

Meat Science and Muscle Biology

83 Dose titration of ractopamine evaluating the effects on carcass cutout yields in feedlot steers. A. Schroeder*¹, D. Hancock¹, D. Mowrey¹, S. Laudert¹, G. Vogel¹, D. Polser¹, and F. McKeith², ¹*Elanco Animal Health, Greenfield, IN*, ²*University of Illinois, Champaign.*

Ractopamine (RAC), was recently approved by the US FDA CVM for feeding to cattle during the last 28 to 42 of the finishing period. A randomized complete block design, replicated at five sites, was used to evaluate carcass cutout yields of beef steers assigned to one of four treatments (0, 10, 20, or 30 ppm, 100% DM). This resulted in a total of 25 experimental units (8-10 steers/pen) per RAC concentration. A subset of each pen (2 carcasses/pen with HCW nearest to the pen average) was selected. Fifty beef sides from each treatment were fabricated according to standard IMPS specifications for 12 cuts. All cuts were trimmed to 0.1 cm fat thickness. Carcass cutout yields were calculated as a percentage of standardized side weight. Least squares means are given in Table 1. Side weight and standardized side weight were increased ($P<.05$) for the 20 and 30 ppm. When expressed as a percentage of standardized weight, the yields of trimmed shoulder clod, tenderloin, inside round, and gooseneck round were increased ($P\leq.07$) for RAC treatments above control. Total wt of closely trimmed subprimal cuts were increased ($P<.05$) for 20 and 30 ppm (59.3 vs 61.6 and 61.7 kg, respectively.) The yield of total closely trimmed subprimal cuts expressed as a percentage of the standardized side was increased ($P=.07$) for 20 and 30 ppm (36.4 vs 37.1 and 37.1%, respectively.) These data demonstrate that feeding RAC can increase carcass value by improving carcass cutout yields when fed at 20 and 30 ppm for the last 28 to 42 days of the finishing period.

Table 1. Effect of RAC on Cutout Yields

| Item | RAC ppm | | | | SE |
|-----------------------|---------------------|---------------------|---------------------|---------------------|-------|
| | 0 | 10 | 20 | 30 | |
| Standardized Side, kg | 162.67 ^b | 163.12 ^b | 165.92 ^a | 166.28 ^a | 0.70 |
| Chuck Roll, % | 5.04 | 5.10 | 5.12 | 5.06 | 0.08 |
| Clod, % | 4.26 ^b | 4.43 ^a | 4.38 ^a | 4.35 ^b | 0.14 |
| Brisket, % | 2.70 | 2.76 | 2.72 | 2.77 | 0.05 |
| Ribeye, % | 3.17 | 3.22 | 3.18 | 3.14 | 0.04 |
| Back Ribs, % | 1.60 | 1.63 | 1.60 | 1.58 | 0.004 |
| Striploin 1x1, % | 2.64 | 2.59 | 2.64 | 2.61 | 0.03 |
| Tenderloin, % | 1.05 ^b | 1.08 ^b | 1.10 ^a | 1.10 ^a | 0.04 |
| Top Butt, % | 2.83 | 2.83 | 2.89 | 2.92 | 0.05 |
| Peeled Knuckle, % | 2.31 | 2.34 | 2.38 | 2.37 | 0.08 |
| Inside Round, % | 4.59 ^b | 4.74 ^a | 4.70 ^b | 4.74 ^a | 0.13 |
| Gooseneck, % | 5.72 ^b | 5.77 ^b | 5.92 ^a | 6.02 ^a | 0.25 |
| Flank Steak, % | 0.49 | 0.49 | 0.49 | 0.47 | 0.007 |

^{ab}Means within a row with different superscripts differ from control ($P\leq.07$)

