 g/kg, respectively, during each of ten consecutive, 2.3 kg incremental increases in pig BW. Based on G:F ratios of pigs during each 4 day period, Lys diets of 1.74, 1.60, 1.46-1.60, 1.32-1.46 and 1.18- 1.32 %, respectively, optimized pig performance from BW of 6-12, 12-14, 14-19, 19-23, and 23-30 kg.

Key Words: Lysine, Late maturing strain, Pigs

M110 Effect of dietary electrolyte balance (dEB) and source in high synthetic amino acid nursery diets. A. M. Gaines[1], B. W. Ratiff[1], B. Hinson*[1], G. L. Allee[1], and J. L. Usry[2], [1]*University of Missouri*, *Columbia*, [2]*Ajinimoto Heartland LLC*, *Chicago, IL*.

A total of 951 (TR-4 × C22; 12.07 ± 0.21 kg) were used to evaluate the effect of dietary electrolyte balance (dEB, calculated as mEq/kg of diet for Na + K – Cl) and source in high synthetic amino acid nursery diets. Pigs were assigned to one of seven dietary treatments in a completely randomized design with 6 replicate pens/treatment. Treatments 1 to 5 consisted of diets with increasing dEB levels (216, 229, 243, 256, and 270 mEq/kg of diet, respectively) achieved through the addition of K as potassium chloride (KCl). To test the effect of dEB source, treatments 6 and 7 consisted of diets with dEB levels of 229 and 243 mEq/kg of diet, respectively achieved through addition of Na as sodium bicarbonate ($NaHCO_3$). All diets were corn soybean meal based (0.325% L-Lysine HCl) and formulated to be isocaloric (3.82 g TID lysine/Mcal ME). Both Na and Cl concentrations were held constant in all diets through alterations in sodium chloride (NaCl) or $NaHCO_3$ addition. Increasing dEB level through the addition of K did not improve ADG (Linear, $P < 0.90$; Quadratic, $P < 0.57$), ADFI (Linear, $P < 0.72$; Quadratic, $P < 0.08$) or G:F (Linear, $P < 0.77$; Quadratic, $P < 0.13$). Furthermore, increasing the dEB level through the addition of Na vs. K did not improve ADG ($P < 0.46$), ADFI ($P < 0.23$), or G:F ($P < 0.51$). These data indicate that growth performance of nursery pigs fed high levels of synthetic amino acids were not affected by dEB.

Key Words: Electrolytes, Pigs, Growth

M111 Efficacy of methionine hydroxy analog free acid relative to DL-methionine in growing pigs. F. O. Opapeju*[1], C. M. Nyachoti[1], M. Rademacher[2], and G. H. Crow[1], [1]*University of Manitoba*, *Winnipeg, MB, Canada*, [2]*Degussa AG*, *63457 Hanau-Wolfgang, Germany*.

A metabolism study was conducted to evaluate the effectiveness of methionine hydroxy analog free acid (MHA-FA, 88%) relative to DL-methionine (DLM, 99%) as a methionine source for pigs. Forty-two Cotswold barrows with an average initial BW of 9±0.52 kg (mean±SE) were obtained in two blocks of 21 pigs each. Pigs were randomly assigned from within block to 7 dietary treatments resulting in 7 replicate pigs per diet. Diet 1, basal diet (BD), was a corn-soybean meal diet and formulated to contain 15.54% CP and 0.21% methionine. Diets 2, 3 and 4 were BD supplemented with 0.034%, 0.068%, and 0.102% MHA-FA, respectively, on an equi-molar basis to the DLM. Diets 5, 6, and 7 were BD supplemented with 0.03%, 0.06%, and 0.09% DLM, respectively. The pigs were housed individually in metabolism crates that allowed for separate but total collection of urine and feces. Pigs had unlimited access to feed and water, and were allowed to adapt to the metabolism crates, feeding regimen and experimental diets for 7 d followed by quantitative collection of feces and urine over the subsequent 5 d. Urinary N (%) declined linearly with increasing supplementation of BD with DLM ($P = 0.003$) and MHA-FA ($P = 0.01$). There were quadratic ($P = 0.009$) and cubic ($P = 0.021$) effects of MHA-FA supplementation to BD on fecal N (%) output but no such effect was observed for DLM. There was a linear response in N retained (g/d) with increasing supplementation of BD with DLM ($P = 0.004$) and MHA-FA ($P = 0.025$). The results indicate that the supplementation of methionine deficient diet with either MHA-FA or DLM improved N retention. Determined with multiple linear regression analysis, the bioavailability of MHA-FA relative to DLM was estimated to be 65.8% (product to product comparison, wt/wt basis) or 74.8% (equi-molar basis) using N retention as a response criterion.

Key Words: DL-Methionine, Methionine hydroxy analog, Pigs

M112 Proteomic evaluation of brush border proteins in pig small intestine. X. Xiao, P. M. Williams, E. A. Wong, and K. E. Webb, Jr.*, *Virginia Tech*, *Blacksburg*.

