shortening. These data suggest subtle benefits to *Longissimus* tenderness from calcium propionate (NutroCAL^{TM}) treatment of steers prior to slaughter.

Key Words: Beef, Tenderness, Calcium

270 Inhibition of lipid oxidation with encapsulated phosphates in muscle foods. J.R. Claus*[1], H. Wang[2], N.G. Marriott [2], and W.N. Eigel[2], [1]*University of Wisconsin-Madison,* [2]*Virginia Polytechnic Institute and State University*.

The objective was to determine if encapsulation would improve the antioxidative property of phosphate in cooked muscle foods. Encapsulation of phosphate was done to protect the phosphate from endogenous phosphatases during the raw meat manufacturing steps. An initial experiment involved incorporation of encapsulated phosphates (0.5% sodium tripolyphosphate, STP or 0.5% sodium acid pyrophosphate, SAPP; meat weight basis) into ground beef patties that were immediately heat processed before storage (3 C). Phosphates were encapsulated with a hydrogenated vegetable oil designed to melt at 74 C (STP) or 60 C (SAPP). Unencapsulated STP samples had the lowest ($P<0.05$) cooking loss. Thiobarbituric Acid Reactive Substances (TBARS) were lower ($P<0.05$) for the phosphate treatments compared to control samples (no phosphate) on day 0 and 6. Unencapsulated STP samples had lower ($P<0.05$) TBARS than the other phosphate treatments on day 0. However, there were no differences ($P>0.05$) in TBARS among the phosphate treatments on day 6. A subsequent experiment involved delay of heat processing after phosphate encapsulation. Ground turkey meat with 1% NaCl was incorporated with unencapsulated STP (0.3% or 0.5%), encapsulated STP (0.3% or 0.5% phosphate), or a blend of unencapsulated (0.3%) and encapsulated (0.2%) phosphate and compared to a control. Treated ground turkey was stored (4 and 24 h, 3 C) before cooking to two different endpoints (74 and 79 C). Cooked turkey was stored (3 C) for 0, 5, and 10 days. An improvement of 77% and 80% in the reduction of TBARS was found with the 0.3% and 0.5% encapsulated STP, respectively, in comparison to the unencapsulated STP. TBARS on day 10 from samples stored 24 h before cooking were higher ($P<0.05$) than the samples stored 4 h prior to cooking. Encapsulation of phosphates has the potential to retard lipid oxidation in further processed meats that required an extended raw meat processing time prior to cooking.

Key Words: Encapsulated phosphate, Lipid oxidation, Meat

271 Future for red meat consumption cannot be accurately evaluated by using per capita: A different approach, per adult human unit versus per capita. S. Hasimoglu*[1], [1]*Continental Analytical Cervices Inc. Salina, KS*.

While the world's population has doubled in the past century, its appetite for meat quadrupled reaching 200 million tons. Even though the World Bank is discussing normalization of per capita (PC) consumption, its erroneous use has rarely been challenged, as if it is the most viable unit that should be used in the evluation of meat consumption. However, PC does not address detailed anthropometrics criteria. When data are presented on PC basis, the assumption must be made that a 6-month-old baby will consume as much meat as a mature person. Aiming to reduce the magnitude of errors inherent PC, a method has been developed for analyzing production and consumption in populations that accounts for variations among age groups within populations. Per adult human use (PAHU) allows standardization of any population and eliminates the "one size-fits-all" PC concept. Application of the PAHU and calculated age groups conversion factors are used in obtaining data presented below. The calculation of the PAHU of the USA population (1985 and 1995) indicated that consuming and producing 239 and 265 million PC was reduced to standardized 199 and 222 million PAHU populations, respectively. Considering equally populated Sweden and Zimbabwe (8.3 million in 1985) and the world PC average meat consumption 29.6 kg/yr, their meat requirements would be 240 000 and 167 000 t/yr respectively. Percentage unit (PU) deviations of PAHU red meat consumption from PC were significantly different; 14.8 and 32.8 PU for Sweden and Zimbabwe respectively. The methodology underlying PC estimate of red meat consumption is an indirect procedure of arriving at a conclusion by disregarding not only the younger but the older portion of the population and the calculated unintended faulty level is not less than 15.86 PU as compared to PAHU. Simply, on the red meat consumption and production predictions, we are trying to find the right answer with the wrong unit, PER CAPITA.