Key Words: Beef steers, Cutout yields, Ractopamine

84 Selection for improvement in pig growth rate does not alter fresh pork quality. C. E. Wagner*¹, E. Huff-Lonergan¹, M. F. Rothschild¹, A. A. Sosnicki^{1,2}, S. B. Jungst², K. J. Prusa¹, and S. M. Lonergan¹, ¹*Iowa State University, Ames*, ²*PIC North America, Franklin, KY.*

It has been hypothesized that selection for improved growth rate can result in a reduction in fresh pork quality. The objective of this study was to investigate the contribution of selection for improved growth

rate to variation in fresh pork quality. A pig population derived from the cross between a commercial line of Duroc sires and white line dams was subdivided according to the sires' estimated breeding value (EBV) for age at 125 kg. The first slaughter group included the most rapid growing pigs sired by High EBV growth boars (n=48) and a control group (n=16). The second slaughter group consisted of the slowest growing pigs sired by Low EBV growth boars (n=48), and a control group (n=16). Loin pH and temperature decline were monitored on each carcass. Fresh pork quality characteristics and water holding capacity were monitored at 2 d postmortem. Sensory traits (juiciness, tenderness, chewiness, flavor, and off-flavor) and star probe texture were measured 10 d postmortem. Pork quality data were analyzed using a mixed linear model including EBV group, sire within EBV group, harvest day, EBV group x harvest day interaction and gender as fixed effects. Dam was considered in the initial analysis, but was removed from final analysis because it did not contribute to the variation of quality traits. Pigs sired by High EBV growth boars were younger at 125 kg (153 d vs. 177 d). Sire EBV group did not affect pH decline in the longissimus dorsi, however, loin temperature at 6 h postmortem was significantly lower in carcasses from pigs sired by Low EBV growth boars. Loin color and drip loss were not affected by EBV group. Loins from pigs sired by fast growth boars had higher subjective marbling scores and higher lipid content than loins from pigs sired by slow growth boars. Sire group did not affect star probe or sensory quality of fresh pork loin. Use of sires with different genetic merit for growth significantly changed growth performance of progeny, but did not significantly affect the quality of fresh pork loin.

Key Words: Growth, Pork quality, Sensory quality

85 Interaction of MC4R and PRKAG3 genotypes with genetic potential for growth on meat quality traits. S. E. F. Guimaraes^{1,3}, M. F. Rothschild¹, E. Huff-Lonergan¹, A. A. Sosnicki^{1,2}, S. B. Jungst², M. Yu¹, and S. M. Lonergan*¹, ¹*Iowa State University, Ames*, ²*PIC North America, Franklin, KY*, ³*Universidade Federal de Vicosa, Vicosa, MG, Brazil.*

Discovery of genetic and biochemical factors that contribute to variation in fresh pork quality is required to improve the value of pork. The objective of this project was to examine individual gene effects on pork loin quality within commercial lines sired by boars within the same overall genetic background but with different genetic merit for growth. A commercial population derived from the cross between a commercial line of Duroc sires and white line dams was subdivided in two groups of slaughter pigs according to the sires' estimated breeding value (EBV) for growth as measured by age to 125 kilograms. Loin pH and temperature decline were monitored on each carcass. Pork quality traits were monitored at 2 d postmortem. Sensory traits were measured 10 d postmortem by a trained panel. The genotypes for MC4R, and PRKAG3 (I199V) were defined. Associations between the genotypes and loin quality traits were tested using the general linear model procedure with a model including EBV group, genotype, sex, sire within EBV group, dam within sire and EBV group, interaction between EBV group and genotype, and slaughter day. PRKAG3 genotype 22 had higher ($P<0.07$) marbling score (2.0) compared to genotype 11 and 12 (1.7 and 1.5). PRKAG3 genotype 22 also resulted in higher ($P<0.05$) off-flavor score (4.2) than genotypes 11 and 12 (3.2 and 3.8). MC4R genotype 12 had higher pH at 120 hr (5.70 vs. 5.66), higher flavor scores and lower off-flavor scores than genotype 22. There was an interaction between growth EBV and MC4R genotype

for pH at 48 h, and 120 h. In both cases, genotype 12 had higher pH than genotype 22 only in pigs sired by fast growing boars. Interestingly, genotype 22 resulted in lower tenderness scores in loins from pigs sired by fast growing boars, but higher tenderness scores in loins from pigs sired by slow growing boars. These results confirm that genotypic effects depend on the background genetic merit for growth.

