for 5 minutes. A linear plateau model of percent internal staining vs. temperature indicated increased internal staining until 70°C with a slope of 1.12. Measures of percent activity indicated complete inactivation of oncospheres at temperature below the gelatinization temperature of potato starch. Additionally, trypan blue staining was not a good measure of viability of *Taenia* eggs.

Key Words: *Taenia hydatigena*, thermal inactivation, viability

Nonruminant Nutrition: Feed Ingredients

M177 Characterization of protein structure of the new co-products from bioethanol production in western Canada using DRIFT Spectroscopy: Comparison among blend DDGS, wheat DDGS and corn DDGS, between wheat and wheat DDGS, and corn and corn DDGS. P. Yu*, D. Damiran, and W. Nuez Ortin, *Department of Animal and Poultry Science, University of Saskatchewan*, *Saskatoon, SK, Canada*.

The objective of this study was to use DRIFT spectroscopy as a novel approach to identify differences in protein molecular structure in terms of amide profile between wheat and wheat DDGS, between corn and corn DDGS, between bioethanol plants, and among wheat DDGS, corn DDGS and blend DDGS. The items assessed included protein amide I, amide II and amide I-to-II ratio. The protein IR spectrum has two primary features, the protein amide I (ca. 1600-1700 cm-1) and amide II (ca. 1500-1560 cm-1) bands. The amide I and II profile depends on the protein molecular structural chemical make-up and they are usually affected by processing methods and condition. The hypothesis was that protein molecular structure (chemical make-up) was changed after bioethanol processing and these changes affected DDGS nutritive value. Results showed that using DRIFT spectroscopy, the protein molecular structural makeup was revealed and identified. Amide I peak area significantly differed between wheat and wheat DDGS (162.5 vs. 291.8 KM unit, P<0.05), corn and corn DDGS (64.4 vs. 261.8 KM unit, P<0.05), wheat and corn (P<0.05). No difference (P>0.05) among wheat DDGS, corn DDGS and blend DDGS was detected. The amide II peak area significantly differed between wheat and wheat DDGS (35.1 vs. 95.0 KM unit, P<0.05), and corn and corn DDGS (14.1 vs. 118.5 KM unit, P<0.05). No differences (P>0.05) between wheat and corn and among wheat DDGS, corn DDGS and blend DDGS were found. Amide I-to-II ratios significantly differred between wheat and wheat DDGS (4.61 vs. 3.08, P<0.05), corn and corn DDGS (4.56 vs. 2.21, P<0.05). No differences (P>0.05) between wheat and corn, between bioethanol plants but significant differences among wheat DDGS, blend DDGS and corn DDGS were detected. These results indicated that bioethanol processing changes the original protein molecular structure (chemical make-up), which may play a major role to determine nutritive value.

Key Words: protein structure and amide I to II ratio, DDGS, molecular spectra

M178 Effects of various cereals on nursery pigs: Gastrointestinal bacterial populations. Y. Liu*, M. Rossoni, J. Barnes, and J. E. Pettigrew, *University of Illinois*, *Urbana*.

A study was conducted to evaluate the influence of different cereal grains on the bacterial populations in the gastrointestinal tract of young weaned pigs. A total of 24 pigs (7.71 kg BW) were weaned at 21 days of age and randomly allotted to one of four treatments. Corn, barley, rolled oats, and rice were the only cereals contained in each treatment. Pigs were allowed *ad libitum* access to feed and water throughout the 14-day experimental period. At the end of the experiment, all pigs were euthanized and slaughtered to collect mucosal and digesta samples from ileum and distal colon. Denaturing gradient gel electrophoresis (DGGE) was used to estimate the species diversity of the bacterial population (the number of bands) and quantitatively measure the similarity of population structures (banding pattern) expressed by Sorenson's pairwise similarity coefficients (Cs) among pigs within (intratreatment) and between (intertreatment) treatments. Intratreatment Cs values varied according to the digestive tract site and sampling type. In ileal mucosa, the higher ($P < 0.05$) intratreatment Cs value in corn group (79, 68, 67% for corn, barley and rolled oats) indicated that feeding corn made pigs more similar to each other. However, in ileal digesta, barley had higher ($P < 0.05$) intratreatment Cs value compared with rolled oats and corn (71, 58, 49% for barley, rolled oats and corn). The intertreatment Cs values were lower ($P < 0.05$) than the intratreatment Cs values in the mucosa of distal colon, indicating that there were significant effects of different cereal grains on microbial populations in the distal colon mucosa of nursery pigs. Pigs fed rolled oats diet had more (22.25 vs. 12.25; $P < 0.05$) bands in ileal digesta than pigs fed corn diets. There was no difference in the number of bands in other sample sites. In a few cases, specific bands were present in most pigs fed one treatment, but absent from most pigs fed other treatments. In conclusion, feeding of different cereals as sources of energy altered microbial populations in the GI tract.

Key Words: cereals, microbial ecology, nursery pigs

M179 Effects of altering the syrup inclusion rate and the dryer recycling rate on DDGS composition and digestibility in pigs. K. A. Houin*, B. E. Aldridge, B. T. Richert, A. L. Sutton, and J. S. Radcliffe, *Purdue University*, *West Lafayette, IN*.

Ten crossbred barrows with an average initial BW of 27 kg were used in a replicated 5 x 5 Latin Square designed experiment to investigate the effects of syrup inclusion rate and dryer recycling rate on nutrient digestibility of DDGS. For this experiment the syrup inclusion level and the dryer recycling rate were altered in a commercial plant to produce the following DDGS batches: 1) normal syrup, normal recycle rate, 2) 0.5x syrup, normal recycle rate, 3) no syrup, normal recycle rate, and 4) 0.5x syrup, no recycling. Diets 1-4 consisted of 50% of each DDGS batch and 50% of a corn basal diet. Diet 5 was the corn basal diet. Each 2-week period consisted of a 7 d adjustment period, then a 7 d collection period comprised of a 3 d total collection, 12 h ileal collection, 3-day adjustment, and a second 12 h ileal collection. Feed was provided at 9% metabolic BW ($BW^{.75}$) in 2 daily feedings and water was provided ad libitum. Ileal samples were pooled by pig and freeze dried. During total collections, feces and urine were collected twice daily. Urine was collected in buckets containing HCl to prevent N loss. Feed, ileal digesta, and feces were analyzed for N, Cr, Ca, P, and DM. Amino acid concentrations of feed and ileal samples were determined by HPLC. As syrup inclusion in DDGS decreased, protein and amino acid concentration increased, while mineral content decreased. For example, CP protein concentration increased from 26.7% to 32.3% when syrup was reduced to 0%, while ash content decreased from 4.0

to 2.0%. Apparent ileal digestibility (AID) of amino acids was higher (P<0.05) for diets containing DDGS compared to the corn basal diet. However, no differences (P<0.10) were detected for AID of amino acids between DDGS batches. Overall, AID of amino acids was high, ranging from 82.6 to 86.6% for lysine. Phosphorus digestibility was higher for batch 1, indicating that the P in syrup is more available than in the DDG. Overall, nutrient digestibilities were higher in DDGS compared to corn. Altering the syrup inclusion rate or the dryer recycling rate had no affect on amino acid AID.

Key Words: pig, dried distillers grains with solubles, digestibility

M180 Combined usage of corn distillers solubles and corn steep water for liquid fed growing-finishing pigs. C. L. Zhu*, D. Wey, and C. F. M. de Lange, *University of Guelph, Guelph, ON, Canada*.

Liquid co-products, such as corn distillers solubles (CDS) and corn steep water (CSW), may serve as alternatives for conventional pig feed ingredients. In previous studies the optimum inclusion levels of CDS and CSW in growing-finishing pig diets have been established at about 15% of diet DM. The aim of this study was to establish the optimum dietary inclusion level of a 50:50 mix of CDS and CSW. Purebred Yorkshire pigs (n= 144; initial and final BW 31.9 and 116 kg, respectively; 4 gilts and 4 barrows per pen; 4 or 5 pens per treatment) were liquid-fed according to a 2-phase feeding program and exposed to one of four dietary treatments: (1) Control (standard corn and SBM based diets), (2) Low (5% CDS + 5% CSW; DM basis), (3) Moderate (10% CDS + 10% CSW), and (4) High co-products (15% CDS + 15% CSW). The DM contents of CDS and CSW were 31.5% and 49.0%, respectively. CSW was stored at source for at least 2 weeks prior to feeding to allow conversion of soluble sugars to lactic acid and incubation with phytase to release phytate phosphorus. Feed delivery (water to feed DM 2.6:1) was computer controlled using feed sensors in the troughs. Pigs had free access to additional water. Increasing dietary levels of co-products reduced ADG (1047, 1055, 966 and 933 g/d for treatments 1 to 4, respectively; SEM 27) and increased feed:gain (2.27, 2.26, 2.37, 2.43; SEM 0.03; DM basis) linearly (P < 0.01). Carcass back fat and estimated lean yield did not differ among treatments 2 to 4 (P > 0.10), but were least favorable (P < 0.05) for Control (backfat 22.4 for Control vs 18.2 to 19.2 mm for other treatments; SEM 0.8; lean yield 58.5 vs. 60.1 to 60.6%; SEM 0.4). Increasing dietary levels of co-products linearly increased lightness (Minolta L value; 48.2, 48.8, 51.0 and 50.9; n=8; SE 0.1; P = 0.03) and drip losses from loin samples (9.1, 8.4, 10.3 and 10.8%; n=8; SE 0.7; P = 0.04). Increasing levels of both CDS and CSW to 10% or more of diet DM compromised growth performance and some aspects of meat quality in growing-finishing pigs.

Key Words: pigs, co-products, liquid feeding

M181 Comparison of drying methods for whole frozen fish commonly fed to marine mammals. S. M. Langowski[1], A. W. White[1], K. L. West[1], K. S. Yamamoto[2], and J. R. Carpenter*[2], [1]*Hawaii Pacific University*, *Honolulu*, [2]*University of Hawaii at Manoa*, *Honolulu*.

Aquaria routinely determine the nutritional composition of the fish that are fed to captive marine mammals by sending samples to commercial laboratories. Establishing proximate composition is expensive and time consuming. However, previous work has demonstrated that dry matter values can be used to predict the proximate composition of fish commonly fed to marine mammals. The aims of this study were to compare different drying methods for whole fish. Six random samples for each fish type (capelin, high fat herring, low fat herring, pollock and squid) were each analyzed in duplicate using six different drying techniques. Fish were homogenized and wet weights obtained prior to drying. Dry weights were obtained using drying temperatures (50°C, 65°C, 100°C) with conventional ovens (CO), a 50°C Forced Air oven (FA), a freeze drier (FD) and a standard microwave (MW). The percent DM and percent error for duplicate analyses were then determined. An ANOVA was run to determine the statistical significance between the drying method and the species of fish dried. The interactions between species were significant (p =.002) which indicated that the degree of percent error in a particular species of fish is dependent on the method of drying. However interactions between drying methods were not significant (p=0.432) which indicated that there is no significant difference in dry matter values among the drying methods. It was concluded that the percent error among duplicate samples can be used to evaluate the repeatability of the various drying methods. Methods with the lowest to highest percent error among the samples were FD, MW, 50CO, 100CO, 65CO, and 50CFA. A standard microwave yields reliable results when used as a drying method for whole fish. It is feasible to obtain results using the microwave on site at zoos and aquaria. In conjunction with DM predictive equations, this could potentially save facilities time and money when interested in the nutritional composition of animal diets.