ASAS Nonruminant Nutrition: Amino Acids, Vitamins, and Minerals in Finishing Pigs

272 Evaluation of synthetic L-Lysine use in finishing pigs. D.C. Kendall*[1], G.L. Allee[1], and J.L. Usry[2], [1]*University of Missouri-Columbia,* [2]*Ajinomoto Heartland Inc.*.

An experiment was conducted with finishing pigs (n=150 PIC C-22 x 337; initial BW = 70 kg) to evaluate the use of synthetic L-Lys on pig performance and carcass characteristics. Pigs were fed one of five dietary treatments with 6 replicates and housed at 5 pigs/pen. Pigs were fed an early finishing diet (EF) until 93 kg and late finishing diets (LF) until 115.5 kg. Diets consisted of a corn-soy positive control, a corn-soy negative control, .15% added L-Lys, .225% added L-Lys, and .30% added L-Lys. Dietary CP for the EF period were 16.1, 14.8, 13.1, 12.3 and 11.5%, respectively, and 13.9, 13.0, 11.2, 10.5, and 9.7%, respectively, for the LF period. True ileal digestible (TID) lysine levels were .71 and .57% for the positive control in the EF and LF. All other diets were formulated at .63 and .51% TID Lys for EF and LF. Ratios of TID Thr and Trp values were maintained relative to lysine of .63 and .20 in EF, .68 and .185 in LF with the addition of synthetic L-Thr or L-Trp. All diets were formulated to be equal on a modified ME basis. Pigs were weighed biweekly to determine average daily gain, average daily feed intake and feed efficiency. In addition, ultrasound measurements were taken on d 0 and at slaughter to determine tenth rib backfat depth and loin eye area. During the EF phase, no differences were observed in ADG or ADFI, however G:F was poorer in pigs fed diets containing .225 and .30% added L-Lys (.335) compared to the positive control (.353; $P\leq.05$). During the LF phase and for the overall finishing period, no differences in growth performance were detected between the diets. Ultrasound measures of tenth rib back fat depth, loin eye area, and percent lean at slaughter did not differ between treatments. At no point were the growth performance or carcass characteristics different between the negative control and diets with added L-Lys. This study shows that finishing swine diets containing up to .30% synthetic L-Lys, supplemented with L-Thr and L-Trp, does not affect growth performance or carcass characteristics.

Key Words: Pigs, Reduced crude protein, Lysine

273 Heat-damaged protein has reduced ileal true digestibility of cystine and aspartic acid in chicks. E.L. Miller*[1], Y.X. Huang[1], S. Kasinathan[1], B. Rayner[1], U. Luzzana[2], V.M. Moretti[2], F. Valfr[2], K. R. Torrissen[3], H.B. Jensen[4], and J. Opstvedt[5], [1]*University of Cambridge,* [2]*Universit degli Studi di Milano, Italy.,* [3]*Institute of Marine Research, Norway.,* [4]*University of Bergen, Norway.,* [5]*Norwegian Herring Oil and Meal Industry Research Institute, Norway.*.

Low temperature fish meal (LT) has better digestibility than regular fish meal (R) in mink. Model systems have shown heat processing of fish muscle between 70 and 120C reduces SH groups and causes racemization of L to D aspartic acid. The objective was to determine the SH content, the extent of racemization of aspartic acid and ileal true digestibility (TD) of amino acids in chicks of Norse LT 94® compared with regular NorSeaMink®. Reactive SH was determined using three methods: 1) reaction with dithiodipyridine, 2) reaction with monobromobimane, and 3) reaction with 4-vinyl pyridine and HPLC separation. Values (mmoles/100 g CP) were LT 2.38, 2.57, 2.11; R 0.62, 0.70, 0.13 by methods 1, 2, 3 respectively. The proportion of D-aspartate (D/D+L) was determined by HPLC separation of the isomers following hydrolysis with 6M HCl at 100C for 6 h to minimize hydrolysis-induced racemization. D/D+L aspartate was 0.004 in freeze dried fish muscle compared with 0.030 in LT and 0.056 in R. Hydrolysis corrected values were LT 0.026, R 0.052. Ileal true digestibility was determined by slaughter of 11 day old chicks fed diets with 0 (200 enzyme hydrolysed casein plus amino acids), 150, 200, 250 g CP/kg of each fish meal as the sole protein

source and chromic oxide as marker. TD was calculated as 1-slope of the regression of ileal N or amino acid on diet N or amino acid. TD for N, cyst(e)ine (as cysteic acid), aspartate, D-aspartate, indispensable amino acids were: LT 0.930.009, 0.890.015, 0.920.007, 0.760.029, 0.940.009; R 0.870.012, 0.750.021, 0.800.013, 0.330.053, 0.880.011. LT meal had more SH and less S-S bonds and D-aspartate than R. TD of all amino acids was better for LT especially cyst(e)ine and aspartate. TD of D-aspartate was particularly low in R.

