was there a response during the Phase 2 period. There was an interaction ($P < 0.05$) between NaCl and zinc oxide where an improved daily gain occurred when diets were without added NaCl, but when NaCl was added, the response to zinc oxide was not present. Copper sulfate improved daily gains ($P < 0.01$) during both the 0-14 and 14-28 d periods. There was an interaction between NaCl and copper sulfate where daily gains were improved more ($P < 0.05$) during each phase when added NaCl was provided. No interaction occurred between zinc oxide and copper sulfate. These results suggest that the dietary level of NaCl may influence the performance responses to zinc oxide or copper sulfate.

Key Words: Salt, Zinc, Copper

179 Evaluating growth performance, plasma and feces of nursery pigs fed organic zinc polysaccharide complex.

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This experiment was conducted to evaluate the effects of feeding titrated concentrations of organic zinc in the form of a polysaccharide complex (SQM-Zn: Quali Tech, Inc., Chaska, MN) on growth performance, plasma Zn and Cu concentrations, and fecal Zn and Cu excretion of nursery pigs. One hundred ninety eight crossbred (PIC: C22 X TF4) pigs were weaned (17 2 d of age; avg. wt. 5.6 .02 kg) and allotted to dietary treatment based on weight and sex. Pigs were housed in an environmentally regulated building with 3 pigs/pen (1.2 x 1.2 m) and 11 pens (replications)/treatment. The experimental Phase 1 nursery diet was fed as crumbled pellets from d 0 to 14. Common diets were fed during Phase 2 (d 15 to 28) and Phase 3 (d 29 to 42). Total lysine concentrations were 1.5 % in Phase 1, 1.25 % in Phase 2, and 1.1 % in Phase 3. All dietary phases contained 135 ppm Zn as $ZnSO_4$, 165 ppm Fe as $FeSO_4$, and 16.5 ppm Cu as $CuSO_4$. Pigs were bled on d 14 to measure plasma Zn and Cu concentrations. The Phase 1 diet utilized 6 dietary Zn treatments: (1) 135 ppm Zn as $ZnSO_4$, (2) 125 ppm Zn as SQM-Zn (organic polysaccharide complex), (3) 250 ppm Zn as SQM-Zn, (4) 375 ppm Zn as SQM-Zn, (5) 500 ppm Zn as SQM-Zn, and (6) 2,000 ppm Zn as ZnO. Pigs fed 2,000 ppm Zn as ZnO had higher (P<.03) ADG during Phase 2 (d 15 to 28) compared to pigs fed the control or SQM-Zn treatments. During Phase 1, Phase 3 and over the entire 42-d study, pigs had similar ADG (P>.05). Dietary treatment had no affect (P>.05) on ADFI and feed efficiency in any phase of the experiment. Pigs fed 2,000 ppm Zn as ZnO had the highest plasma Zn concentrations (P<.01) compared with all other treatments. Plasma and fecal Cu concentrations were not affected (P>.05) by Phase 1 dietary Zn treatments. At the end of Phase 1, pigs fed 2,000 ppm Zn as ZnO had the highest fecal Zn excretion (g/d and %; P<.0001) compared to the other dietary treatments. These results indicate that feeding lower concentrations of Zn may not affect nursery pig performance, but will reduce the amount of Zn excreted.

