

calculated using an indigestible marker. Broilers fed the L diet to 90 hr were better able to handle a deficiency in P in the grower/finisher phase (22 to 38 d of age) than those fed a C diet in the first 90 hr. Not only were the broilers fed the L diet early heavier ( $P < 0.05$ ) at 38 d of age (2275.6 vs 2235.4 g for the L-C-L and the C-C-L Trt, respectively), but they had better feed efficiency (1.76 vs 1.89 in the L-C-L and C-C-L Trt, respectively), had higher tibia ash and higher P retention (56.54 vs 45.39% for the L-C-L and C-C-L Trt, respectively) than those fed the C diet in the first 90 hr of life. This clearly establishes that “imprinting” or permanent modifications are occurring post-hatch that are long term and allow for improved P utilization when P deficient diets are fed in the grower/finisher phases.

**Key Words:** Phosphorus, Conditioning, Imprinting

**M218 Calcium and available phosphorus levels at 2:1 ratio for growing broiler chickens.** S. Bunzen, H. S. Rostagno\*, L. F. T. Albino, L. R. Nery, and C. R. Silva, *Viçosa Federal University, Viçosa, MG, Brazil.*

The reduction of phosphorus (P) levels in broiler chickens diets will certainly help to decrease costs and P excretion with reduced effect on the environment. There are many interrelationships between calcium (Ca) and P suggesting that nutritional studies should be run evaluating Ca:available P (aP) levels at a constant ratio of 2:1. A study was carried out with the objective of determining the best %Ca:%aP level for broiler chickens from 22 to 35 days of age. A floor pen trial with 1,440 broilers (Cobb 500; 720 males and 720 females) was conducted using a completely randomized block design, in a 2 x 6 factorial arrangement (Gender x 6 %Ca:%aP levels) with eight replicates and 15 birds per experimental unit (pen). The experimental diets were based on corn (0.03% Ca / 0.08% aP) and soybean meal (0.24% Ca / 0.18% aP), supplemented with dicalcium phosphate (24.5% Ca / 18.5% aP) and limestone (38.4% Ca) to obtain 6 %Ca:%aP levels (0.40 / 0.20, 0.50 / 0.25, 0.60 / 0.30, 0.70 / 0.35, 0.80 / 0.40 and 0.90 / 0.45). Weight gain, feed consumption, feed conversion and bone (tibia) parameters (ash, Ca and P from three birds per pen) were evaluated. Feed consumption was not affected ( $P > 0.05$ ) by the experimental treatments. Weight gain improved linearly ( $P < 0.05$ ) to the dietary Ca:aP levels (gain males =  $1095.26 + 102.286 \text{ aP}$ ;  $R^2 = 0.64$ , and gain females =  $895.90 + 153.143 \text{ aP}$ ;  $R^2 = 0.57$ ) with an improvement of 36 g/male and 44 g/female (highest - lowest gain). Feed conversion of males and females broilers showed a quadratic response ( $P < 0.05$ ) described by the equations;  $Y = 1.86068 - 0.675337 \text{ aP} + 0.85 \text{ aP}^2$  ( $R^2 = 0.87$ ) for males, and  $Y =$

$1.99459 - 1.44471 \text{ aP} + 2.01429 \text{ aP}^2$  ( $R^2 = 0.75$ ) for females. Based on feed conversion and using a 95% confidence limit, the recommended levels are: 0.377% aP / 0.754% Ca for broiler males and 0.341% aP / 0.682% Ca for broiler females.

**Key Words:** Available Phosphorus, Broilers, Calcium

**M219 The effects of Quantum™ phytase on broiler chick live performance and tibia ash percentage.** M. E. Persia\* and M. R. Bedford, *Syngenta Animal Nutrition, RTP, NC.*

Chick tibia ash percentage (TAP) is a sensitive measure of the phosphorus adequacy of poultry diets. Three experiments were conducted to determine the effects of two doses of Quantum™ phytase (QP) on TAP and live performance of chickens fed reduced nonphytate phosphorus (NPP) diets. Four experimental diets were utilized including a positive control diet (PC) that met or exceeded all NRC (1994) recommendations, a negative control diet (NC) similar to the PC but deficient in NPP (0.20% NPP) and the same NC diet supplemented with either 250 or 500 FTU of QP/kg (250 and 500, respectively). In all experiments, 12 blocks of either 6 or 12 Cobb x Cobb broiler chicks were assigned to each of the four treatments utilizing a randomized complete block design. Chicks were raised on experimental diets from 0 to 21 d in Petersime battery pens located in an environmentally controlled room. Weight gain and feed intake were recorded for the 21 d period. At the conclusion of the experiment, chicks were sacrificed and the right tibia was collected from four chicks per replicate group for fat-free TAP determination. Data were analyzed using ANOVA and means separated using specific pre-planned contrasts. Over all experiments, chick weight gain and feed intake was reduced 162 and 171g, respectively, when birds were fed the NC compared with PC rations. Phytase supplementation significantly increased weight gain and feed intake of the NC ration, resulting in overall increases of 95 and 128 g for weight gain and 96 and 137 for feed intake with 250 and 500 FTU/kg, respectively. Tibia ash percent was reduced by 8.3, 8.9 and 7.6% units between the NC and PC fed chickens in experiments 1, 2 and 3, respectively. Supplementation of the NC ration with 250 and 500 FTU/kg significantly increased TAP restoring 2.9, 2.3 and 2.7% units and 4.9, 4.3 and 4.8% units, respectively. These data demonstrate the consistent ability of QP to liberate P and increase weight gain, feed intake and TAP of chicks fed NPP deficient diets.

**Key Words:** Tibia ash, Phytase, Broiler

## Nonruminant Nutrition: Weanling Pig Nutrition and Physiology

**M220 Dietary nucleotides supplementation improves growth performance of early weaned pigs.** D. Martinez-Puig\*<sup>1</sup>, J. Morales<sup>2</sup>, E. Borda<sup>1</sup>, C. Piñeiro<sup>2</sup>, and C. Chetrit<sup>1</sup>, <sup>1</sup>*Bioiberica S.A., Palafolls, Barcelona, Spain,* <sup>2</sup>*PigChamp Pro-Europa, Segovia, Spain.*

In the weaning period, transition from sow's milk to the postweaning diet causes the withdrawal of milk nucleotides. Dietary nucleotide are known to be important for the maturation of the gastrointestinal tract and in the development of immune function (Carver et al., 1991). The objective of the present experiment was to study the effect of dietary supplementation of a nucleotide preparation (Nucleoforce Piglets™) on the productive performance of early weaned pigs. 192 suckling

piglets of 14 days of age were distributed into two treatments according to the litter and fed with two creep feed diets, one supplemented with the nucleotide preparation (1000 ppm) and the other no supplemented. Piglets were weaned at 21 days of age and consumed the experimental diets till day 35. From day 35 until day 56 all piglets were fed with the same diet. Performance was determined on days 21, 28, 35 and 56. Mortality and faecal consistency were also assessed. During the prestarter period (21 to 35 d), the average daily gain of pigs fed the nucleotide preparation was numerically higher (76.7 g/d;  $P = 0.12$ ) than that of the pigs fed the control diet (53.5 g/d), although no differences were detected on the feed conversion ratio. During the starter period (35-56d), the nucleotide supplementation significantly improved

average daily gain by 20% ( $P=0.02$ ) and numerically improved feed conversion ratio by 23.7% ( $P=0.14$ ). There were no significant effects on mortality and faecal consistency, but were numerically better on the nucleotide supplemented group. The overall results suggest that dietary nucleotide supplementation at 1000 ppm significantly improves the performance of early weaned pigs.

**Key Words:** Dietary Nucleotides, Productive Performance, Weaning Pigs

**M221 The effect of soybean oil, tallow and coconut oil supplementation on growth performance, serum lipid changes and nutrient digestibility in weaned pigs.** J. H. Cho<sup>\*1</sup>, H. J. Kim<sup>1</sup>, Y. J. Chen<sup>1</sup>, J. S. Yoo<sup>1</sup>, B. J. Min<sup>1</sup>, J. D. Kim<sup>2</sup>, and I. H. Kim<sup>1</sup>, <sup>1</sup>*Dankook Univ, Cheonan, Choong nam, Korea*, <sup>2</sup>*CJ Feed Co. Ltd, Incheon, gyeong gi, Korea*.

