

1640 Dual labeling immunofluorescent staining demonstrates the presence of a protease-inhibiting protein (ovoinhibitor) in the chicken pituitary. C. M. Oubre*¹, K. E. Clements¹, F. Vandesande², and L.R. Berghman¹, ¹Texas A&M University, ²University of Leuven, Belgium.

Ovoinhibitor is a serine protease-inhibiting protein that specifically inhibits serine proteinases such as trypsin and chymotrypsin. During recent attempts to raise monoclonal antibodies (MABS) against chicken bursa of Fabricius proteins, one MAB was produced that specifically recognized chicken ovoinhibitor. This was the first demonstration of ovoinhibitor in an avian immune organ. Further immunocytochemical research revealed that in the pituitary and the brain of the chicken, some cells undeniably displayed immunoreactivity for ovoinhibitor. The present study was aimed at identifying the hypophysial hormone-producing cells that express ovoinhibitor immunoreactivity. Therefore, pituitary glands from 4-week old birds were fixed in phosphate-buffered paraformaldehyde (4% w/v) and 30- μ m vibratome sections were stained as floating sections in 12-well tissue culture plates. The mouse MAB

against Ovoinhibitor was used in conjunction with polyclonal antibodies against Luteinizing Hormone (LH), Growth Hormone (GH), Proopiomelanocortin (POMC) and Prolactin (PRL) and S-100, respectively. The mouse MAB was visualized with a rhodamine-conjugated secondary antibody, whereas the polyclonal rabbit antisera were detected with a biotinylated secondary antibody combined with FITC-conjugated streptavidin. This procedure stained ovoinhibitor-positive cells in red, while the pituitary hormone-positive cells were stained green; overlapping antigens were clearly visible in yellow. The results of these dual-staining experiments revealed partial co-localization of ovoinhibitor with GH, LH, and POMC, each time in a subset of the respective hormone producing cells. By contrast, no co-localization with PRL and S-100 could be demonstrated. Serine protease inhibitors from another family (the serpins) have recently been identified in rat brain and pituitary. In the latter, they have been suggested to play a role in the regulation of cell-extracellular matrix interactions .

Key Words: chicken, pituitary, ovoinhibitor

ASAS Nonruminant Nutrition: Vitamins, Minerals, and Energy

1641 The effect of genotype, parity and folic acid supplement on the expression of leptin, and its receptors in embryonic and endometrial tissues from pigs at 15 days of gestation. F. Guay¹, A. Giguere*², M.-F. Palin², C.L. Girard², J.J. Matte², and J.P. Laforest¹, ¹Laval University, Department of Animal Science, Qc, Canada, ²Dairy and Swine R & D Centre, Lennoxville, QC, Canada.

We have previously demonstrated mRNA expression of leptin (*Lep*) and its receptors (*Lepr* and the long form *Lepr-L*) in endometrium and embryos at 25 days of gestation in sow. We have also shown that expression levels of *Lep* and *Lepr-L* could be influenced by dietary supplement of folic acid (B9). *Lep* and its receptors may therefore have a direct role in the embryo-maternal dialogue. The objectives of this study were to compare the mRNA expression of leptin (*Lep*) in backfat tissue, and its receptors (*Lepr* and *Lepr-L*) in embryonic and endometrial tissues of sows in relation to the genotype, parity, and B9 supplement. Eleven nulliparous Yorkshire-Landrace (GT), 12 multiparous Landrace (LD) and 10 multiparous Meishan-Landrace (ML) sows were randomly assigned to 2 dietary treatments: 0 ppm or 15 ppm of B9 given from the estrous preceding mating up to slaughter, on d15 of gestation. Embryonic and endometrial tissues were collected to evaluate the mRNA expression of *Lepr* and *Lepr-L* while expression levels of *Lep* were assessed in backfat tissue. Blood samples were taken at mating and at slaughter to determine the concentration of circulating leptin; backfat thickness was also recorded. The embryonic *Lepr-L* transcript was barely detectable. Endometrial *Lepr* and *Lepr-L* and embryonic *Lepr* expression were higher in LD than in GT and ML sows ($P < .01$). No B9 effect was seen on *Lep* and its receptors; breed and parity did not influence *Lep* in backfat. Plasma leptin and backfat thickness were higher in ML than in LD and GT sows ($P < .01$). Circulating *Lep* was correlated with backfat thickness ($r = 0.54$, $P < 0.01$) but not with backfat expression levels of *Lep*. These results suggest a developmental regulation of leptin receptors (*Lepr* and *Lepr-L*) in early pregnancy. The effect of B9 on *Lep* gene expression may occur between d15 and d25. Furthermore, in early gestation, the circulating leptin concentration is related to adiposity.

Key Words: Leptin, Sow, Gestation

1642 The effect of genetic type and parity and folic acid supplement on homocysteine metabolism from sows on day 15 of gestation. F. Guay*¹, A. Giguere², M.-F. Palin², C.L. Girard², J.J. Matte², and J.-P. Laforest¹, ¹Laval University, Department of Animal Science, Qc Canada, ²Dairy and Swine R & D Centre, AAC, Qc Canada.

Supplements of folic acid (B9) have been shown to increase prolificacy in multiparous sows by increasing embryo survival. B9 supplement is also recognized to decrease the concentrations of homocysteine (HCY), which is known to be potentially teratogenic. The objective of this study was to compare the effects of B9 supplement on HCY metabolism in early gestating sows. Eleven nulliparous Yorkshire-Landrace (GT), 12 multiparous Landrace (LD) and 10 multiparous Meishan-Landrace (ML) sows were randomly assigned to 2 dietary treatments: 0 ppm or 15 ppm

of B9. Supplements were given from the estrous preceding mating up to slaughter on d15 of gestation. The uterine flushing was collected to evaluate the total content of HCY in the uterine lumen. Blood samples were taken at mating (d0), d5, d10 and d15 of gestation to determine the concentrations of circulating HCY. B9 supplementation had no significant effect on the concentration of circulating HCY, but it decreased ($P \leq .06$) HCY content of uterine flushing in LD (115 16 nmol vs 84 17 nmol) and GT sows (138 23 nmol vs 98 12 nmol) but not significantly in ML sows (117 30 nmol vs 102 30 nmol). ML (18.3 1.3 μ M) and GT (16.6 1.0 μ M) sows had lower ($P \leq .01$) concentrations of circulating HCY than LD sows (24.5 1.3 μ M). These results suggest that a decrease in the content of HCY in the uterine flushing may play an important role in the control of embryo survival by a supplement of B9.

Key Words: Folic acid, Homocysteine, Sow

1643 Phosphorus removal with and without phytase in finishing pigs. G.A. Apgar*¹, C.M. Peter², T.A. Guthrie¹, K.E. Griswold¹, and D.H. Baker², ¹Southern Illinois University, Carbondale, ²University of Illinois, Urbana.