Key Words: drying methods, proximate analysis, microwave and freeze dried

M182 Effects of feeding soybean meal from high protein or low oligosaccharide varieties of soybeans to weanling pigs. K. M. Baker*, B. G. Kim, and H. H. Stein, *University of Illinois*, *Urbana*.

An experiment was conducted to determine the effect of using 5 different sources of soybean meal (SBM) on growth performance of weanling pigs. The 5 sources included hexane extracted SBM produced from high protein (SBM-HP) or conventional soybeans (SBM-CV), and mechanically extruded-expelled SBM produced from high protein soybeans (EE-SBM-HP), low oligosaccharide soybeans (EE-SBM-LO), or conventional soybeans (EE-SBM-CV). A total of 200 pigs were weaned at approximately 20 d of age and randomly allotted to treatment diets. Five phase 1 diets containing each source of SBM were fed during the initial 14 d post-weaning and 5 phase 2 diets were fed during the following 17 d. All diets within each phase were formulated to contain similar quantities of ME and standardized ileal digestible AA. Digestibility values for AA and ME in the 5 SBM were measured in previous experiments. The ADG, ADFI, and G/F were determined for each phase and for the entire experimental period. There were no differences observed for ADG, ADFI, and G/F, for phase 1, phase 2, or for the entire period. These data confirm that the values for ME and digestible AA that were previously measured in SBM produced from high protein or low oligosaccharide varieties of soybeans can be used to formulate diets for weanling pigs without compromising pig performance.

Table 1. Performance during a 31-d post-weaning period of weanling pigs fed diets containing soybean meal (SBM) from high protein (HP), low oligosaccharide (LO), or conventional (CV) varieties of soybeans that were hexane extracted (HE) or extruded-expelled (EE)

Item	HE-SBM-HP	HE-SBM-CV	EE-SBM-HP	EE-SBM-LO	EE-SBM-CV	SEM	P-value
Initial BW, kg	5.37	5.32	5.33	5.33	5.35	0.32	0.681
ADFI, g	373	387	378	403	378	20	0.644
ADG, g	258	264	248	273	256	12	0.532
G:F	0.695	0.687	0.656	0.679	0.678	0.01	0.067
Final BW, kg	13.37	13.52	13.02	13.78	13.28	0.60	0.55

N=9.

Key Words: high protein soybean meal, low oligosaccharide soybean meal, weanling pigs

M183 The granulated barley provided during the finishing period improves the production cost, intramuscular fat percentage and oleic acid content in muscle from heavy pigs. A. Daza[1], M. A. Latorre*[2], G. Cordero[3], A. Olivares[3], and C. J. López-Bote[3], [1]*Universidad Politécnica de Madrid, Madrid, Spain*, [2]*Centro de Investigación y Tecnología Agroalimentaria de Aragón, Zaragoza, Spain*, [3]*Universidad Complutense de Madrid, Madrid, Spain*.

This trial was conducted to determine the growth performance, production cost, carcass traits, and intramuscular fat (IMF) quality of heavy pigs fed one of two different diets. Thirty-two Duroc × (Large White × Landrace) barrows (86.6 kg BW) were randomly allotted to sixteen pens (2 pigs per pen) and fed according to the following treatments: sixteen pigs were given a control diet (3200 kcal ME/kg, 13.6% CP, and 0.60% digestible lys) and the other sixteen pigs received granulated barley (3000 kcal ME/kg, 10.1% CP, and 0.26% digestible lys). Both groups of pigs were slaughtered at 129.8 kg BW. The dietary treatments did not affect growth rate, daily intake or carcass traits. Feed conversion ratio was higher (P<0.05) for pigs fed barley than for pigs fed the control diet (5.11 vs. 4.52 kg/kg, sem = 0.14). However, the cost of production of carcass weight/kilogram was lower (P<0.05) in pigs that consumed barley than for those given the control diet (1.30 vs. 1.73 euros/kg, sem =0.014). The IMF percentage in Longissimus dorsi muscle tended to be (P<0.07) higher in pigs fed granulated barley than in pigs fed the control diet (1.73 vs. 1.30%, sem = 0.15). The pigs fed granulated barley had higher (P<0.05) a*, b*, and c* values and a lower (P<0.05) H° value and thawing losses than the pigs fed the control diet, while no significant differences were observed for shear force, L* value, and cooking losses. The dietary treatments did not significantly effect the proportions of C16:0, C18:0, and SFA in IMF from the Longissimus dorsi muscle. However, the C18:1 n-9 and MUFA proportions were higher (P<0.05) in IMF from pigs fed granulated barley than in that from pigs fed the control diet (48.38 vs. 45.79%, sem = 0.56 and 52.49 vs. 49.82%, sem = 0.56, respectively). We can conclude that the granulated barley provided during the finishing period improved the cost of production, intramuscular fat proportion and oleic acid content in muscle from heavy pigs.

Key Words: barley, finishing period, heavy pigs

M184 Nutritive utilization of protein and amino acids from raw cowpea flour (*Vigna unguiculata*) in growing rats. G. Kapravelou[1], J. Martino*[1], E. Nebot[1], J. M. Porres[1], and I. Fernández-Fígares[2], [1]*University of Granada, Granada, Spain*, [2]*Spanish Research Council, CSIC, Granada, Spain*.

Cowpea (*Vigna unguiculata*) is a widely consumed legume with important nutritional and functional potential due to its high content of protein, complex carbohydrates, minerals, vitamins and antioxidants. The aim of this study was to compare raw cowpea and casein-methionine (control) in terms of nutritive utilization of protein and amino acids using the rat as a model. Two experimental diets in which casein or raw cowpea flour were the sole sources of protein, both supplemented with 0.5% methionine, were ad libitum fed for two weeks to growing rats (10 per group) individually housed in metabolic cages to allow for separate urine and feces collection. Prior to the experimental period, the animals were fed a low-protein (4%) diet for 6 days to estimate endogenous excretion of N and amino acids. Daily food intake was similar (P ≥0.05) between the two groups studied, whereas standardized digestibility of protein and most AA of the raw cowpea diet was significantly lower than control (79.4 *vs*. 91.5% for N, 83.1 *vs*. 93.6% for total AA; P ≤0.001) No differences (P ≥0.05) were found for metabolic utilization of protein. Weight gain (5.22 *vs*. 4.16 g/day; P ≤0.001) and growth efficiency coefficient (daily gain/ protein intake; 3.03 *vs*. 2.77; P ≤0.01) were significantly higher for the control fed rats when compared to the raw cowpea group. Liver and spleen weights were higher (P≤0.05) and cecal weight was lower (P ≤0.05) in the control group of rats when compared to the raw cowpea group, whereas no differences (P ≥0.05) were found in colon weight. In conclusion, nutritive utilization of cowpea protein ought to be significantly enhanced to achieve a nutritive utilization similar to casein. Heat treatment or fermentation are technological treatments that could potentially improve the protein quality of raw cowpeas. Further investigation is warranted to improve the nutritive value of this legume.

Key Words: cowpeas, protein and amino acids, nutritive utilization

M185 Influence of sunflower seed meal on histological alterations of broiler chickens. S. Salari*, H. Nassiri Moghaddam, J. Arshami, A. Golian, and M. Maleki, *Ferdowsi University of Mashhad, Mashhad, Iran*.

In this study, 176 day-old male broiler chickens (Ross strain) were allocated to four treatments in pens (120x100x90 cm) with four replicates (11 birds /pen) in a completely randomized design to evaluate the effect of sunflower seed meal (SFSM) on histological alterations of the small intestine in broiler chickens. Treatments were 0, 7, 14 and 21 percent of SFSM for 1-28 days and calculated to contain 20.86% CP and 2900 kcal of ME per kg of diet. At the end of the experiment (28 days of age) one bird from each treatment was killed by cervical dislocation, and segments were removed from the duodenum, jejunum, and ileum as follows: 1) intestine from the gizzard to pancreatic and bile ducts was referred to as the duodenum, 10 cm of first section of which was taken for microscopy; 2) 10 cm of first section, between the point of entry of the bile ducts and Meckel's diverticulum (jejunum), and 3) 10 cm of first section from Meckel's diverticulum to the ileocecal junction (ileum). The samples were flushed with physiological saline and fixed in 10% formalin. Cross sections for each intestinal sample were prepared after staining with hematoxylin and eosin using standard paraffin embedding procedures. Villus height was measured from the tip of the villus to the villus-crypt junction; crypt depth was defined as the depth of the invagination between adjacent villi. The villus width measured at the bottom of villi. The slides were evaluated

using Olympus (BX51, Japan) microscope coupled with camera and the computer image analysis software for the morphometrical research was used. The results showed that by increasing levels of SFSM in the diets, villus height and crypt depth of duodenum and jejunum were significantly ($p<0.05$) decreased and increased, respectively. But SFSM did not affect the villus of the ileum. Also, incorporation of SFSM had a significant effect on villus width ($p<0.05$). We concluded that the high fiber content of SFSM had a negative effect on histological parameters of the small intestine of broilers.

Key Words: histology, villus, broiler chicks

M186 Guar gum as a source of soluble non-starch polysaccharides for swine decreases nutrient digestibility and ammonia emission while increasing manure odor. W. Zhang[1], E. van Heugten*[1], T. van Kempen[1,2], and V. Fellner[1], [1]*North Carolina State University*, *Raleigh*, [2]*Provimi, RIC*, *Brussels, Belgium*.

