1.80, 2.00, 2.20, and 2.40) improved (linear, P < 0.03) ADG (808, 818, 857, 864, 868, 877 ± 23 g/day), feed efficiency (0.31, 0.31, 0.32, 0.32, 0.33, 0.34 ± 0.005), and (quadratic, P < 0.01) lean percentage (53.9, 53.9, 53.6, 53.6, 54.2, 54.2 ± 0.15 %). Numeric improvements (linear, P = 0.12) in IOMFC ($106.64, 106.66, 106.98, 107.09, 107.60, 107.81 ± 1.40/pig) were observed as lysine increased. The equation (lysine:calorie ratio = -0.0133 × BW, kg + 3.6944) describes the lysine:calorie ratio that optimized performance and IOMFC from 40 to 120 kg.

**Key Words:** Lysine, Pigs, Economics

**191 Determining an optimum lysine:calorie ratio for 35 to 120 kg gilts in a commercial finishing facility.** R.G. Main, S.S. Dritz, M.D. Tokach, R.D. Goodband, and J.L. Nelssen, *Kansas State University, Manhattan*.

Our objective was to determine the optimum lysine:calorie ratio (g total dietary lysine/Mcal ME) for 35 to 120 kg gilts (PIC L337 × C22) in a commercial finishing environment. Four trials were conducted using randomized complete block designs (42 pens/trial, 4,520 pigs). Six treatments of increasing lysine:calorie ratio were used in each study. Diets were corn-soybean meal-based with 6% choice white grease. Lysine:calorie ratios were attained by adjusting the amount of corn and soybean meal. No crystalline lysine was used. As in trial 1 (35 to 60 kg, reported in 2002), increasing lysine:calorie ratio (1.96, 2.24, 2.52, 2.80, 3.08, and 3.36) in trial 2 (60 to 85 kg) increased (quadratic, P< 0.02) ADG (916, 935, 960, 973, 951, 936 ± 12 g/d), feed efficiency (0.40, 0.41, 0.41, 0.43, 0.40, 0.41 ± .005), income over marginal feed costs (IOMFC; $14.42, 14.68, 14.90, 15.14, 14.13, 13.80 ± .27/hd), feed cost per kg of gain ($0.32, 0.32, 0.32, 0.33, 0.35, 0.36 ± .004), and reduced (linear, P< 0.01) backfat. In trial 3 (78 to 103 kg), increasing lysine:calorie ratio (1.53, 1.78, 2.03, 2.28, 2.53, and 2.78) improved (quadratic, P< 0.02) ADG (807, 813, 900, 917, 912, 897 ± 18 g/d), feed efficiency (0.32, 0.32, 0.35, 0.36, 0.36, 0.36 ± 0.005), IOMFC ($11.32, 11.24, 13.18, 13.41, 13.20, 12.56 ± .36), feed cost per kg of gain($.381, .388, .359, .361, .365, .382 ± .006), and reduced (linear, P< 0.01) backfat. In trial 4 (100 to 120 kg), increasing lysine:calorie ratio (1.40, 1.60, 1.80, 2.00, 2.20, and 2.40) improved (linear, P< 0.02) ADG (722, 725, 767, 837, 880, 879 ± 19 g/d), feed efficiency (0.30, 0.30, 0.33, 0.35, 0.36, 0.36 ± 0.007), IOMFC ($105.66, 106.19, 107.46, 108.87, 109.64, 109.64 ± 1.57), feed cost per kg of gain ($0.40, 0.40, 0.38, 0.36, 0.36, 0.37 ± .008), and (quadratic, P< 0.04) lean percentage (54.7, 55.1, 54.6, 55.1, 55.3, 55.5 ± .15%). The equation (lysine:calorie ratio = -0.0164 × BW, kg + 4.004) describes the lysine:calorie ratio that met biological requirements and optimized IOMFC from 35 to 120 kg.

**Key Words:** Lysine, Pigs, Economics

**192 Evaluation of the lysine requirements for barrows fed ractopamine HCl (Paylean®) under conditions of heat stress.** D. C. Kendall*, J. W. Frank, A. M. Gaines, G. F. Yi, and G. L. Allee, *University of Missouri, Columbia*.