Two trials were conducted using 171 crossbred pigs (53.3 +/- 1.4 kg) to evaluate the effects of removing the inorganic P from finishing diets with or without phytase. The finisher period was broken into two 28-d phases, with the early phase formulated to contain 0.82% lysine and the late phase 0.65% lysine. Dietary treatments (Trt) were: 1) control (early = 0.49% total P, 0.19% available P (aP); late = 0.43% total P, 0.15% aP); 2) control without inorganic P (early = 0.36% total P, 0.07% aP; late = 0.33% total P, 0.06% aP); and 3) diet 2 + 500 U/kg phytase. Pigs were given ad-libitum access to feed and water. Average daily gain, ADFI and G:F were calculated every 2 wks. Pigs were scanned via ultrasound at 98.9 +/- 1.1 kg for 10th rib backfat (BF) and loin eye area (LEA). One barrow and one gilt per pen were slaughtered (ave wt 108.4 +/- 1.4 kg) and metacarpals III and IV collected for bone ash determination. Data were analyzed using the GLM procedures of SAS (1999). The models included the effects of trial, dietary treatment, replicate and all pertinent interactions. There were no significant trial*treatment interactions. During both the early and late phases, pigs fed diet 3 had greater ($P < 0.05$) ADG than pigs fed diet 2. Pigs fed diet 3 also had greater ($P < 0.05$) daily feed intake during the late phase than pigs fed diet 2. Feed efficiency was not affected by dietary treatments. Loin eye area was greater for pigs fed Trt 1 ($P < 0.05$) than those fed Trt 2 and 3, or pigs fed Trt 3 ($P < 0.05$). Pigs fed Trt 1 tended to have greater ($P = .072$) ash content than pigs fed Trt 2 and 3. Removing P during the finishing phase did not alter BF, but reduced LEA and feed intake compared with animals fed a diet with supplemental P. Pigs fed supplemental phytase had improved ADG compared with non-supplemented pigs, but had lower LEA than control pigs.

Key Words: Pigs, Phytase, Finishing

1644 Effects of dietary chromium yeast supplementation on growth performance and carcass characteristics in growing-finishing pigs. C. Y. Liu*, J. N. Hsu, and L. C. Cheng, *Pig Research Institute Taiwan, ROC.*

Two experiments were conducted to evaluate the effects of chromium yeast on growth performance and carcass characteristics in growing-finishing pigs. In Exp. 1, 60 crossbred pigs (average 39.7 kg BW; 4 pigs/pen, 5 pens/treatment) were fed a corn-soybean meal diet (16% CP and .8% lysine) supplemented with 0, 200, or 400 ppb of Cr from chromium yeast (S.I. Lesaffre). Backfat and loin eye area were measured at termination from 2 pigs/pen with close BW. The addition of Cr increased ADG (788, 847, 857 g/d; $P < .05$) but did not affect ADFI (2.45, 2.56, 2.56 kg/d) or F/G ratio (3.13, 3.02, 2.98). Backfat was significantly reduced by Cr supplementation at 400 ppb level (2.73, 2.52, 2.29 cm; $P < .01$) without changes in loin eye area (45.2, 46.7, 47.3 cm²). In Exp. 2, 18 crossbred pigs (average 87.2 kg BW) were individually fed a basal diet (16% CP and .8% lysine) without or with 800 ppb of Cr for final 3 weeks. All pigs were slaughtered for determination of backfat and loin eye area. Dietary 800 ppb of Cr increased ADG (941 vs 1118 g/d; $P < .05$) and backfat (2.39 vs 2.77 cm; $P < .1$); however, ADFI (2.78 vs 3.27 kg/d), F/G (2.97 vs 2.91) or loin eye area (44.9 vs 47.4 cm²) were not significantly ($P > .1$) changed. The results of this study indicate that dietary Cr as chromium yeast is effective to improve performance and its effects are dependent on dietary level and feeding phase.

Key Words: Pigs, Chromium yeast, Performance

1645 Vitamin E and selenium improve pork stability in finishing pigs fed diets deleted of vitamin-mineral premix. S. C. Choi*¹, B. J. Chae, and In K. Han², ¹*Division of Animal Res. Sci., Kangwon National University,* ²*Dept. of Animal Sci. and Tech., Seoul National University, Suwon, Korea.*

Two feeding trials were conducted to determine the effect of inclusion levels, or deletion of vitamin-mineral (VM) premixes on growth performance and pork stability in finishing pigs. In expt. 1, a total of ninety-six pigs (L×Y×D, 85.09±3.12kg) were employed for a 4-week feeding trial. Treatments were 50% (Control), 100%, 150%, and 200% of NRC (1998) requirements for vitamins and trace minerals. In expt. 2, a total of 108 pigs (L×Y×D, 84.76±.58kg) were employed for a 4-week feeding trial. Treatments were 0% (Control), 200% VM, and 200% vitamin E and Se listed in NRC(1998) requirements. After feeding trials, four pigs/treatment were sacrificed for the analysis of pork quality. ADG and feeding/gain (F/G) were the best at 150% VM addition level (quadratic, $p < .05$) among treatments. Dressing percentage and backfat thickness in pigs were not affected by different addition levels of VM premixes. Pork stability in terms of TBARS was linearly ($p < .05$) improved as dietary VM premix was increased (expt. 1). ADG, F/G and pork stability (TBARS) were also reduced ($p < .05$) when VM premixes were deleted. However, adding vitamin E and Se improved ($p < .05$) ADG and pork stability in pigs fed diets deleted VM premix (expt. 2). It might be concluded that adding vitamin E and Se is necessary in finisher diets deleted VM premix for pork quality.

Key Words: Vitamin-mineral premix, Vitamin E, Se

1646 Effect of calcium to phosphorus ratio on grower-finisher pig performance and mineral excretion. J.J. Callan*¹, S.M. Brady¹, D. Cowan², M. McGrane³, and J.V. O' Doherty, ¹*University College Dublin,* ²*Novo Nordisk, Novo Nordisk S.A., Chesham, Bucks, UK,* ³*Trouw Nutrition, Leixlip, Co. Kildare, Ireland.*

Two experiments were conducted to evaluate the effects of phosphorus (P) level and Calcium (Ca): total P (tP) ratio on the efficacy of microbial phytase when added to diets containing barley, wheat and soya bean meal. In experiment 1, 48 entire male pigs were fed individually food containing (T1) 5.5 g/kg tP and 7.0 g/kg Ca, (T2) 5.5 g/kg tP and 7.0 g/kg Ca and 750 FYT/kg of *Peniophora lycii* (*Pen. lycii*) phytase, (T3) 4.3 g/kg tP and 7.0 g/kg Ca and (T4) 4.3 g/kg tP and 7.0 g/kg Ca and 750 FYT/kg of *Pen. lycii* phytase. In experiment 2, 48 entire male pigs were fed individually food containing (TT1) 4.3 g/kg tP and 7.0 g/kg Ca, (TT2) 4.3 g/kg tP and 7.0 g/kg Ca and 750 FYT/kg of *Pen. lycii* phytase, (TT3) 4.3 g/kg tP and 4.3 g/kg Ca and (TT4) 4.3 g/kg tP, 4.3 g/kg Ca and 750 FYT/kg of *Pen. lycii* phytase. In experiment 1, the pigs offered the low P diets had a lower P ($P < 0.001$) and Ca ($P <$

0.05) intake and a lower faecal P and Ca excretion ($P < 0.05$) than the pigs given the adequate P diets. These pigs also had a lower daily gain ($P < 0.01$), feed intake ($P < 0.05$) and feed conversion ratio (FCR) ($P < 0.05$). The inclusion of phytase to both the adequate and the low P diets increased energy and Ca digestibility ($P < 0.05$). In experiment 2, lowering the Ca: tP ratio from 1.6:1 to 1.0:1 increased the DE content of the diet ($P < 0.05$). The inclusion of phytase increased the digestibility of the N and Ca as well as the DE content ($P < 0.05$). There was a significant ratio by phytase interaction ($P < 0.5$) in P digestibility. The inclusion of phytase increased P digestibility when added to the 1.0:1 ratio diet, however phytase had no effect when added to the 1.6:1 ratio diet. The inclusion of phytase increased ($P < 0.05$) feed intake and weight gain. Lowering the Ca: tP ratio resulted in an improvement in FCR (2.3 v 2.4, s.e.m 0.03; $P < 0.05$). In conclusion the beneficial effects of phytase supplementation are adversely affected by a wide Ca: tP ratio.