Key Words: Zinc, Copper, Pigs

180 Iron bioavailability of humate in young pigs.

S. W. Kim*, L. E. Hulbert, H. A. Rachuonyo, and J. J. McGlone, *Texas Tech University*.

Humate is derived from mineral humic substances that include several biologically active and inactive compounds which are commonly used for improving soil fertility. Use of humate in swine diets is a relatively new concept. A series of research projects has been conducted to evaluate the efficacy of humate as a feed additive for swine. As a first approach, a study was conducted to test the bioavailability of iron in humate for nursery pigs. Humate contained 8,700 ppm of iron as determined by atomic absorption spectrophotometry. One hundred fifty pigs (Newsham, Colorado Springs, CO) were not given supplemental iron while nursing for 21 d. Pigs were weaned on d 21 and allotted to five treatments (four control treatments with different levels of supplemented iron; 0, 12, 54, and 69 ppm from FeSO4 and one treatment with 88 ppm iron from humate). Pigs were fed diets for 5 wk ad libitum and water was accessible freely. Body weight and feed intake were measured weekly. Blood samples were taken from pigs on d 28 to determine the number of red blood cells and hemoglobin concentration. Pigs fed a diet with the humate grew faster ($P < 0.05$) during the first week postweaning, but performance was not different during the entire period. Feed intake and gain:feed ratio were the same among treatments. Slope ratio technique was used for the data analysis. The concentration of blood hemoglobin did not respond to dietary iron levels using this model. However, the number of red blood cells (106/L) was modeled by 4.438 + 0.017 x ′Fe (ppm) from FeSO4′ + 0.012 x ′Fe (ppm) from the humate′. Based on the comparison between the slopes (0.012/0.017), iron in humate was 71% as available as the iron in FeSO4. However, there was no difference between the slopes for dietary FeSO4 and humate iron ($P > 0.05$). Humate can replace FeSO4 as an alternative iron source for pigs at 71% relative bioavailability.

Key Words: Nursery Pigs, Iron Bioavailability, Humate

181 Timing of magnesium supplementation through drinking water to improve fresh pork quality.

B. R. Frederick*, E. van Heugten, and M. T. See, *North Carolina State University*.

Thirty-two pigs were used to determine the timing effect of Mg supplementation through drinking water on fresh pork quality. Pigs (16 castrated males, 16 females) were individually penned, provided 2.7 kg of feed (0.12% Mg) daily, and allowed free access to water via a nipple waterer for the duration of the study. After 5 d of adjustment, pigs (119 ± 4 kg BW) were randomly allotted by weight and sex to 900 ppm supplemental Mg in drinking water for 0, 2, 4, or 6 d prior to slaughter. Pigs were then transported, approximately 110 km, to the abattoir and slaughtered approximately 45 min after arrival. At 24 h post-mortem, *Longissimus dorsi* and *Semimembranosus* chops were placed on Styrofoam trays with absorbent pads and wrapped in oxygen permeable film for retail fluid loss and color determination at 0, 2, 4, 6, and 8 d of storage at 4°C. Approximately 60 g of each muscle was suspended in a covered plastic container, stored for 48 h at 4°C to determine drip loss. Magnesium did not affect loin pH at 45 min or 24 h post-mortem. However, ham pH tended to be greater in pigs offered Mg supplementation for 2 d than those not supplemented, 5.71 vs. 5.62 ± 0.03, respectively ($P = 0.08$). Drip loss from the loin (3.29, 2.46, 3.16, and 3.55 ± 0.42%) and ham (3.33, 3.26, 3.83, and 3.36 ± 0.30%) were not affected by Mg supplementation for 0, 2, 4, and 6 d, respectively. Furthermore, loin retail fluid loss was not affected by Mg supplementation during retail storage. However, ham retail fluid loss from pigs provided supplemental Mg for 2 d, but not 4 or 6 d, was lower after 4 d (4.15 vs. 6.08 ± 0.52%, $P < 0.05$) and 8 d of storage (6.25 vs. 8.22 ± 0.62%, $P \leq 0.05$) than pigs without Mg supplementation. Minolta L∗, a∗, and b∗ color measurements of the loin were not affected by Mg supplementation. Magnesium supplementation for 2 d, but not 4 or 6 d, decreased initial yellowness (b∗) of the ham compared to no added Mg, 6.85 vs. 8.95 ± 0.59 ($P < 0.04$). These data suggest Mg supplementation through drinking water for 2 d can improve color and reduce retail fluid loss of ham.