This study was designed to determine the impact of soluble NSP (sNSP) on nutrient digestibility and emission of ammonia and odor from manure. Diets consisted of a low fiber control (degermed, dehulled corn and soy protein isolate) and the control with 2, 4, or 8% added guar gum (> 75% galactomannan). Pigs (n=28; BW = 26.8±1.4 kg) were fed diets for 4 wk. Subsequently, feces and urine were collected quantitatively for 3 d and pigs were then sacrificed for collection of digesta from the ileum, cecum, and colon. Fresh manure was obtained by mixing feces and urine for each pig at the ratios they were produced. Aged manure was obtained by anaerobically aging this mixture for 21 d. Guar gum did not affect fecal DM output, but linearly decreased ($P < 0.001$) ileal and fecal DM content and thus increased daily fecal output ($P < 0.02$). Apparent ileal N digestibility ($P < 0.01$), fecal N and GE digestibility ($P < 0.001$), ADFI, ADG, N intake, and N retention ($P \leq 0.03$) linearly decreased with increasing guar gum. pH of the colon content, but not ileum or cecum, decreased linearly with increasing guar gum. Fecal concentrations of acetic acid, propionic acid, butyric acid, valeric acid, and total SCFA increased linearly ($P < 0.05$) with increasing guar gum. Increasing guar gum had no effect on odorants and pH in fresh manure, but it linearly ($P < 0.05$) increased dimethyldisulfide ($\log_{10}$ peak area; 7.96, 8.32, 8.57, and 8.55), dimethyltrisulfide (7.03, 7.45, 7.76, and 7.92), and phenol (7.45, 7.67, 7.81, and 7.80) in head space and acidity of aged manure. Odor intensity tended ($P = 0.08$) to increase (2.96, 3.27, 3.40, and 3.35) with increasing guar gum in aged manure, but not fresh manure. Cumulative manure ammonia emission increased in fresh manure with increasing guar gum but only up to 24 h ($P < 0.05$). In aged manure, ammonia emission decreased linearly (up to 47% at 12 h and 7% at 96 h; $P < 0.05$) with increasing guar gum. In conclusion, the use of sNSP reduced ammonia emission in aged manure, but decreased nutrient digestibility and increased odor emission, thus limiting its environmental benefits.

Key Words: ammonia, NSP, odor

M187 The effect of dried distillers grains with solubles in the diet of the growing-finishing pig on performance and nitrogen and phosphorus excretion. P. McDonnell, J. J. Callan, and J. V. O'Doherty*, *Lyons Research Farm, University College Dublin*, *Newcastle, Co Dublin, Ireland*.

A completely randomised design experiment was performed to determine the optimum inclusion level of dried distillers grains with solubles (DDGS) on pig growth performance, carcass characteristics, apparent nutrient digestibility, nitrogen (N) balance, phosphorous (P) balance and ammonia emissions. Three hundred fifty two pigs (42.4 kgs, SD = 6.4 kgs) were blocked on the basis of initial live weight and assigned to one of the 4 dietary treatments: (T1) basal diet, (T2) basal diet with 100g/kg DDGS, (T3) basal diet with 200g/kg DDGS, (T4) basal diet with 300g/kg of DDGS. The DDGS directly replaced wheat in the diet. The diets were formulated to contain similar concentrations of ileal digestible amino acids, available P and net energy. There was no effect of increasing levels of DDGS on daily gain, feed intake, gain to feed ratio and carcass characteristics during the experimental period. There was a linear decrease ($P<0.01$) in DMD and gross energy digestibility with increasing levels of DDGS in the diet. There was a linear increase in N intake ($P<0.01$), urinary N excretion ($P < 0.001$) and total N excretion ($P < 0.001$) with increasing levels of DDGS in the diet. There was a linear decrease ($P < 0.01$) in P intake as the level of DDGS increased in the diet. There was no difference in ammonia emissions as the level of DDGS increased in the diet. Results from this study indicate that the inclusion levels of 300g/kg of DDGS in the diet of the growing-finishing pig do not affect performance or carcass characteristics. However, increasing the level of DDGS in the diet will increase total nitrogen excretion.

Key Words: pigs, DDGS

M188 Influence of sunflower seed meal (SFSM) on body organ weights and blood parameters of broiler chickens. S. Salari*, H. Nassiri Moghaddam, J. Arshami, and A. Golian, *Ferdowsi University of Mashhad*, *Mashhad, Iran*.

In this study, 176 day-old male broiler chickens (Ross strain) were allocated to four treatments with four replicates (11 in each replicate) in a completely randomized design to evaluate the effect of sunflower seed meal on body organ weight and blood parameters of broiler chicks for 7 weeks. Treatments were 0, 7, 14 and 21 percent of SFSM for starter (1-21 days) and grower phases (22-49 days). The starter phase diets were calculated to contain 20.86% CP and 2900 kcal of ME per kg of diet. They also contained 18.75% CP and 3000 kcal of ME per kg of diet for the grower phase. At 28 days of age, blood samples were collected from chicks. At the end of the experiment (49 days), one bird from each replicate was slaughtered to study the relative weights of liver, abdominal fat, gizzard, thigh, breast and gastrointestinal tract. The results of the present study indicated that triglyceride and LDL concentrations decreased significantly and HDL concentration increased ($P<0.05$) in the birds fed increasing levels of SFSM but the activity of alkaline phosphatase and the levels of calcium, phosphorus, glucose and protein in serum were not affected by the treatments employed. The relative weight of the breast, thigh, liver and abdominal fat were not affected by the SFSM. However, the relative weight of gizzard and gastrointestinal tract were increased significantly ($P < 0.05$) in birds fed SFSM diets compared to those fed control diet. It is concluded that SFSM can be used in broiler chick diets and its high fibre content had no significant effect on body organ weight and blood parameters.

Key Words: blood parameters, organ, broiler chicks

M189 The effects of increasing the level of rapeseed meal in the diet of the growing-finishing pig on the growth performance and nitrogen and phosphorus excretion. P. McDonnell, S. Figat, J. J. Callan, and J. V. O'Doherty*, *Lyons Research Farm, University College Dublin*, *Newcastle, Co. Dublin, Ireland*.

A completely randomized design experiment was performed to examine the effects of increasing the level of rapeseed meal (RSM) and reducing the level of soybean meal (SBM) on the growth performance, carcass characteristics, apparent nutrient digestibility, nitrogen (N) balance, phosphorous (P) balance and ammonia emissions in the diet of the growing-finishing pig. Three hundred thirty-six pigs (42.1 kgs S.D. = 3.0 kgs) were blocked on the basis of initial live weight and assigned to one of four dietary treatments. (T1) basal diet with 210g/kg SBM; (T2) basal diet with 140g/kg SBM and 70g/kg RSM; (T3) basal diet with 70g/kg SBM and 140g/kg RSM; (T4) basal diet with 210g/kg RSM. All diets were formulated on an ileal digestible amino acid, net energy and available phosphorous basis. There were no significant effects of increasing levels of RSM on average daily gain, feed intake, gain to feed ratio and carcass characteristics during the experimental period. There was a linear decrease in gross energy digestibility ($P<0.01$) with increasing levels of RSM in the diet. There was a linear decrease ($P<0.05$) in N intake ($P<0.05$), urinary N excretion ($P<0.01$), N digestibility ($P<0.05$), total N excretion ($P<0.05$) and N retention ($P<0.05$) with increasing levels of RSM. There was a quadratic response ($P<0.05$) in fecal P excretion and total P excretion with increasing levels of RSM in the diet. There was no further increase in fecal P excretion and total P excretion above 140 g/kg RSM inclusion. The results of this study indicate that RSM can be used as a direct replacement for soybean meal with no depression in performance when formulated on an ileal digestible amino acid and net energy basis. Increasing the level of RSM in the diet will reduce N intake, urinary N excretion and total N excretion.

Key Words: rapeseed, soybean, pigs

M190 Effect of hydrothermally processed corn on fecal digestibility of energy in cannulated roosters. L. Babinszky* and J. Tossenberger, *Kaposvár University*, *Kaposvár, Hungary*.

The trial aimed to determine how hydrothermal processing of corn in corn-soy based broiler diets affects fecal digestibility and availability [intake-feces-urine/intake] of dietary energy. Studies were conducted with 4 adult Hy-Line brown roosters (initial live weight: 3.4 ± 0.2 kg) per treatment (trt), in 2 replicates (n=8/trt). Before the studies a simple T-cannula was implanted in the terminal colon to allow separate and quantitative collection of feces and urine, and thus the determination of digestibility of energy. Diets [starter (S); grower (G); finisher (F)] contained 13.0;13.1;13.2 MJ AMEn (calculated), 226;213;182 g CP, 13.0;12.2;9.6 g LYS and 10.6;9.3;7.1 g M+C per kg. Proportion of corn in diets was 515;515;566 g/kg. Two trts per diet were formulated. Trts "A" were formulated with untreated corn (UTC); trts "B" with steam-flaked corn (100°C, 101.3 kPa, 30 min) (SFC). Nutrient content of the diets was determined according to AOAC (1989); energy content of diet, feces, urine was measured in an adiabatic bomb calorimeter. Data were analyzed by ANOVA (SAS, 2004). The digestibility of energy in diets with UTC was 87.0% (S), 88.5% (G) and 89.3% (F); energy availability was 83.7%, 85.2% and 86.1%. Steam flaking of the corn component increased energy digestibility to 88.6%, 90.1% and 90.9% ($P<0.05$) and improved availability to 86.0%, 87.3% and 88.4% ($P<0.05$). The difference between digestibility and availability in diets with UTC was 3.3% (S), 3.3% (G) and 3.2% (F) (3.3% on average); while in diets with SFC it was 2.6%, 2.8% and 2.5% (2.6% on average). Diets with SFC in contrast to diets with UTC had: DE 14.6 vs 14.4 (S); 15.3 vs 15.0 (G); 15.4 vs. 15.1 MJ/kg (F); AME 14.3 vs 13.8 (S); 14.9 vs 14.5 (G); 15.0 vs 14.5 (F) MJ/kg; AMEn 13.6 vs 13.3 (S); 14.4 vs 14.0 (G); 14.5 vs. 14.1 (F) MJ/kg. Lower differences in AMEn vs AME are attributable to higher N retention of birds fed SFC diets. It can be concluded that the higher energy level due to heat treatment of ingredients should be taken into account in the formulation of dietsl.

Key Words: rooster, digestibility, availability

M191 Evaluation of blue mussel shells as an alternative dietary calcium source for laying hens. J. L. MacIsaac*[1] and D. M. Anderson[2], [1]*Atlantic Poultry Research Institute*, *Truro, Nova Scotia, Canada*, [2]*Nova Scotia Agricultural College*, *Truro, Nova Scotia, Canada*.