Despite understanding much about intestinal function in pigs, factors governing intestinal development in pigs are poorly understood. A novel approach to studying intestinal development is the use of proteomics, which is the study of the complete set of translated proteins in a given biological sample. Piglets from each of seven sows were killed at birth (d 0) and during lactation (d 7 and 21). The jejunum was collected and the mucosa was gently scraped off with glass slides. Samples of the seven pigs from an age group were pooled and a brush border membrane (BBM) fraction was prepared and used in two-dimensional PAGE analysis. Triplicate proteome maps of BBM proteins from each age were constructed. A total of 733 individual protein spots were observed and densities of these were compared among the three age groups. Densities of 60 spots decreased three to 50-fold from d 0 to d 21. Density of 48 spots increased three to 114-fold from d 0 to d 21. Twenty six spots were observed at d 21 but not at d 0. To identify selected developmentally regulated proteins, 134 spots were excised from gels and identified by LC-MS/MS analysis. Most spots contained a single protein, but some contained more than one. Among the identified proteins, some were structural in function (i.e., beta actin, beta tubulin, and myosin), some were enzymes (i.e., lactase-phlorizin hydrolase, leucine aminopeptidase, neutral endopeptidase, sucrase isomaltase, and aminopeptidase N) and some had other functions (i.e., procadherin alpha 3, lactose binding protein, elongation factor Tu, calcium and integrin binding protein 1, and apolipoprotein A). Interestingly, there were seven forms of aminopeptidase N ranging in size from 40.2 to 112.3 kD. Three had the same MW of 112.3 but different pI (6.6, 6.7 and 8.3) suggesting differences in post translational modifications. Of particular interest was that there were at least 21 proteins, which are unnamed. Proteomic approaches to studying BBM development offer virtually unlimited discovery potential.

Key Words: Proteomics, Gene expression, Development

M113 Effect of probiotics supplementation on growth performance and intestinal microbiology in weaning pigs. H. J. Jung*, J. C. Park, Y. H. Kim, H. K. Moon, I. C. Kim, and S. J. Lee, *National Livestock Research Institute, RDA*, *Cheonan, Korea*.

This study was conducted to investigate the effects of probiotics on growth performance, hematological change and intestinal flora in weaning pigs. A total of 72 pigs (Landrace) with an average initial body weight of 6.79 ± 0.08 kg were used in this 6 week experiment. Pigs were allotted to three treatments (six replicates per treatment and four pigs per pen) according to a randomized complete block design. Dietary treatments were : 1) NC (negative control; basal diet), 2) PC (positive control diet; NC diet + 0.1% antibiotics, Avilamycin), 3) PRO (Control diet + 0.2% probiotics). During 0–2 weeks, ADG increased significantly in PRO treatment compared to NC and PC treatments ($P < 0.05$). In 3–6 weeks, ADG was increased slightly in PRO treatment without significant difference ($P > 0.05$). However, ADFI and gain/feed were not affected by treatments. Blood urea Nitrogen, albumin and total protein concentration of serum were not affected by pigs fed diets with probiotics ($P > 0.05$). In Lactobacilli concentration of intestine, pigs fed probiotics supplementation diets tended to be increase compare to the NC and PC diets ($P > 0.05$). Supplementation of probiotics in diet decreased E. Coli concentration ($P < 0.05$). In conclusion, dietary probiotics tended to increase growth performance, Lactobacilli concentration compared to the pigs fed the NC and PC diets.

Key Words: Probiotics, Growth performance, Weaning pigs

M114 Growth performance of pigs fed diets supplemented with an ammoniated formic acid (FA) solution. A. F. Harper*[1], M. J. Estienne[1], and H. Miettinen[2], [1]*Virginia Polytechnic Institute and State University*, *Blacksburg*, [2]*Kemira Oyj*, *Helsinki, Finland*.

Crossbred weanling pigs (n = 120, 19 ± 3 d of age) were used to assess the growth response to dietary inclusion of FA (62 % formic acid, 37 % ammonium formate). Based on weaning weight and ancestry, pigs were assigned to blocks consisting of three pens of five barrows each and three pens of five gilts each (four total blocks). Within block and sex, pens were randomly assigned to receive the following dietary treatments: 1) control diet during the nursery period (d 1 to 36) and control diet during the growing-finishing period, 2) control diet during the nursery period and 0.8 % FA during the growing-finishing period, or 3) 1 % FA during the nursery period and 0.8 % FA during the growing-finishing period. Thus, there were a total of four gilt pens and four barrow pens per treatment. Pigs were weighed off-study as intact blocks at approximately 116 kg BW. Diets were un-medicated and fed in two formulation phases during the nursery period and four formulation phases during the grower-finisher period. Feed and water were available ad libitum. Health of the pigs was excellent with no mortality and no pigs removed for veterinary reasons. During the nursery period there was no sex effect on ADG, ADFI or G:F ($P > 0.24$). There were no effects of diet on ADG or ADFI ($P > 0.13$), however, a trend ($P = 0.064$) for improved feed efficiency with FA was observed with control pigs having G:F of 0.627 ± 0.008 compared to 0.643 ± 0.008 for the FA-supplemented pigs. For the nursery and grower-finisher periods combined, barrows had greater ADFI and ADG than gilts ($P < 0.003$) with no difference in G:F ($P = 0.19$). There was no effect of dietary treatment on ADG, ADFI or G:F ($P > 0.51$) and no sex by diet interaction ($P > 0.63$). Under the conditions of this study, supplementing FA showed a trend for improved feed efficiency during the nursery period but did not influence overall performance from weaning to market weight.

Key Words: Pigs, Ammoniated formic acid, Growth

M115 Effect of inorganic acids on growth performance and health status in piglets. D. T. Liem[1], C. Lückstädt[2], and G. Schatzmayr*[3], [1]*University of Agriculture and Forestry*, *Ho Chi Minh City, Vietnam*, [2]*Biomin Deutschland GmbH*, *Zell u. A., Germany*, [3]*Biomin GmbH*, *Herzogenburg, Austria*.