Key Words: MC4R, PRKAG3, Pork quality

86 Associations between animal, transportation, and slaughterhouse practices and meat pH in beef. N. Mach^{*1}, M. Devant¹, A. Bach^{2,1}, and A. Velarde³, ¹Unitat Remugants, IRTA, Barcelona, Spain, ²ICREA, Barcelona, Spain, ³Centre de Tecnologia de la Carn, IRTA, Spain.

Prolonged muscular activity or stress before slaughter usually results in depletion of glycogen in the muscles, with a consequent reduction of lactic acid production post-mortem. The objective of this study was to evaluate the influence of factors related to animal, farm, transportation, and animal handling at the slaughterhouse, as well as their interactions, on pH of beef meat. A total of 5,649 cattle (341±45 d of age) from 181 different Spanish farms were surveyed in 3 periods (spring, summer, and winter) and 33 variables related to animal, farm, transportation, and animal handling at the slaughterhouse were recorded. Ultimate meat pH was measured at the *Longissimus dorsi* 24 h after slaughter (pH24). After a variable selection procedure a mixed-effects model was conducted with 10 variables (4 random and 6 fixed) to identify the main factors and their interactions affecting pH24. Average incidence of pH24 above 5.8 was 13.81%. The pH24 was greater ($P < 0.01$) in winter (5.74 ± 0.025) than in spring (5.66 ± 0.008) and summer (5.67 ± 0.008), and increased ($P < 0.01$) as transportation time increased (0.0001 ± 0.00006 pH24 increase per km). Bulls pH24 increased ($P < 0.01$) when loaded into a truck with cattle from other farms (5.67 vs 5.70 ± 0.012 , one vs several origins, respectively), when waiting time at slaughterhouse increased ($5.66, 5.69, 5.69, 5.74 \pm 0.013, < 8$ h, 8-12 h, 12-16h, > 16h, respectively), and when slaughterhouse stocking density was between 3.27 m^2 to 3.84 m^2 . When the daily number of animals slaughtered was large and waiting time at slaughterhouse increased, pH24 also increased ($P = 0.06$). Despite that the present study indicates that bull handling before slaughter plays an important role in pH24, there is a large proportion of the observed variance on pH that could not be explained.

Key Words: Beef, Meat pH, Preslaughter management

87 The role of integrin and desmin in water-holding capacity in pork. W. Zhang^{*}, E. Huff-Lonergan, and S. Lonergan, Iowa state University, Ames.

The purpose of this study was to examine relationship between the degradation of the proteins integrin and desmin, μ -calpain autolysis and water-holding capacity in pork. Drip loss was measured in the loin after 1 and 5 days of postmortem storage and sirloin purge loss was analyzed after 7 days of storage in meat from sixty-four Duroc x Yorkshire pigs. μ -Calpain autolysis (d 1), intact integrin (d 1, d 5) and intact desmin (d 1, d 7) were evaluated in muscle samples using western blotting. Intensity of intact integrin in postmortem samples at d 1 was negatively correlated with d 1 drip loss ($-0.302, P < 0.05$) and total drip loss (cumulative over d 1-5) ($-0.286, P < 0.05$). At d 5 postmortem, the intensity of intact integrin was significantly negatively correlated to d 2-5 (cumulative) drip loss ($-0.254, P < 0.05$) and d