This experiment was conducted to determine the effect of soybean oil, tallow and coconut oil supplementation on growth performance, serum lipid changes and nutrient digestibility in weaned pigs. One hundred twenty cross-bred [(Yorkshire×Landrace)×Duroc, 6.92±0.01kg average initial BW] were used in a 35 d growth trial. Dietary treatments included CON (5% soybean oil), T0.5 (4.5% soybean oil + 0.5% tallow), C0.5 (4.5% soybean oil + 0.5% coconut oil) and C1.0 (4.0% soybean oil + 1.0% coconut oil). For the whole period and from d 14 to 35, G/F was increased in C0.5 and C1.0 treatments compared with T0.5 treatment ( $P<0.05$ ). ADG and ADFI were not affected by treatments. On d 14, C1.0 treatment was higher in serum HDL-cholesterol than C0.5 treatment and atherogenic index was increased in C0.5 treatment compared to T0.5 and C1.0 treatments ( $P<0.05$ ). Digestibility of fat was improved for pigs fed C1.0 diet compared with those fed T0.5 diet on d 35 ( $P<0.05$ ). However, there were no significant differences in digestibilities of DM, N and DE. In conclusion, feeding diets containing soybean and coconut oils in weaned pigs increased feed efficiency and fat digestibility than feeding those containing soybean oil and tallow.

**Key Words:** Coconut Oil, Tallow, Weaned Pigs

**M222 Dietary supplementation with *atractylis macrocephala koidz* polysaccharides enhances growth performance in weaned pigs.** Z. Bin<sup>\*1</sup>, L. L. Li<sup>2</sup>, Y. L. Yin<sup>2</sup>, H. Z. Peng<sup>1</sup>, K. M. Yang<sup>3</sup>, T. J. Li<sup>2</sup>, Z. P. Hou<sup>2</sup>, P. Zhang<sup>2</sup>, and G. Y. Wu<sup>1,4</sup>, <sup>1</sup>*Hunan Agricultural University, Changsha, Hunan, China*, <sup>2</sup>*Institute of Subtropical Agriculture, The Chinese Academy of Sciences, Changsha, Hunan, China*, <sup>3</sup>*Hunan Zhenghong Science and Technology Co., Changsha, Hunan, China*, <sup>4</sup>*Texas A&M University, College Station*.

This study was conducted to evaluate the effects of *atractylis macrocephala koidz* polysaccharides (AP) on growth performance in weaned piglets. A total of 120 piglets (Landrace x Yorkshire) weaned at 28 d of age (average BW of 7.5 kg) were assigned randomly to 1 of the 5 treatment groups, with 3 replicates and 8 pigs per replicate. The treatments represented dietary supplementation with 0% (control), 0.3%, 0.6% or 0.9% AP, or 0.02% aureomycin (an antibiotic) to corn- and soybean meal-based diet. All pigs had free access to their diets and drinking water. In the first 14-d (28 to 42 d of age) and second 14-d (42 to 56 d of age) phases, dietary supplementation with all dosages of AP did not affect ( $P>0.05$ ) feed intake but with 0.6% AP increased

( $P<0.05$ ) ADG by 7.6% and 18.5%, respectively, compared with the control pigs. In the second phase, the gain:feed ratio was 14.0% higher ( $P<0.01$ ) in pigs supplemented with 0.6% AP, and the value was 7.4% higher ( $P<0.05$ ) in piglets supplemented with 0.9% AP, compared with the control and antibiotic-supplemented pigs. In both phases, growth performance did not differ ( $P>0.05$ ) statistically among pigs supplemented with the 3 dosages of AP. These results indicate that dietary supplementation with 0.6% AP resulted in a most favorable effect on growth performance in weaned piglets. We suggest that AP is an effective alternative to a feed antibiotic for post-weaning growing swine. (Supported by NSFC, CAS, and Hunan Natural Science and Technology Foundation)

**Key Words:** Polysaccharides, Herbs, Weaned Pigs

**M223 Dietary supplementation with Chinese herbal formula affects serum concentrations of amino acids in weaned pigs.** X. F. Kong<sup>\*1</sup>, Y. L. Yin<sup>1</sup>, F. G. Yin<sup>1</sup>, H. J. Liu<sup>1</sup>, F. F. Xing<sup>1</sup>, T. J. Li<sup>1</sup>, R. L. Huang<sup>1</sup>, and G. Y. Wu<sup>1,2</sup>, <sup>1</sup>*Institute of Subtropical Agriculture, The Chinese Academy of Sciences, Changsha, Hunan, China*, <sup>2</sup>*Texas A&M University, College Station*.

This experiment was conducted to determine the effects of dietary supplementation with Chinese herbal formula (CHF) on serum concentration of amino acids (AA) in weaned pigs. Sixty piglets weaned at 21 d of age were randomly assigned to one of the three treatment groups, representing supplementation with 0 (control) or 0.2% CHF, or 0.02% colistin (an antibiotic) to a corn- and soybean meal-based diet ( $n = 20$  pigs/group). On d 7, 14, and 28 after initiation of CHF supplementation, venous blood samples were obtained for the analysis of serum protein and AA using an Auto-Blood Biochemical Analyzer and an Auto-AA Analyzer, respectively. The results indicated that dietary supplementation with CHF increased ( $P < 0.05$ ) serum concentrations of total protein and albumin as well as ADG, compared with the other two groups of pigs. On d 7, serum concentrations of Phe were higher ( $P<0.05$ ), but serum concentrations of Ala, Pro, Lys, Arg, Met, branched-chain AA, aromatic AA, and total AA were lower ( $P<0.05$ ) in CHF-supplemented piglets than in the other two groups of pigs. On d 14, the CHF treatment increased ( $P<0.05$ ) serum concentrations of Ile, Ala, Glu, aromatic AA, and total AA, compared with the control group and increased ( $P<0.05$ ) serum concentrations of Asp, Cys, His, Lys, Thr and Met, compared with colistin-supplemented piglets. On d 28, serum concentrations of Ala, Met, branched-chain AA, aromatic AA, and total AA were higher ( $P<0.05$ ) in CHF-supplemented than in control pigs, and serum concentrations of His and Tyr were higher ( $P<0.05$ ) in CHF-supplemented pigs, compared with the other two groups of pigs. These results suggest that dietary supplementation with CHF may affect the digestion of dietary protein or whole-body amino acid metabolism, thereby improving growth performance in weaned pigs. (Supported by NSFC and CAS)

**Key Words:** Chinese Herbs, Weaned Pigs, Amino Acids

**M224 Effects of feeding resistant starch on glucose and hormone levels in plasma of weaned pigs.** X. Wu<sup>\*1</sup>, S. Y. Bin<sup>1</sup>, G. Y. Wu<sup>1,2</sup>, X. F. Kong<sup>1</sup>, Y. L. Yin<sup>1</sup>, T. J. Li<sup>1</sup>, and R. L. Huang<sup>1</sup>, <sup>1</sup>*Institute of Subtropical Agriculture, The Chinese Academy of Sciences, Changsha, Hunan, China*, <sup>2</sup>*Texas A&M University, College Station*.

Two experiments were conducted to determine effects of feeding resistant starch (RS) on concentrations of glucose, insulin, growth hormone (GH), thyroid hormones (T3 and T4), in plasma of the weanling piglet as an model for studying infant nutrition. In Experiment 1, 12 pigs (Duroc×Landrace×Yorkshire) weaned at 28 d of age (BW of  $8.8 \pm 1.0$  kg) were randomly assigned into one of the four treatments, representing control, isonitrogenous (20%), isocaloric (16 MJ/kg), and iso-starch (39%) diets. The four diets were formulated with corn, brown rice, sticky rice and RS as starch sources, with their RS content being 2.29%, 0.94%, 0.00% and 20.64%, respectively. On d 25 of the feeding trial, venous blood samples were obtained at time zero and every 1 h for 12 h. Plasma was analyzed for glucose, insulin, GH, T3 and T4. The results indicated that feeding RS decreased ( $P < 0.05$ ) postprandial plasma concentrations of glucose, insulin, GH, T3 and T4, while sticky rice increased plasma concentrations of glucose and insulin ( $P < 0.05$ ) at 1 h post feeding, compared with the other groups of pigs. Plasma concentrations of insulin in piglets fed the sticky rice diet was 69.2  $\mu$ U/ml at 1 h post feeding, which was 59%, 74% and 161% higher ( $P < 0.05$ ) than those in pigs fed the corn, brown rice and sticky rice diets, while plasma concentrations of glucose at 1, 2, 3, 6, and 8 h post feeding were lower ( $P < 0.05$ ) than those in the other three groups of pigs. These results suggest that RS is potentially beneficial for improving insulin sensitivity in young pigs. (Supported by NSFC and CAS)

**Key Words:** Resistant Starch, Weaned Pigs, Plasma Parameters

**M225 Effect of adding a wheat dextrin on growth performance of nursery pigs.** H. Yang<sup>1</sup>, J. Less<sup>2</sup>, D. Holzgraefe<sup>1</sup>, M. Cecava<sup>1</sup>, T. Radke<sup>1</sup>, M. Franklin<sup>\*1</sup>, and C. Sparks<sup>3</sup>, <sup>1</sup>ADM Animal Nutrition Research, Decatur, IL, <sup>2</sup>ADM Specialty Feed Ingredients, Decatur, IL, <sup>3</sup>ADM Alliance Nutrition, Quincy, IL.