Two experiments were conducted to evaluate the lysine requirement of barrows fed ractopamine HCl (Paylean®, RAC) under heat-stress conditions. Exp. 1 was conducted in the Brody environmental chambers at the University of Missouri. Seventy-two barrows (TR-4 x PIC C-22) were subjected to a controlled cycling heat stress (cycling from 27 C at 2400 h to 35 C maintained from 1100 to 1900 h; HS) and fed corn-soy meal diets containing 10 ppm RAC and 3.51 Mcal ME/kg. Pigs were fed one of three dietary Lys levels (0.70, 0.95, or 1.20% total Lys) for 20 days to 6 replicate pens of 3 pigs/pen. An additional treatment consisted of pigs housed at thermoneutral conditions (21 C; TN) and fed a diet containing 10 ppm RAC and 1.20% total Lys. There was a linear improvement in ADG (P < 0.05) and feed efficiency (P < 0.05) with increasing Lys level (593, 633, and 782 g/d, respectively; 0.178, 0.218, and 0.255, respectively). Pigs fed the 1.20% total Lys diet in the TN environment had higher ADG (P < 0.01), ADFI (P < 0.01) and tended to be more efficient (0.371 vs 0.340, P < 0.07) than pigs fed 1.20% total Lys in HS. In Exp. 2, 210 barrows (TR-4 x PIC C-22) were housed in a cycling heat stress environment (28 to 34 C) and fed corn-soy meal diets containing 10 ppm RAC and 3.47 Mcal ME/kg. Pigs were fed one of four dietary Lys levels (0.90, 1.10, 1.30, or 1.50% total Lys) for 25 d to 6 replicate pens of 7 pigs/pen. A fifth treatment consisted of the 0.90% total Lys diet without RAC. There were no differences in ADG or loin eye area accretion among the RAC fed treatments; however, ADFI (P < 0.01) and tenth rib backfat accretion (P < 0.05) decreased linearly with increasing Lys level. Therefore, feed efficiency linearly (P < 0.01) and quadratically (P < 0.05) improved with increasing Lys level (0.399, 0.414, 0.441, and 0.421, respectively). Pigs fed diets with 10 ppm RAC and 0.90% total Lys had greater ADG (P < 0.02), feed efficiency (P < 0.001), and loin eye area accretion (P < 0.03) than non-RAC fed pigs. These experiments demonstrate that feeding Paylean® improves the growth performance of heat-stressed pigs and that the lysine requirement of barrows fed Paylean® may be as high as 1.30% total lysine under heat-stress conditions.

**Key Words:** Pigs, Ractopamine, Lysine

**193 The effects of environmental housing conditions on two ractopamine use programs in finishing pigs.** S. A. Trapp*, B. E. Hill, S. L. Hankins, A. P. Schinckel, and B. T. Richert, *Purdue University, West Lafayette, IN*.

Littermate barrows (93) and gilts (96) were used in a 6-wk study evaluating the effect of environmental housing conditions on two ractopamine use programs for late finishing pigs. All pigs were weaned into an SEW nursery. Following the nursery period, they were sorted into two environments: an all-in-all-out grow/finish facility with high bio-security measures in place (AIAO) or into a continuous flow system for the grow/finish phase (CF). At an average initial BW = 72.1 kg, pigs were allotted by weight, sex and ancestry to one of three ractopamine (RAC) treatments (trt): 1) control, no RAC; 2) 5 ppm RAC wks 0-3, 10 ppm RAC wks 4-6; 3) 10 ppm RAC wks 0-6. Barrows were fed a 1.05% Lys diet wks 0-3 and a 1.00% Lys diet wks 4-6; gilts were fed a 1.15% Lys diet wks 0-3 and a 1.10% Lys diet wks 4-6. Pigs fed RAC had increased ADG (1022 vs 867 g/d; P < 0.05) and increased G:F (0.416 vs 0.359; P < 0.05) compared to the control trt during wk 0-3. Overall, pigs fed RAC had increased ADG (958 vs 872 g/d, P < 0.05) and increased G:F (0.378 vs 0.338, P < 0.05) compared to the control trt. Additionally, pigs fed trt 2 had greater ADG (990 vs 926 g/d, P < 0.05) than trt 3 during wk 0-6. Pigs fed trt 2 also had increased final BW (109.0, 114.0, 110.8 kg; trt 1-3 respectively, P < 0.05) than the control trt. Real-time ultrasound data indicate that pigs fed RAC had increased loin eye area (LEA) (42.8, 45.8, 46.0 $cm^2$; trt 1-3 respectively, P < 0.05) and decreased $10^{th}$ rib backfat (20.4, 18.5, 18.4 mm; trt 1-3 respectively, P < 0.05). No significant differences between housing systems or interactions between grow/finish environments and treatments were found for overall ADG, ADFI, G:F, or carcass characteristics (P > 0.05). However, pigs in the CF environment were 11 d older at the start of the experimental BW. Both RAC use programs had increased pig growth rate and feed efficiency with nearly identical LEA and backfat depths over the control. Additionally, the step-up RAC trt had greater final BW and ADG than the constant RAC trt, while utilizing less RAC in the late finishing period.