In Atlantic Canada, over 5000 tonnes of blue mussel shells (BMS) are produced annually. A trial designed as a one-way analysis with calcium source as the main effect (30% oyster shell (OS): 70% ground limestone (GL), 30% large particle limestone (L): 70% GL, 30% large particle blue mussel shells (BMS): 70% ground blue mussel shells (GBMS), 100% GL, 100% GBMS) was conducted to evaluate BMS as a replacement for large particle sized commercial OS or L as well as ground L. A total of 480 White Leghorn (Lohmann Lite) hens were fed the experimental diets starting at 25 weeks of age for 52 weeks. A calcium balance study was conducted at 30 weeks of age. Calcium source did not have an effect ($P>0.05$) on hen-day production, feed consumption or body weights for the duration of the trial. Egg weights did not differ ($P>0.05$) among the treatments except at the end of the trial. Eggs produced from hens fed the GBMS treatment (62.3 g egg^{-1}) weighed less ($P\leq0.05$) than those produced from hens fed the OS/GL (66.3 g egg^{-1}) and BMS/GBMS (67.3 g egg^{-1}) treatments. Up to 77 weeks of age, there was no effect ($P>0.05$) of calcium source on egg specific gravity (SG) except at 45 weeks of age. Egg breaking strength was not affected ($P>0.05$) by calcium source except at 29 and 59 weeks of age. Birds fed the diet containing L/GL maintained a higher ($P\leq0.05$) calcium balance (1.91 g bird^{-1} day^{-1}) than those fed the OS/GL (1.25 g bird^{-1} day^{-1}) and GL (1.09 g bird^{-1} day^{-1}) diets. Birds fed the GBMS diet maintained a higher ($P\leq0.05$) calcium balance (1.76 g bird^{-1} day^{-1}) than those birds fed the GL diet. BMS and GBMS effectively replaced OS and GL as sources of large and fine particle calcium for layer hens.

Key Words: blue mussel shells, laying hen, production performance

M192 Feeding flax to late-pregnant and lactating sows: Effects on sow immunity and antibody transfer to their piglets. M. Lessard*, H. V. Petit, A. Giguère, and C. Farmer, *Dairy and Swine Research and Development Centre, Agriculture and Agri-Food Canada*, *Sherbrooke, QC, Canada*.

The impact of feeding flax as seed, meal or oil to late-pregnant and lactating sows on sow immunity and transfer of antibody (Ab) against ovalbumin (OVA) to piglets was studied. Sixty gilts were fed one of four diets from d 68 of gestation until d 21 of lactation. Diets were: standard without flax, CTL (n=15); 10% flaxseed, FS (n=16); 6.5% flaxseed meal, FSM (n=14); and 3.5% flaxseed oil, FSO (n=15). On d 88 and 101 of gestation, sows were immunized against OVA. Jugular blood samples were obtained before the 1st injection and on d 110 of gestation and d 2 and 21 of lactation to measure Ab against OVA (anti-OVA), lymphocyte proliferation and lymphocyte production of γ-interferon (IFN-γ) after activation with concanavalin A. Milk samples were obtained on d 3 and 20 of lactation to measure anti-OVA. One piglet per litter was slaughtered on d 1 postpartum and a jugular blood sample obtained for anti-OVA analyses. In CTL sows, IFN-γ production by lymphocytes dropped between d 101 of gestation and d 2 of lactation, whereas in FS sows, it increased (P = 0.007). Anti-OVA response for

the whole experimental period was greater in FS than in FSO sows (P = 0.03) and there was no difference between CTL sows and sows from other groups. Anti-OVA concentration in milk on d 3 of lactation was not affected by treatments. Serum concentrations (laboratory arbitrary unit, AU) of anti-OVA in 2 d-old piglets were greater (P = 0.002) in FS (730 AU), FSM (782 AU) and FSO (1098 AU) litters than in CTL (233 AU) litters and percent mortality on d 2 postpartum was lower (P = 0.03) for FS (20.2%), FSM (20.2%) and FSO (20.1%) litters compared with CTL (24.5%) litters. The lymphocyte proliferative response was not affected by treatments. In conclusion, feeding flaxseed to pregnant and lactating sows altered their cellular and humoral immune responses, and feeding flax as seed, meal or oil increased the transfer of anti-OVA to their offspring and reduced piglet mortality. These results suggest that feeding flax to sows may have beneficial effects on piglet health. *Thanks to Shur-Gain and the Québec Federation of Swine Producers for financial support.*

Key Words: fatty acids, immunity, sow

M193 Changes in gut microbiota of broiler chicks fed distillers dried grains with solubles (DDGS) during a coccidial infection. V. Perez-Mendoza*[1], C. Jacobs[1], C. Parsons[1], J. Barnes[1], M. Kuhlenschmidt[1], M. Jenkins[2], and J. Pettigrew[1], [1]*University of Illinois*, *Urbana*, [2]*United States Department of Agriculture*, *Beltsville, MD*.

The effect of dietary DDGS and *Eimeria* infection on composition of the chick gut microbiota was evaluated using a CRD with a factorial arrangement of 3 diets (0, 10, and 20% DDGS) × 2 challenges [*Eimeria acervulina* (*Eimeria*) or non-infected (NoCh)]. The experimental unit was a cage with 5 chicks (8 replicates/treatment) for a total of 240 chicks (6 d old, 82.8±0.11 g BW). Experimental diets were fed at d 7 of age and inoculation was 3 d later: single oral dose of *Eimeria* at 1×10^6 sporulated oocysts/dose. Chicks' weight was recorded on inoculation day and 14 d after; feed intake was also recorded. Mucosal scrapings from the cecum were collected from all chicks and pooled per cage on d 14 post-inoculation. Microbial diversity was assessed as the number of bands by denaturing gradient gel electrophoresis using the V3 region of bacterial 16S ribosome, where each band represents at least 1 bacterial species. Sorenson's similarity percentages (Cs) were used to compare banding patterns between pairs of pens within treatments (homogeneity) and among treatments (inter-treatment Cs values). Feed intake was reduced only by *Eimeria* (40.9 vs. 37.3 g/d; SEM=0.38; P<0.001). Weight gain was reduced by *Eimeria* (30.1 vs. 26.7 g/d; SEM=0.22; P<0.001) and 20% DDGS (28.7, 28.7, 27.8 g/d; SEM=0.27; P=0.03); no interaction was detected. *Eimeria* reduced (P=0.02) microbial diversity, but 10% DDGS increased it in both *Eimeria* and NoCh (DDGS quadratic, P<0.001): 24.9, 31.1, 25.5, 27.8, 36.4, 27.4 bands (SEM=1.7) for 0, 10, and 20% DDGS with *Eimeria* and NoCh. Feeding 10% DDGS increased homogeneity in NoCh chicks, but feeding 20% DDGS reduced it in *Eimeria* chicks (*Eimeria* × DDGS quadratic, P=0.07). Analysis of inter-treatment Cs values indicated that microbiota was changed by each level of DDGS and *Eimeria*, as shown by lower inter-treatment Cs than corresponding intra-treatment values (P<0.05). In summary, dietary DDGS did not prevent *Eimeria* infection, but changed chick gut microbiota regardless of the infection. Additional studies are needed to determine if the observed changes on gut microbiota can be utilized to improve intestinal health.

Key Words: broilers, DDGS, microbiota

M194 Effects of feeding garbanzo beans and canola seed meal to finishing pigs on production, carcass quality and expression of key metabolic control genes. J. McNamara, A. Hutchins, A. Youngquist*, J. Busboom, J. Vierck, C. Schachtschneider, A. Whalen, J. Miller, and A. Lowe, *Washington State University*, *Pullman*.

The objective was to determine production, carcass traits and quality, and to explore gene expression in adipose tissue, liver and muscle of finishing pigs fed garbanzo beans or canola seed meal. Animals (n = 182;Yorkshire and Duroc crosses) were blocked by weight and allotted to diets: Control (C): 61.5% Corn, 31% Peas, 4% SBM; Garbanzo beans (GB): 62.5% Corn, 30% GB, 4% SBM; Canola Seed Meal (CS): 77.5% Corn, 19% CS or both (GBCS): 71% corn, 12.75% garbanzo beans, 12.75% CSM. Pigs were started at BW of 55.7 (SE .53) kg and were fed 9 weeks until the average BW was 110.9 (SE 0.97) kg. An initial slaughter group of 26 pigs was killed for comparison. Treatment groups did not differ in feed intake (2.98 kg/d), ADG (0.91 kg/d) or gain:feed (0.31). Ending BW of pigs killed for carcass analysis (n = 48, 117.4 kg); 10th rib back fat (2.50 cm); loin eye area (39.4 sq cm); and other slaughter and carcass quality traits were not affected by diet. Animals fed CS had numerically more backfat (2.5 and 2.6 cm for CSM and Both). Animals fed C or CS had numerically larger LEA (40.8 and 40.5 sq cm). The GB diet was 1.8% lower in protein, the GBCS diet had about 0.4% less, and animals on GB did eat numerically less feed; this would explain the difference in LEA. However, a diet with garbanzo beans at the same protein concentration would likely support high carcass quality. Adipose tissue (subcutaneous over 10th rib); muscle (semimembranosus) and liver samples were taken and RNA was extracted; RNA samples from 30 pigs showed high quality (A260:A280 = 2.10). Expression of several genes coding for lipogenic enzymes (acetyl CoA carboxylase, fatty acid synthetase); lipolysis control (beta-adrenergic receptors, hormone sensitive lipase) in adipose and liver were measured by RT-PCR. Gene transcripts for lipogenic enzymes mirrored fatness of the animals. There were no clear dietary effects on expression of these genes. These alternative crops can be used for quality pork production without negatively affecting performance or underlying metabolic controls.

Key Words: alternative feeds, carcass quality, gene expression

M195 Digestible and metabolizable energy of oils and lards for growing pigs. H. O. Silva, R. V. Sousa, E. T. Fialho*, J. A. F Lima, and L. F. Silva, *University Federal of Lavras*, *Lavras, MG, Brazil*.

The importance of accurate and reliable Digestible Energy (DE) and Metabolizable Energy (ME) values for oils and lards becomes evident when one considers the fact that energy is the most expensive component of swine diets. Therefore, the objective of this study was to determine the DE and ME values of five samples of different oil sources and two lard sources using a common control diet. The oils used included canola, soybean, linseed, PUFA (polyunsatured fatty acids) , and coconut oil, while the fats were tallow and choice yellow grease. A total of 40 barrows with an average BW of 40.2 ± 1.4 kg were used in the study. For each of the seven experimental diets, diets were formulated by substituting 15 g/kg of oil or lard to a basal corn-soybean meal diet that contained 190 g CP/kg of diet. The corn and soybean meal were adjusted at the same ratio to account for the substitution. Each diet was fed to five barrows in individual metabolism cages with a 5-d acclimation followed by a 5-d period of total, but separate, collection of feces and urine. The DE (kcal/kg) and ME (kcal/kg) results obtained were: canola oil (8630 ± 42 and 8340 ± 38); soybean oil (8670 ± 62 and 8410 ± 56); linseed oil (8380 ± 14 and 8220 ± 46); PUFA (8750 ± 34 and 8540 ± 43); coconut oil (8860 ± 87 and 8680 ± 82); tallow (8880 ± 76 and 8710 ± 58), and

choice yellow grease (8870 ± 67 and 8690 ± 74). There were differences in DE and ME among the oils studied (P<0.05), showing that choice yellow grease had higher energetic values than oils, possibly due to a higher concentration of saturated fatty acids. In conclusion, the variation in each of the oils and lards may be dependent on their fatty acid concentrations. The interaction among these components influences energy content in the ingredients used for swine feed.