1-7 (cumulative) total purge loss ($-0.287, P < 0.05$). There were no significant correlations between the intensity of intact integrin at d 1 or d 5 and μ -calpain autolysis at d 1. Intensity of intact desmin at d 1 was positively correlated with d 2-5 (cumulative) drip loss ($0.308, P < 0.05$) and d 1-7 (cumulative) purge loss ($0.480, P < 0.01$). There were significant correlations between the intensity of intact desmin from 7 days samples and d 1 drip loss ($0.363, P < 0.01$), d 2-5 (cumulative) drip loss ($0.259, P < 0.05$), d 1-5 (cumulative) total drip loss ($0.394, P < 0.01$) and d 1-7 (cumulative) total purge loss ($0.279, P < 0.05$). The intensity of intact desmin at d 7 was positively correlated with 80 kDa ($0.346, P < 0.05$) and 78 kDa subunits of μ -calpain ($0.286, P < 0.05$), while it was negatively correlated with 76 kDa subunit ($-0.396, P < 0.01$). However, the intensity of intact desmin at d 1 was not correlated with the μ -calpain autolysis at d 1. Less degradation of integrin was associated with less drip loss in fresh pork. However, more degradation of desmin was associated with less drip loss. These data indicate that these proteins could play different roles in governing drip loss in early postmortem pork.

Key Words: Integrin, Desmin, μ -calpain

88 Impacts of beef cattle diets containing corn or sorghum distillers grains on beef color, fatty acid profiles, and sensory attributes. R. K. Gill^{*1}, D. L. VanOverbeke², and A. DiCostanzo¹, ¹University of Minnesota, St. Paul, ²Oklahoma State University, Stillwater.

Strip loins from 260 carcasses, of crossbred-yearling steers, were evaluated to test the effects of feeding corn (C) or sorghum (S) distillers grains (DG) on beef color, lipid oxidation, fatty acid profiles, tenderness, and sensory attributes. Dietary treatments consisted of a steam-flaked corn (SF C) diet without (control) or with 15% C dry or wet DG (C D DG; C W DG) or S dry or wet DG (S D DG; S W DG) and alfalfa hay (R). Additional treatments included S D DG or S W DG with no hay (NR). In Harvest 2, steaks from steers fed SF C or S DG had lower L*, but higher a* ($P < 0.05$) values than those from steers fed DG or C DG, respectively. Also, L* values in steaks from steers fed S W DG with R were higher ($P < 0.05$) than those from steers fed S W DG with NR. In Harvest 1, feeding DG increased ($P < 0.05$) omega-6 fatty acid concentrations. In both harvest groups, feeding D DG increased ($P < 0.05$) linoleic acid concentrations. In Harvest 2, C DG diets increased ($P < 0.05$) linoleic acid concentrations compared to S DG diets. In addition, increased ($P < 0.05$) concentrations of α -linolenic acid in steaks resulted from feeding S D DG or S W DG with R. Across both Harvest groups, feeding DG increased ($P < 0.05$) the omega-6:omega-3 ratio when compared to SF C, and feeding C DG increased ($P < 0.05$) this ratio when compared to S DG. Furthermore, steaks from steers fed C DG had greater ($P < 0.05$) concentrations of *trans*-vaccenic acid than those steaks from steers fed S DG. Also, in Harvest 1, the CLA isomer 18:2, *trans*-10, *cis*-12 was increased ($P < 0.05$) in steaks from DG diets. On d 1 of retail display, in Harvest 2, steaks from steers fed S D DG with R had higher ($P < 0.05$) TBAR values than those from steers fed S D DG with NR. Feeding DG at 15% of the dietary DM did not affect sensory attributes or WBSF values.

Key Words: Distillers grains, Beef quality, Fatty acid profiles

89 Solution enhancement and post-enhancement storage effects on the quality, sensory and retail display characteristics of beef triceps brachii muscles. C. W. Rowe^{*1}, R. T. Baublits¹, A. H. Brown, Jr.¹, F. W. Pohlman¹, E. J. Yancey², Z. B. Johnson¹, and P. Dias-Morse¹, ¹University of Arkansas, Fayetteville, ²Tyson Foods, Inc., Rogers, AR.