**Key Words:** Ractopamine, Pigs, Environment

**194 Interactive effects between dietary L-carnitine and ractopamine HCl (Paylean®) on finishing pig growth performance.** B. W. James*[1], M. D. Tokach[1], R. D. Goodband[1], J. L. Nelssen[1], S. S. Dritz[1], K. Q. Owen[2], and J. C. Woodworth[2], [1]*Kansas State University, Manhattan,* [2]*Lonza, Inc., Fair Lawn, NJ*.

A total of 2,152 pigs were used in four experiments to determine the interactive effects of dietary carnitine and ractopamine HCl (Paylean®, RAC). All trials were arranged as factorials with main effects of carnitine (0, 25, or 50 ppm in Exp. 1 and 2 and 0 or 50 ppm in Exp. 3 and 4) and RAC (0, 5, or 10 ppm in Exp. 1 and 0 or 10 ppm in Exp. 2, 3, and 4). Dietary carnitine was fed from 38 kg to market (Exp. 1 and 3) or for the last 3 or 4 wk before market (Exp. 4 and 2, respectively). Ractopamine was fed prior to market for 4 wk in Exp. 1, 2, and 3, and 3 wk in Exp. 4. Experiments 1 and 2 were conducted in university research facilities and Exp. 3 and 4 in commercial research barns. All diets were formulated to 1.0% Lys during the last phase of each experiment. In all experiments, pigs fed RAC had increased (P < 0.05) ADG and feed efficiency (G:F) compared to pigs not fed RAC. Feeding carnitine prior to the RAC feeding period did not affect (P > 0.25) pig performance. In Exp. 1 and 2, carnitine did not affect (P > 0.46) ADG during the 4 wk prior to market; however, G:F tended (quadratic; P < 0.07) to improve with increasing carnitine in Exp. 2. In Exp. 3, a carnitine × RAC interaction was observed (P < 0.04) for ADG and G:F. Both carnitine and RAC improved performance, but not additively. In Exp. 4, pigs fed carnitine had increased (P < 0.04) ADG (0.88 vs 0.84 kg) and G:F

(0.36 vs 0.35) compared to pigs not fed carnitine and the response was additive to that of RAC. In analysis of the treatments common to all experiments, pigs fed diets containing RAC had increased ($P < 0.01$) ADG (1.03 vs 0.93 kg) and G:F (0.40 vs 0.35) compared to pigs not fed RAC. Carnitine tended to increase ($P < 0.07$) ADG (1.00 vs 0.96 kg) and improved ($P < 0.01$) G:F (0.38 vs 0.37) compared to pigs not fed carnitine. These results suggest that carnitine and RAC improve growth performance of finishing pigs with the greatest response to carnitine occurring in commercial environments.

**Key Words:** Carnitine, Ractopamine, Pigs

**195 Interactive effects of dietary L-carnitine and ractopamine HCl (Paylean®) on finishing pig carcass characteristics and meat quality.** B. W. James*[1], M. D. Tokach[1], R. D. Goodband1[1], J. L. Nelssen[1], S. S. Dritz[1], K. Q. Owen[2], and J. C. Woodworth[2], [1]*Kansas State University, Manhattan,* [2]*Lonza, Inc., Fair Lawn, NJ.*