Key Words: metabolism assay, energetic value, fatty acids

M196 Feeding flax to late-pregnant and lactating sows: Effects on fatty acid profiles, hormones and performances of sows and their litters. C. Farmer*, A. Giguère, M. Lessard, and H. V. Petit, *Agriculture and Agri-Food Canada, Dairy and Swine R & D Centre, Sherbrooke, QC, Canada*.

The impact of feeding flax as seed, meal or oil to late-pregnant and lactating sows on fatty acid (FA) profiles and sow and litter performances was studied. Sixty gilts were fed one of four diets from 68 d of gestation until 21 d of lactation. Diets were: standard without flax, CTL (n=15); 10% flaxseed supplementation, FS (n=16); 6.5% flaxseed meal supplementation, FSM (n=14); and 3.5% flaxseed oil supplementation, FSO (n=15). Jugular blood samples were obtained on d 62 and 110 of gestation and on d 2 and 21 of lactation to measure FA profiles and concentrations of estradiol, prolactin and progesterone. Milk samples were obtained on d 3 and 20 of lactation. One piglet per litter was slaughtered on d 1 for compositional analyses and piglets were weighed on d 2, 7, 14, 21 (weaning), 28, and 56. On d 110 of gestation and d 21 of lactation, sows fed FS and FSO had less SFA ($P < 0.05$), more PUFA ($P < 0.001$), more n-3 FA ($P < 0.001$) and a lower n-6/n-3 FA ratio ($P < 0.001$) in their serum than sows fed FSM. Milk from sows fed FS and FSO also showed increased n-3 FA ($P < 0.01$) and decreased n-6/n-3 FA ratio ($P < 0.001$) on both d 2 and 20 of lactation. Carcass from FS and FSO newborn piglets had increased n-3 FA ($P < 0.001$) and decreased n-6/n-3 FA ratio ($P < 0.01$) compared with FSM piglets. Circulating hormonal concentrations in sows were not affected overall ($P > 0.1$). On d 20 of lactation, milk from FS, FSM, and FSO sows had more protein than that from CTL sows ($P < 0.01$). FSM piglets tended to weigh more on d 28 ($P < 0.1$) and weighed more on d 56 (23.8 vs 22.6 kg, $P < 0.05$) than FS and FSO piglets. Carcasses of one day-old FSM piglets had greater glycogen (102.8 vs. 59.1 µmole/g, $P < 0.0001$) and DM ($P = 0.05$) contents than those of FS and FSO piglets but organ weights and circulating concentrations of glucose and IGF-I did not differ ($P > 0.1$). Feeding flax as seed or oil to sows altered their FA profiles and that of their offspring without affecting litter growth rate, whereas feeding FSM improved postweaning growth of piglets. *Thanks to Shur-Gain and the Québec Federation of Swine Producers for financial support.*

Key Words: flax, lactation, pigs

M197 Effect of the substitution of soybean meal and corn for cull chickpeas on the apparent digestibility of nutrients in growing diets for pigs. J. M. Uriarte*, J. F. Obregon, H. R. Guemez, R. Barajas, and P. A. Valdez, *Universidad Autónoma de Sinaloa, Culiacán, Sinaloa, México*.

The objective of this experiment was to determine the effect of the substitution of soybean meal and corn for cull chickpeas on apparent digestibility of nutrients in growing diets for pigs. Six pigs (BW = 42.25 ± 1.45 kg; Large White × Landrace × Large White × Pietrain) were used in a replicated Latin Square Design. Pigs were assigned to consume one of three diets: 1) Diet with 18.0% CP and 3.27 Mcal ME/kg, containing corn 69.9%, soybean meal 27.6%, and premix 2.5% (CONT); 2) Diet with 18.0% CP and 3.26 Mcal ME/kg with corn 51.7%, cull chickpeas 25%, soybean meal 18.5%, vegetable oil 2.3%, and premix 2.5% (CHP25), and 3) Diet with 18.0% CP and 3.26 Mcal ME/kg with corn 33.5%, cull chickpeas 50%, soybean meal 9.4%, vegetable oil 4.6%, and premix 2.5% (CHP50). Pigs were individually placed in metabolic crates (0.6 × 1.2 m). The adaptation period was 6 days and sample collection period was 4 days. From each diet and period, one kg of diet was taken as a sample and the total fecal production was collected. DM excreted in feces (216, 221, and 195 g/day) was not affected by treatments (P=0.64) for CONT, CHP25 and CHP50, respectively. Crude protein in feces was similar (P=0.51) between treatments (46, 51 and 44 g/day). Apparent digestibility of DM was equal (P = 0.81) across treatments (88.67, 88.28 and 89.33%). Apparent digestibility of crude protein was not altered (P=0.85) by CHP inclusion (86.30, 85.19 and 86.14%). These results suggest that cull chickpeas can be used up to 50% in growing pig diets without affecting nutrient digestibility.

Key Words: chickpeas, digestibility, pigs

M198 The effect of corn of different textures in dry grain or silage forms on digestibility and growth performance of piglets from 7 to 15 kg. E. T. Fialho*, J. V. Neto, V. S. Cantarelli, M. G. Zangeronimo, J. A. F. Lima, and P. B. Rodrigues, *University Federal of Lavras, Lavras, MG, Brazil*.

A study was conducted to evaluate corn with different textures and storage forms on digestibility of nutrients and growth performance in young piglets. A total of 24 barrows with initial BW 18.7 ± 1.5kg were blocked by weight and randomly allotted to one of four treatments. The treatments were in a 2 × 2 factorial arrangement with main effects of corn textures (flint and dentate) and ensilage process (dry grain and corn grain-70%DM-silage). The diets were formulated to meet the nutrient requirements of piglets according to NRC (1998). Each treatment was fed to six barrows in individual metabolism cages with a 5-d acclimation followed by a 5-d period of total, but separate, feces and urine collection. The results show significant differences (P<0.05) with the silage process, which shows increases (P>0.05) in the digestible coefficient of dry matter and digestible protein and on digestible energy of diets when compared to the results from dry grain. The textures of corn did not show (P>0.05) any influence on digestibility of nutrients on diets formulated with the corn that was tested. A total of 60 barrows (initial weight of 6.5 ± 1.5 kg) were used in a growth performance study for 28-d post-weaning, and were randomly allotted to one of the four treatments described in the metabolism assay. There were three pigs (two barrows and one gilt) per pen and five pens/treatment. Throughout the whole period of the experiment, there were no treatment effects (P>0.05) on body weight, ADG or daily feed intake for piglets fed diets with different flint or dentate corns textures. The dentate corn and the ensilage processes improved (P<0.05) F:G in comparison to the flint texture. In conclusion, the use of ensilage corn increases the digestibility of nutrients and improves the F:G of rations formulated with dentate corn in diets for piglets from 7 to 15 kg.

Key Words: performance, metabolism assay, piglets

M199 Changes in diversity and homogeneity of the gut microbiota of pigs fed distillers dried grains with solubles (DDGS) after an *E. coli* challenge. V. Perez-Mendoza*[1], J. Barnes[1], C. Maddox[1], J. Pluske[2], and J. Pettigrew[1], [1]*University of Illinois, Urbana*, [2]*Murdoch University, Murdoch, WA, Australia*.

To determine changes in pig gut microbiota due to dietary DDGS and *E. coli* infection post-weaning, 48 pigs (6.6±0.51 kg BW) were used in a CRD with a factorial arrangement of 4 diets (0, 5, 10, and 20% DDGS) × 2 challenges [β-hemolytic F18 SLT2 *E. coli* (EcCh), or distilled water (NoCh)]. Diets were fed at weaning (21 d old) and inoculation begun 3 d after (1 oral dose during 3 consecutive days, with 10^{10} cfu/dose in EcCh). Mucosal scrapings were collected from jejunum, ileum, cecum, and colon on post-inoculation d 11. Microbial diversity was assessed as the number of bands by denaturing gradient gel electrophoresis using the V3 region of bacterial 16S ribosome, where each band represents at least 1 bacterial species. Sorenson's similarity percentages (Cs) were used to compare banding patterns between pairs of pigs within treatments (homogeneity) and among treatments (inter-treatment Cs values). In jejunum, microbial diversity was greater (P<0.001) in EcCh; homogeneity increased in NoCh pigs fed 10 and 20% DDGS, but it was reduced with 10% DDGS in EcCh pigs (DDGS × Challenge quadratic, P<0.03). In ileum, microbial diversity and homogeneity did not change. In cecum, microbial diversity was greater in pigs fed 5 and 10% DDGS than in those fed 20% (DDGS quadratic, P<0.01); homogeneity was reduced in EcCh pigs fed 10 and 20% DDGS (DDGS × Challenge linear, P<0.01). In colon, homogeneity was reduced by feeding 10% DDGS in NoCh and by 20% DDGS in EcCh pigs (DDGS × Challenge, P<0.001). Analysis of inter-treatment Cs values indicated differences between most of the EcCh treatments and specific levels of DGGS in NoCh pigs across intestinal sites: microbiota of NoCh pigs fed 10 and 20% DDGS differed (lower inter-treatment Cs than corresponding intra-treatment values; P<0.05) from that of EcCh pigs fed 0 and 20% DDGS in jejunum, or fed 10 and 20% DDGS in cecum. Pig gut microbiota may be altered differently by the inclusion level of DDGS in the diet and the presence of enteropathogenic *E. coli*. It is not clear whether the observed changes in gut microbiota alter intestinal health.

Key Words: pigs, DDGS, microbiota

M200 Variation and relationships in nutrient and mineral composition for six species of whole fish commonly used as animal feeds. K. S. Yamamoto*[1], J. R. Carpenter[1], S. Atkinson[2], L. Polasek[2], and H. Zaleski[1], [1]*University of Hawaii at Manoa, Honolulu*, [2]*Alaska SeaLife Center, Seward, AK*.

Capelin (*Mallotus villotus*), herring (*Clupea harengus*), mackerel (*Scomber scombrus*), pollock (*Theragra chalcogramma*), smelt (*Allosmerus elongates* and *Hypomesus pretiosus*), and squid (*Loligo* spp.) are six species of whole fish commonly used as animal feeds, particularly as prey in captive marine mammal diets. Due to the great variation in nutrient composition between and within species, knowledge of the nutrient content of these prey items is essential when performing research and also in the daily management and husbandry of marine mammals where diet assessment is critical. The purpose of this study was to determine the variation and relationships of nutrient and mineral composition both on a DM and as-fed basis for a variety of whole fish species [capelin (n=70), herring (n=99), mackerel (n=25), pollock (n=45), smelt (n=37) and squid (n=52)]. Frozen samples had been collected from three different locations in Hawaii and Alaska and analyzed between 1982 and 2007. Proximate analysis to evaluate DM, CP, EE, ash was performed using standard methods of the Association of Official Analytical Chemists, and GE was determined by bomb calorimetry. Minerals were determined by inductively coupled plasma emission spectroscopy. Nutrient data for each species was sorted according to both %CP and %EE and correlations run to determine relationships. Percent DM and H_2O differed significantly (p<0.05) between all fish species analyzed in this study. On a DM basis, percent EE between herring and smelt, and between capelin and mackerel did not differ. Ash (%, DM basis) did not differ between pollock and mackerel, and between squid and smelt. Percent CP (DM basis) did not differ between capelin, pollock and mackerel, and between herring and smelt. Gross energy (kcal/g, DM basis) did not differ between capelin, squid, and pollock. Inverse relationships were observed both between EE and CP, and between GE and CP. It was also determined that mineral content tended to parallel CP content. Squid did not have the same nutrient trends observed in the other prey items and was the only non-fish species considered.