Key Words: Pork Quality, Magnesium Sulfate, Water

182 Effects of ractopamine dose and feeding duration on pig performance 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 evaluate the impact of ractopamine HCl (Paylean®, Elanco Animal Health) dose and feeding duration on growth performance and carcass composition. Forty-five pens (1,035 gilts; initially 103.2 ± 0.62 kg) were alloted to one of 9 treatments. Treatments included pigs fed 5 or 10 ppm ractopamine for the last 7, 14, 21, or 28 days prior to market and a control treatment without ractopamine. There were 23 pigs per pen and 5 pens per treatment. Diets were corn-soybean meal based, formulated to contain .75 and 1.00 % total dietary lysine for the control and ractopamine supplemented diets, respectively. At slaughter, fat and loin depth were measured to calculate lean percentage. Daily gain (0.66, 0.76, 0.77, 0.77 kg/d for 5 ppm and 0.78, 0.81, 0.78, 0.80 kg/d for 10 ppm for 7, 14, 21, or 28 d) and feed efficiency (G:F; 0.27, 0.31, 0.31, .30 for 5 ppm and .31, .32, .31, .31 for 10 ppm for 7, 14, 21, or 28 d) were increased (P≤.04) for pigs fed 5 ppm ractopamine for 14, 21, or 28 days as well as pigs fed 10 ppm for all durations compared to the control (ADG, 0.60 kg/d; G:F, 0.25). The 5 ppm, 7 day treatment was intermediate in both daily gain and feed efficiency. Ractopamine dose (5 vs.10 ppm) did not affect (P≥.16) carcass parameters measured. Fat depth decreased (16.3, 15.7, 15.3, 14.8 ± .36 mm) and lean percentage (56.0, 56.6, 56.8, 57.0 ± .15%) increased linearly (P≤.01) as ractopamine feeding duration increased from 7 to 28 days. However, the control treatment was intermediate to all other treatments. Ractopamine feeding duration did not affect (P≥.93) yield (76.9, 76.9, 77.0, 76.7 ± .3 %) or loin depth (67.7, 67.1, 67.4, 67.7 ± 1.5 mm). Feeding

ractopamine supplemented diets at 5 ppm 14 to 28 days and 10 ppm 7 to 28 days prior to slaughter improved growth rate and feed efficiency. Ractopamine feeding duration (in conjunction with increased dietary lysine level) also linearly reduced fat depth and increased lean percentage in this study.

Key Words: Ractopamine, Dose, Duration

183 Effect of ractopamine (Paylean®) feeding program on growth performance and carcass value. M. T. See*[1], T. A. Armstrong[2], and W. C. Weldon[2], [1]*North Carolina State University,* [2]*Elanco Animal Health.*

To determine if ractopamine (RAC) response can be enhanced by changing the levels in the diet during different phases of feeding, 100 barrows and 100 gilts (initial BW = 71 kg) were randomly allotted to one of four dietary treatments. Treatments were: 1) Control diet containing no RAC wk 0-6; 2) Step-up RAC: 5 ppm wk 1 and 2; 10 ppm wk 3 and 4; and 20 ppm wk 5 and 6; 3) Step-down RAC: 20 ppm wk 1 and 2; 10 ppm wk 3 and 4; and 5 ppm wk 5 and 6; and 4) Average RAC: 11.7 ppm wk 0-6. All diets were formulated to contain 1.2% lysine. Overall, ADG was increased (1.0 vs. .93 kg/d; $P < .05$) and feed/gain decreased (2.77 vs. 3.21; $P < .01$) for pigs fed RAC compared to the control. Feed cost/kg gain did not differ between dietary treatments but total feed cost/pig was greater ($21.67 vs. $19.44; $P < .01$) for pigs fed RAC. Loin muscle area, kg of boneless trimmed ham and % fat free lean increased ($P < .01$) in pigs fed RAC. Carcass value was calculated using a common North Carolina pricing system and lean value of the carcass was based on USDA reported prices for boneless pork primal cuts. When value was adjusted to a common final weight, carcass value/pig did not differ ($P > .10$) among treatments but lean value/head was increased by $4.69 ($P < .01$) for pigs fed RAC. When value was not adjusted for final weight allowing a comparison of equal time on feed, a treatment x sex interaction ($P < .01$) was observed for carcass value with control gilts having the least value ($114.86) and barrows fed the average RAC treatment having the greatest value ($132.07) but not significantly different from control barrows ($130.59). Lean value per head was greater for the Step-up and Average RAC treatments than the Step-down or Control ($129.27^a, $128.11^a, $127.35^b, $123.49^c; $P < .01$) treatments. Ractopamine resulted in a favorable response in growth performance and yielded more lean pork at a greater feed cost. Carcass and lean value data indicate that the decision to feed RAC and the feeding program used with it should be made based on marketing plans. Economic benefits from RAC feeding may be achieved if pigs are sold on pounds of lean pork and not on a typical carcass value basis. Economic benefits of RAC feeding may also be achieved for pigs fed to a constant age rather than a constant weight.