Key Words: Pigs, Phytase, Ratio

1647 Determination of true phosphorus digestibility and the gastrointestinal endogenous phosphorus loss associated with soybean meal for growing-finishing pigs. A. Ajakaiye*, M. Z. Fan, T. Archbold, R. R. Hacker, C. W. Forsberg, and J. P. Phillips, *University of Guelph, Guelph, Ontario, Canada..*

A trial was conducted to determine true phosphorus digestibility and the gastrointestinal endogenous phosphorus loss associated with soybean meal fed to growing-finishing barrows. Four Yorkshire barrows, an average initial BW of 40 kg, were fed four diets according to a 4 x 4 Latin square design with four experimental periods. The diets were cornstarch-based containing four levels of phosphorus (0.09, 0.18, 0.27, and 0.36%, on as-fed basis) from solvent-extracted soybean meal. Chromic oxide (0.35%) was included as a digestibility marker. Each experimental period consisted of 8-d with 4-d adaptation and 4-d collection of representative fecal samples. Average feed intake was 2,500 g/d with free access to water. True fecal phosphorus digestibility value was determined by regression analysis technique. The true fecal phosphorus digestibility, corrected for the gastrointestinal endogenous phosphorus loss was determined to be 52.0±10.3% in soybean meal. The gastrointestinal endogenous phosphorus loss in feces was estimated to be 0.52±0.10 g/kg DM diet intake. The endogenous phosphorus loss is an inevitable component of total phosphorus requirement in the growing-finishing pigs. True phosphorus digestibility values in feed ingredients for growing-finishing pigs should be determined.

Key Words: Endogenous phosphorus, True phosphorus digestibility, Soybean meal for pigs

1648 Boron supplementation to pigs increases the production of tumor necrosis factor-alpha and interferon-gamma. T.A. Armstrong* and J.W. Spears, *North Carolina State University, Raleigh.*

Two experiments were conducted to determine the effects of dietary boron (B) on the production of cytokines following an endotoxin challenge. In both experiments pigs were obtained from litters generated from sows fed low B (control) or B-supplemented (5 mg/kg) diets. In experiment (Exp) 1 and 2, 28 and 35 pigs, respectively, (21 d old) remained with their littermates throughout a 49 d nursery phase and were maintained on either a control or B-supplemented diet. In Exp 1, 12 pigs/treatment were moved to individual pens at the completion of the nursery phase and maintained on their respective experimental diet. On d 99 of the study, pigs were injected with 150 µg phytohemagglutinin (PHA) to evaluate a local inflammatory response. Pigs receiving the B-supplemented diet had a decreased ($P < 0.01$) inflammatory response following PHA injection. Peripheral blood monocytes were isolated from 6 pigs/treatment on d 103 and cultured in the presence of lipopolysaccharide (LPS) to determine the effect of B upon tumor necrosis factor-α (TNF-α) production from monocytes. Isolated monocytes from B-supplemented pigs tended to have a higher production of TNF-α. In experiment 2, pigs were group housed with their littermates following the nursery phase for 43 d, after which 10 pigs/treatment were moved to individual pens. In Exp 1 and 2, pigs were randomly assigned within dietary treatment to receive either an i.m. injection of saline or LPS at d 117 and d 109, respectively. The dose of LPS in Exp 1 and 2 was 100 and 25 µg LPS/kg BW, respectively. In Exp 1, serum TNF-α was increased ($P < 0.01$) at 2 h and tended to be increased ($P < 0.11$) at 6

and 24 h post-injection by B; however, only numerical trends existed for a B-induced increase in TNF- α in Exp 2. Serum interferon- γ (IFN- γ) was increased ($P < 0.01$) at 6 h and tended to be increased ($P < 0.08$) at 24 h post-injection in Exp 1. In Exp 2, B also tended to increase IFN- γ . These data indicate that B supplementation increases the production of cytokines, which indicates a role of B in the immune system. However, these data do not explain the reduction in localized inflammation following an antigen challenge in pigs.

Key Words: Boron, Inflammation, Cytokines

1649 The effects of α -lipoic acid (LA) on performance and health of weaned neonatal pigs. K. R. Maddock^{*1}, E. P. Berg¹, C. A. Stahl¹, M. L. Linville¹, and J. A. Carroll², ¹University of Missouri, Columbia, ²ARS-USDA, Columbia, MO.

Two trials were conducted to evaluate the potential benefit of supplemental LA on growth, feed conversion, and health status of neonatal pigs. For both trials, gilts were weaned into individual pens at 21d of age, and treatments were administered orally for 11d. On d11, gilts were nonsurgically fitted with jugular cannulae. On d12, gilts received a dose of lipopolysaccharide (LPS; 150 μ g/kg) intravenously. Blood samples were collected at 15-min intervals for 30 min prior to, and 180 min after, LPS to monitor serum glucose, cortisol, tumor necrosis factor- α (TNF- α), and neutrophil and lymphocyte counts. Trial 1 consisted of 18 gilts (6.74 \pm 0.63 kg) allotted to three treatments: 1) no supplemental LA (CON, n=6); 2) LA1, 35 mg/kg BW daily (n=6); 3) LA2, 75 mg/kg BW daily (n=6). ADG ($P < 0.05$) and ADFI ($P < 0.05$) were greater in CON pigs compared to LA1 and LA2 pigs. There was no effect of LA on serum glucose, cortisol, TNF- α , % neutrophils, and % lymphocytes. LPS increased serum glucose, cortisol, TNF- α , and decreased % neutrophils and % lymphocytes ($P < 0.001$). A linear contrast of serum glucose showed a trend ($P < 0.1$) such that LA1 was lower than CON. Trial 2 consisted of 21 gilts (7.05 \pm 1.12 kg) allotted to three treatments: 1) no supplemental LA (CON, n=7); 2) LA3, 8 mg/kg BW daily (n=7); 3) LA4, 15 mg/kg BW daily (n=7). There were no LA effects on ADG, ADFI, cortisol, insulin, % neutrophils and % lymphocytes or lymphocyte counts. LPS increased serum glucose, cortisol, TNF- α , and decreased neutrophil counts and lymphocyte counts ($P < 0.001$). There was a time by LA effect in serum glucose ($P < 0.004$) where LA3 and LA4 were higher than CON. Time 0 neutrophil counts were higher ($P < 0.003$) in the LA3 and LA4 pigs compared to CON pigs. These results suggest that supplementing LA does have an effect on glucose during an LPS challenge, and an effect on neutrophil populations.