Key Words: whole fish, nutrient composition, nutrient-mineral relationships

M201 In vitro starch kinetics hydrolysis and fermentation of field peas (*Pisum sativum*). C. A. Montoya, P. Kish, and P. Leterme*, *Prairie Swine Centre Inc., Saskatoon, SK, Canada*.

The reason for the high variability in digestible energy content of field peas in pigs is unclear. No acceptable relationship between chemical composition and energy value has been established so far. Starch hydrolysis could partly be responsible for that variation. Therefore, the kinetics of starch hydrolysis of 15 pea samples of high and low quality was studied in vitro. The rate of fermentation in the large intestine was also studied. A sequential in vitro hydrolysis of starch was carried out (pepsin 120 min plus one mix of pancreatin, isomaltase and maltase enzymes for 240 min). Samples were taken at different times to analyse soluble glucose. The residues of hydrolysis were used to evaluate their rate of fermentation by the gas technique. Differences in starch hydrolysis were observed after 20 min of pancreatin mix hydrolysis (i.e. 140 min after pepsin addition). Camry and Cooper pea cultivars presented the highest rate of hydrolysis and Midas and Montero the lowest (P < 0.001). The trends remained until 360 min of hydrolysis (P < 0.001; 98.4, 91.3, 74.7 and 74.4%, respectively). A negative correlation was observed between the rate of starch hydrolysis at 360 min and the NDF content of peas (r= 0.55; P = 0.036). The residues of hydrolysis of the Midas and Montero cultivars presented the highest rates of fibre fermentation in the large intestine (252 and 254 ml, respectively; P < 0.001). This could partly be explained by their higher content in resistant starch. The Sage cultivar presented the lowest rate of fermentation (232 ml), explained by its higher NDF content (205 vs. 186 to 132 g/kg DM). In conclusion, differences in in vitro starch hydrolysis and fermentation were observed among the pea cultivars. The large differences in starch hydrolysis could possibly explain the variation in digestible energy content of field peas observed in pigs.

Key Words: pigs, peas, starch

M202 Ileal amino acid digestibility in dried distillers grains with solubles originating from wheat, corn or wheat-corn blend fed to growing pigs. Y. Yang*, E. Kiarie, B. A. Slominski, A. Brûlé-Babel, and C. M. Nyachoti, *University of Manitoba, Winnipeg, MB, Canada*.

The aim was to determine the apparent (AID) standardized (SID) ileal CP and AA digestibility in dried distiller′s grains with solubles

(DDGS) derived from wheat (wDDGS), a wheat-corn (70:30 wt/wt) blend (wcDDGS), or corn (cDDGS). Three diets, each containing one of the DDGS samples as the only protein source, and a low-casein diet were fed to 12 ileal cannulated pigs (20.3±1.3 kg BW) in a two-period cross-over design, giving six replicates per diet. The casein diet was used to estimate basal endogenous CP and AA losses for determining SID. All diets contained chromic oxide (0.3%) as an indigestible marker. Daily feed allowance was set at 4% BW at the beginning of each period and was offered in two equal amounts at 0800 and 1630 h in mash form. After 5 d of diet adaptation, digesta were collected for 12 h each on d 6 and 7. The AID and SID of CP were similar among the DDGS samples and averaged 69% and 80%, respectively. The wcDDGS had higher ($P < 0.05$) AID (%) of His (76 vs. 71), Ile (79 vs. 73), Leu (81 vs. 75), Val (76 vs. 70), and Met (83 vs. 76) than wDDGS. Among the indispensable AA, Lys and Thr had the lowest AID values in all DDGS samples and averaged 45% and 60%, respectively. The mean AID values for indispensable and dispensable AA were 68, 74, and 72 and 66, 69, and 68 for wDDGS, wcDDGS and cDDGS, respectively. The wcDDGS and cDDGS samples had higher ($P < 0.05$) SID (%) of Leu and Met compared with wDDGS. The SID of Ile was higher ($P < 0.05$) for wcDDGS than for cDDGS. The SID values for Lys and Thr were 56, 61, and 57 and 71, 74, and 74 for wDDGS, wcDDGS, and cDDGS, respectively, and were lower than for other AA. The mean SID values for indispensable and dispensable AA were 78, 82, and 83 and 80, 82, and 81 for wDDGS, wcDDGS and cDDGS, respectively. The results show that Lys and Thr were poorly digested compared to other AA, which may be indicative of damage to these AA during processing.

Key Words: DDGS, amino acid digestibility, pigs

M203 In vitro rabbit cecal fermentation patterns of four substrates: Glucose, cellobiose, microcrystalline cellulose and NDF separated from alfalfa hay. H. J. Yang*[1], Q. Yue[1], Y. C. Cao[1], D. F. Zhang[1], and J. Q. Wang[2], [1]*China Agricultural University, Beijing, P.R. China*, [2]*State Key Laboratory of Animal Nutrition, Institute of Animal Science, China Academy of Agricultural Sciences, Beijing, P.R. China*.

The in vitro cecal fermentation patterns of glucose (GLU), cellobiose (CEB), microcrystalline cellulose (MCC) and neutral detergent fiber prepared from alfalfa hay (aNDF) were investigated with New Zealand hybrid mixed cecal microorganisms of broiler rabbits. At the end of 72 h incubation, Carboxymethyl cellulase activity was highest with GLU (436 umol sugar L^{-1} min^{-1}), while with MCC it was significantly lower than with GLU and CEB (P<0.05). Xylanase activity tended to be higher compared with aNDF (591 umol sugar L^{-1} min^{-1}), MCC and GLU as the substrate than those with CEB. Feruloyl esterase activities were highest with aNDF (8.7 umol Ferulic acid L^{-1} min^{-1}), which was at least twice that of MCC and CEB (P<0.05). Less volatile fatty acids were produced from aNDF than those from other substrates (P<0.05). Fermentation of aNDF and MCC produced significantly more propionate and less butyrate than fermentation of GLU. With aNDF as the substrate, the molar percentage of acetate was significantly lower than with the other substrates (P<0.05), while that of glucose was highest with 80.1% (mol/mol). As a molar proportion of the total gas production, more methane was produced from MCC and aNDF, while that of GLU and CEB was almost zero. Therefore, the presence of low molecular weight carbon source without ester bond linkage like glucose and cellobiose might stimulate rabbit cecal microbes to produce more carboxymethyl cellulase, whereas the presence of microcrystalline cellulose or more ester bond linked cell walls in alfalfa stimulate activities of the acetyl esterase and ferulic acid esterase. Methane can be produced by rabbit cecal microorganisms and methanogenesis increases gradually with an increasing fiber content in feeds.

Key Words: rabbit, in vitro cecal fermentation, methanogenesis

M204 Nutritional evaluation of fermented fish meal (*L. acidophilus* GB-LC2 and *B. licheniformis* GB-F2) based on nitrogen balance and nutrient digestibility in comparison with spray-dried plasma protein for weanling pigs. J. H. Cho*[1], J. S. Yoo[1], J. H. Ahn[2], I. B. Chung[2], and I. H. Kim[1], [1]*Dankook University, Cheonan, Choongnam, Korea*, [2]*National Institute of Animal Science, RDA, Korea*.

Fifteen crossbred [(Landrace × Yorkshire) × Duroc] barrows (8.58±0.32 kg) with simple T-cannulas were used to compare spray dried animal plasma with fermented (*L. acidophilus* GB-LC2 and *B. licheniformis* GB-F2) local fish meals on nitrogen balance and apparent ileal nutrient digestibility. Dietary treatments are as follows: 1) SDAP (3% Spray-dried animal plasma), 2) FFA (5% fermented domestic fish meal: *L. acidophilus* GB-LC2) and 3) FFL (5% fermented domestic fish meal: *B. licheniformis* GB-F2). After a 14 d recovery period, pigs were permitted a 7 d adjustment to the experimental diets and 2 d of ileal digesta collection. Nitrogen concentration and excretion in the urine were lower in SDAP group than FFA and FFL groups (P<0.05). SDAP group had lower N concentration and excretion in the feces than FFL group (P<0.05). Additionally, total N excretion of SDAP group was lower than that of the other groups (P<0.05). N retention and biological value were greater in SDAP group than FFL treatment (P<0.05), and N ileal digestibility was higher in SDAP group than FFA and FFL group (P<0.05). Moreover, calcium digestibility in SDAP group was found to be higher (P<0.05) than FFA group. Also, arginine, histidine, isoleucine, lysine, phenylalanine, aspartic acid, cysteine and glutamic acid digestibilities were higher in SDAP group than FFL group (P<0.05). Finally, the digestibilies of valine and tyrosine were greater in SDAP group than in the other groups (P<0.05).

Key Words: fermented fish meal, nitrogen balance, weanling pig

M205 Apparent metabolizable energy of hydrolyzed swine intestinal mucosa (Palbio RD50®) for broiler chickens. D. Solà-Oriol[1], R. Muns[1], D. Martínez-Puig*[2], and J. F. Pérez[1], [1]*Universitat Autònoma de Barcelona, Bellaterra, Spain*, [2]*Bioiberica, Palafolls, Spain*.

Palbio RD50® is a hydrolyzed intestinal mucosa ingredient which is commonly used as a highly digestible protein source for feed formulation. However, less information is available about its dietary metabolisable energy content for poultry. The objective of the present study was to determine the N corrected apparent metabolizable energy (AMEn) value of hydrolyzed intestinal mucosa of swine with 50%CP (HIM50) for broiler chickens. Twenty four female broiler chickens (BW 1610 g ± 64) were individually allocated and randomly distributed into three experimental groups. Three experimental treatments were formulated with corn, soybean meal 44%CP and HIM50 as the only energy sources. The T1 diet contained 69.9% corn and 26.41% soybean meal at a fixed ratio (control diet, AMEn=2685 kcal•kg^{-1}); T2 and T3 were prepared by the substitution of 5% and 10% of the corresponding amount of corn-soybean meal by HIM50. Feed was offered *ad libitum* in mash form. After a 5-d adaptation period, feed intake was individually controlled and animal excreta samples were collected for 3 consecutive days. Dry Matter (DM) and Gross Energy (GE) were determined in feed and in excreta samples after freeze drying. Nitrogen content was

also determined in order to obtain AMEn, assuming that the excreted N energy is 8.22 kcal•g^{-1} N. The estimated AMEn content of the control diet was 2685 kcal•kg^{-1}. It was estimated that an inclusion of 5 or 10% of HIM50 in the corn-soybean meal based diet for broilers, under the conditions of the present study, reduced the AMEn of the diet by 28 and 57 kcal•kg^{-1}, respectively. It is concluded that the calculated value of AMEn for hydrolyzed intestinal mucosa of swine with 50%CP for the animals used in the present study was 2227 kcal•kg^{-1}.