Two studies were conducted to evaluate whether a wheat dextrin (PremiDex™) improves performance of nursery pigs. In Exp 1, weanling pigs (n=180; BW=4.82 kg) were blocked by initial BW to one of two dietary treatments (TRT), with 18 pens per TRT and five pigs per pen. The TRT were PremiDex (PD) at 0.0 or 0.2% of diet. In Exp 2, weanling pigs (n=150; BW=4.15 kg) were blocked by initial BW to one of five dietary TRT, with six pens per TRT and five pigs per pen. Dietary levels of PD were 0.0, 0.1, 0.2, 0.3, and 0.6%. ADG, ADFI and G/F were measured throughout four phases ending at d 6, 13, 27 and 35 in Exp 1, and d 7, 14, 28, and 42 in Exp 2. Feeds were pelleted in the first two phases and were meal thereafter in both studies. Antibiotic, mannanoligosaccharide (CitriStim™), and acidifier were included in all diets. Addition of 0.2% PD did not affect overall ADG (411 vs. 418 g;  $P > 0.10$ ) or ADFI (563 vs. 554 g;  $P > 0.10$ ) of nursery pigs in Exp 1, but tended to improve G/F (0.72 vs. 0.74;  $P = 0.076$ ). In Exp 2, increasing PD from 0.0 to 0.6% did not affect ADG, ADFI or final BW ( $P > 0.10$ ). However, pigs fed 0.2% PD were 0.91 kg heavier than pigs fed no PD at the end of the study. PremiDex improved feed efficiency in a quadratic ( $P = 0.01$ ) and cubic ( $P = 0.03$ ) manner. In summary, the test wheat dextrin (PremiDex) improved feed efficiency of nursery pigs.

**Table 1.**

Exp 2	% PremiDex					SE	Lin	Quad	P value Cubic
	0.0	0.1	0.2	0.3	0.6				
ADG, g (d 0 to 42)	425	433	444	422	423	14	0.91	0.24	0.83
ADFI, g (d 0 to 42)	670	623	650	618	638	19	0.40	0.19	0.76
G/F (d 0 to 42)	0.64	0.69	0.68	0.68	0.66	0.01	0.54	0.01	0.03
End weight, kg	22.16	22.30	23.07	22.60	22.19	0.50	0.94	0.24	0.85

**Key Words:** Dextrin, Pig, Prebioite

**M226 Effects of  $\delta$ -aminolevulinic acid on growth performance, nutrients digestibility, blood characteristics and immune responses of weanling pigs challenged with lipopolysaccharide.** Y. J. Chen<sup>\*1</sup>, J. H. Cho<sup>1</sup>, Y. Wang<sup>1</sup>, Y. Huang<sup>1</sup>, Y. Hyun<sup>2</sup>, T. G. Ko<sup>2</sup>, and I. H. Kim<sup>1</sup>, <sup>1</sup>Dankook University, Cheonan, Choognam, Korea, <sup>2</sup>Easy Bio System Inc, Cheonan, Choognam, Korea.

Eighty pigs (BW=7.21 kg) were allotted to 4 dietary treatments with 4 pens per treatment and 5 pigs per pen. Diets were supplemented with 0, 5, 10, or 15 ppm  $\delta$ -aminolevulinic acid (ALA) of diet and fed for 35 days. Subsequently, 20 pigs were selected from 0 and 10 ppm ALA added treatments (10 pigs in each treatment) and half of those pigs which from same dietary treatment (n=5) were injected with either LPS (50  $\mu$ g/kg BW) or sterile saline, resulting to a 2x2 factorial arrangement. Blood sample and rectal temperature date were collected at 0, 2, 4 and 12 h after challenge. Growth performance was not affected by treatments during feeding period. Digestibilities of DM and N were improved in 15 ppm ALA added treatment at d 35 ( $P < 0.05$ ). Serum haemoglobin and iron concentrations were increased in 10 ppm ALA added treatment ( $P < 0.05$ ). At d 35, RBC and WBC counts were affected with 5 and 10 ppm ALA supplemented treatments had greatest level ( $P < 0.05$ ). During challenge period, rectal temperature was elevated by LPS injection at 2 and 4 h postchallenge ( $P < 0.05$ ). Plasma cortisol concentration was increased by LPS injection at 2 and 4 h postchallenge and an ALA alleviate effect was exhibited at 2 h postchallenge ( $P < 0.01$ ). Concentration of plasma IGF-I was higher in ALA included treatments at 2 h postchallenge ( $P < 0.05$ ). Injection of LPS elevated plasma TNF- $\alpha$  concentration at 2, 4 and 12 h ( $P < 0.01$ ) while ALA alleviate effect was observed at 2 and 4 h postchallenge. Challenge of LPS decreased WBC counts in blood at 2 and 4 h postchallenge ( $P < 0.01$ ). At 12 h postchallenge, blood cell counts were influenced by LPS challenge while an ALA supplemented effect was only observed on WBC count ( $P < 0.05$ ). In conclusion, dietary supplementation of ALA can improve DM and N digestibilities and attenuate inflammatory response by improving iron status of weanling pigs.

**Key Words:** Delta-Aminolevulinic Acid, Lipopolysaccharide, Weanling Pigs

**M227 Animal performance as influenced by organic acid supplementation into the diet of post-weaning piglets.** C. Lückstädt<sup>\*1</sup>, S. Nitsch<sup>1</sup>, N. Kvietskute<sup>2</sup>, A. Stupeliene<sup>2</sup>, V. Sasysyte<sup>2</sup>, and R. Gruzauskas<sup>2</sup>, <sup>1</sup>*Biomim GmbH, Herzogenburg, Austria*, <sup>2</sup>*Veterinary Academy of Lithuania, Kaunas, Lithuania*.

During weaning pigs are exposed to a large variety of physiological and environmental stressors. Intensive research has therefore been directed to the potential of natural growth promoters, like organic acids. They have been shown to be effective in reducing the incidence of gastrointestinal disorders, thereby improving growth performance in pigs. Moreover, due to a decrease in gastric pH, acidification of the diets creates favorable conditions for nutrient digestibility, especially in young piglets. The objective of this study was to evaluate the potential of an organic acid blend in post-weaning pig diets regarding its effect on BW, daily weight gain and gain:feed ratio. The trial was conducted in a commercial pig farm under surveillance of the Veterinary Academy of Lithuania. The aim of the trial was to test the acidifier Biotronic<sup>®</sup>, an organic acid blend consisting of formic acid, propionic acid and their salts on a sequential release medium (3 kg per t of feed), against a commercial piglet diet containing no acidifying additive. Feed and water were available ad libitum. 52 piglets (Pietrain × Yorkshire × Landrace hybrid), 35 days of age, were randomly selected and litter wise allocated to 2 treatment groups. The trial lasted over a period of 28 days. Performance data were measured on a bi-weekly basis. Piglets in the acidifier group weighed 30.77 kg compared with 29.31 kg in the negative control group and the final BW of 63 day old piglets differed numerically (P=0.186). Based on average daily weight gain, a numerical enhancement of more than 11% could be monitored (708 g vs. 634 g for treatment and control, respectively; P=0.115). The G:F was improved by approximately 3% (0.60 and 0.58 for treatment and control, respectively). It can be concluded that the use of the organic acidifier Biotronic<sup>®</sup> increased numerically performance data of piglets under European production conditions.

**Key Words:** Organic Acidifier, Piglet Growth, Gain:Feed Ratio

**M228 Evaluation of an extruded wheat and milk by-product mixture in diets for early-weaned pigs.** B. Vicente, M. P. Serrano, D. G. Valencia, R. Lázaro, and G. G. Mateos\*, *Universidad Politécnica de Madrid, Spain*.