At weaning pigs are exposed to physiological and environmental stress, which often results in reduced feed intake and little or no weight gain. During the last few decades, diets for weaning piglets have been boosted with various antibiotics in prophylactic doses against gastrointestinal disorders in order to obtain the economic benefits in terms of improved growth rates (4 to 15%) and feed efficiency (2 to 6%; Mroz, 2003). However, in recent years there has been growing public concern about the use of antibiotics in animal agriculture and the risk of developing cross-resistance of pathogens to antibiotics used in human therapy. This has prompted the pig industry to look for alternatives to antibiotic growth promoters that will give similar pig performance. The objective of this study was to evaluate the potential of inorganic acids as alternatives to antibiotic growth promoters (AGP′s) in nursery pig diets in order to see their the efficacy on BW, diarrhea and resistance to illness of piglets. The trial was conducted in a commercial pig farm in Vietnam. The aim of the trial was to test the acidifier Biotronic P (2 kg per t of feed) against a commercial piglet diet containing no acidifying additive. Feed and water were available ad libitum. 120 piglets (Yorkshire x Landrace x Duroc hybrid) at 25 d old were randomly selected and divided into 2 treatment groups. Piglets were housed in individual weaner cages (4 m x 3 m x 0.6 m) over a 28 d trial period. Performance data were measured on a weekly basis. Piglets in the treated group weighed 15.63 kg compared to 14.15 kg in the negative control group and the final BW and ADG of 43 day old piglets differed highly significantly ($p < 0.001$). The G:F was improved by 6% (0.69 and 0.65 for treatment and control respectively) and this increase was again statistically significant ($p < 0.05$). Finally, the daily diarrhea rate was improved and differed highly significantly at $p < 0.001$ (1.11% and 2.83% for treatment and control respectively). It can be concluded that the use of the inorganic acidifier Biotronic P improved significantly performance data and health status of treated piglets under Vietnamese conditions.

Key Words: Acidifier, Piglet growth, Diarrhea

M116 Impact of various dietary cereals on clinical response to *E. coli*. J. Buckingham[1], F. Ji*[2], P. J. Laski[2], and J. E. Pettigrew[2], [1]*QAF Meat Industries Pty Ltd.*, [2]*University of Illinois*, *Urbana*.

Two experiments were conducted to determine the impact of cereals on clinical response to *E. coli*. Pigs weaned at about 21 days of age were housed in disease containment chambers with 3 pigs/chamber and given ad libitum access to feed and water throughout the experiments. Rectal temperature (RT) and subjective fecal diarrhea score (DS, 5-point scale: 0 = normal; 1 = mild diarrhea; 2 = medium; 3 = severe; 4 = watery) were measured. A pathogenic *E. coli* (K88+) derived from a field outbreak was orally inoculated once after adaptation to the chambers at a dose of 2×10^9 CFU/pig, near the range shown in a preliminary experiment to produce mild clinical signs. In each experiment, 48 pigs were randomly allotted into 8 treatments in a 4 × 2 factorial arrangement, with 2 chambers of 3 pigs per treatment. Type of cereal (corn, barley, rolled oats, and rice) and *E. coli* challenge (yes or no) were the main factors. In Exp. 1, diarrhea due to *E. coli* occurred during the adaptation period, so the pigs were not given the challenge dose; RT was measured at 0 and 120 h and DS at 0, 24, 48, 72, 96, and 120 h from the start of measurements after the confirmation

of clinical signs. In Exp. 2, the same 4 cereal treatments were imposed; RT and DS were measured at 0, 24, 48, 72, 96, 120, 144, 168, and 192 h after challenge. In Exp. 1, the RT was not affected ($P = 0.45$) by cereals. Pigs fed corn had higher DS ($P < 0.01$) than others (1.81, 0.65, 1.17, 0.88, SEM = 0.22, for corn, barley, rolled oats, and rice, respectively). In Exp. 2, there were no differences among diets and no diet by challenge interactions, but there were complex interactions ($P < 0.01$) of challenge with time in both RT and DS and diet with time in RT. Overall values were for RT (mean = 39.68, SEM = 0.02) and DS (mean = 1.16, SEM = 0.06). The mild *E. coli* challenge did not affect RT but increased DS (0.91 vs. 1.41; $P < 0.01$). In summary, these results suggest that cereal may influence resistance to enteric disease, but further research is needed to evaluate this finding.

Key Words: Cereals, *E. coli* Challenge, Nursery pigs

M117 Efficacy of a mannan oligosaccharide and antimicrobial on the gastrointestinal microbiota of young pigs. J. C. Miguel*, P. J. Laski, and J. E. Pettigrew, *University of Illinois at Urbana-Champaign*, *Urbana*.