Three experiments utilizing 1,356 pigs were conducted to determine the interactive effects of dietary carnitine and ractopamine HCl (Paylean®, RAC) on carcass and meat quality. Experiments were arranged as factorials with main effects of carnitine and RAC. Carnitine levels were 0, 25, or 50 ppm in Exp. 1 and 2 and 0 or 50 ppm in Exp. 3. Ractopamine levels were 0, 5, or 10 ppm in Exp. 1 and 0 or 10 ppm in Exp. 2, and 3. Dietary carnitine was fed from 38 kg to market (Exp. 1 and 3) or for 4 wk before market (Exp. 2). Ractopamine was fed for 4 wk. Experiments 1 and 2 were conducted at university research facilities and Exp. 3 in a commercial research barn. A carnitine × RAC interaction ($P < 0.02$) was observed for visual color, L*, and a*/b* in Exp. 1. In pigs fed RAC, increasing carnitine decreased L* and increased visual color scores and a*/b* compared to pigs not fed RAC. Ultimate pH tended to increase (linear, $P < 0.07$) with increasing carnitine. Drip loss decreased (linear, $P < 0.04$) in pigs fed increasing carnitine. In Exp. 2, a carnitine × RAC interaction was observed ($P < 0.04$) for visual firmness and drip loss. Visual firmness scores decreased in pigs fed increasing carnitine and no RAC, but increased with increasing carnitine when RAC was added to the diet. Drip loss decreased with increasing levels of carnitine when fed with RAC. Percentage lean was higher ($P < 0.01$) for pigs fed RAC. A carnitine × RAC interaction ($P < 0.03$) was observed in Exp. 3 for fat thickness and percentage lean. Fat thickness decreased and lean percentage increased in pigs fed carnitine or RAC, but the responses were not additive. Pigs fed carnitine tended ($P < 0.06$) to have decreased drip loss. Pigs fed RAC had decreased ($P < 0.05$) 10th rib and average backfat and decreased drip loss compared to pigs not fed RAC. These results suggest that ractopamine increases carcass leanness and supplemental carnitine reduces drip loss when fed in combination with ractopamine.

**Key Words:** Carnitine, Ractopamine, Pigs

**196 Effects of fish oil on growth performance, immune, adrenal and somatotrophic responses of weanling pigs after lipopolysaccharide challenge.** Y. L. Liu[1], D. F. Li*[1], L. M. Gong[1], G. F. Yi[2], and A. M. Gaines[2], [1]*China Agricultural University, Beijing,* [2]*University of Missouri, Columbia.*

Seventy-two crossbred pigs weaned at 28 d of age were used to investigate the effects of fish oil on growth performance, immune, adrenal, and somatotrophic responses following E. coli lipopolysaccharide (LPS) challenge in a 2 × 2 factorial arrangement of treatments. The main factors consisted of oil type (7% corn oil or fish oil) and immune challenge (LPS or saline). Pigs were randomly assigned to treatments. On d 14 and 21 postweaning, pigs were i.p. injected with either 200 $\mu$g/kg BW of LPS or an equivalent amount of sterile saline. At 3 h postinjection, blood plasma samples were collected for analysis of IL-1$\beta$, cortisol (CS), GH, and IGF-I. On d 2 after LPS challenge, blood samples were collected for lymphocyte proliferation and antibody responses to Albumin Bovine V Boehringer (BSA). The performance parameters of ADG, ADFI, and G:F were also evaluated during the 28 d experiment. Our results indicated that LPS-challenge depressed ADG ($P \leq 0.05$) from d 14-28 and ADFI ($P \leq 0.05$) from d 14-21. On both d 14 and 21, plasma IL-1$\beta$ ($P \leq 0.01$), CS ($P \leq 0.001$), and blood lymphocyte proliferation ($P \leq 0.05$) were increased, whereas IGF-1 ($P \leq 0.01$) was decreased after LPS-challenge. LPS-challenge also resulted in decreased plasma GH ($P \leq 0.05$) on d 14. Neither LPS-challenge or oil type affected serum antibody response to BSA ($P \geq 0.10$). Fish oil did improve ADG and ADFI during the first LPS-challenge period (d 14-21; $P \leq 0.10$). No LPS-challenge × oil type interactions were observed for any of the growth performance parameters during the 28 d period ($P \geq 0.10$). Fish oil decreased blood lymphocyte proliferation incubated with 16 $\mu$g/mL concanavalin A during the first challenge period ($P \leq 0.10$); however, no LPS-challenge × oil interaction was observed ($P \geq 0.10$). On both d 14 and 21, feeding fish oil decreased plasma CS ($P \leq 0.05$) and plasma IL-1$\beta$ ($P \leq 0.10$) in LPS-challenged pigs. Pigs fed fish oil also had higher plasma IGF-1 ($P \leq 0.10$) as compared to pigs fed the corn oil diet on both d 14 and 21. No LPS-challenge × oil interaction was observed for plasma GH ($P \geq 0.10$). These data suggest that fish oil alters indices of the immune axis that may lead to improved growth performance during an inflammatory challenge.