Condensed lactoserum (CL) is a by-product of the cheese and milk protein industry that results from the ultrafiltration and pasteurization of liquid whey. In a previous study we observed that the inclusion in the diet of 49% of an extruded mixture of CL and wheat (20:80 on DM basis) had little effect on productive performance but increased the incidence of diarrhea (ID). It was hypothesized that the high electrolyte content of CL (2.1% Na and 6.1% K on DM basis) was responsible for the high ID. After ultrafiltration, the electrolyte content of the original CL was reduced by approximately 30%. The ingredient tested in current trial was an extruded mixture (18:82 on DM basis) of CL low in electrolytes and wheat (CL-W). The CL used had 62.5% lactose and 7.7% CP on DM basis. We studied the effect of increasing levels of CL-W (0, 15, 30, 45, and 60%) in the diet on performance of pigs from 24 to 50 d of age and on apparent total tract digestibility (ATTD) of nutrients at 36 d. All diets were isonutritive except for electrolyte content that increased with increasing levels of CL-W (0.27 to 0.39% for Na, 0.51 to 0.71% for Cl, and 1.04 to 1.12% for K for the control and the 60% CL-W containing diets, respectively). Each treatment

was replicated seven times (six piglets) and the trial lasted 26 d. From 24 to 34 d of age an increase in CL-W content of the diet increased ADG (L; P<0.05) and tended to improve ADFI and FCR (L; P<0.10). Inclusion level did not affect productive performance from 34 to 45 d of age but from 45 to 50 d reduced ADFI and improved FCR (L; P<0.05). For the entire experiment no differences were found among treatments for any trait studied. An increase in the level of CL-W increased digestibility of all nutrients (P<0.01) except CP. We conclude that reducing the electrolyte content of the condensed lactoserum will allow its use at levels of up to 10.8% in diets for young pigs.

**Key Words:** Electrolytes, Milk By-Product, Pig Performance

**M229 Relationship between texture and preference of cereal based diets in piglets.** D. Solà-Oriol<sup>1</sup>, E. Roura<sup>\*2</sup>, and D. Torrallardona<sup>1</sup>, <sup>1</sup>*IRTA, Mas de Bover, Constantí (Tarragona), Spain*, <sup>2</sup>*Lucta SA, Barcelona, Spain*.

We have reported that diet palatability in piglets depends on the cereal source used and its inclusion level. Although the perception of flavor is a combination of taste and smell, texture could be a sensory input that may play an important role in modifying palatability. In the present study we evaluated the relationship between the preference for different cereals and their textural properties as indicator of mouth feel during eating. A series of double choice preference trials was conducted to evaluate the palatability of different cereals compared to a common reference diet (REF) containing 60% rice. A total of 63 diets were tested (5 trials with 3 cereals at 3 inclusion levels and 3 trials with 3 cereals at 2 inclusion levels). In each trial 144 piglets in 36 pens were given simultaneous access to two diets in two feeding hoppers; one with the REF diet and the other with a diet in which different proportions (15, 30 or 60%) of rice were replaced by the different cereals. Preference in each pen was calculated as the percentage contribution of the cereal diet to total feed intake. Additionally, hardness, fragility, chewing work and adhesiveness of each diet were also measured with a texture analyzer. Pearson's correlation coefficients between preference and texture parameters were analyzed using the CORR procedure of the statistical package SAS. Hardness, fragility and chewing work were negatively correlated with preference (Pearson's correlation coefficients: r = -0.51, -0.52 and -0.38, respectively; P<0.01). On the other hand, no correlation was observed between preference and adhesiveness (P>0.1). In conclusion, reducing the hardness and fragility of feed, as well as reducing its chewing work is a way of improving its acceptability in piglets.

**Key Words:** Cereal Texture, Palatability, Piglet

**M230 Effect of processing cereals on feed digestibility and meal retention in piglets.** D. Solà-Oriol<sup>1\*</sup> and D. Torrallardona, *IRTA, Mas de Bover, Constantí (Tarragona), Spain*.

Cereals with a high nutrient digestibility are recommended for piglet diets. Processing of cereals may improve nutrient availability and digestive function. The present trial studied the effect of cereal processing on the digestibility and proximal GIT digesta flow. Eight diets containing 60% of white rice (raw or cooked), whole oats (raw or steam-rolled with hull removal) whole oats (raw or cooked) or naked oats (raw or micronized) were studied. The apparent digestibilities

for CP (ileal) and DM and OM (ileal and faecal) were measured in 24 pigs fitted with an ileal T-cannula in four consecutive 7d-periods, using TiO<sub>2</sub> as indigestible marker (n=12). The fractional meal retention (FMR) in the proximal GIT (estimated from ileal DM flow) was measured in 16 pigs (4 periods) for 28 h after feeding (n=8). FMR as a function of time was fitted with a modified power exponential function ( $y(t)=1-(1-e^{-kt})^b$ ) for each pig using the NLIN procedure of the statistical package SAS. The emptying rate ( $k$ , %/min) and the extrapolated  $y$ -intercept ( $b$ ) from the terminal portion of the curve were obtained, and used to calculate  $T_{1/2}$  (minutes to empty half of the contents) and the lag time ( $T_{lag}$ , min) by solving  $t$  from  $\dot{y}(t)=0$ . The effects of cereal and technological process were analyzed using the GLM procedure of the statistical package SAS. Steam rolling with hull removal of whole oats improved ( $P<0.001$ ) fecal DM (75.1 vs. 83.9) and OM digestibilities (78.6 vs. 89.1). Moreover steam rolling of whole oats reduced  $b$  ( $P<0.01$ ),  $T_{1/2}$  (783 vs. 568;  $P<0.05$ ) and  $T_{lag}$  (639 vs. 398;  $P<0.05$ ). Cooking whole oats reduced the ileal digestibilities of DM (61.4 vs. 57.2;  $P<0.01$ ), OM (64.4 vs. 61.0;  $P<0.05$ ) and CP (77.1 vs. 72.7;  $P<0.001$ ). Cooking rice or micronizing naked oats did not affect digestibility or proximal GIT DM flow ( $P>0.1$ ). It is concluded that the response to cereal processing depends on both the characteristics of the cereal and the technological treatment considered.

**Key Words:** Piglet, Processed Cereals, Digestibility

**M231 Storage affects the palatability of protein sources in piglet diets.** D. Solà-Oriol<sup>1</sup>, E. Roura<sup>\*2</sup>, and D. Torrallardona<sup>1</sup>, <sup>1</sup>IRTA, Mas de Bover, Constantí (Tarragona), Spain, <sup>2</sup>Lucta SA, Barcelona, Spain.

We have shown previously that protein source affects palatability in piglets. Proteins may be affected during storage due to chemical reactions that alter their composition and the release of volatile compounds. Palatability for skimmed milk (SM), soybean protein concentrate (SPC) and potato protein (PP), before or after storage (300d) was evaluated using a double choice preference test vs. a reference diet (REF). Stored SM was used beyond its expiry date, which was not the case for SPC and PP. Each pen (4 pigs) was offered the choice between the REF diet and a protein source diet (in mash form). Protein sources were included at 5, 10 and 20% by replacing a soy protein product (56% CP) from the REF diet. Each pen was offered the same protein source in three consecutive 4d periods testing the inclusions levels of 5, 10 and 20%, respectively. Preference (percentage contribution of the tested protein diet to total intake) was measured for each pen. The preference values were analyzed taking into account the effects of protein source (P), inclusion level (L), storage (S) and their interactions using the GLM procedures of the statistical package SAS. Significant effects for P ( $P<0.0001$ ), L ( $P<0.05$ ), S ( $P<0.0001$ ), P $\times$ S ( $P<0.001$ ) and L $\times$ S ( $P<0.001$ ) were observed (n=9; SD = 14.4). The preferences of the three protein sources were: SM=39, SPC=32 and PP=12%. Preference decreased with increasing inclusion level: 31, 27 and 24%. Storage reduced preference from 37 to 17%. The interaction P $\times$ S indicated different reductions in preference due to S for the different proteins: SM (55 vs. 23 %), SPC (42 vs. 22%) and PP (16 vs. 7%). Finally, the interaction L $\times$ S indicates that whereas L affected the preference of the non-stored proteins (45, 39 and 30% at 5, 10 and 20%), it did not affect that of the stored ones (18, 15 and 19% at 5, 10 and 20%). It is concluded that storage reduces the palatability

of proteins and that the magnitude depends on the protein source independently of its level of inclusion.