Key Words: Fish meal, Sulfhydryl, Racemization

274 Effect of increased levels of crystalline essential amino acids on growth performance and nitrogen retention of broiler chicks fed low-CP diets.

K. Bregendahl* and D.R. Zimmerman, *Iowa State University, Ames*.

Bioavailability of crystalline AA (cAA) in low-CP diets may be lower due to destruction before consumption (i.e., Maillard reactions) or inefficient use during digestion/absorption. Therefore, an experiment was conducted to investigate whether increased dietary levels of cAA improve the growth performance and N retention of broiler chicks fed low-CP diets. A total of 306 day-old broiler chicks was fed a common corn-soybean meal (SBM) diet (24% CP) for 1 wk, after which the chicks were allotted to one of five diets (D) in a completely randomized design (10 chicks per pen, 6 replications; 146 g initial BW). Chicks had free access to the isoenergetic diets (3.20 Mcal ME_n/kg), which consisted of a control diet (D1; 24.0% CP), D2 (18.5% CP), D3, D4, and D5. The CP content of D2 was reduced by altering the corn:SBM ratio in D1 and adding cAA (Arg, Ile, Lys, Met, Thr, and Val) to 105% of NRC (1994) AA levels. Diets D3, D4, and D5 were formulated by increasing the cAA levels in D2 by 15, 30, and 45%, respectively, replacing Glu (making D2 though D5 isonitrogenous). After 2 wk on test, chicks were weighed, fasted for 24 h, and two chicks per pen were euthanized. The whole-body N contents of the chicks fed D1 through D5 as well as six baseline chicks were determined. Treatment means were compared using orthogonal contrasts. ADG (52.2, 50.6, 49.9, 49.3, 49.6 g/d for D1, D2, D3, D4, and D5, respectively), ADFI (68.6, 72.1, 71.2, 70.7, 69.8 g/d), feed utilization (G:F; 0.762, 0.701, 0.701, 0.697, 0.711), and N retention (1.45, 1.31, 1.30, 1.26, 1.26 g/d) of chicks fed D1 were superior ($P < 0.05$) to that of chicks fed D2 through D5. No linear or quadratic effects ($P > 0.10$) of increasing the cAA levels were observed on ADG or G:F, while ADFI ($P = 0.01$) and N retention ($P = 0.06$) decreased linearly. Based on these data, growth performance and N retention of chicks fed low-CP diets are not improved by increasing the amounts of dietary cAA above that needed to supply essential AA at NRC (1994) recommended levels

Key Words: Low Crude Protein, Performance, Crystalline Amino Acids

275 Supplemental fat and/or reduced dietary crude protein effects on growth performance, carcass characteristics, and meat quality of late finishing barrows reared in a controlled hot environment.

J.D. Spencer*[1], A.M. Gaines[1], G. Rentfrow[1], W. Cast[2], J. Usry[3], and G.L. Allee[1], [1]*University of Missouri-Columbia,* [2]*Premium Standard Farms,* [3]*Ajinomoto Heartland Inc.*.