Key Words: α -Lipoic acid, Immune, Neonatal pig

1650 Effects of feeding different chelated copper and zinc sources on growth performance and their excretions in feces for weaning pigs. S. H. Lee^{*1}, S. C. Choi, W. T. Kim, B. J. Chae, and Y. K. Han², ¹Division of Animal Res. Sci., Kangwon National Univ., ²Feed Res. Inst., National Agri. Coop. Fed., Anyang, Korea.

Two feeding trials were conducted to study the effects of dietary Cu and Zn sources on performance and fecal excretions of Zn and Cu for weaning pigs. In Expt. 1, a total of 150 pigs (L \times Y \times D, 12.30 \pm 2.07kg) were randomly assigned to five treatments with three replicates (10 pigs/pen): 170 ppm Cu from CuSO₄, 85 ppm Cu from Cu-amino-chelate[®] (CAC), 170 ppm Cu from CAC, 85 ppm Cu from Cu-Lysine (CL), and 170 ppm Cu from CL. In Expt. 2, a total of 150 pigs (L \times Y \times D, 12.52 \pm 1.8kg) were randomly assigned to five treatments with three replicates (10 pigs/pen): 120 ppm Zn from ZnSO₄, 60 ppm Zn from Zn-amino-chelate[®] (ZAC), 120 ppm Zn from ZAC, 60 ppm Zn from Zn-Methionine (ZM), and 120 ppm Zn from ZM. Each expt. was conducted for 28 days. A metabolic study was also conducted to determine the fecal excretions of Cu and Zn in pigs fed the diets containing the above minerals sources. Fifteen pigs (13.51 \pm 1.6kg) were assigned to five treatments (3 pigs/treatment) in individual metabolic cages to collect feces. There was no difference ($p > .05$) in ADG and ADFI among treatments, but FCR was improved ($p < .05$) in pigs fed the 170 ppm CAC than 85 ppm CL (Expt. 1), and the ADG was higher ($p < .05$) in pigs fed the 120 ppm ZM than the 120 ppm inorganic and 60 ppm ZAC and ZM (Expt. 2). The fecal excretions of Cu and Zn were reduced ($p < .05$) when those minerals were chelated with amino acids. It might be concluded that the efficacy of the chelated Cu and Zn with amino acids or single amino acid are similar in terms

of performance, and fecal excretions of the minerals can be reduced in pigs fed chelated ones.

Key Words: Cu, Zn, Pig

1651 Dietary copper source and level increases pituitary growth hormone mRNA levels in weaning pigs. X. G. Luo^{*1}, X. Kuang¹, Q. H. Li¹, J. F. Li¹, T. D. Crenshaw², B. Liu¹, G. Z. Shao¹, and S. X. Yu¹, ¹Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, P. R. China, ²University of Wisconsin, Madison, U. S. A..

An experiment was conducted with 30 crossbred (Landrace \times Large White) weaning barrows averaging 9.5 kg BW and 35 d to investigate the effects of dietary Cu source and level on growth, plasma growth hormone (GH) levels, tissue Cu contents, and pituitary GH mRNA levels. Pigs were randomly allotted by bodyweight and litter to one of three treatments in a randomized complete block design, and fed basal corn-soybean meal-whey diets supplemented with 15 (n=6) or 250 ppm Cu as Cu sulfate (n=12) or 250 ppm Cu as Cu-glycine (n=12), respectively. There were six pigs for the 15 ppm Cu treatment and 12 pigs for each of the two 250 ppm Cu treatments. Pigs were individually kept in fiber glass metabolism crates in a metabolism room for the duration of the 28-d experiment. Pigs were allowed free choice continuous access to feeds and tap water. Pigs were individually weighed and feed intake was recorded weekly. At the end of the trial, a blood sample was taken from each pig, and then all pigs were slaughtered for tissue sample collections. Pituitary gland samples were frozen in a liquid nitrogen immediately after taken, and pituitary GH mRNA levels were determined by RT-PCR procedure. Neither Cu source nor Cu level affected ($P > 0.10$) growth rate, feed intake, feed conversion ratio, plasma GH levels, or Cu contents in plasma, pancreas, kidney and spleen. However, pigs fed the diet with 250 ppm Cu added as Cu-glycine had higher ($P < 0.007$) pituitary GH mRNA levels than pigs fed diets with 15 or 250 ppm Cu as Cu sulfate. Pigs fed diets with 250 ppm Cu added from either Cu sulfate or Cu-glycine had increased ($P < 0.002$) Cu contents in brain, liver and heart compared to pigs fed the diet with 15 ppm Cu added from Cu sulfate. No differences ($P > 0.60$) were detected between the two Cu sources. These results indicate that Cu could enhance the growth of young pigs by promoting the pituitary GH gene expression; Pituitary GH mRNA levels might be more sensitive than conventional serum or plasma GH levels as a reflection of GH status in the body; And organic Cu-glycine was more effective than inorganic Cu sulfate in increasing pituitary GH mRNA levels in weaning pigs. Supported by the National Natural Science Foundation of China (Project No: 39600107).

Key Words: Copper, Pituitary GH mRNA, Weanling pigs

1652 Effects of long-chain polyunsaturated fatty acids (LCPUFA) on body composition and tissue accretion rates in the neonatal pig. S. A. Mathews^{*1}, R. J. Harrell¹, W. T. Oliver¹, J. A. Brown¹, O. Phillips¹, X. Lin¹, J. Odle¹, and D. A. Diersen-Schade², ¹North Carolina State University, Raleigh, ²Mead Johnson Nutritionals, Evansville, IN.

The effects of LCPUFA supplementation and source on body composition and tissue accretion rates were examined in the neonatal pig. Piglets had *ad libitum* access from d 1 to 16 of age to a skim milk-based formula with different fat sources added to provide 50% of the energy. Fat sources included LCPUFA as follows: single cell oil triglyceride (TG), egg phospholipid (EPL), TG with phospholipid and cholesterol added to match EPL (TG+PL), a control with no added LCPUFA (CTL), and an essential fatty acid deficient diet (EFAD). Formulas with LCPUFA provided 0.6% of fatty acids as arachidonic acid and 0.3% as docosahexaenoic acid. A group of 10 piglets remained on the sow for the duration of the study (Sow). An initial group of 10 piglets were taken at d 1 of age to serve as a reference group. Average daily gain was similar in all groups (320 \pm 20 g/d, $P > 0.1$). Average daily feed intake (1953 \pm 68 g/d) and feed efficiency (1.58 \pm 0.06) was similar across all treatments ($P > 0.1$). Whole body tissue accretion data are presented below. Protein accretion was greater in the TG, TG+PL and EPL fed piglets compared to the EFAD fed and sow-reared piglets ($P < 0.03$). Accretion of fat was greatest in the sow-reared piglets ($P < 0.0001$). TG fed piglets had greater fat accretion than the PL or the EFAD fed piglets ($P < 0.02$). Water accretion was greater in the TG, TG+PL, PL and CTL compared to the sow-reared and EFAD piglets ($P < 0.05$). These data demonstrate

that the source of LCPUFA increased protein and water accretion, but resulted in a decrease in the amount of fat accretion.