Key Words: AMEn, broiler, feedstuff evaluation

M206 Digestibilities of components in three sources of liquid mycelium feed products in growing pigs. W. C. Sauer[1,2], A. B. Araiza*[1], B. Schutte[3], M. Cervantes[1], A. Morales[1], R. Zijlstra[2], and J. L. Landero[1], [1]*ICA, Universidad Autónoma de Baja California, Mexicali, BC, México*, [2]*DAFNS, University of Alberta, Edmonton, AB, Canada*, [3]*S&P Consultancy, Bennekom, The Netherlands*.

The digestibilities of components in three different liquid mycelium feed products (LMP) were determined with pigs. The LMP are feed ingredients obtained from *Penicillium chrysogenum* cultivated for the production of penicillin G. The LMP were Vevocel®, Vevocid® and flocculated Vevocid. In Exp. 1, the apparent ileal digestibilities (AID) of CP and AA were determined with pigs fitted with post-valve T-cannulas. Four diets were fed. The basal was a corn-barley-soybean meal based diet. The other 3 diets consisted of 70% of the basal diet and 30% of each of the 3 preparations of LMP on a DM basis. The AID of CP and AA in the preparations of LMP were determined with the difference method. Eight barrows with an average initial BW of 42.2 kg, were assigned to the four dietary treatments. The barrows were fed twice daily, at 0800 and 2000, equal amounts each meal, at a rate of 2.4 times the daily maintenance requirement for ME (418 kJ/BW$^{0.75}$). Each experimental period comprised a 7 d adaptation period followed by a 5 d collection of ileal digesta from 0800 to 2000 on d 8, 9, 10, 11, and 12. The AID of CP and AA were usually highest (P<0.05) in flocculated Vevocid, intermediate in Vevocel® and lowest in Vevocid®. In the same order for the feed ingredients, the AID of CP were 64.7, 61.3 and 52.3%, respectively. For lysine, which is often limiting, the AID were 76.3, 67.7 and 61.4%, respectively. In Exp. 2, the total tract digestibilities (ATTD) of components including GE, CP and P were determined with intact pigs, with an average initial BW of 42.4 kg. This experiment was carried out exactly under the same conditions as described under Exp. 1. Feces were collected from 0800 on d 8 until 0800 on d 13. There were no differences (P>0.05) in the ATTD of GE, ranging from 77.9 to 82.8%; the ATTD of P was higher (P<0.05) in Vevocel® (70.2%) and flocculated Vevocid (67.8%) than in Vevocid® (61.5%). The ATTD of CP was higher (P<0.05) in flocculated Vevocid® (87.9%) than in Vevocel® (83.7%) and Vevocid® (82.6%). These data show significant differences in the AID and ATTD of components between the different liquid mycelium products

Key Words: swine, digestibility, mycelium

M207 A spreadsheet program for making a balanced Latin square design. B. G. Kim* and H. H. Stein, *University of Illinois, Urbana*.

The Latin square design is often employed in animal experiments to minimize the number of animals required to detect statistical differences. In this design, each treatment is assigned once to each row and each column, and the sequences of rows and columns are randomized. This procedure generally does not balance out potential carryover effects. For example, treatment A may immediately precede treatment B never or more than once. A systemic method is available for balancing the first order residual effects. Even though this is not overly complicated, it is time-consuming if an experiment requires a large size of square or multiple squares. Therefore, we have developed an Excel spreadsheet-based program, the Balanced Latin Square Designer, to facilitate the generation of Latin squares balanced for carryover effects. The source codes for the modules have been written in Visual Basic for Application as an Excel XP add-in. The program allows a user to input the number of treatments that is equal to the number of animals and periods in a square. A user may also input the number of squares. Then, the program will automatically generate Latin squares. For an even number of treatments, each treatment immediately precedes and follows every other treatment exactly once in the square. For Latin squares with an odd number of treatments, the first order residual effects can only be balanced if they are replicated an even number of times, and the spreadsheet program allows for that. The program also displays a table for an experimental schedule sorted by period and animal. The Balanced Latin Square Designer allows animal scientists to quickly and accurately generate Latin squares balanced for the first order carryover effects. This program reduces the amount of time required to prepare Latin square experiments.

Key Words: animal experiment, carryover effect, Latin square design

M208 Influence of phytase on the apparent ileal digestibility of amino acids in soybean meal diets in growing pigs. H. Silva, E. Fialho*, R. Sousa, N. Schoulten, W. Santos, L. Silva, and V. Cantarelli, *University Federal of Lavras-UFLA, Lavras-MG- Brazil*.

A total of eight barrows with an initial BW of 38.7 ± 2.1 kg were surgically equipped with a T-cannula in the distal ileum and used to evaluate the effect of phytase level supplementation on the apparent ileal digestibility of amino acids (AIDAA) in growing pig. The pigs were randomly allotted to four dietary treatments (0, 400, 800 and 1200 FTU/kg) during a 4-wk experiment in a Latin Square Design. Pigs were fed corn soybean meal based on diets formulated to meet the requirements for apparent ileal digestible lysine (0.61%) for growing pigs according to NRC (1998). Phytase (from Natuphos@5000) and 0.25% chromic oxide as an indicator were used in the diets. During wk 1, pigs were fed only a basal diet; during wk 2 to 4, treatment diets were provided, and ileal samples were collected on day 6 and 7 of each week. The supplementation of phytase improved the apparent ileal digestibility coefficient of Glu, Gly, Arg, Ala, Pro, Tyr, His and Lys. A linear increase (P = 0.009) was observed for phytase level on the apparent ileal digestibility coefficient of Thr and Ser, and a quadratic effect was observed (P = 0.006) for the apparent ileal digestibility coefficients of Val, Phe, total of non-essential amino acids and total of essential amino acids. Phytase additions between 440 and 900 FTU/kg in the diets maximized ileal AA digestibility values. In conclusion, phytase supplementation is beneficial by improving the apparent ileal digestibility of all essential and non-essential AA in growing pigs fed corn-soybean meal diets, and also reduces the environmental pollution impact due to higher ileal AA digestibility.

Key Words: ileal digestibility, phytase, growing pigs

M209 Effects of the gestation and farrowing housing system on physiology and performance of primiparous sows and piglets. W. S. Ju*, L. G. Piao, H. F. Long, Y. D. Jang, S. K. Jang, and Y. Y. Kim, *Seoul National University, Seoul, Korea*.

The objective of this experiment was to investigate the effects of different environments on gilts and their progeny during gestation, farrowing and lactation. A total of 41 gilts (Yorkshire x Landrace) were assigned to 2 treatments in a completely randomized design. Treatments were: 1) S - housed in gestation stall (2.15 × 0.6 m) and then farrowing crate (2.50 × 1.80 m), 2) P - housed in open pen (3.9 × 2.4 m) during gestation and lactation. During the whole gestating period, no significant differences were observed in the body weight and backfat thickness among all treatments. However, P gilts had higher backfat gain than S at d 110 of pregnancy($P<0.01$). Apart from the third week, the feed intake and body weight of the P group in the lactation period was greater than the S group ($P<0.05$). On the other hand, there were no differences in the weight and backfat thickness loss of lactating sows. The treatments had no effect on litter size, litter weight and litter weight gain. Although significant differences were not found, the mortality number and rate of piglets of treatment P were numerically higher than treatment S. The crushing rates (9.5% of P vs. 5.2% of S; $P=0.10$) and death rate (not crushed; 9.0% of P vs. 3.6% of S; $P=0.09$) also had a similar tendency. The colostrum and milk composition of lactating sows were not affected by treatments. These results indicated that the housing in open pen during gestation, farrowing and lactation increased not only the gestation backfat thickness, feed intake and body weight of lactating sows, but also preweaning mortality rate of piglets, but did not affect other reproductive performances and milk composition of primiparous sows compared with the housing in commercial environments of Korea.

Key Words: farrowing condition, gilt, reproductive performance

M210 The effect of different double choice feeding protocols on the measurement of feed preferences. D. Solà-Oriol[1], E. Roura[2], and D. Torrallardona*[1], [1]*IRTA, Mas de Bover, Constantí, Spain*, [2]*Lucta SA, Barcelona, Spain*.

Piglets are able to choose between two feeds depending on their preference. However, as pigs may associate the preferred feed with the position of the hopper containing it, a change in hopper position may affect preference evaluation. A trial was conducted to study the effect of changing hopper position on the measurement of relative preference between a CONTROL diet and the same diet supplemented with a FLAVOR (Luctarom, Lucta SA, Spain) and an acidifier (Luctacid, Lucta SA, Spain). One hundred and eight 35-d old pigs *(LD × Pi)* of mixed sexes, in 36 pens were used. Each pen (3 pigs) was offered one of four experimental treatments, and preference was measured for three consecutive periods of 3, 4 and 3 days. The four experimental treatments were as follows: T-1: CONTROL vs. FLAVOR without changing hopper location; T-2: CONTROL vs. FLAVOR changing the position of the hoppers at the start of the second and third periods; T-3: CONTROL vs. CONTROL without changing hopper location; and T-4: CONTROL vs. CONTROL changing hopper location at the beginning of periods 2 and 3. Preference (percentage contribution of the test diet to total intake) was measured for each pen. The preference values of each treatment at each experimental period were compared to the neutral value of 50% of preference by using the TTEST procedure of the statistical package SAS. The preference values obtained for the FLAVOR diet were: 81.6%, 72.2% and 72.8% for T-1 and 88.3%, 76.8% and 73.1% for T-2 for the 1st, 2nd and 3rd periods, respectively. For both treatments, all the values were significantly different from the neutral value of 50% ($P<0.05$). On the contrary, for treatments T-3 and T-4 the relative preference of one of the diets over the other one were only significantly different from the neutral value of 50% in period 1 but not for periods 2 and 3. The effects observed for period 1 could be explained by the previous position of a single hopper before the trial started. It is concluded that the addition of flavor and acidifier improved feed preference for the piglets, and that piglets were able to identify the preferred feed even if the hopper position was changed.

Key Words: double choice, palatability, piglet

M211 Influence of the type of diet on the growth performance of two genotypes of quails in a floor housing system. D. Cardoso-Jiménez[1], A. Z. M. Salem*[1,2], R. Rojo-Rubio[1], and A. Perez-Cháves[1], [1]*Centro Universitario UAEM-Temascaltepec, Universidad Autónoma del Estado de México, Toluca-Tejupilco, Estado de México, México*, [2]*Alexandria University, Alexandria, Egypt*.