An experiment was conducted to evaluate the effects of a mannan oligosaccharide product (MOS) and antimicrobial (carbadox) on the gastrointestinal microbiota of young pigs. Twenty-four pigs were weaned at 21.2 d and 5.95 kg BW and randomly allocated to one of four dietary treatments arranged in a 2 x 2 factorial, with the factors being 0.2% MOS and 55 ppm carbadox. Twelve pigs, representing 3 pigs per treatment, were euthanized at either 7 or 21 d post-wean. Luminal contents and mucosal scrapings were collected from the pars esophagea, fundus, jejunum, ileum, proximal colon and distal colon for genomic DNA isolation. The variable region 3 (V3) of 16S rDNA was amplified by PCR and denaturing gradient gel electrophoresis (DGGE) was utilized to generate microbial profiles. An evaluation of the PCR-DGGE band numbers, with each band representing one or more microbial species, indicated there was a stronger effect of carbadox at 7 d post-wean seen as an increase ($P<0.05$) in the number of bands in the luminal contents of the proximal segments of the gastrointestinal tract. At 21 d post-wean, MOS had an opposite effect of decreasing ($P<0.05$) the number of bands in both the luminal contents and mucosa throughout the gastrointestinal tract. At both 7 and 21 d post-wean, the Sorenson's pairwise similarity coefficients (C_s), a measure of microbial diversity among samples according to PCR-DGGE banding patterns, revealed there was more similarity ($P<0.05$) in the gastrointestinal microbiota of pigs within compared to between diets indicating treatment-dependent alterations. Gastrointestinal microbiota analysis revealed that carbadox, in the absence or presence of MOS, made pigs more similar (higher C_s) to each other during the first 7 d post-wean. This same effect was not seen at 21 d post-wean, in that pigs fed MOS, in the absence or presence of carbadox, were more similar (higher C_s) to each other. These observations suggest that both MOS and carbadox alter microbiota in the gastrointestinal tract of young pigs.

Key Words: Pigs, Gastrointestinal microbiota, 16S rDNA PCR-DGGE

M118 Evaluation of three mannanoligosacchride products in swine nursery diets. H. Yang[1], T. Shipp*[2], J. Less[3], T. Radke[1], and M. Cecava[1], [1]*ADM Animal Nutrition*, *Quincy, IL*, [2]*ADM Animal Health and Nutrition*, *Quincy, IL*, [3]*ADM Specialty Feed Ingredients*, *Decatur, IL*.

Two 42-d studies were conducted to evaluate the effect of three mannanoligosacchride (MOS) products on nursery pig performance. Weanling pigs (n=180; BW=3.93 ± 0.20 kg in Exp1 and n=150; BW=4.66 ± 0.20 kg in Exp2) were blocked by initial BW to one of five dietary treatments (trt), with six pens per trt and five or six pigs per pen. Exp1 trts were: control (NC; no MOS); NC + commercial MOS (PC); and 0.2, 0.4, or 0.8% of test MOS (CitriStim). PC diets contained 0.2, 0.2, 0.1 and 0.1% commercial MOS for phase (P) 1-4, respectively. Exp2 trts were: control (C; no MOS); C+0.2 or 0.4% drum-dried MOS (DDM); and C+ either 0.2% spray-dried test MOS (CitriStim; CS) for all P (CS1) or 0.2, 0.2, 0.1 and 0.1% CS for P1-4, respectively (CS2). ADG, ADFI and G:F were measured at end of each P (d 7, 14, 28, and 42). Feeds were pelleted in P1 & P2 and meal thereafter, and all diets changed with phase. Exp1 ADG, ADFI and G:F were similar for NC and PC ($P > 0.13$). Increasing test MOS from 0.0 to 0.8% did not affect ADG or ADFI (data not shown; $P > 0.13$), but tended to cubically affect G:F (0.636, 0.648, 0.630, 0.636; $P = 0.13$), suggesting 0.2% test MOS as the optimal inclusion level. In Exp2, increasing DDM from 0.0 to 0.4% did not affect ADG or ADFI ($P > 0.10$), but tended to improve G:F (quadratic effect; $P = 0.09$). Statistical contrasts revealed that the mean ADG and ADFI ($P < 0.01$) and G:F ($P = 0.09$) of the pigs fed CS1 and CS2 were greater than for pigs fed no MOS, and were 1.69 kg heavier at the end of the study. In summary, test MOS improved performance of nursery pigs.

Table 1.

Exp2				CS			P value		
	Con	DDM		CS1	CS2		DDM		Con
% MOS	0.0	0.2	0.4	.2/.2/.2/.2	.2/.2/.1/.1	SE	Lin	Quad	v CS
ADG, g (d 0 to 42)	438	452	448	470	473	8	0.37	0.37	0.003
ADFI, g (d 0 to 42)	592	604	606	630	630	11	0.36	0.72	0.010
G:F (d 0 to 42)	0.740	0.749	0.740	0.747	0.751	0.004	0.99	0.09	0.093
End Weight, kg	22.89	23.59	23.46	24.47	24.68	0.38	0.30	0.38	0.002

Key Words: Pigs, Mannanoligosacchride, DFM

M119 Growth performance of nursery pigs fed different cereal grains on a commercial farm. V. G. Perez-Mendoza*[1], M. U. Steidinger[2], G. R. Hollis[1], and J. E. Pettigrew[1], [1]*University of Illinois*, *Urbana-Champaign*, [2]*Swine Nutrition Services Inc*, *Anchor, IL*.