Key Words: Ractopamine, Growth Performance, Economics

184 Evaluation of the effects of dietary fat, conjugated linoleic acid, and ractopamine on growth performance and carcass quality in genetically lean gilts. T. E. Weber*, B. T. Richert, and A. P. Schinckel, *Purdue University.*

Gilts (n=180; Newsham XL sires x Newsham parent females; initial BW 59 kg) were assigned to a 2 x 2 x 3 factorial arrangement consisting of ractopamine (RAC; 0 or 10 ppm), conjugated linoleic acid (CLA; 1% of a product containing 60% CLA isomers or 1% soybean oil) and dietary fat in an 8 wk feeding trial. Dietary fat treatments consisted of : 1) 0% added fat; 2) 5% choice white grease (CWG); and 3) 5% beef tallow (BT). RAC treatments were imposed when the gilts reached an average BW of 85.5 kg and lasted for the duration of the final 4 wk until carcass data were collected at an average BW of 112 kg. Gilts fed CLA had greater (0.40 vs 0.38; $P < 0.01$) G/F wk 0 to 8 than gilts not fed CLA. Fat provided as CWG or BT tended to increase ADG (0.98 vs 0.95 kg; $P < 0.10$), decreased ADFI (2.45 vs 2.55 kg; $P < 0.02$) and increased G/F ($P < 0.01$) as compared to gilts fed 0% added fat. RAC increased ADG (1.05 vs 0.87; $P < 0.01$) and G/F (0.42 vs 0.35; $P < 0.01$) wk 4 to 8. Gilts fed RAC had greater ($P < 0.01$) dressing percentages than gilts fed no RAC. Added dietary fat tended ($P < 0.06$) to increase dressing percentage. Tenth rib backfat (BF) tended ($P < 0.06$) to be decreased by feeding CLA. Gilts fed RAC tended ($P < 0.10$) to have lower 10th rib BF than gilts fed diets devoid of RAC. Gilts fed CWG had greater ($P < 0.05$)10th rib BF and last rib BF than gilts fed BT. Feeding RAC increased (57.8 vs 56.2; $P< 0.01$) predicted percent lean. Predicted percent lean was also increased by feeding CLA (57.5 vs 56.5; $P < 0.03$) Gilts fed CLA tended to have greater loin eye areas (LEA; $P < 0.06$) than gilts fed no CLA. Feeding RAC or 5% fat increased ($P < 0.01$) LEA. Gilts fed either CLA or fat tended ($P < 0.10$) to have greater marbling scores than gilts fed diets devoid of CLA or fat. Gilts fed CLA had greater ($P < 0.01$) belly firmness than gilts fed no CLA. These results demonstrate that RAC, CLA, and added fat each enhance certain growth performance and carcass characteristics when used alone or in conjunction with one another.

Key Words: CLA, Ractopamine, Dietary Fat

185 Effects of ractopamine and carnitine in diets containing 5% fat for finishing pigs. S. A. Trapp*[1], B. T. Richert[1], A. P. Schinckel[1], and K. Q. Owen[2], [1]*Purdue University, West Lafayette, IN,* [2]*Lonza, Inc., Fair Lawn, NJ.*