**Key Words:** Piglet, Protein Sources, Palatability

**M232 Cereal nutrient composition correlates with feed oro-sensorial perception in piglets.** D. Solà-Oriol<sup>1</sup>, E. Roura<sup>\*2</sup>, and D. Torrallardona<sup>1</sup>, <sup>1</sup>IRTA, Mas de Bover, Constantí (Tarragona), Spain, <sup>2</sup>Lucta SA, Barcelona, Spain.

The taste sensory system provides information on major nutrients such as carbohydrates or proteins, whereas the olfactory sensory system detects feed volatiles. The combination of both will provide the basis for the diversity of flavors found in the diet. Piglet diets are formulated taking into account the nutritional value of feed ingredients from a proximal analysis. Feed oro-sensorial perception can be related with the nutrient availability or composition. In the present work we studied the direct relationship between cereal nutritional values and feed preference. Eight double choice preference trials (36 pens; 4 animals/pen) were conducted using a diet with 60% of white rice as reference (REF). In each trial, three cereals were tested and a double control test (rice vs. rice) was included. Overall, the preference for a total of 24 cereal based diets was obtained. In the test diets all the rice from the REF diet was replaced by the cereal to be tested. Preference was calculated as the percentage contribution of the test diet to total feed intake. For each cereal, dry matter (DM), ash (ASH), crude fibre (CF), ether extract (EE), gross energy (GE) and crude protein (CP) were measured and digestible energy (DE) content was calculated. The relationship between the preference and the nutritional values measured was determined as a Pearson's correlation coefficients using the CORR procedure of the statistical package SAS. No significant ( $P>0.1$ ) Pearson's correlation coefficients between preference and DM, ASH, EE, GE and CP were observed, however, CF and DE showed linear relationships with preference ( $r = -0.61$  and  $-0.54$ ;  $P<0.01$ , respectively). In conclusion, DE and CF of cereals are directly associated with their palatability. Further studies are required to assess the role of mouth feel associated with CF. Other nutrient-related compounds may better explain the oro-sensorial perception of feed.

**Key Words:** Cereals Nutrients, Piglet, Palatability

**M233 The body weight-related differences of leptin and neuropeptide Y (NPY) gene expression in pigs.** T. Z. Shan<sup>\*</sup>, Y. Z. Wang, J. X. Liu, and Z. R. Xu, Institute of Feed Science, Hangzhou, Zhejiang, China.

To determine if the body weight change is directly related to altered leptin and neuropeptide Y (NPY) gene expression, we assessed the adipose tissue weight, adipose deposition rate, leptin and NPY mRNA levels, serum leptin concentration in pigs weighted 1, 20, 40, 60, and 90 kg. The results indicate that the weight of adipose tissues and the adipose deposition rates of pigs significantly increased and correlated with BW from 1 kg to 90 kg ( $P < 0.01$ ). Serum leptin concentration and leptin mRNA levels in omental adipose tissue (OAT) increased from 1 to 60 kg, then decreased from 60 to 90 kg. At 60 kg, the serum leptin concentration and leptin mRNA level significantly increased by 33.5% ( $P < 0.01$ ) and 98.2% ( $P < 0.01$ ) respectively as compared with the levels at 1 kg. At 60 kg, the amount of leptin mRNA in

subcutaneous adipose tissue (SAT) was significantly higher than that of 1 and 40 kg animals ( $P < 0.05$ ). NPY gene expression also changed with BW and at 60 kg, the NPY mRNA level significantly decreased by 54.0% ( $P < 0.05$ ) as compared with that in 1 kg. Leptin mRNA in OAT correlated with serum leptin concentrations ( $r=0.98$ ,  $P < 0.01$ ), the body weight ( $r=0.82$ ,  $P < 0.05$ ) and fat deposition rate ( $r=0.81$ ,  $P < 0.05$ ). Our results first reported that the developmental expression of leptin in porcine OAT, PAT and SAT, and first proved that the expression of leptin in OAT was the primary source of circulating leptin. These results could provide some information for gene therapy to manipulate leptin secretion, which will lead to practical methods of controlling appetite and growth in farm animals, thereby regulating and improving efficiency of lean meat production and meat production quality.

**Key Words:** Pig, Leptin, Neuropeptide Y

**M234 *In vitro* screening of plant materials as anti-adhesive agents against *E. coli* K88.** S. Galletti<sup>1,2</sup>, P. G. van Wikselaar<sup>2</sup>, D. Tedesco<sup>1</sup>, and P. M. Becker<sup>\*2</sup>, <sup>1</sup>University of Milan, Milan, Italy, <sup>2</sup>Animal Sciences Group of Wageningen UR, Lelystad, The Netherlands.

Due to the ban of antibiotics in feeds, alternative ways are needed to improve animal health and performance. A promising strategy is to supply animals with feed ingredients that act as alternative adhesion sites, thus facilitating bacterial shedding from the gut and reducing colonization and infection. In order to screen the ability of different materials as anti-adhesion agents, a microplate-based *in vitro* method was developed. In this test, different feed/food ingredients and plant by-products from the EU project Safewastes were tested for their binding ability towards the pig pathogen *E. coli* K88. ELISA microplates were coated with suspensions of powdered test ingredients in PBS buffer (Safewastes by-products SW1 to SW11, coffee grounds, konjac gum, locust bean gum, sesame seed expeller, tomato, yeast product) and incubated overnight at 4°C. Quenching was done with 1% BSA in PBS as blocking solution. BSA-coated wells were included as control. After filling with BHI broth, plates were incubated at 37°C in the reading chamber of a photometer. The O.D. was automatically read at a wavelength of 650 nm at 15 min intervals. All OD data were processed by non-linear regression analysis (P-NLIN, SAS). Parameters of the sigmoidal growth curves obtained were analysed by GLM procedure (SAS). The test principle was based on an inverse relationship between initial cell densities and the appearance of growth: The higher adhering cell numbers are, the shorter are the detection times of bacterial growth. Testing of different ingredients resulted in rankings according to their adhesive capacity towards *E. coli* K88, the sorting being based on the respective detection time of cell growth. Detection times ranged from 2.43 h (SEM=0.103 h) for the first position (yeast product) to 5.76 h (SW6) for the last one, being 4.47 h for BSA as a control. The yeast product, SW11, sesame seed expeller and SW7 had significantly lower detection times with respect to control ( $P < 0.05$ ), and therefore were considered promising anti-adhesive agents against *E. coli* K88. These ingredients were destined for further testing and validation in an *in vivo* trial on challenged pigs.

**Key Words:** Anti-Adhesion, *E. coli* K88, Plant Materials

**M235 Dose response trials of an enhanced milky flavor in a pig nursery program 1: linear and quadratic effects on piglet performance.** E. Roura<sup>\*1</sup>, I. R. Ipharraguerre<sup>1</sup>, and D. Torrallardona<sup>2</sup>, <sup>1</sup>Lucta S.A., Barcelona, Spain, <sup>2</sup>IRTA, Centre Mas de Bover, Constantí, Spain.

Two trials were conducted in newly weaned 26d-old pigs to study the effect of the addition of an enhanced milky flavor to feed with and without its water-soluble formulation applied to drinking water. In trials 1 and 2 respectively, 192 and 132 piglets (*Landrace* × *Pietrain*) were distributed in four or three blocks of 12 pens according to initial body weight. Pigs were offered free access to 1 of 6 diets differing only in the flavor dose (trial 1: 0, 250, 500, 750, 1000 and 1500 ppm and trial 2: 0, 1000, 2000, 3000, 4000 and 5000 ppm). Additionally, half of the pens were offered flavored water during the first 28 (trial 1) or 14 (trial 2) days postweaning. Single effects of feed treatments for the non-flavored water groups are reported here. At the end of the pre-starter phase (0-14 d postweaning) of trial 1, animals in the 1500 ppm group had the numerically highest ADG (121 g/d) and ADFI (180 g/d). When compared to the control diet, all diets treated with flavor improved ( $P < 0.05$ ) feed efficiency during the starter phase (14-28 days postweaning), but overall (0-28 d postweaning) only the diet treated with 1500 ppm of flavor improved ( $P < 0.05$ ) ADG. However, when only equidistant doses were analyzed (0, 500, 1000 and 1500 ppm), a significant ( $P < 0.10$ ) linear effect was observed for ADG throughout the 28 days. In trial 2 flavor addition in feed resulted in increases in ADG in the pre-starter phase ( $P < 0.01$ ) and overall ( $P < 0.05$ ). At the end of the trial, feed treated with 1000, 2000, 3000 and 5000, but not 4000, ppm of flavor increased ( $P < 0.05$ ) ADG by 21, 21, 19 and 26% respectively compared with the control. In trial 2, the response to increasing flavor dosage was quadratic ( $P < 0.01$ ). It is concluded that adding the enhanced milky flavor to feed results in higher ADG in weanling pigs and that such response is linear at low doses (up to 1500 ppm) but becomes quadratic for the high doses (1000 through 5000 ppm).