	CTL	EFAD	TG	TG+PL	PL	Sow	SEM
Protein, g/d	39.9 ^{a,b}	24.9 ^b	44.9 ^a	39.9 ^a	39.8 ^a	29.6 ^b	1.5
Ash, g/d	6.4 ^{a,b}	5.4 ^b	7.5 ^a	7.3 ^a	6.4 ^{a,b}	6.4 ^{a,b}	0.3
Water, g/d	208 ^a	178 ^b	229 ^a	215 ^a	201 ^a	161 ^b	6
Fat, g/d	28.4 ^{a,c,d}	24.5 ^c	32.6 ^d	30.6 ^{a,c,d}	24.7 ^{a,c}	47.6 ^b	1.4

^{a,b,c} Within a row, treatments lacking a common superscript differ ($P < 0.05$).

Key Words: Long chain PUFA, Pig, Neonate

1653 Utilization of energy and performance of piglets fed low protein diets. L. Le Bellego* and J. Noblet, *INRA, St Gilles, France.*

Eight blocks of five to six castrated male littermates were used to study the effect of reducing dietary CP level on performance and energy utilization in piglets. Four wheat - barley - corn - soybean meal diets (D1, D2, D3 and D4) providing 1.0 g of standardized digestible lysine per MJ NE were prepared. The reduction of CP was achieved by partial replacement of soybean meal by wheat, barley and corn; CP levels were 22.4, 20.4, 18.4, 16.9% and NE contents were 10.28, 10.33, 10.52, and 10.52 MJ/kg for D1, D2, D3 and D4, respectively. Diets were supplemented with industrial AA in order to maintain an optimal AA supply. One or two littermates per block were slaughtered at the beginning of the experiment (about 12 kg BW) to measure initial body composition, and the four remaining littermates were affected to the four diets. Pigs were penned individually with *ad libitum* access to feed and water and were slaughtered at about 27 kg. Gain of nutrients and energy were calculated according to the comparative slaughter technique. Reduction of dietary CP level resulted in higher ADFI ($P=0.05$) with D2, D3 and D4 (1049 g/d on average) than with D1 (959 g/d). However, ADG was not affected by diet composition (666 g/d on average). Adjustment of data for identical ME intakes (2.52 MJ/d/kg BW^{0.60}) revealed that BW gain and its composition were not affected by dietary CP level; mean daily gains of empty BW, water, protein and lipid were 100.0, 75.7, 18.9 and 13.0 g/kg BW^{0.60}, respectively; daily ash gain decreased ($P<0.05$) from D1 (3.0 g) to D4 (2.7 g). The partition of daily ME intake between energy gain and heat production was comparable for all diets (0.94 and 1.58 MJ/kg BW^{0.60}, respectively). The AA composition of gain (% of N x 6.25) was not affected by dietary CP level, except for histidine that was reduced ($P<0.05$) from D1 (2.95%) to D4 (2.40%). These results demonstrate that, at optimal AA supplies, dietary CP level in piglet feeds can be reduced to a large extent with no impact on performance, composition of gain and energy utilization in piglets; N excretion is then markedly reduced.

Key Words: Piglet, Dietary Protein, Energy Utilization

1654 Effects of feed processing methods on growth performance and ileal digestibility in weaning pigs. S. H. Ohh*¹, J. W. Joo, S. H. Lee, S. C. Choi, Y. H. Shim, K. N. Han, B. J. Chae, and In K. Han², ¹*Division of Animal Res. Sci., Kangwon National Univ., Chuncheon,* ²*Dept. of Animal Sci. and Tech., Seoul National Univ., Suwon, Korea.*

Two feeding trials were conducted to compare the processing effects of feeds in young pigs. In expt. 1, a total of 108 pigs (L×Y×D; 24-d old, 7.60±.5kg BW) were randomly allotted to three treatments (three replicates, 12 pigs/pen): Meal (M), simple pellet (SP), and expanded pellet (EP). In expt. 2, a total of 96 pigs (L×Y×D; 14-d old, 5.21±.77kg BW) were randomly allotted to three treatments (four replicates, 8 pigs/pen): M, EP, and expanded crumble (EPC). Each expt. was conducted for 14 days. Diets were pelleted with 2.8mm die in diameter at 40°C. For expanding, diets were expanded at 70°C, and then pelleted with 2.8mm die in diameter at 60°C, and crumbled, according to the designs. The ileal digestibilities of expanded whey powder (WP), spray-dried plasma protein (SDPP), and fish meal (FM) were determined with cannulated pigs (7.44±1.6kg) with different expanding temperatures: 100, 120, and 140°C, respectively. The ADG, ADFI and F/G of pigs fed a SP diet were better ($p<.05$) than those fed M or EP diets (expt. 1). In expt. 2, there was no difference ($p>.05$) in ADG, but feed intake was reduced, resulting in improved ($p<.05$) F/C in pigs fed EP and EPC as compared with those fed a M diet. The ileal digestibilities of histidine in WP, isoleucine

in SDPP, and valine in FM were reduced ($p<.05$) when the temperature was 140°C, but ileal digestibilities of most amino acids were not reduced when these ingredients were expanded at up to 120°C. It could be concluded that simple pelleting of diets containing highly palatable and digestible ingredients would be better than expanding and expander processing of the diets could reduce palatability and ileal digestibility in weaning pigs.

Key Words: Pelleting and expanding, Digestibility, Pig

1655 The effect of pelleting temperature on anti-*E. coli* F4 immunoglobulin activity in spray-dried egg and porcine plasma. M. D. Drew*, A. E. Estrada, and A. G. Van Kessel, *University of Saskatchewan, Saskatoon SK Canada.*

The effects of pelleting on the activity of chicken egg immunoglobulin (Ig) or porcine plasma Ig in feed was tested. Hyperimmune chicken egg Ig specific for *E. coli* F4 was produced by immunizing laying hens with an *E. coli* F4 bacterin. The immune eggs were spray-dried prior to use. Spray-dried porcine plasma (AP920, American Protein Corporation) and the spray-dried egg Ig were added to a barley and wheat based pig starter ration at a level of 5% of the diet. The diets were then pelleted at 80, 90 or 105°C (pellet temperature measured at the die outlet) through a die containing holes 5 mm in diameter. Anti-F4 titers of the unpelleted and pelleted feeds were measured using an enzyme-linked immunosorbent assay (ELISA). The feed samples were diluted 1:100 with phosphate buffered saline and shaken overnight. The solids were then allowed to settle and the supernatants were applied to ELISA plates coated with purified F4 antigen in a series of doubling dilutions. Endpoint titers were defined as the last dilution that produced an absorbance plus 3 standard deviations above background. The anti-F4 Ig titer of plasma was 1:1,600 in the pre-pelleted feed. This was reduced to 1:800, 1:400 and 1:200 by pelleting at 80, 90 or 105°C respectively. The anti-F4 Ig titer of the egg Ig was 1:6,400 in the unpelleted feed. Pelleting at any of the three temperatures used in this experiment completely destroyed anti-F4 Ig activity measured by ELISA. The results demonstrate that egg Igs are more sensitive to heat denaturation during pelleting than plasma Igs. Incorporation of egg Ig products into animal diets should be done after pelleting if diet temperatures of greater than 80°C are used. Porcine plasma Igs are more resistant to heat denaturation than egg Igs but temperatures of 80°C or higher reduce specific porcine Ig activity in pelleted feeds.