Growth performance and carcass yield of two genotypes of quails *Coturnix coturnix japonica* variety Japanese (JAP) and *Coturnix coturnix japonica* variety Jumbo (JUM)) were compared by feeding three experimental diets in a factorial design (2 genotypes × 3 experimental diets). One hundred and twenty six birds (~58g) of each genotype (10 d of age of both sexes) were used for a 15 d experimental period. Quail chicks were randomly assigned in three groups of each genotype (42 birds of each). Each group received one of the three experimental diets; ground yellow corn-based diet (Diet I), ground rice-based diet (Diet II), or commercial concentrate (Diet III) in 6 experimental groups (2 genotypes × 3 diets) with 7 birds per pen. Diets were formulated to meet the requirements of quails and were fed ad libitum. Quails from both genotypes ate more (326.9 vs. 218.3 and 190.0g/d, respectively; $P=0.0012$) from Diet III versus Diets I and II. Overall, quails of both genotypes had optimal growth ($P=0.001$) consuming corn-based diets vs. the other diets. Feed conversion ratio (FCR) was improved when Diet II or Diet III was fed vs. Diet I. Final BW and ADG were improved in JAP fed Diet I and Diet III, while it was only improved in JUM when fed Diet I vs. the other diets. FCR had the highest value ($P=0.0016$) in JUM fed Diet I, while it was inferior in the same genotype fed Diet III. FCR in JAP was not affected by the three types of diets. Carcass yield was improved ($P<0.05$) in JAP fed Diet I or Diet III vs. Diet II. Our results suggested a better growth performance and carcass yield of quails fed a corn-based diet or a commercial concentrate compared with a rice-based diet and JAP had more efficient diet utilization than JUM.

Key Words: quails, diets types, growth performance

M212 Effects of a dietary complex enzyme in corn distillers dried grains with solubles (DDGS) on meat quality and pork fatty acid composition of loin muscle. J. S. Yoo*[1], H. D. Jang[1], T. X. Zhou[1], J. P. Wang[1], and C. Y. Lee[2], [1]*Dankook University, Cheonan, Choongnam, Korea*, [2]*Regional Animal Industry Center, Jinju National University, Jinju, Gyeongnam, Korea*.

This study was conducted to evaluate the effects of a dietary complex enzyme (β-mannanase 800 IU/kg and Xylanase 700 IU/kg) in a diet containing corn distillers dried grains with solubles (DDGS) on meat quality and pork fatty acid composition. 96 pigs ([(Landrace × Yorkshire) × Duroc], 68.77 kg average initial body weight) were used in an 8 week growth assay. Dietary treatments included 1) corn-soybean meal diet, 2) corn-soybean meal diet + 0.05% enzyme complex, 3)

corn-soybean meal diet with 5% DDGS and 4) corn- soybean meal diet with 5% DDGS + 0.05% enzyme complex. The pigs were allotted randomly into four pigs per pen with six replicate pens per treatment in a completely randomized design. Pigs were slaughtered at the end of experiment and the loin muscle was obtained for meat quality. Meat pH ($p<0.01$), firmness ($p<0.01$) and redness ($p<0.05$) were higher in DDGS treatment than corn-soybean meal treatment. However, color, marbling, lightness, yellowness, TBARS, water holding capacity, drip loss, cooking loss and loin muscle area were not significantly different among treatments ($p>0.05$). The pigs fed the diet containing DDGS had higher total UFA concentration and total UFA/SFA ratio of loin and backfat. In conclusion, DDGS can change pH, firmness, redness and total UFA concentration and total UFA/SFA ratio of meat and backfat, however, enzyme addition has no affect on meat quality.

Key Words: DDGS, fatty acid composition, finishing pigs

M213 Supplementation with phytase and xylanase can increase energy availability in swine diets containing corn distillers dried grains with solubles (DDGS). M. D. Lindemann*[1], G. A. Apgar[2], G. L. Cromwell[1], P. H. Simmins[3], and A. Owusu-Asiedu[3], [1]*University of Kentucky, Lexington*, [2]*Southern Illinois University, Carbondale*, [3]*Danisco Animal Nutrition, Marlborough, UK*.

One way of enhancing dietary energy at times of high feed prices is to use exogenous enzymes to improve diet digestibility and utilize more of the nutrients already present in a diet containing byproducts such as DDGS. To examine the potential for enzymes to enhance nutrient release, a study was conducted with 96 crossbred pigs (mean initial and final BW of 64 and 123 kg) allotted to pens of 4 pigs (2 barrows and 2 gilts). Treatments were: 1) a positive control [PC] corn-soybean meal diet with 20% DDGS and 3% choice white grease [CWG], and 2) a negative control [NC] similar to the PC but with 1% CWG and no inorganic P source. The NC was lower in ME [90 kcal/kg] and available P [about 0.02%]. The enzymes added were phytase (Phyzyme® 6-phytase, EC 3.1.3.26; PHY; 250 or 500 U/kg diet) and xylanase (Porzyme® 9300, endo 1,4-beta-xylanase; XYL; 2000 or 4000 U/kg diet). Diets 3-8 were the NC plus: 3) 250 PHY and 0 XYL, 4) 250 PHY and 2000 XYL, 5) 250 PHY and 4000 XYL, 6) 500 PHY and 0 XYL, 7) 500 PHY and 2000 XYL, and 8) 500 PHY and 4000 XYL. The ADG for the PC and NC (1.04 vs 1.05 kg), ADF (2.78 vs 2.93 kg), and F/G (2.68 vs 2.78) were as anticipated with higher F/G in the NC diet. Fecal digestibility for DM (77.1 vs 73.7%, P=0.02), energy (75.5 vs 71.4%, P=.006), and N (72.7 vs 68.8%, P=0.007) was consistently higher for PC compared to NC. For Trt 3-8 the ADG (1.04, 1.07, 1.03, 1.00, 0.95, and 1.01 kg) and F/G (2.77, 2.73, 2.66, 2.75, 2.75, and 2.68) illustrated an apparent release of energy with incremental PHY and XYL additions. For Trt 3-8 the DM (76.1, 76.7, 74.6, 76.2, 74.4, and 74.6%), energy (73.8, 74.4, 71.2, 73.7, 72.0, and 71.6%), and N (70.9, 71.7, 70.3, 71.1, 69.5, and 71.3%) digestibility confirmed an improved digestibility. The inclusion of PHY improved digestibility ($P<0.05$) of all 3 components. Further improvements in fecal digestibility were not observed with XYL but the recovery of F/G was observed only when the high level of XYL was included with the PHY. These data demonstrate that appropriate exogenous enzymes are a means of nutrient release in diets containing byproducts.

Key Words: phytase, pigs, xylanase

Physiology and Endocrinology: Endocrinology and Metabolism

M214 Methionine requirements for the preimplantation bovine embryo. L. Bonilla*[1], D. Luchini[2], E. Devillard[3], and P. J. Hansen[1], [1]*University of Florida, Gainesville*, [2]*Adisseo USA, Inc., Alpharetta, GA*, [3]*Adisseo France, SAS, Commentry, France*.

The objective was to determine the requirement of in vitro produced embryos for the essential amino acid methionine. Oocytes were matured for 20-22 h and fertilized for 6-8 h. Embryos were cultured in groups of 15 in 25 µL microdrops of potassium simplex optimized medium - bovine embryo modification 2 (KSOM-BE2) at 38.5°C in 5% (v/v) oxygen. In Experiment 1 (n=963 putative zygotes in 4 replicates), embryos were cultured with 0, 35, 50, 100, 200 or 400 µmol/L L-methionine for 8 d. The percent of oocytes that cleaved was observed at Day 3 after insemination and blastocyst development at Day 7 and 8. At Day 7, a group of blastocysts was stained with Hoescht 33258 to determine total cell number. There was no effect of methionine concentration on cleavage rate. The percent of oocytes that developed to blastocyst was lower for embryos without methionine at Day 7 ($P<0.05$) and 8 ($P<0.01$) than other groups but was similar for embryos cultured with 35-400 µmol/L. Least-squares means were 4.2, 23.2, 18.2, 21.5, 16.3, and 21.3 for 0, 35, 50, 100, 200, or 400 µmol/L for Day 7 (SEM=3.4%) and 13.5, 36.1, 30.9, 33.6, 29.8 and 33.0 for Day 8 (SEM=3.4%). Total cell number was not affected by methionine concentration. In Experiment 2 (n=1,204 putative zygotes in 4 replicates), embryos were cultured with 0, 7, 14, 21, 28 or 35 µmol/L methionine. There was no effect of methionine concentration on cleavage rate. The percent of oocytes that developed to blastocyst was lower for embryos without methionine at Day 7 ($P<0.005$) and 8 ($P=0.01$). At Day 7, least-squares means were 8.2, 20.3, 27.2, 27.7, 24.3, and 21.2 for 0, 7, 14, 21, 28, or 35 µmol/L (SEM=2.5%). There was a tendency for 7 µmol/L to be lower than 14 ($P=0.07$) and 21 µmol/L ($P=0.06$). At Day 8, least-squares means were 17.8, 35.2, 37.8, 43.0, 37.9, and 33.6 for 0, 7, 14, 21, 28, or 35 µmol/L (SEM=3.5%). Means were similar for 7-35 µmol/L. In conclusion, methionine requirements for optimal blastocyst yield are between 7 and 21 µmol/L. Further studies to further define optimal concentration and to examine competence of embryos for development after transfer are warranted. *Support: Adisseo.*

Key Words: methionine, embryos, development

M215 Effect of exogenous insulin and fasting on estradiol production and growth hormone receptor (GHR) and insulin-like growth factor I (IGF-I) genes expression by the pre-ovulatory follicle of ewes. A. Schneider[1], L. F. M. Pfeifer[1], E. Schmitt[1], J. W. Silva Neto[1], L. T. Hax[1], M. M. Antunes[1], F. A. B. Del Pino[1], G. R. Paludo[2], and M. N. Corrêa*[1], [1]*Federal University of Pelotas, Brazil*, [2]*University of Brasilia, Brazil*.

The aim of this study was to investigate the effect of fasting and insulin injections for 96 hours on estradiol concentrations and expression of GHR and IGF-I mRNA in the pre-ovulatory follicle of ewes. In the eleventh day of the estrous cycle 15 ewes received an injection of $PGF_2\alpha$, 36 hours after a GnRH injection and 24 hours after a CIDR® was inserted and removed 6 days later together with an injection of $PGF_2\alpha$ (Day 0). In Day -2 the ewes were divided in: 1) control group (CG, n = 5) that received a maintenance diet; 2) insulin group (IG, n = 5) that received insulin injections (s.c., 0.25 IU/kg) every 12 hours