Beef triceps brachii muscles (6 d postmortem; n = 15; muscle sections, n = 45) were sectioned into thirds and allocated to one of three treatments. The treatments were untreated (CNT), or injected at a 12% pump rate with either tap water-only (H2O) or a solution comprising tetrasodium pyrophosphate and sodium chloride at 0.4% and 1.0% target final product weight concentrations, respectively (TSPP/NaCl). Each muscle (comprising all three treatments) was then allocated to 2, 14, or 28 d of vacuum-packaged 1 °C storage. Purge losses during storage were greatest ($P < 0.05$) for H2O muscles and least ($P < 0.05$) for TSPP/NaCl muscles. Purge losses also increased ($P < 0.05$) from 2 d to 14 d of storage. Steaks enhanced with TSPP/NaCl had less ($P < 0.05$) free water and lower ($P < 0.05$) cooking losses than either CNT or H2O steaks. Storage duration did not affect ($P > 0.05$) Warner-Bratzler shear force (WBS) or sensory tenderness, but juiciness decreased ($P < 0.05$) with increased storage duration. While storage duration did not impact ($P > 0.05$) instrumental color characteristics, aerobic plate counts generally increased during storage. The TSPP/NaCl steaks had lower ($P < 0.05$) WBS values, and improved ($P < 0.05$) sensory tenderness and juiciness characteristics compared to CNT or H2O steaks. While CNT steaks had greater ($P < 0.05$) L* values (lightness) than TSPP/NaCl steaks, TSPP/NaCl steaks had similar ($P > 0.05$) oxymyoglobin proportions (630/580 nm) and a* values (redness) as CNT steaks. These results suggest enhancement with TSPP/NaCl can improve triceps brachii yield and palatability characteristics. Increased post-enhancement storage did not impact or worsened palatability while increasing purge losses, suggesting general deleterious effects of increased postmortem storage for this muscle.

Key Words: Beef, Enhancement, Storage

90 Dietary high-tannin sorghum reduces oxidation in rat muscles. R. Larrain* and J. Reed, University of Wisconsin, Madison.

High tannin sorghums (HTS) contain proanthocyanidins (condensed tannins), which have antioxidant activity. The objective of this study was to test if diets containing HTS reduce lipid and protein oxidation in muscles of rats. Male Sprague Dawley rats were used in a factorial design with four diets and two feeding periods. Diets modified from NIH-07 contained corn and HTS at a ratio of 0:50, 20:30, 35:15 and 50:0 percent of the diet (S0, S20, S35 and S50, respectively). HTS had 37.6 mg/g proanthocyanidins (vanillin method). Feeding periods were 2 and 10 weeks (2W and 10W). Rats were randomly assigned to diets within each feeding period (n=9 or 10). Rats in 2W and 10 W groups started the experiment at 13 and 5 weeks of age, respectively. They were killed by decapitation. Samples of longissimus and soleus muscles were taken immediately post-mortem. After 48 hrs of storage at 4°C, same muscles from the other half of the carcass were sampled and stored wrapped in O₂ permeable film at 4°C in the dark for 6 days. Markers of lipid and protein oxidation (TBARS and carbonyl content) were evaluated. Each muscle was analyzed independently. Factors in the model were diet, feeding period, storage and their interactions. Comparisons were made using LSD to S0 within storage and feeding period. After 6 days of storage, soleus muscle from 2W-S50 had