Variation among cereal grains in carbohydrate composition may affect bacterial populations in the gut, which may in turn alter growth performance and resistance to enteric infection. This experiment was conducted on a commercial farm to test whether corn, barley, rolled oats, or rice as the main energy source in the diet for newly weaned pigs affects growth performance. The experiment was a RCBD; pigs were blocked by weight and room (3 wt categories and 4 rooms). Pens were experimental units with 21 pigs 20 d old; gender distribution always was equal within blocks. There were 12 replicates per treatment,

a total of 1008 pigs. There was a 4-stage feeding program with decreasing diet complexity: 1, 1, 2 and 2 wk per phase. Calculated ME value for all phases was 3.5 Mcal/kg; SID Lys was per phase: 1.45%, 1.45%, 1.30%, and 1.15%. Amounts of soybean meal and soybean oil were varied to meet the ME and SID Lys targets. Diets for phases 1 and 2 were in mini-pellet form; those for phases 3 and 4 were in meal form. The rice diets were low in fat and difficult to pellet, and may have been heat-damaged. During the first week pigs fed corn or rolled oats ate more and grew faster (Table). Over the 6-wk period, pigs fed rice or corn grew fastest. Gain:Feed ratio was not different among treatments (P>0.20). Pigs removed, including mortality, was lowest (3.6%) for barley and rice. These results show significant differences among dietary cereals, with rice and corn supporting the fastest growth under these conditions.

Table 1. Growth performance of nursery pigs fed different cereal grains

	Corn	Barley	Rolled oats	Rice	SEM
ADG, wk 1, g	124.7 [a]	102.1 [b]	116.5 [a]	98.2 [b]	5.0
ADFI, wk 1, g	145.5 [a]	126.7 [b]	139.4 [a]	120.2 [b]	4.1
ADG, overall, g	330.5 [ab]	307.0 [c]	322.7 [b]	336.7 [a]	4.6
ADFI, overall, g	495.2 [a]	462.0 [b]	488.6 [a]	503.6 [a]	7.9
Pig removals, %	7.1 [ab]	3.6 [b]	8.3 [a]	3.6 [b]	1.5

[abc] Means within a row without a common superscript differ (P < 0.05)

Key Words: Cereals, Weaned pig, Growth performance

M120 Glycemic index in young pigs fed rice or corn either raw or cooked. B. Vicente, D. G. Valencia, J. M. González, D. Menoyo, R. Lázaro, and G. G. Mateos*, *Universidad Politécnica de Madrid*, *Spain*.

The glycemic index (GI) is useful to rank carbohydrates in humans according to their postprandial blood glucose responses. A low GI of a meal indicates a high level of satiety. Starch structure, heat processing of the cereal (HP), and degree of starch gelatinization (SG) have been shown to affect GI values of cereals in humans but no data is available for pigs. We conducted a trial to study the influence of cereal source, HP of the cereal, and degree of SG of rice on the GI in young pigs. There were four experimental diets and seven replicates (individual pig) per diet. The control diet was a complex diet that included fish meal, soybean meal, and 50% raw corn. The experimental diets were similar to the control diet but the raw corn was substituted by HP corn, raw rice, or HP rice. The percentage of SG was 15% for raw corn, 83.6% for HP corn, 15% for raw rice, and 63.7% for HP rice. Predicted GI of the experimental diets was determined using the International Tables of GI values (2002) and was higher for piglets fed rice than for piglets fed corn. Also, the predicted GI of the cereals increased with HP. The GI was determined *in vivo* at 33 d and 49 d of age using glucose as reference food. Piglets were fasted for 12 h and then, they were fed their experimental meals that contained approximately 50g of available carbohydrates. Pigs were sampled (capillary blood) at 0, 20, 60, 120, and 180 min after feeding to obtain the glucose curves. The GI was calculated by expressing the incremental blood glucose area in the test sample as a percentage of the corresponding area from a reference standard food. GI was higher for pigs fed rice than for pigs fed corn (48.1 vs. 43.3%; P<0.001). Heat processing of the cereal also increases GI values (51.2 vs. 40.2%; P<0.001). Results of this study indicate that rice feeding increases the GI with respect to corn feeding and that HP of the cereal also increases the GI. These data might explain, at least in a part, the increase in feed intake observed when rice is fed to piglets in substitution of corn.

Key Words: Rice, Glycemic index, Starch gelatinization

M121 Development of a model to determine preferences for feed ingredients in young pigs. E. van Heugten*[1], K. Ange-van Heugten[1], W. Zhang[1], and E. Roura[2], [1]*North Carolina State University*, *Raleigh*, [2]*Lucta SA*, *Barcelona, Spain*.

The objective of this study was to develop a model in young pigs to evaluate preferences for feed ingredients. Twenty-two pigs (BW = 8.33 ± 0.10 kg) were adjusted to solid feed (corn-soybean meal based) for 21 d and subsequently housed one pig per pen. Each pen contained two identical feeders, positioned side-by-side. During the first four d, pigs were offered one of two complete diets with either corn or rice as the major grain source (60% of the diet) in both feeders. Diets were identical with the exception of grain source and grains were ground through the same screen. Thus, pigs were not offered a choice and this period served to determine potential side preferences (i.e., the left versus the right feeder) and to determine whether previous exposure to grains had an effect on subsequent preference when offered a choice. Following this initial period, pigs were offered the rice-based diet (Rice) in one feeder and the corn-based diet (Corn) in the other feeder. Pigs were allowed to consume feed freely from either feeder for 72 h and feed disappearance was measured every 24 h. Pigs consumed 249 g/d from the left feeder and 329 g/d from the right feeder (P = 0.22) during the four-day period when no choice was offered. Total consumption of Rice (556 g/d) was not different (P = 0.34) from Corn (600 g/d) during the pretest period. When offered a choice, pigs clearly preferred Rice compared to Corn on d 1 (489 vs. 248 g/d; P = 0.02), d 2 (589 vs. 155 g/d; P < 0.001), d 3 (680 vs. 132 g/d; P < 0.001), and overall (586 vs. 178 g/d; P < 0.001). Preference was impacted by prior exposure only on d 1 (P = 0.02). Pigs previously exposed to Corn highly preferred Rice (623 vs. 159 g/d; P < 0.001), but pigs previously exposed to Rice did not demonstrate a preference (336 vs. 355 g/d; P = 0.75). Results of this study demonstrate that prior exposure will impact preferences briefly and that two d is adequate for determining preferences for ingredients and flavors in future studies.