Key Words: Pelleting, Egg immunoglobulin, Plasma

1656 Solutein enhances piglet growth post weaning. H.M. Miller*¹ and P. Toplis², ¹*University of Leeds, Leeds, LS2 9JT, UK,* ²*Primary Diets Ltd, Ripon, HG4 5HT, UK.*

Piglets fed diets containing porcine plasma (PP) in wk1 post-weaning have better feed intakes and growth rates than piglets fed skim milk based starter diets. We aimed to determine whether similar improved piglet performance occurred when piglets received Solutein (soluble PP) in their water supply instead of in feed. We also investigated whether Solutein in water further improved performance of piglets receiving a PP based diet. One hundred and twenty eight 25.1d old (sd = 4.22) piglets (62.5% Large White, 25% Landrace, 12.5% Duroc) weighing 7.8kg (sd = 1.91) were weaned into fully slatted flat deck pens. Piglets were not creep fed pre-weaning. Each pen (1.37m x 1.43m) contained 8 pigs allocated on the basis of litter, liveweight and sex. Four treatments were fed until d14 post-weaning: A Control, no plasma, B plasma in water, C plasma in feed, D plasma in water and feed. Solutein was included in the water for 5d at 2.4%, then for 5d at 1.2% and for a further 4d at .7%. Four pens were randomly allocated to each treatment. Diets contained ZnO (Zn 2500 ppm) and were formulated to contain 16.3 MJ DE/kg, 1.65% total lysine. From d14 onwards all piglets received the same diet (15.0 MJ DE/kg, 1.5% total lysine) and no water supplementation. Pigs were individually weighed at 0, 7, 14 and 20d post-weaning. Food and water were provided *ad libitum* throughout the 20d trial. Data were analysed using the GLM procedure of Minitab 12.2. Growth rate, 184 v 117 14 g/d, and FCR, 0.98 v 1.50 0.07, were better for all PP supplemented pigs than control pigs in wk1, ($P<.05$). No additional benefit accrued from PP in both feed and water. End BWs of PP fed pigs were numerically greater than those of control pigs but this failed to reach significance (14.5 v 13.9 0.3 kg). Feed intake over the 20d trial was greater for C piglets than for any other treatment ($P<.05$). All 3 PP treatments were equally effective in stimulating piglet performance

during wk 1 of the trial. Therefore PP in water is as effective as in the diet. PP in both diet and water gave reduced feed intake in wk3.

Key Words: Piglet, Plasma, Growth

1657 Effect of weaning weight and diet on the post-weaning performance of pigs. P.G. Lawlor^{*1}, P.B. Lynch¹, J.V. O'Doherty², and P.J. Caffrey², ¹Teagasc, Moorepark Research Centre, Cork, Ireland, ²University College Dublin, Ireland.

The objective of this experiment was to assess the effect of weaning weight and post-weaning diet on the performance of weaned pigs. Pigs were weaned from 32 litters at 22 days of age. Four pigs (2 light and 2 heavy) were taken from each litter (n=128), blocked on sex, litter origin and weaning weight and individually assigned at random to 2 dietary treatments; (1) high density diet (230 g/kg wheat, 200 g/kg maize, 175 g/kg full-fat soya, 120 g/kg dried whey, 110 g/kg dried skim milk, 95 g/kg herring meal; 17.4 g/kg lysine and 16.1 MJ DE/kg) and (2) medium density diet (434 g/kg wheat, 100 g/kg maize, 210 g/kg full-fat soya, 75 g/kg dried whey, 50 g/kg dried skim milk, 100 g/kg herring meal; 15.7 g/kg lysine and 15.1 MJ DE/kg). The duration of the experiment was 26 days. There was no interaction between weaning weight and post-weaning diet. Weaning weight was 7.1 and 5.8 kg (s.e. 0.08; P<0.01) and pig weight at day 26 post-weaning was 17.5 and 15.4 kg (s.e. 0.23; P<0.01) for heavy and light weight categories, respectively. The differential in weaning weight was associated with a difference in birth weight, which was 1549 vs. 1379 g (s.e. 28; P<0.01) for heavy and light weight categories respectively. In the period from day 0 to 26 post-weaning, feed intake was 440 and 396 g/day (s.e. 8.0; P<0.01) and daily gain was 389 and 355 g/day (s.e. 8.0; P<0.01) for heavy and light weight categories, respectively. Weaning weight was found to be a good determinant of weight at day 26 when terms for litter origin were included (R²=0.67; P<0.001 for the high density diet and R²=0.77; P<0.001 for the low density diet). Intake from day 0 to 26 post-weaning was not affected by diet (P>0.05). However, daily gain was 384 vs. 360 g/day (s.e. 8.0; P<0.05) and FCE was 1.10 vs. 1.16 g/g (s.e. 0.014; P<0.01) for high density and low density diets respectively. Pig weight at day 26 was 16.8 vs. 16.0 kg (s.e. 0.22; P<0.05) for high density and low density diets respectively. It is concluded that a natural advantage in weaning weight was still evident at day 26 post-weaning. The high density diets improved post-weaning pig performance.

Key Words: Weaning weight, Post-weaning, Pigs

1658 Effect of pre-weaning management and post-weaning nutrition on the performance of weaned pigs. P.G. Lawlor¹, P.B. Lynch^{*1}, J.V. O'Doherty², and P.J. Caffrey², ¹Teagasc, Moorepark Research Centre, Cork, Ireland, ²University College Dublin, Ireland.

The objective of this experiment was to assess the effect of pre-weaning management designed to increase weaning weight and post-weaning (PW) nutrition on the performance of weaned pigs. Thirty litters with more than 10 live born pigs were selected. At 11 days of age, pigs of average weight for the litter were removed from 15 litters so that 8 pigs remained per sow. These litters were given access to creep feed (16.5 MJ DE/kg and 18.7 g/kg lysine) until weaned. The remaining litters were left intact and were not given creep feed. Pigs were weaned at 27 days of age and two mixed sex pairs of pigs were formed from each litter (n=54 pairs). Pairs were blocked on litter origin and weight and assigned to one of the following treatments; (1) 10 kg starter diet (17.4 g/kg lysine and 16.1 MJ DE/kg; 230 g/kg wheat, 200 g/kg maize, 175 g/kg full-fat soya, 120 g/kg dried whey, 110 g/kg dried skim milk, 95 g/kg herring meal) followed by link diet (15.0 g/kg lysine and 15.3 MJ DE/kg; 481 g/kg wheat, 81.5 g/kg maize, 220 g/kg full fat soya, 100 g/kg herring meal, 75 g/kg dried whey) to 27 days PW (high dietary regimen; HDR) or (2) 4 kg starter diet, 10 kg link diet and weaner diet (13.6 g/kg lysine and 14.0 MJ DE/kg; 542 g/kg wheat, 200 g/kg barley, 150 g/kg soya, 75 g/kg herring meal) to 27 days PW (low dietary regimen; LDR). Thereafter pigs were fed common diets to 156 days of age. Reducing litter size and creep feeding increased weaning weight from 7.9 to 8.5 kg (s.e. 0.14; P<0.05). This weight advantage was lost by day 14 PW (P>0.05). Daily gain from day 0 to 27 PW was 472 and 427 g/day (s.e. 12.8; P<0.05) and FCE from day 0 to 27 PW was 1.26 and 1.36 g/g (s.e. 0.026; P<0.01) for HDR and LDR, respectively. Feed intake and daily gain, were similar for both treatments in the period from weaning to day 129 PW (P > 0.05) and from day 27 to 129 PW (P>0.05) respectively.