significantly lower ($P < 0.05$) TBARS than 2W-S0 (6.86 ± 1.49 vs. 11.22 ± 1.57 nmol/mg protein) and 10W-S35 had significantly lower TBARS than 10W-S0 (5.95 ± 1.57 vs. 10.54 ± 1.49). Carbonyls were significantly lower in 2W-S35 and 2W-S50 compared to 2W-S0 in aged soleus (4.71 ± 0.43 and 4.12 ± 0.41 vs. 6.15 ± 0.43 nmol/mg protein) and in 10W-S20, 10W-S35 and 10W-S50 compared to 10W-S0 in aged longissimus (7.23 ± 0.23 , 6.47 ± 0.23 , 7.03 ± 0.21 vs. 8.12 ± 0.21). Oxidation markers were reduced in rat muscles after 6 days of storage and were muscle dependent: longissimus had differences only in carbonyls while soleus in both TBARS and carbonyls. HTS has the potential to be used in animal diets to reduce oxidation in muscle foods.

Key Words: Proanthocyanidins, Oxidation, Sorghum

91 Effect of birth weight and feeding strategies during the growing-finishing period on growth performance, carcass characteristics, and meat quality in pigs. G. Bee*, C. Biolley, B. Dougoud, W. Herzog, and G. Guex, Agroscope Liebefeld-Posieux, Swiss Federal Research Station for Animal Production and Dairy Products (ALP), Posieux, Fribourg, Switzerland.

Compared to heavier littermates, low-birth-weight pigs tend to exhibit slower growth, increased fat deposition, and impaired meat quality such as tenderness. Feeding strategies aiming to reduce large intra-litter variations in muscle growth will benefit production economy and improve quality uniformity of pork. Thus, the effects of 3 feeding regimes applied during the growing-finishing period on growth performance, carcass characteristics, and meat quality traits of the LM and dark (STD) portion of the semitendinosus were assessed in low-(LW = 1.12 kg) and high-birth-weight barrows (HW = 1.94 kg). From 21 litters the lightest and heaviest barrow was selected and randomly assigned to one of 3 dietary treatments; AA: ad libitum feed access from 27 to 102 kg BW, RA: restricted feeding from 27 to 63 kg and ad libitum feed access from 63 to 102 kg BW, and RR: restricted feeding from 27 to 102 kg BW. Regardless of the birth weight, AA- and RA-barrows grew faster ($P < 0.01$) than RR-barrows (0.76 vs. 0.66 kg/d). The ADFI was highest ($P < 0.01$) in AA- (2.11 kg), intermediate in RA- (1.99 kg), and lowest in RR-barrows (1.77 kg). In the 3 treatment groups LW-barrows consumed more feed (204 vs. 193 kg; $P < 0.01$) and were less efficient (G/F: 367 vs. 380 g/kg; $P = 0.01$) than HW-barrows. Carcasses of the LW-barrows had lower ($P = 0.02$) lean percentage (55.0 vs. 56.5%) and higher ($P \leq 0.03$) percentages of subcutaneous (14.9 vs. 13.4%) and omental fat (1.8 vs. 1.5%) than HW-barrows. The LM of RA-barrows was lighter (L*: 52.6 vs. 50.6; $P = 0.03$) than the LM of AA- and RR-barrows. Shear force values tended to be higher ($P \leq 0.08$) in the LM (4.0 vs. 4.3 kg) and STD (4.2 vs. 4.7 kg) of RR- than of AA- and RA-barrows. The LM of LW-barrows was more yellow (b*: 3.2 vs. 2.8; $P = 0.05$) and redder (a*: 6.4 vs. 5.9; $P = 0.08$) than the LM of HW-barrows. The present findings revealed that independent of the feeding regime low birth weight was associated with impaired carcass quality. Furthermore, compensatory growth positively affected meat tenderness also in low birth weight pigs.