**Key Words:** Pigs, Fish Oil, Lipopolysaccharide

**197 Evaluation of a botanical extract in nonmedicated diets for pigs 15 to 113 kg body weight.** B. V. Lawrence*[1], J. D. Hahn[1], S. Hansen[1], J. Hedges[1], E. Hansen[1], R. Musser[1], and J. Corley[2], [1]*Hubbard Feeds Inc., Mankato, MN,* [2]*Prince Agri Products, Inc., Quincy IL.*

A botanical extract (Xtract) addition to antibiotic free diets was evaluated in 3 trials. In Exp. 1, 549 pigs (15.1 ± 0.82 kg) were allotted to 1 of 3 treatments (n = 8), either non-medicated diet (Non-Med), Non-Med + 182 g/t Xtract, or medicated with Tylan at 44 g/t (Med). During the 21-d trial, ADG tended to be lower ($P < 0.10$) for the Non-Med (571 g/d) compared with Xtract (610 g/d) and Med (615 g/d) pigs. Intake was similar ($P > 0.10$) across treatments (927 ± 59.9 g/d) resulting in an improvement in gain/feed ($P < 0.01$) for the Xtract (0.65) compared with Non-Med (0.62) treatments. Gain/feed was highest ($P < 0.05$) for the Med (0.68) treatment. In Exp. 2, 254 pigs (30.2 ± 1.46 kg) were used to evaluate Xtract vs. Non-Med in a 91-d trial (n = 6). No treatment differences were detected ($P > 0.10$). Pigs had an ADG of 914 ± 41.8 g/d with a gain/feed of 0.39 ± 0.03. In Exp. 3, 351 pigs (24.3 ± 0.76 kg) were allotted to Non-Med, Xtract, or Med treatments (n = 6) in a 100-d trial. In Exp. 3, the Med group consisted of a rotation of 660 g/t chlortetracyline for 7 d followed by 44 g/t of Tylan for 21 d. Cumulative ADG (885 ± 29.6 g/d) and gain/feed (0.39 ± 0.02) were not different ($P > 0.10$) across treatments. However, during period 3 (day 43 to 64) an undiagnosed digestive disturbance occurred. During this period, gain/feed was improved ($P < 0.05$) for the Xtract (0.42) and Med (0.42) treatments compared with Non-Med (0.38). The improvement in gain/feed was the result of a numerical improvement ($P > 0.20$) in ADG (889 vs 928 and 942 g/d) and numerical decrease ($P > 0.31$) in intake (2.38 vs 2.25 kg/d). Results of these experiments suggest that during periods of disease challenge, Xtract may improve ADG and gain/feed compared with Non-Med pigs. This improvement may be intermediate to, or equal to that observed with in-feed antibiotics. When no disease challenge is present, pig performance may not be improved by either Xtract or the antibiotic programs evaluated in these trials.

**Key Words:** Botanical Extract, Pigs, Antibiotics

**198 Effect of milk supplementation with *Lactobacillus brevis* 1E-1 on intestinal microflora, intestinal morphology, and pig performance.** D. C. Brown*[1], M. E. Davis[1], C. V. Maxwell[1], Z. B. Johnson[1], T. Rehberger[2], K. J. Touchette[3], and J. A. Coalson[3], [1]*University of Arkansas, Fayetteville,* [2]*Agtech Products, Inc., Waukesha, WI,* [3]*Merrick's, Inc., Union Center, WI.*

Two experiments were conducted to determine the effect of milk supplementation with *Lactobacillus brevis* 1E-1 on pig performance, intestinal microflora, and gut morphology. Litters were allotted to two treatments at farrowing: 1) control milk supplement, and 2) as 1 with 1E-1. At weaning, pigs from the two lightest blocks were offered the control treatment for 5 d. One pig/litter was sacrificed at 10, 22 (weaning), and 28 d of age to assess gut morphology and intestinal microflora populations. In Exp. 1, pigs fed 1E-1 had a greater ADG ($P \leq 0.05$) compared to the control in the first 5 d postweaning. Small pigs provided milk supplement also had increased ADG ($P \leq 0.05$) in the first 5 d postweaning compared to normal-sized pigs. Gain:feed was greater ($P \leq 0.05$) from d 0 to 14 after weaning when small pigs were previously fed 1E-1 compared to control pigs, while previous supplementation did not affect performance of normal-sized pigs (interaction, $P \leq 0.05$). Data previously reported from this experiment indicated that 1E-1 decreases *E. coli* populations in the jejunum pre-weaning and at weaning