Key Words: Pigs, Preference, Feedstuffs

M122 Effects of diet type and an artificial high intensity sweetener (SUCRAM®) on weaned piglet performances. P. Schlegel*[1] and R. Hall[2], [1]*Pancosma S.A.*, *Le Grand-Saconnex, Geneva, Switzerland*, [2]*Cooperative Research Farms*, *Richmond, VA*.

Three hundred sixty crossbred (PIC; Cambrough 22 X 337 and Primer combination) 18-d old weaned piglets, were blocked on the basis of initial BW and gender and allotted to 36 pens in a randomized complete-block design. The 2x3 factorial arranged treatments consisted of three types of diets (iso-energetic, iso-lysine iso-vitamin and iso-mineral) varying in their formulation complexity for feeding phase 1 (d 0 to 11) and 2 (d 11 to 25) and in the inclusion or not of a sweetener SUC (SUCRAM®; Pancosma S.A.) for feeding phases 1 through 3 (d 0 to 46). Diet complexity (High, Medium, Low) was varied by modifying levels of dried whey, cheese by-products, fish meal, spray-dried porcine plasma and dried red blood cells. Medium was considered as representative to common U.S. nursery formulations.

SUC was included in phases 1 to 3 at 500, 250 and 130 g/ton FM respectively. All diets were fed ad-libitum. Diet complexity effect: ADFI and ADG were increased ($p<0.001$) using High compared to Medium and Low during phase 1, 2 and overall (769 vs. 690 and 710 g/d, respectively for overall ADFI and 540 vs. 486 and 501 g/d respectively for overall ADG). SUC effect: ADFI and ADG were increased ($p<0.05$) using SUC during phase 2 (ADFI by + 7.6% and ADG by + 8.9%), 3 (ADFI by + 4.2% and ADG by + 6.1%) and overall (ADFI by + 3.7% and ADG by + 5.5%). Overall FCR was improved ($p<0.01$) using SUC by -1.6% (1.429 vs. 1.406). Diet complexity*SUC effect: No interactions ($p>0.05$) between the two factors were observed for ADFI, ADG or FCR during any feeding phase nor overall. Finally, the improved ADFI and ADG of High and SUC were independent from each other. Sweetening the piglet diets with SUCRAM® permitted to improve feed intake, weight gain and feed conversion ratio for the whole post-weaning period.

Key Words: Piglet, Sweetener, Diet

M123 Adding a milky flavor in drinking water and an enhanced milky flavor in feed improves piglet growth compared to the use of no flavor or a sweetener. E. Roura*[1], J. Coma[2], and D. Torrallardona[3], [1]*Lucta SA*, *Barcelona, Spain*, [2]*Vall Companys*, *Lleida, Spain*, [3]*IRTA, Centre Mas Bové*, *Reus, Spain*.

The effects of adding a high intensity sweetener (HIS) to feed and of the combination of adding a milky flavor (MF) in drinking water and in feed on the performance of weanling pigs were investigated. One hundred and twenty newly weaned 26 d-old pigs (Landrace x Pietrain) in 24 pens of 5 animals each were used. The animals were offered free access to 4 experimental diets consisting of a basal diet (T-1) and the same diet with three different flavour preparations: HIS (T-2), MF (T-3) and the same MF enhanced with an orosensorial supplement (T-4). The composition of the basal diet changed from a pre-starter to a starter specification on day 13 of trial. Additionally, the animals from each experimental treatment had free access to different water supplies that in the case of treatments T-3 and T-4 contained the same MF up to d 22 of trial. For the first 4 d after weaning the animals on T-4 had a higher ($P<0.05$) ADFI than those on T-2 (90 vs 41 g/d). For the whole pre-starter phase, the animals on T-3 and T-4 also had a better ($P<0.05$) G:F ratio than those on T-2 (0.484 and 0.532 vs 0.303 g/g, respectively). During the starter phase, the animals on T-2 and T-4 had a higher ($P<0.05$) ADFI than those on T-3 (698 and 682 vs 586 g/d, respectively). Overall the 28 day trial, the animals on T-4 had a higher ($P<0.05$) ADFI than those on T-3 (463 vs. 394 g/d) while T-1 and T-2 were intermediate (435 and 449 g/d). Final average body weights at the end of the trial were 17.43, 16.79, 16.65 and 16.06 kg for animals on T-4, T-2, T-1 and T-3 respectively. It is concluded that, treatment with a HIS may reduce ADFI during the pre-starter phase. The addition of a milky flavour in the drinking water after weaning together with an enhanced milky flavour in the feed improved ADFI and G:F in the pre-starter phase as well as ADFI in the overall experiment resulting in apparently heavier piglets.