Key Words: Birth weight, Compensatory growth, Meat quality

92 Intramuscular administration of zinc metallothionein to preslaughter-stressed pigs improves anti-oxidative function and pork quality. L. L. Li¹, Z. P. Hou¹, Y. H. Liu², D. X. Hou³, B. Zhang², G. Y. Wu^{1,4}, C. B. Yang¹, X. J. Yang¹, Z. R. Tang¹, Y. L. Yin^{*1}, and M. Z. Fan^{1,5}, ¹*Institute of Subtropical Agriculture, The Chinese Academy of Sciences, Changsha, Hunan, P.R. China*, ²*Hunan Agricultural University, Changsha, Hunan, P.R. China*, ³*Kagoshima University, Kagoshima, Japan*, ⁴*Texas A&M University, College Station*, ⁵*University of Guelph, Guelph, Ontario, Canada*.

This study was conducted to determine the effects of exogenous zinc-metallothionein (Zn-MT) on anti-oxidative function in pork meat. After feeding a corn- and soybean meal-based diet for two weeks, 48 pigs (Duroc×Landrace×Chinese Black Pig) were assigned randomly into one of four treatment groups (12 pigs/group). Pigs in group 1 were maintained under non-stress conditions, whereas pigs in groups 2, 3 and 4 were aggressively handled for 25 min to produce stress. Then, pigs in groups 1 (control group) and 2 (negative control group)

received intramuscular administration of saline, while pigs in groups 3 (low dose group) and 4 (high dose group) received 0.8 and 1.6 mg rabbit liver Zn-MT per kg body weight, respectively. Pigs were slaughtered at 3 and 6 h post-injection. Zn-MT treatment increased ($P < 0.05$) the activities of superoxide dismutase (SOD) and glutathione-peroxidase (GSH-PX) while decreasing the concentration of malondialdehyde (MDA) in the liver. These responses were greater ($P < 0.05$) at 6 h than at 3 h post Zn-MT injection. Zn-MT treatment increased ($P < 0.05$) hepatic SOD mRNA levels in a time- and dose-dependent manner, and decreased ($P < 0.05$) blood activities of glutamate-pyruvate transaminase and lactate dehydrogenase (indicators of tissue integrity). Zn-MT administration decreased ($P < 0.05$) lactic acid concentrations, thereby increasing ($P < 0.05$) the pH and water-holding capacity of the meat. Collectively, our results indicate that intramuscular administration of Zn-MT to preslaughter-stressed pigs improves tissue anti-oxidative ability and pork quality. Supported by funds from the Chinese Academy of Sciences and China NSF.

Key Words: Stress, Metallothionein, Pork quality

Nonruminant Nutrition: Nursery Nutrition - Swine

93 Supplemental inulin affects digesta soluble Fe and sulfide concentrations in weanling pigs. K. Yasuda^{*1}, K. R. Roneker¹, D. D. Miller², R. M. Welch³, and X. G. Lei¹, ¹*Cornell University, Ithaca, NY*, ²*Cornell University, Ithaca, NY*, ³*USDA/ARS, U.S. Plant, Soil and Nutrition Laboratory, Ithaca, NY*.

Our laboratory has shown previously the improvement of bioavailability of dietary Fe for hemoglobin repletion by supplemental inulin in weanling pigs. The objective of this study was to determine the metabolic mechanisms for that improvement conferred by inulin. Twelve weanling pigs (BW = 7.70 ± 0.19 kg, n=6 per treatment,) were fed a corn-soybean meal based diet (BD, without inorganic Fe addition, 54 mg Fe/kg) or the BD + 4% inulin (Synergy 1, Orafiti, Tienen, Belgium) for 6 wk. Body weight gain and blood hemoglobin concentrations of individual pigs were measured weekly, and feed intake of individual pigs was recorded daily. All pigs were killed at the end of trial to collect digesta samples from stomach, duodenum, jejunum, cecum, and colon to assay for pH, phytase activity, and concentrations of total soluble Fe and sulfide. Compared with those fed the BD, pigs fed 4% inulin had higher ($P < 0.05$) hemoglobin repletion efficiency (20.4 vs. 24.9%), soluble Fe concentration in colon digesta (1.2-1.6 vs. 2.1-2.9 μmol/g), and phytase activity in lower jejunum digesta (19.1 vs. 42.5 mU/g), but lower ($P < 0.05$) sulfide concentration in distal colon digesta (4.8 vs. 3.3 μmol/g). There was no significant difference in growth performance, digesta pH, or digesta concentrations of total Fe between the two groups of pigs. In conclusion, supplemental inulin enhanced Fe solubility and decreased Fe binding compound sulfide in colon digesta. (Supported in part by a grant from Harvest-Plus, International Food Policy Research Institute, Washington DC).