A total of 196 barrows (88 kg) were housed in a finishing facility (7 pigs/pen) with temperatures cycling between 29.4 and 35°C. A 2x2 factorial with two CP levels (13.6 or 11.3%) and two added fat levels (1 or 8%) allowed for 7 replicates (pens)/trt. All diets were corn/sbm and formulated to the same digestible lysine:ME ratio. Diets were fed until pigs approached 114 kg. Pigs were ultrasound for 10^{th} rib backfat (ultBF) initially and before slaughter. Fat-o-meter fat depth (FOMBF), ham and loin 45 minute pH (45pH), ultimate ham pH(ultHpH), ham Hunter score (Ham L*), and total body electrical conductivity of the cut ham were taken from all pigs after slaughter. The right loin from 25 pigs/trt was subjected to pH measurement (ultLpH), loin intramuscular-fat content (IM), Hunter score (loin L*), and storage (14-d vacuum-sealed whole loin and 7-d retail display). Pigs fed the high CP/low fat (control) grew slower than all other trts ($P \leq .08$). However, high fat resulted in improved G:F regardless of CP level ($P \leq .01$). High fat diets had greater FOMBF, while high fat or lower protein both increased ultBF ($P \leq .05$). Reduced protein decreased ham weight and ham lean weight ($P \leq .04$). There was no difference in loin or ham 45 pH ($P \geq .05$), but low CP diets had lower ultHpH ($P \leq .05$). Pigs fed high fat diets had lower (darker) L* values at the ham face, as well as on the cut loin surface prior to and after the 14-d vacuum seal and 7-d retail display. UltLpH was also higher with high fat inclusion ($P \leq .10$). Low CP fed pigs displayed less purge loss after the 7-d retail display ($P \leq .06$) and 14-d storage ($P \leq .19$). There was no difference in IM among treatments. These results suggest that 8% added fat or reduced dietary CP content (2.3%) improves finishing pig growth rate in hot environments, and fat inclusion improves G:F and meat quality regardless of CP level.

Key Words: Pigs, Temperature, Meat quality

276 A rapid method to determine "true metabolic availability" of amino acids in feedstuffs for pigs.

R.O. Ball*, R.F.P. Bertolo, P.B. Pencharz, and S. Mhn, *University of Alberta*.

Some digested and absorbed amino acids (AA) in feeds cannot be used for protein synthesis by the pig. True ileal digestibility does not account for metabolically unavailable AA (eg Maillard products). The proportion of these unavailable AA varies with the growing and processing conditions for feedstuffs, preventing accurate diet formulation. We developed a rapid method (2 weeks), based on the indicator AA oxidation technique, to determine the "true metabolic availability" (MA) of AA for protein synthesis. Increasing AA intake below the requirement decreases indicator AA (phenylalanine, PHE) oxidation inversely to protein synthesis. Per unit AA intake, the MA of a feedstuff is equivalent to the decrease in oxidation relative to that supported by the free form of the test AA. Four catheterized barrows were fed a base diet for 7 d at 95 g/$kg^{0.75}$. Test diets were then fed for 2 d after which PHE oxidation was determined twice on subsequent days. The 5 test diets were: low lysine (LYS, 56% of requirement), low LYS + free LYS (90% of requirement), low LYS plus either raw peas or heated peas or heated peas + LYS (90% of requirement). PHE oxidation was quantified during 4h primed constant infusions of 425.0 (SE 6.9) kBq/h of L-[1-^{14}C]-PHE. The first 2 diets provided the change in oxidation per g added free LYS, which is deemed 100% available, to predict MA of lysine in the other diets. In raw peas, MA was 65.3%, and in heated peas, MA was -2.9% of that of free LYS, indicating that the heating rendered the LYS in peas totally unavailable. When adding back free LYS to the level in raw pea diet, LYS MA was 64.9%, similar to raw pea diet. This indicates that the change in oxidation due to heating was entirely due to the change in dietary available LYS content. The present rapid method can be used to determine the MA of LYS and other AA in feeds. Using such information to formulate pig diets more accurately would result in more consistent performance and cost-efficient production.

Key Words: Pig, Lysine availability

277 A method to measure the amino acid requirement of individual pigs.

S. Mhn*, R.F.P. Bertolo, and R.O. Ball, *University of Alberta*.

Although amino acid requirements for growing pigs are well established, there are no estimates of their variation in the population determined by measurements on individual pigs. We chose the indicator amino acid oxidation method (IAAO) to determine the lysine (LYS) requirement in individual pigs for an estimate of the mean requirement and its variation. When LYS intake increases, the relative excess and oxidation of the indicator (phenylalanine, PHE) diminishes. PHE oxidation remains constant once the LYS intake exceeds the requirement for protein synthesis. Oxidation is measured by quantifying the $^{14}CO_2$ release from a primed, constant infusion of L-[1-^{14}C]-PHE. Four individually housed barrows (18.0kg SE 1.8) were surgically implanted with venous catheters for isotope infusion. They were offered, in random order, isonitrogenous and isoenergetic diets with 7 lysine concentrations (56, 67, 78, 90, 101, 123 and 145% of requirement, NRC, 1998) at 95 g/$kg^{0.75}$. After a validated minimum adaptation time of 2 days, indicator oxidation was determined for each dietary lysine level during 4 h primed, constant infusions of L-[1-^{14}C]-PHE at a rate of 470.9 kBq/h (SE 17.1). The LYS requirement was calculated using a linear broken line model within individual pigs. For each pig, PHE oxidation decreased linearly ($P<0.05$) as the LYS level increased until the requirement was reached; thereafter, PHE oxidation remained constant. The LYS requirement was 94, 99, 101, 117% of the NRC (1998) values for the four individual animals. The mean requirement for all pigs was 103 10%, in agreement with the estimate by NRC (1998). The IAAO method gives values for LYS requirements similar to conventional methods. The short (<3 weeks) experimental period allows, for the first time, the generation of an estimate of population variability. This allows the calculation of the effect of choosing a