Key Words: Feed and water intake, Piglet weaning, Flavor

M124 The use of an enhanced milky flavor but not of standard flavors in feed improves growth of pigs at weaning compared to a non-flavored control feed. E. Roura*[1], L. Levrouw[2], D. Solà-Oriol[3], and D. Torrallardona[3], [1]*Lucta SA*, *Barcelona, Spain*, [2]*DSM, Nutritional Products NV*, *Belgium*, [3]*IRTA, Centre Mas Bové*, *Reus, Spain*.

The effect of adding an enhanced milky flavor to a post-weaning feeding program combined with a standard milky flavor in drinking water on piglet performance was investigated. Ninety-six newly weaned 26 d-old pigs (Landrace x Pietrain), in 24 pens of 4 animals each, were used. The animals were offered free access to 4 diets consisting of a basal diet (T-1) and the same diet with three different flavor preparations: red fruit (T-2), standard milky (T-3) and milky flavor enhanced with an orosensorial supplement (T-4). The composition of the basal diet changed from a pre-starter to a starter formula at d 13 of trial. Additionally, the animals from each experimental treatment had free access to different water supplies that in the case of treatments T-3 and T-4 contained a milky flavour for the first 13 d of trial. During the pre-starter phase, the animals on T-4 grew faster ($P<0.05$) than those on T-1 and T-2 (145 vs. 104 and 97 g/d, respectively) although not significantly different from T-3 (108 g/d). Despite not being significantly different ($P>0.05$), the animals on T-4 maintained the highest ADG during the starter phase and throughout the whole experimental period. Thus, at the end of the trial (28 d), piglets on T-4 achieved an ADG of 300 g/d, which was 10.7%, 17.6% and 12.3% higher than T-1, T-2 and T-3, respectively. It is concluded that the addition of a milky flavour in the drinking water after weaning together with a milky enhanced flavour in the pre-starter and starter feeds improves performance of weanling pigs. The enhancement of a standard milky flavor with an orosensorial supplement was highly effective particularly during the pre-starter phase.

Key Words: Feed and water intake, Piglet weaning, Flavor

M125 Effects of dietary delta-aminolevulinic acid and chitooligosaccharide on growth performance, nutrient digestibility and hematological characteristics in weanling pigs. Y. J. Chen*[1], B. J. Min[1], J. H. Cho[1], H. J. Kim[1], J. S. Yoo[1], J. D. Kim[3], D. K. Kang[1], H. R. Kim[2], and I. H. Kim[1], [1]*Dankook University*, *Cheonan, Chungnam, Korea*, [2]*Pukyong*, *Busan, Korea*, [3]*CJ Feed Co.*, *Incheon, Korea*.

The influence of feeding delta-aminolevulinic acid (ALA) and chitooligosaccharide (COS) on growth performance, nutrient digestibility and hematological characteristics in weanling pigs was investigated in a 5 wk experiment. A total of 105 pigs (BW of 4.94±0.73 kg) were allotted to seven dietary treatments in three replications (five pigs per pen) in a randomized complete block design. Pigs were fed diets in two phases corresponding to wk 0-2 and 3-5 with all nutrients met or exceeded NRC (1998) recommendations. Seven experimental diets were formulated as follow: 1) NC (Control diet), 2) PC (NC + antibiotic 0.1%; Chlortetracycline+Sulfathiazole+Penicillin), 3) ALA (NC + ALA 3 ppm), 4) COS (NC + COS 0.1%), 5) AC1 (NC + ALA 1 ppm and COS 0.1%), 6) AC2 (NC + ALA 3 ppm and COS 0.3%) and 7) AC3 (NC + ALA 5 ppm and COS 0.5%). Feed and water were provided ad libitum during all experimental period. No effects were observed in ADG and ADFI during wk 0-2, 3-5 and all experimental periods ($P>0.05$). The G:F was improved in ALA and AC3 treatments compared with NC and AC1 treatments over the entire experimental period ($P<0.05$). DM digestibility was higher in AC3 treatment than

NC and AC1 treatments ($P<0.05$). N digestibility was higher in both PC and AC3 treatments compared with NC and AC1 treatments ($P<0.05$). The RBC count was increased in ALA treatment compared with NC treatments ($P<0.05$). Hemoglobin in AC2 treatment was higher than NC treatment ($P<0.05$). Lymphocyte, WBC, IgG and total iron binding capacity were not affected among all treatments ($P<0.05$). The reduction of total protein was higher in NC treatment than PC, ALA, COS and AC3 treatments ($P<0.05$). Iron concentration was higher in ALA and all of the AC treatments than NC treatment ($P<0.05$). In conclusion, supplementation of 3 ppm ALA or 5 ppm ALA with 0.5% COS may have beneficial effects on weanling pig.

Key Words: Delta-Aminolevulinic acid, Chitooligosaccharide, Weanling pigs

M126 Dietary supplementation with the Chinese herb improves growth performance and tissue integrity in weanling piglets. F. G. Yin[1], X. F. Kong[1], Y. L. Yin*[1], H. J. Liu[1], Y. P. Liao[1], and G. Y. Wu[1,2], [1]*Institute of Subtropical Agriculture, The Chinese Academy of Sciences*, *Changsha, Hunan, P.R. China*, [2]*Texas A&M University*, *College Station*.