**Key Words:** Flavor, Feed Intake, Piglet

**M236 Dose response trials of an enhanced milky flavor in a pig nursery program 2: benefits of flavoring water up to 14 d.** E. Roura<sup>\*1</sup>, I. R. Ipharraguerre<sup>1</sup>, and D. Torrallardona<sup>2</sup>, <sup>1</sup>Lucta S.A., Barcelona, Spain, <sup>2</sup>IRTA, Centre Mas de Bover, Constantí, Spain.

Two trials were conducted in newly weaned 26-d-old pigs to study the effect of the addition of an enhanced milky flavor to feed and water. In trial 1 and 2 respectively, 192 and 132 piglets (*Landrace* × *Pietrain*) were distributed in four or three blocks of 12 pens according to initial body weight. Pigs were offered free access to 1 of 6 diets differing only in the flavor dose (trial 1: 0, 250, 500, 750, 1000 and 1500 ppm and trial 2: 0, 1000, 2000, 3000, 4000 and 5000 ppm). In addition, half of the pens were offered flavored water (3000 ppm) during the first 28 (trial 1) or 14 (trial 2) days postweaning. In trial 1, adding flavor to water numerically increased ADG by 6% in the pre-starter phase (0-14 d postweaning). However, during the starter phase (14-28 days postweaning) an interaction for ADG ( $P < 0.1$ ) and ADFI ( $P < 0.08$ ) between the addition of flavor to water and feed was observed. In this phase offering flavored water to animals that consumed non-flavored feed increased ADG by 18% and ADFI by 20% compared with pigs offered non-flavored water and feed (negative control). However, offering flavored water to animals that consumed flavored feed did not improve further these parameters. A similar interaction ( $P < 0.09$ ) was

observed for ADFI for the overall trial (0-28 days postweaning). In trial 2, water treatment did not result in significant effects or interactions. Nevertheless, among the water flavored groups, ADG was numerically higher for dietary low doses 0, 1000 and 2000 and lower for dietary high doses 3000, 4000 and 5000 when compared to the non-flavored water groups. It is concluded that addition of an enhanced milky flavor to feed and/or water improves piglet growth in the pre-starter phase. Furthermore, benefits from flavoring feed and water for 14 d postweaning appear to be additive at doses not higher than 2000 ppm in feed.

**Key Words:** Flavor, Water Intake, Piglet

**M237 Response of enterotoxigenic *Escherichia coli* K88 infected piglet jejunal segments to extracts derived from degradation of soybean and canola meal polysaccharides by carbohydrase enzymes.** E. Kiarie\*, B. A. Slominski, and C. M. Nyachoti, *University of Manitoba, Winnipeg, MB, Canada.*

Enterotoxigenic *E. coli* K88 (ETEC) infection results in fluid secretion and electrolyte losses in piglet small intestine. In the present study, effect of perfusing extracts from soybean (SBM) and canola (CM) meals containing polysaccharide hydrolysis products on net absorption was investigated using ETEC-infected jejunal segments. Extracts were generated by incubation of ethanol-extracted SBM and CM with a combination of polysaccharide degrading enzymes including pectinase, cellulase, mannanase, xylanase, glucanase and galactanase activities. Following incubation, the slurries were centrifuged and the supernatants were mixed with absolute ethanol to produce 2 fractions: 80% ethanol-solubles (ES) and 80% ethanol insolubles (EI). Eight pigs weaned at 21 d of age and fed a commercial starter diet for 7 d were held under anesthesia and 10 segments were prepared in jejunum of each pig. Extracts from SBM and CM were studied in 2 independent experiments involving 4 piglets each in which 2 factors were studied: extract type (EI vs. ES) and time of ETEC infection (before perfusion vs. 30 min after perfusion). Pairs of jejunal segments (1 noninfected and the other ETEC-infected) were perfused simultaneously with different extracts during a 7.5 h. In each piglet 1 pair of segments was perfused with saline as a control. Net absorption of fluid and solutes was determined. In both Experiments ETEC-infected segments perfused with saline had the lowest ( $P < 0.05$ ) net fluid and solutes absorption compared with SBM and CM extract. Interaction ( $P < 0.001$ ) between extract type and time of infection was only evident for SBM in which case perfusing ES extracts 30 min before infection resulted in high fluid ( $835 \pm 22$  vs.  $428 \pm 51$   $\mu\text{l}/\text{cm}^2$ ) and solutes ( $259 \pm 7.1$  vs.  $133 \pm 16$   $\mu\text{Osmol}/\text{cm}^2$ ) absorption compared with ETEC infection before perfusion. In conclusion, SBM and CM polysaccharide hydrolysis products were beneficial in maintaining fluids and solutes balance during ETEC infection.

**Key Words:** Carbohydrase Enzymes, Enterotoxigenic *E. coli*, Piglet

**M238 Performance, immune response and intestinal microbial populations of weanling pigs fed diets containing a specially prepared potato protein.** Z. Jin<sup>1</sup>, Y. X. Yang<sup>1</sup>, J. Y. Choi<sup>1</sup>, P. L. Shinde<sup>1</sup>, T. W. Hahn<sup>1</sup>, H. T. Lim<sup>1</sup>, Y. K. Park<sup>2</sup>, K. S. Hahn<sup>2</sup>, and B. J. Chae<sup>\*1</sup>, <sup>1</sup>Kangwon National University, Chuncheon, Kangwon-Do, Republic of Korea, <sup>2</sup>Chosun University, Kwangju, Republic of Korea.

A total of 280 weanling pigs (Landrace  $\times$  Yorkshire  $\times$  Duroc) were used in a 28-d growth study to investigate the effects of feeding a potato protein (PP) on growth performance, immunity, and bacterial populations in large intestine. These weanling pigs (initially  $6.42 \pm 0.74$  kg and  $23 \pm 3$  d of age) were randomly allotted to five treatments on the basis of their body weight, each treatment comprised of four pens and each pen had 14 piglets. Dietary treatments included: NC (negative control; basal diet); PC (positive control; basal diet + 0.15% apramycin and 0.10% colistin sulfate); PP (basal diet added with 0.25, 0.50 and 0.75% of potato protein). PP was extracted from a special potato breed (*Solanum tuberosum* L cv. Gogu) containing antimicrobial peptides (Potamin-1). PC treatment showed significantly ( $P < 0.05$ ) higher ADG than PP, but PP showed linear improvement ( $P < 0.05$ ) in ADG and ADFI. The feeding of PP to weanling pigs had no effect ( $P > 0.05$ ) on their immune response. The total anaerobic bacteria in caecum and rectum, *Staphylococcus* in caecum and *E. coli* in colon were significantly ( $P < 0.05$ ) lower in PC than PP. Similarly, PP had lower (linear,  $P < 0.05$ ) total anaerobic bacteria and *Staphylococcus* in caecum, rectum and colon, and *E. coli* in colon than NC, respectively. These results suggest that PP used in this experiment can be a candidate as an animal growth promoter in weanling pigs.