In the period from day 27 to 50 PW, FCE was improved for LDR (1.66 vs. 1.72, s.e. 0.020; P<0.05). It is concluded that the advantage in weaning weight caused by better pre-weaning management was lost in the early post-weaning period. Feeding a HDR improved performance in the early post-weaning but did not benefit lifetime performance.

Key Words: Creep feed, Post-weaning, Pigs

1659 The effect of choice feeding complete diets on the performance of weaned pigs. P.G. Lawlor^{*1}, P.B. Lynch¹, J.V. O'Doherty², and P.J. Caffrey², ¹Teagasc, Moorepark Research Centre, Cork, Ireland, ²University College Dublin, Ireland.

Three experiments were undertaken to compare choice feeding and phase feeding for weaned pigs (19 to 24 days old). In Experiment 1, 24 mixed sex groups of 16 pigs were blocked on weaning weight and assigned to the following treatments; (A) starter diet (18.3 g/kg lysine and 16.6 MJ DE/kg) for 11 days followed by link diet (15.0 g/kg lysine and 15.3 MJ DE/kg) to 27 days, (B) starter diet and link diet offered free choice to 27 days and (C) starter diet and weaner diet (13.0 g/kg lysine and 14.3 MJ DE/kg) offered free choice to 27 days. In Experiment 2, 66 pigs, blocked as individuals on sex and weaning weight were assigned to treatments as in Experiment 1. In Experiment 3, 24 single sex groups of 16 pigs were blocked on sex and weaning weight and randomly assigned to treatments as in experiment 1 but with treatment C being; starter diet and link diet offered free choice to 26 days with feeder position rotated twice weekly. In Experiments 1 and 3, a weaner diet (14.1 g/kg lysine and 14.4 MJ DE/kg) was fed to all pigs following the experimental period. In Experiment 1, daily gain was 406, 410 and 397 g/day (s.e. 6.7; P>0.05), FCE was 1.25, 1.21 and 1.28 g/g (s.e. 0.01; P<0.01) and the proportion of intake as starter diet was 0.20, 0.50 and 0.47 (s.e. 0.023; P<0.01) during the period from day 0 to 27 for treatments A, B and C, respectively. In the period between day 27 and 57 there was no effect of treatment on pig performance (P>0.05). Within pen variation in pig weight was similar for all treatments at day 14, 27 and 56 (P>0.05). In Experiment 2, daily gain was 403, 436 and 394 g/day (s.e. 13.0; P=0.07), FCE was 1.20, 1.16 and 1.24 g/g (s.e. 0.02; P<0.05) and the proportion of intake as starter diet was 0.19, 0.57 and 0.53 (s.e. 0.024; P<0.01) during the period from day 0 to 26 for treatments A, B and C, respectively. In Experiment 3, daily gain was 465, 486 and 488 g/day (s.e. 9.4; P>0.05), FCE was 1.14, 1.10 and 1.07 g/g (s.e. 0.015; P<0.01) and the proportion of intake as starter diet was 0.21, 0.48 and 0.55 (s.e. 0.022; P<0.001) during the period from day 0 to 26 for treatments A, B and C, respectively. Pig weight at day 49 was 36.4, 37.1 and 37.3 kg (s.e. 0.27; P=0.09). In conclusion, choice feeding improved post-weaning pig performance.

Key Words: Choice feeding, Post-weaning, Pigs

1660 Effects of microencapsulation of natural antimicrobials on the secretory, microbiological and digestive processes in the small intestine of piglets. Z. Mroz^{*1} and W. Krasucki², ¹Institute for Animal Science and Health, ID-TNO Animal Nutrition, Lelystad, The Netherlands, ²Agricultural University of Lublin, Poland.

Ten weaning piglets of 9.5 kg initial BW were fitted with newly developed re-entrant catheters in the exocrine pancreatic duct and with ileal cannulas (SICV) to compare the effects of in-feed natural antimicrobials (bioactive proteins/peptides from milk) without and with a novel, beeswax-based microencapsulation on the pancreatic and mucin secretions, ileal morphology, microflora, and digestion of amino acids. The piglets were sib paired to form 2 blocks (no/yes microencapsulation), and each block was randomly allotted to 5 diets according to a 5 x 5 Latin square design. The diets were as follows: 1) a corn-SBM-based diet (BD)+0.1% placebo; 2) BD+0.1% bovine IgG; 3) BD+0.1% bovine lactoferrin and lactoperoxidase blend (LLB); 4) BD + 0.1% bovine lactoglobulins (LG); 5) BD+0.1% probiotic blend (PB). In each period of 7 d (5-d adaptation and 2-d sampling) piglets were given ad libitum access to feed and water. Exocrine pancreatic secretion (postprandial volume, protein, bicarbonate) were not affected by the diets or microencapsulation, whereas trypsin and chymotrypsin activities were greater (P<0.05) for all the microencapsulated additives. Feeding IgG, LLB, LG and PB in the microcapsules decreased (P<0.05) mucin production in the ileal digesta, with a tendency to improve morphological and histometrical characteristics in the terminal ileum. There was a positive effect (P< 0.05) of microencapsulation on the apparent ileal digestibility

of lysine (+1.5%), methionine (+1.9%), tyrosine (+2.1%) and arginine (+2.5%), irrespective of the additive. Also, due to this microencapsulation, we observed a greater ($P < 0.05$) population of Lactobacilli, whereas hemolytic E.coli counts were reduced ($P < 0.05$). These data imply that in-feed bioactive proteins/peptides addressed as antimicrobials instead of antibiotics should be preferably microencapsulated against their gastric hydrolysis and for enhancing their efficacy along the small intestine of piglets.

Key Words: Piglets, Microencapsulation, Antimicrobials

1661 Effects of dietary conjugated linoleic acid (CLA) on carcass characteristics and serum leptin and lipid profile of rabbits. C. Corino¹, V. Bontempo*², S. Magni¹, and G. Pastorelli¹, ¹University of Milan/Italy, ²University of Molise, Campobasso/Italy.