The experiment was conducted to determine the effects of dietary supplementation with the Chinese herb on growth performance, diarrhea incidents, serum biochemical parameters, and tissue integrity in weanling piglets. Sixty pigs were weaned at 21 days of age, housed individually and assigned randomly into one of three treatment groups (20 pigs/group), representing the corn- and soybean meal-based diets supplemented with 0 (control) or 0.2% Chinese herb or 0.02% Colistin (an antibiotic). The genus and species of the herbs used in the study were *Astragalus membranaceus (Fisch.) Bge.var.mongholicus (Bge) hsiao; Acanthopanax senticosus (Rupr. Et Maxim) Harms; Codonopsis pilosula (Franch.) Nann.; Crataegus pinnatifida Bge.; and Salvia miltiorrhiza Bge.* Pigs had free access to diets and drinking water. Feed intake and BW were measured weekly. Blood samples were obtained randomly from 5 piglets of each treatment group at wks 1, 2, 3, and 4 post-weaning. Results indicated that dietary supplementation with the Chinese herb for 4 wks increased ($P < 0.05$) ADG by 18.8% (432.1 vs 363.8 g), did not affect ($P > 0.05$) F:G (1.57 vs 1.62), and reduced ($P < 0.05$) diarrhea incidence by 40% in piglets, when compared with the control group. Dietary supplementation with Colistin did not affect ($P > 0.05$) ADG (385.9 vs 363.8 g)and had no effect ($P > 0.05$) on F:G (1.67 vs 1.62). At wk 1, serum concentrations of triglycerides in the herb-supplemented piglets were lower ($P < 0.05$) than those in the control group. At wk 2, the activity of serum creatine kinase (an indicator of tissue integrity) was lower ($P < 0.05$) in the herb-supplemented piglets in comparison with the other two groups. At wk 4, the activity of stomach amylase in the herb-supplemented piglets was higher ($P < 0.05$) than in the control and Colistin-supplemented piglets. These findings suggest that the Chinese herbal formula is a highly effective and safe feed additive for improving growth performance, preventing diarrhea, and protecting tissue integrity in weanling piglets. Supported by funds from the Chinese Academy of Sciences and China NSF.

Key Words: Growth performance, Chinese herb, Pigs

Physiology and Endocrinology: Estrous Synchronization

M127 Post-AI interventions in lactating dairy cattle. I. Ovarian responses to GnRH, hCG, and exogenous progesterone (CIDR). J. S. Stevenson*, D. E. Tenhouse, M. A. Portaluppi, and A. Lloyd, *Kansas State University*, *Manhattan*.

We hypothesized that increasing concentrations of progesterone (P4) after AI would increase fertility. Our objective was to assess changes in ovarian structures and ovulation rate in response to GnRH, hCG, or exogenous progesterone (CIDR insert) beginning 4 to 8 d after AI (d 0) and again 7 d later (d 7). Blood was collected from 749 cows in 3 herds on d 0 and 7. Ovaries of 161 cows were scanned for the presence of early diestrous corpus luteum (CL). Once confirmed, cows were assigned randomly to serve as controls (CON) or receive a CIDR insert for 7 d, 100 μg of GnRH, or 3,300 IU of hCG. Ovarian structures were scanned and mapped before treatment and on d 7. More ($P < 0.01$) cows were induced to ovulate in response to GnRH and hCG. Diameter of follicles that ovulated did not differ (13.8 ± 0.5; n = 70 vs. 12.7 ± 0.4; n = 78), respectively, for GnRH and hCG cows. Compared with CON, cows treated with GnRH or hCG had fewer ($P < 0.01$) follicles ≥ 5 mm on d 7 than d 0, more ($P < 0.01$) induced CL (d 7), and more ($P < 0.01$) total CL (d 7), but serum P4 was only increased ($P < 0.01$) after hCG. Largest follicle diameter on d 7 were less ($P < 0.05$) after GnRH and hCG, but total follicular volume on d 7 (data not shown) was reduced ($P < 0.05$) by GnRH, hCG, and CIDR compared with CON. Volume of the original luteal structures were increased ($P < 0.05$) by hCG, but tended ($P = 0.07$) to be reduced by CIDR and GnRH compared with CON. Total CL volume was increased ($P < 0.05$) by hCG, but reduced ($P < 0.05$) by CIDR compared with CON. We concluded that GnRH and hCG effectively induced ovulation, increased number of CL (not total CL volume after GnRH), but only increased serum P4 in hCG-treated cows.

Table 1.

Trait	CON	CIDR	GnRH	hCG
Ind. ov., %	4.9 (41)	4.9 (41)	60** (40)	77.5** (40)
Ind. CL/cow (d 7), no.	0.1 ± 0.1 (41)	0.1 ± 0.1 (41)	0.7* ± 0.1 (40)	1.1* ± 0.1 (41)
Incr. P4 (d 0-7), ng/mL	2.5 ± 0.2 (190)	2.2 ± 0.2 (179)	2.3 ± 0.2 (193)	3.7* ± 0.2 (187)
Change in orig. CL vol., mm^3	3131 ± 619 (55)	1350$^+$ ± 662 (50)	1446$^+$ ± 652 (50)	4766* ± 640 (52)
Follicle diam. (d 7), mm	14.3 ± 0.7 (41)	13.2 ± 0.8 (40)	11.6* ± 0.8 (36)	11.0** ± 0.7 (38)
Total CL vol. (d 7), mm^3	12,298 ± 1106 (41)	8,008** ± 1101 (41)	12,373 ± 1117 (40)	18,410** ± 1108 (40)

Different ($^+P = 0.07$; $*P < 0.05$; $**P < 0.01$) from control.

Key Words: hCG, GnRH, Luteal capacity