**Key Words:** Potato Protein, Weanling Pigs, Growth

**M239 Decreasing postnatal skeletal muscle protein synthetic activity is associated with a reduction in the expression of S6K1 in fed young pigs.** X Yang\* and M. Z. Fan, *Centre for Nutrition Modeling, University of Guelph, Guelph, Ontario, Canada.*

The objective of this study was to investigate the association between developmental changes of fractional protein synthesis rates (FSR) and the expression of ribosomal protein S6 kinase 1 (S6K1) in the skeletal muscle of fed young pigs. Thirty-six purebred Yorkshire gilts were used at the ages of d 1, 4, 6, 12, 20 and 28 (1 wk post-weaning). Piglets were given intraperitoneally a flooding dose of Phe containing L-[ring-2H5]Phe in saline. Plasma and loin muscle samples at 30 min post-injection were collected for the determination of tracer Phe enrichment by GC-MS. Total and phosphorylated (Thr 389) forms of S6K1 were examined by Western blot. The FSR of skeletal muscle decreased linearly ( $P < 0.05$ ) from d 1 (20.8 %/d) to day 28 (5.3 %/d). Linear (total and the phosphorylated forms) and quadratic (phosphorylated form) decreases in S6K1 abundances ( $P < 0.05$ ) were observed, and the changes were correlated ( $P < 0.05$ ;  $r = 0.69$  and  $0.59$  for total and phosphorylated S6K1, respectively) with FSR at the ages of d 1 to 28. Furthermore, the ratio of the phosphorylated S6K1 to total S6K1 abundance was linearly and quadratically decreased ( $P < 0.05$ ) from d 1 to 28 in the fed young pig. These results indicate that the decreasing FSR in skeletal muscle is associated with a reduced expression of S6K1 in fed pigs during the early postnatal growth.

**Key Words:** Pigs, Ribosomal Protein S6 Kinase 1, Muscle Protein Synthetic Activity

**M240 Effect of plant extracts on growth performance and immune status in weaning pigs.** H. J. Jung<sup>\*1</sup>, J. C. Park<sup>1</sup>, Y. H. Kim<sup>1</sup>, S. Y. Jee<sup>1</sup>, S. D. Lee<sup>1</sup>, H. D. Jang<sup>1</sup>, H. J. Kim<sup>2</sup>, I. H. Kim<sup>2</sup>, H. K. Moon<sup>1</sup>, S. W. Kim<sup>3</sup>, I. C. Kim<sup>1</sup>, and S. J. Lee<sup>1</sup>, <sup>1</sup>National Livestock Research Institute, Cheonan, Chungnam, Republic of Korea, <sup>2</sup>Dankook

University, Cheonan, Chungnam, Republic of Korea, <sup>3</sup>Texas Tech University, Lubbock.

This study was conducted to investigate the effects of plant extracts on growth performance, immune status in weaning pigs. A total of 125 crossbred ([Landrace×Yorkshire]×Duroc) pigs with an initial body weight of  $7.05 \pm 0.07$  kg were used in this 6-weeks experiment. Pigs were allotted to five treatments (five replicates per treatment and five 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), 3) PL 1 (Control diet + 0.2% Mistole), 4) PL 2 (Control diet + 0.2% Stevia), 5) PL 3 (Control diet+0.2% SMUS<sup>®</sup>). In overall trial, ADG was increased PL 3 treatment compared with NC and other PL treatment ( $p < 0.05$ ). However, blood traits were not affected by treatments. The morphology of small intestine was not affected by pigs fed diets with plant extracts, but villi height and crypt depth of small intestine improved significantly in PL 3 treatment compared with other treatments ( $p < 0.05$ ). In conclusion, plant extracts tended to improve growth performance, morphology of small intestine compared with the pigs fed the NC and PC diets.

**Key Words:** Plant Extracts, Immune, Weaning Pigs

**M241 Effect of probiotics in lactating sows diets on sows and litter performance.** A. Castellanos A<sup>\*1</sup>, J. A. Renteria F<sup>2,1</sup>, J. A. Cuaron I<sup>2,1</sup>, and C. A. Mejia G<sup>2,1</sup>, <sup>1</sup>FES-C UNAM, Ajuchitlan, Qro, <sup>2</sup>CENIDFA-INIFAP, Ajuchitlan, Qro.

To evaluate the effect of two probiotics on sow and litter performance, 562 sows ( $257 \pm 33$  kg) were fed four lactation diets. A Control diet (C) formulated to satisfy the requirements of lactating sows (NRC, 1998) based on sorghum-soy bean meal, a 2nd diet (B) similar to C with the addition of 0.5 kg of a probiotic containing the combination of two bacteria *Bacillus Licheniformis* and *B. subtilis*, a 3rd diet (Y) similar to C plus the addition of 3 kg of a probiotic containing *Saccharomyces cerevisiae*, a 4th diet (BY) similar to C plus the addition of both probiotics. Sows were fed the diets starting on day 100 of gestation and until weaning. Response variables were; feed intake during lactation (total TFI and ADFI), number and weight of born pigs, number and weight of weaned pigs, and weight lose during lactation. Experimental design was a CRB whit factorial arrangement 2x2, the experimental unit was the sow and its litter, and block was the maternity building. Data were analyzed using the GLM of SAS (9.1.3). In TFI during lactation an interaction yeast\*bacteria was found ( $P < 0.05$ , SEM= 2.54) 99.2, 93, 95.2, 101.3 kg for C, B, Y, and BY respectively. For litter weight at weaning an interaction yeast\*bacteria was observed ( $P = 0.09$ , SEM = 1.8375) 54.3, 53.8, 53.3, 60 kg, for C, B, Y and BY respectively. For the number of pigs wean a B effect was observed, ( $P < 0.04$ , EEM = 0.137) 9.62 vs. 9.12. While for the average weight of wean pigs a Y effect was observed ( $P < 0.001$ , SEM= 0.079) 6.2 vs. 5.6. For sow weight lose during lactation an interaction yeast\*bacteria was observed ( $P < 0.06$ , SEM= 5.45) 19.18, 42.01, 22.42, 28.86 kg; C, B, Y and BY respectively. In conclusion, the combination of both probiotics used in this experiment resulted in an improved litter performance, without affecting sow performance. The inclusion of bacteria probiotic in lactating sows diets increased the number of weaned pigs. The inclusion of yeast in lactating sows diets increased the average weight of weaned pigs.

**Key Words:** Sow, Probiotics, Performance

**M242 Evaluation of Concept PR 100 in diets for nursery pigs.** J. M. DeRouchey<sup>\*1</sup>, E. J. Wiedmann<sup>1</sup>, M. D. Tokach<sup>1</sup>, R. D. Goodband<sup>1</sup>, J. L. Nelssen<sup>1</sup>, S. S. Dritz<sup>1</sup>, and J. Whitehead<sup>2</sup>, <sup>1</sup>Kansas State University, Manhattan, KS, <sup>2</sup>Concept Nutrition, Ltd, Preston, UK.

Concept PR 100 (CNPR), a plant based protein ingredient with added synthetic amino acids and nucleic acids, was compared to spray-dried animal plasma (SDAP) in nursery pig diets. Two separate experiments, each utilizing 180 weanling pigs (initially 5.51 and 5.15 kg for Exp. 1 and 2, respectively and 21 d of age) were used in 28-d feeding trials. In Exp. 1, five experimental diets were fed which included: 1) Control (no specialty protein source); 2) 2.5% SDAP; 3) 5.0% SDAP; 4) 2.5% CNPR; and 5) 5.0% CNPR. In Exp. 2, diets 1, 2, and 3 were similar to Exp. 1, while a modified CNPR was used at 2.5% and 5.0%, respectively for the 4th and 5th treatment diets. In Exp. 1 from d 0 to 14, pigs fed increasing levels of SDAP or CNPR had improved (linear and quadratic,  $P < 0.001$ ) ADG and ADFI. Pigs fed increasing levels of SDAP or CNPR also had improved (linear,  $P < 0.001$ ) G:F. When comparing the mean of pigs fed diets containing SDAP versus CNPR, pigs fed SDAP had greater ( $P < 0.002$ ) ADG, ADFI, and BW at d 14 compared to pigs fed CNPR. Overall, (d 0 to 28), pigs fed increasing SDAP or CNPR had greater ADG, ADFI and final BW (linear,  $P < 0.004$ ) than pigs fed the control diet. There was no overall growth differences between pigs fed SDAP and CNPR ( $P > 0.11$ ). For Exp. 2 from d 0 to 14, pigs fed increasing SDAP had improved (linear,  $P < 0.01$ ) ADG, ADFI, G:F. Pigs fed increasing CNPR had improved (quadratic,  $P < 0.001$ ) G:F. However, pigs fed SDAP had greater ( $P < 0.03$ ) ADG, ADFI, and BW at d 14 compared to those fed CNPR. Overall (d 0 to 28), pigs fed increasing levels of SDAP had greater ( $P < 0.03$ ) ADG and tended to have improved ( $P < 0.08$ ) ADFI and G:F. Also, pigs fed increasing levels of CNPR had improved (quadratic,  $P < 0.009$ ) G:F. There was no overall differences in growth between pigs fed SDAP and CNPR ( $P > 0.22$ ). These data indicate that pigs fed SDAP compared with CNPR generally had greater performance during the test period, however these differences were not found at the conclusion of the studies.