To study the effect of ractopamine (RAC) in conjunction with carnitine in elevated fat diets, three hundred gilts (avg. initial BW = 85.4 kg) of two terminal crosses (European, ET; and US, UST) were assigned diets fed for the last four weeks before slaughter. Five dietary treatments (TRT) were used: 1) control; 2) 50 ppm carnitine; 3) 5 ppm RAC; 4) 50 ppm carnitine and 5 ppm RAC; and 5) 10 ppm RAC. All diets were formulated to 1.15% lysine and contained 5% added choice white grease. The gilts were weighed and feed intake was recorded on d 0, 14, and 28. In addition, 3 gilts/pen (36/TRT) were ultrasonically scanned on d 0, 14, and 28 for backfat and loin eye area to estimate composition and tissue accretion curves. Individual hot carcass weight and carcass ultrasound of loin and backfat depth measurements were taken at a commercial pork processor. Pigs fed TRTs 4 and 5 had greater ADG during d 0-14 (834, 866, 952, 1052, 1073 g/d, $P<.001$, TRTs 1-5, respectively) and d 0-28 (854, 845, 907, 960, 943 g/d, $P<.01$, TRTs 1-5, respectively) compared to pigs fed treatments 1 and 2. No difference was found in ADFI between diets. Gilts fed TRTs 3, 4, and 5 had greater gain:feed ($P<.01$) from d 0-14 (375, 379, 430, 451, 466 g/kg, TRTs 1-5, respectively) and d 0-28 (357, 348, 391, 399, 398 g/kg, treatments 1-5, respectively) compared to pigs fed TRTs 1 and 2. Pigs fed diets with RAC had increased carcass loin depths (67.8, 66.4, 70.6, 70.5, 71.7 mm; $P<.05$, TRTs 1-5 respectively). However, only TRTs 3 and 5 had increases in plant measured percent lean ($P<.01$) compared to the other TRTs. The UST gilts tended to have greater ADG d 0-28 (922 vs 885 g/d; $P<.07$), but had increased plant fat depth (15.5 vs 13.4 mm; $P<.001$) with reduced plant percent lean (56.0 vs 56.6%; $P<.01$) and reduced carcass yield (75.2 vs 76.1%; $P<.01$) compared to the ET gilts. This data indicates that during the first 14 days while feeding ractopamine, carnitine may enhance the ractopamine response with increased body weight gain and improved feed efficiency.

Key Words: Carnitine, Ractopamine, Pigs

186 Interactive effects between Paylean® (Ractopamine HCl) and dietary lysine on pork quality and loin, belly, and ham composition. M. J. Webster*, R. D. Goodband, M. D. Tokach, J. A. Unruh, J. L. Nelssen, S. S. Dritz, D. E. Real, J. M. DeRouchey, J. C. Woodworth, and T. A. Marsteller[1], *Kansas State University, Manhattan, KS,* [1]*Elanco Animal Health, Indianapolis, IN.*

A total of 432 pigs was used to evaluate the effects of Paylean and dietary lysine on pork quality and loin, belly, and ham composition. The 12 dietary treatments included Paylean (0, 5, and 10 ppm) and 4 levels of lysine. For pigs fed no Paylean, lysine levels were 0.6, 0.8, 1.0, and 1.2%. For pigs fed Paylean, lysine levels were 0.8, 1.0, 1.2, and 1.4%. The dietary treatments were fed to pigs from 79 to 109 kg. There were three pigs per pen and 12 pens per treatment (six pens of each sex). One pig per pen was harvested on d 14 and d 28 of the experiment. At 24 h postmortem, carcasses were fabricated into the primal cuts. After a 30 min bloom, the loin surface at the 10^{th} rib was analyzed for color (Hunter $L^*a^*b^*$ values), drip loss, ultimate pH, visual color, firmness, and marbling. After spareribs were removed and the belly trimmed, belly firmness was evaluated by suspending the belly perpendicularly over a bar (skin side up) and the distance was recorded between the belly ends initially and after a five-minute period. A sample from each loin (9^{th} rib), ham (biceps femoris), and belly, from the same anatomical region, was collected, frozen, and analyzed for protein, lipid, ash, and moisture content. For the endpoint data, increasing Paylean decreased (linear, $P< .0001$) initial and 5-minute belly firmness. Visual marbling score decreased (linear $P < .05$) as lysine increased for pigs