Key Words: Inulin, Pigs, Iron

94 Additivity of effects of copper and zinc in diets for weaned piglets on a commercial farm. V. G. Perez-Mendoza^{*1}, M. U. Steidinger², G. R. Hollis¹, T. M. Fakler³, and J. E. Pettigrew¹, ¹*University of Illinois, Urbana-Champaign*, ²*Swine Nutrition Services Inc, Anchor, IL*, ³*Zinpro Corporation, Eden Prairie, MN*.

A total of 1008 newly weaned pigs (21 d old; 5.25±1.0 kg) were used in a commercial farm to test whether the performance effects of

organic copper (Availa-Cu) are additive to the performance effects of zinc oxide (ZnO). This was a RCBD with 4 dietary treatments in a 2x2 factorial arrangement of Availa-Cu (0 vs. 100 ppm Cu) and ZnO (0 vs. 3000 ppm Zn); pigs were blocked by weight and room (3 wt categories and 4 rooms). Pens were experimental units with 21 pigs; gender distribution was equal within blocks. Copper was added throughout the entire experiment (6 wk) and ZnO only during the first 2 wk; these high levels of Cu and Zn were in addition to the nutrient levels provided by the standard trace mineral premix. This was a 4-stage feeding program with decreasing diet complexity: 1, 1, 2 and 2 wk per phase. Diets used in phases 1 and 2 were in mini-pellet form, and phases 3 and 4 were in meal form. The only interaction ($P=0.05$) between Cu and Zn was in ADFI during the first week, which was increased by Zn in the absence (106 vs. 134 g; $P < 0.01$), but not in the presence (130 vs. 132 g; SEM=6.5; $P=0.88$) of Cu. During the entire 6-wk period both Cu and Zn increased ($P < 0.001$) ADG and ADFI: Availa-Cu increased ADG by 33 g in the absence of Zn (250 vs. 283 g; $P < 0.001$), and by 15 g in the presence of Zn (300 vs. 315 g; SEM=12.3; $P < 0.09$); there was not an interaction ($P=0.14$). Availa-Cu increased ADFI by 44 g in the absence of Zn (401 vs. 445 g; $P < 0.001$), and by 22 g in the presence of Zn (459 vs. 481 g; SEM=17.1; $P < 0.06$); there was not an interaction ($P=0.18$). An outbreak of diarrhea due to *E. coli* caused a high rate of pig removal (including mortality), which was reduced ($P < 0.001$) by Zn (17.1 vs. 6.6%; SEM=2.1). These results show beneficial effects of both Availa-Cu and zinc oxide, and the lack of significant interaction suggest that the effects are at least partially additive. These results also confirm the protective effect of ZnO against enteric infections.

Key Words: Organic copper, Zinc oxide, Weaned pigs

95 Importance of vitamin B₁₂ enterohepatic cycle in growing pigs. D. P. Prévêraud^{*1,2}, C. L. Girard¹, F. Guay², N. Le Floc^{h3}, and J. J. Matte¹, ¹*Agriculture and Agri-Food Canada, Lennoxville, Qc, Canada*, ²*Laval University, Ste-Foy, Qc, Canada*, ³*INRA, St-Gilles, France*.

Endogenous B₁₂ in the small intestine originates from the enterohepatic cycle (EHC) and from the low bioavailable B₁₂ vitamers synthesized