**Key Words:** Swine, Protein Source, Growth

**M243 The effect of American alligator (*Alligator mississippiensis*) serum on growth performance of weanling pigs.** J. T. Compton<sup>\*</sup>, M. E. Merchant, T. S. Shields, and F. M. LeMieux, *McNeese State University, Lake Charles, LA.*

Antibiotic use in the food animal industry is a major concern. The use of antibiotics in animal feed is a common practice. Of the total antibiotic production for both human and animal purposes, approximately 25% is used for food animals and 90% of that portion has been reported as being used in subtherapeutic concentrations (Lehenbauer et al., 2002). Subtherapeutic use in these animals is mainly for improved feed efficiency and growth. Subtherapeutic use in farm production animal diets has been a common practice since 1946 when the addition of subtherapeutic levels of antimicrobials was found to enhance growth in poultry (Moore et al., 1946). Today, consumers are concerned of the potential of bacteria resistance to these antibiotics. If a cost efficient antimicrobial substitute for these traditional antibiotics can be found producers and consumers will benefit. Alligator serum has exhibited antimicrobial properties in vitro (Merchant et al., 2003, 2004, 2005) decreasing bacterial and *Escherichia coli* growth. To our knowledge no in vivo research had been performed to date. The objective of this study was to evaluate the effect of 0.5% alligator serum (AS) on growth

performance of nursery pigs fed diets with or without antibiotics. Weaning pigs (n = 100; 7.44 kg BW) were assigned to one of four dietary treatments with six replications per treatment and three, four, or five pigs per pen. The ADG, ADFI, and G/F were measured at d 7, 14, and 21. Pigs fed diets containing AS had increased (P < 0.05) ADG from d 0 to 7 and d 14 to 21, and overall when compared with pigs fed diets without antibiotic.

**Key Words:** Pigs, Alligator, Antibiotic

**M244 Post-weaning development of the microbiota composition and activity in piglets fed diets with wheat bran, wheat middlings or sugar beet pulp.** F. Molist\*, A. Gómez de Segura, E. G. Manzanilla, J. Gasa, R. G. Hermes, and J. F. Pérez, *Universitat Autònoma de Barcelona, Spain.*

To determine the effect of dietary fibrous ingredients on intestinal microbial population and activity, 48 early-weaned (24–25 days) pigs were divided into six dietary treatments: a standard diet (STD) based on corn, barley and soybean protein; or high fibrous diets obtained by replacing some major ingredients of STD with 8% Wheat bran (WB), 8% Wheat middlings (WM), 6% Sugar beet pulp (SBP), 4% Wheat bran and 3% Sugar beet pulp (WB–SBP), or 4% Wheat middlings and 3% Sugar beet pulp (WM–SBP). After 10 and 15 days receiving ad libitum the experimental diets, animals were weighed, sacrificed, and digesta samples from the caecum, colon and rectum were taken. Short-chain fatty acid (SCFA) concentration was determined and microbial counts for enterobacteria and lactobacilli were determined by quantitative-PCR. Inclusion of WB promoted increases in the weight gain of the animals at day 15 (142, 1256, 136, 1164, 700, 1187 g for STD, WB, WM, SBP, WB–SBP, WM–SBP). Wheat bran, either at 8% or 4% promoted a decrease in enterobacteria counts in the caecum (11.1, 9.9, 11.7, 10.8, 8.2 and 11.6 log 16 S rDNA gene copies/g FM) and feces (10.3, 9.2, 11.5, 10.9, 8.7, 11.9 log 16 S rDNA gene copies/g FM for STD, WB, WM, SBP, WB–SBP, WM–SBP, respectively, P<0.001) of piglets 15 days after weaning. No significant differences were observed on the lactobacilli counts at d15 or on the microbial counts at d10. The SCFA concentrations increased significantly from d10 to d15 in the caecum and feces. Diets supplemented with SBP decreased the isoacids (isobutyrate and isovalerate) proportions in the caecum of piglets at day 10 after weaning (P<0.003) and in the feces at day 15 post-weaning (P<0.004), while the inclusion of WB significantly increased the percentage of butyrate in the caecum at d15 (7.14, 14.22, 5.39, 4.63, 12.36, 11.48 %

for STD, WB, WM, SBP, WB–SBP, WM–SBP, respectively, P<0.001). Results suggest a beneficial shift in the composition and activity of the hindgut microbial population of early weaned piglets fed on diets supplemented with WB.

**Key Words:** Piglets, Dietary Fiber, Microbial Population

**M245 Dietary preference for methionine sources in 8 to 25-kg nursery pigs.** T. Eittle<sup>1</sup>, M. Rademacher<sup>2</sup>, F. X. Roth<sup>3</sup>, and R. L. Payne<sup>\*2</sup>, <sup>1</sup>BOKU University, Vienna, Austria, <sup>2</sup>Degussa, Hanau, Germany, <sup>3</sup>Technical University of Munich, Munich, Germany.

Feed intake during the nursery period of growth is crucial to a pig's growth and development. As such, there is considerable interest about how the ingredients used in a typical nursery pig diet influence feed intake, and if a pig can demonstrate a preference for a particular ingredient. Therefore, the objective of this study was to investigate the dietary preferences of nursery pigs given the choice of diets supplemented with either DL-Met (DLM, 99%) or liquid Met hydroxy analogue (MHA-FA, 88%), which are the commonly used sources of supplemental Met. Mixed-sex pigs with an initial body weight of 8.1 ± 1.0 kg were randomly subdivided into 8 groups of 12 animals each for a 5-wk choice feeding trial. Groups 1 through 4 were fed one of the following treatments: 1) a Met-deficient basal diet (0.25% Met, 0.32% Cys, and 1.36% Lys); 2-3) diet 1 plus 0.1 or 0.2% DLM; or 4) diet 1 plus 0.113% MHA-FA. Treatment groups 5 through 8 were able to choose from pairs of treatment diets, and their treatments were: 5) diet 1 plus 0.1% DLM or 0.113% MHA-FA; 6) diet 1 plus 0.1% DLM or 0.152% MHA-FA; 7) diet 1 plus 0.2% DLM or 0.225% MHA-FA; or 8) diet 1 plus 0.2% DLM or 0.305% MHA-FA. Pigs fed treatments 5 and 6 had higher (P < 0.05) ADFI than those fed the Met-deficient basal diet. Pigs in treatment groups 2 through 8 had improved (P < 0.05) ADG and feed:gain compared with those fed the Met-deficient basal diet. In the non-choice groups (treatments 1 through 4), feed intake was not influenced (P > 0.05) by Met source or concentration. However, in the choice-fed groups, pigs fed treatments 5, 7, and 8 consumed a higher percentage (P < 0.05) of their total feed intake from the diets containing DLM than they did from the diets containing liquid MHA-FA. In this trial, pigs expressed a dietary preference for DL-Met when given a choice of supplemental Met sources. Furthermore, this preference may be the result of sensory properties of the diets offered to the nursery pig.

**Key Words:** Ingredient, Methionine, Pig

## Physiology & Endocrinology - Livestock and Poultry: Endocrinology and Metabolism

**M246 Hormonal response of bulls to glucose challenge in a segregating family structure.** R. Pfuhl\*, O. Bellmann, F. Schneider, C. Kühn, and K. Ender, *Research Institute for the Biology of Farm Animals (FBN), Dummerstorf, Germany.*

Cattle of the accretion type (Charolais) and the secretion type (Holstein) differ in their hormonal regulation of nutrient utilization. To deepen the insight in the physiological backgrounds, 65 F<sub>2</sub> cross bulls from five Charolais grandfathers and Holstein grandmothers were investigated to test a potential segregation of their glucose-induced insulin response. Growing bulls showed the highest hormonal activity at the age of eight months due to the onset of puberty. Thus, bulls of five families were

subjected to a glucose challenge test at this age. Every bull received a glucose solution intravenous (1g/kg BW<sup>0.75</sup>) via catheter into the jugular vein. Blood samples were taken in the same way before and 7, 14, 21 and 28 minutes after glucose administration. Serum insulin and glucagon concentrations as well as the glucose concentration in the whole blood were recorded. The data were evaluated with the GLM procedure of SAS. All tested bulls showed a characteristic glucose clearance curve (P=0.9832). In contrast, the insulin response curve differed and showed high variation between and within the five families. The average serum insulin concentration of family 4 reached greatest values and decreased slower, than in the other families.