A study was conducted to determine the effect of conjugated linoleic acid (CLA) synthesized from sunflower oil on growth, carcass characteristics, serum leptin and lipid blood profile of rabbits. One hundred and eight NZW rabbits, half male and half female, averaging 1.80 kg LW, allotted within weight and sex to a randomised complete experimental design, were fed ad libitum conventional pelleted diets supplemented with different fat: 0.5 % sunflower oil (C), 0.25 % sunflower oil and 0.25 % CLA (T1), 0.5 % CLA (T2). CLA oil contained 65 % CLA isomers (Conlinco, Inc., Detroit Lakes, Minnesota 56502 USA). Thirty-six rabbits, 12 of each group, half males and half females, were slaughtered at three different slaughtering weight (age): 2.5 kg (76 d), 2.8 kg (90 d), and 3.1 kg (104 d). No effect of CLA supplementation was observed on ADG, FI, FE, dressing percentage, pH and meat colour. Perirenal fat weight decreased at the medium slaughtering weight ($P = 0.089$) and it increased at the higher slaughtering weight ($P = 0.01$). No effect was observed on interscapular fat. CLA supplementation reduced triglycerides and total cholesterol ($P < 0.05$), and increased serum leptin concentration (2.02, 2.67 and 2.35 ng/ml, respectively, SEM = 0.194, $P = 0.06$). A gender effect was observed on triglycerides with higher values in males than females ($P < 0.01$). A similar effect was also found on leptin, but higher values were measured on females (2.57 vs 2.13 ng/ml, $P = 0.06$).

PSA Nutrition: Feed Regimens, Digestion, and Gut Morphology

1663 Effects of protein levels on ostrich performance and carcass traits. I. Cormier*, M.R. Lefrancois, and R. Bergeron, *Universite Laval, Quebec, Quebec, Canada.*

This study was conducted to assess the impact of a linear increase in dietary protein levels on performance, carcass quality and health of ostriches. Sixty-four unsexed crossed ostriches were raised in a greenhouse and fed ad libitum complete pelleted diets from 2 to 10 mo of age. Sixteen ostriches were randomly allotted four per pen to either one of four diets containing 18 to 23% CP for the starter (2 to 4 mo), 14 to 18% for grower (4 to 7 mo), and 12 to 15% for the finisher (7 to 10 mo). Except for protein levels, these diets supplied similar amounts of energy, fiber, lysine and methionine per kg of feed within each growing period. Body weight (BW), average daily gain (ADG), feed intake, feed efficiency (FE) were measured throughout the experiment. The ostriches' performance was recorded on a monthly basis. Carcass weight (CW) and yield (CY), viscera, heart and liver weights, meat cuts yields, and meat pH and color were also measured at the end of the trial. Carcasses were cut up into 12 meat parts according to the Canadian Ostrich Association chart and weighed. Meat pH was measured in the fan and inside the leg muscles 6 h post mortem. The Minolta color index (L, a*, b*) was used to assess meat color for these two carcass parts. Data were analyzed according to a complete block randomized design using protein level and body weight as the main factors. Mean live BW and CW were 95.15 ± 0.40 kg and 55.83 ± 1.35 kg, respectively. Cumulative ADG and FE were 310 ± 10 g and 0.160 ± 0.003 , respectively. Mean CY was $57.20 \pm 0.74\%$. Average meat pH was 6.27 ± 0.05 for the inside leg and 6.43 ± 0.06 for the fan. Total meat cuts yield was $40.56 \pm 0.53\%$ of the carcass. Besides the worst oyster cut yield ($P < 0.01$) for the third highest protein level, there was no significant differences ($P > 0.05$) between dietary treatments for the measured variables. There were no leg problems and mortality could not be associated with specific dietary treatments. Our results suggest

Our data suggest that conjugated linoleic acid reduce fatness and total serum cholesterol in rabbits. Our data are also consistent with the hypothesis that CLA has the potential to inhibit atherosclerosis.

Key Words: Dietary conjugated linoleic acid, Rabbit, Serum lipid profile

1662 Physiological adaptation to prolonged food restriction: a model study in growing rats. Ewa Furstenberg*¹, ¹Warsaw Agricultural University, Warsaw, Poland.

Organisms subjected to chronic food restriction attempt to mitigate the effects of deficiency by a series of physiological and behavioral responses, which are considered as adaptation to the low energy intake. Adaptation to energy restriction is expected to occur at different levels i.e. growth, rate, body size and composition, as well as energy metabolism. Whether the animals are able to economize on energy by reducing basal metabolism and whether it is an adaptive process per se resulting in decrease in metabolic rate beyond that predicted for the change in body size and/or composition or it is only secondary to changes in body weight and its components is, however, still controversial. The present study was carried out in 48 young growing female and male rats (RF group), which at different body weights (60, 75, 90, 105g) were subjected to food restriction (FR) by feeding constant stipulated rations (14.2, 15.9, 17.7, 19.4 g of standard laboratory diet, ME=1474kJ/100g, respectively) from ad libitum until maintenance level (i.e. constant body weight). Control group (C, n=24) was fed ad libitum throughout the experiment. During the experiment all rats were subjected to at least 2 measurements of resting metabolic rate (RMR). At the end, anatomical and chemical composition of animals was determined. Main results showed that the animals adapted to progressing energy deficit primarily by reducing final body weight and decreasing body fat and that female rats were more sensitive to food restriction than male rats. With respect to energy metabolism, when RF rats were compared with ad lib controls, RMR (in absolute values or relative to body weight and metabolic body weight) was significantly depressed in male rats, however, in females RMR was increased. Higher RMR in RF females than in female controls could be attributable in part to higher protein body mass. These results highlight some of the important differences between male and female rats in their mode of adaptation to restricted feeding.

Key Words: energy metabolism, food restriction, sex

that growing ostriches can perform equally well across a wide range of dietary protein levels without negative impacts on performance, carcass quality and health.

Key Words: Ostrich, Protein, Carcass

1664 Feeding program for broiler breeder hens based on the prediction equations of metabolizable energy requirements. N.K. Sakomura*, E.R. Freitas, C.B.V. Rabello, A.L. Santos, and O.M. Junqueira, ^{UNESP} Faculdade de Ciências Agrárias e Veterinárias de Jaboticabal - Sao Paulo - Brasil.

The purpose of this study was to evaluate feeding programs based on prediction equations of metabolizable energy requirements for broiler breeder after 55 weeks old. Seven hundred forty broiler breeder females Hubbard Hy-Yield and eighty males Peterson 55 wks of age, were distributed in a randomized design with 4 treatments and 5 replications of 37 birds. The feeding programs were: 1- Feeding according to the lineage recommendation, 2- Energy reduction 2 kcal/bird/day for each week, 3- Feeding according to UNESP (2000) equation: $ME = W^{0.75}(192.76 - 6.32T + 0.12T^2) + 7.62G + 2.40EM$, 4- Feeding according to NRC (1994) equation: $ME = W^{0.75}(173 - 1.95T) + 5.50G + 2.07EM$, where ME=energy requirement (kcal/bird/day), W=body weight (kg), T=temperature (C), G=weight gain (g) and EM=egg mass (g). The energy reduction program provided 417 kcal/bird/day, 181g of body weight gain (BWG) and 63.5 % of egg production from 55 to 66 wks of age. The feeding based on lineage recommendation provided 428 kcal/bird/day, 230 g BWG and 64.0 %. The equations UNESP and NRC promoted more energy intake (447 and 484 kcal/bird/day) consequently higher BWG (286 and 645g) and similar egg production 63,6% and 61,3%, respectively. The feeding programs did not affect the