specified safety factor on herd performance. This method is suitable to use with all dietary indispensable amino acids.

Key Words: Growing pig, Lysine requirement, Variation

278 Protein requirement re-evaluated for juvenile rainbow trout (Oncorhynchus mykiss). Zongjia Cheng*, R.W. Hardy, E.L Brannon, and M. Casten, *University of Idaho, Hagerman, ID.*

Seven experimental diets (3,600 kcal DE/kg diet) were made with CP levels ranged from 27 to 45% (as fed basis) at 3% increment to evaluate the protein requirement for juvenile rainbow trout (initial BW 11.3 g) using practical feed ingredients. Fish were stocked into twenty-one 150 L fiberglass tanks with 3 tanks per treatment (diet), each tank was supplied with 4 L/min of untreated, constant temperature (14.5 C), spring water at the Hagerman Fish Culture Experiment Station, University of Idaho. Fish were fed 3 time/d and 6 d/wk to apparent satiation for a period of 6 weeks. Results showed that there were significant differences among treatments in weight gain (WG, P<.0001) and feed conversion ratio (FCR, P<.01). WG was 14.9.8, 16.21.2, 17.91.0, 19.8.8, 21.1.6, 22.31.9 and 21.11.3 g; FCR was 1.4.1, 1.4.1, 1.3.1, 1.2.0, 1.1.0, 1.1.1 and 1.1.1 g feed/g gain, for fish fed 27, 30, 33, 36, 39 42 and 45% CP diets, respectively. Quadratic regression based on WG revealed that the CP requirement for juvenile rainbow trout was 42.24% (as fed basis), the relationship can be expressed as: WG = -0.026(CP)^2 + 2.1963(CP) - 26.122 (R^2 = .8959); The CP requirement for juvenile rainbow trout was 44.08% (as fed basis) based on FCR, and the relationship can be expressed as: FCR = 0.0012(CP)^2 - 0.1058(CP) + 3.3932 (R^2 = .9537). These data showed that the CP requirement for juvenile rainbow trout fed practical diets was higher than NRC (1993) recommended values of 38% (as fed basis).

Key Words: Protein requirement, Rainbow trout, Weight gain, Feed conversion ratio

279 Effect of genotype and dietary lysine content during the grower phase on growth performance, serum urea N, and carcass and meat quality. J. Fabian*, L. I. Chiba, D. L. Kuhlers, L. T. Frobish, C. R. Kerth, K. Nadarajah, W. H. McElhenney, and B. L. Anderson , *Auburn University, Auburn, AL.*

A total of 32 select line (SL) and 32 control line (CL) Duroc pigs were used in two trials to determine the effect of selection for lean growth efficiency and dietary lysine content during the grower phase on pig performance. In each trial, pigs weighing 20 kg were assigned to 16 pens with two gilts or two barrows per pen, and pens were randomly assigned within genetic lines to one of the four grower (G) diets (0.5, 0.7, 0.9, or 1.1 g lysine/kg diet). After 50 kg BW, all pigs were fed finisher 1 (F1; 50-80 kg BW) and finisher 2 (F2; 80-105 kg BW) diets formulated to meet the NRC nutrient requirements. Pigs were allowed ad libitum access to feed and water. Blood samples were taken from each pig at 20, 50, and 105 kg BW. Pigs were subjected to ultrasound backfat (UBF) measurement at 50 and 105 kg BW. The initial statistical analyses revealed that variances between the two trials were homogeneous, thus the data were combined. During the G phase, pigs consumed less feed [linear (Ln), P < 0.001] and grew faster (Ln, P < 0.05) and more efficiently (Ln, P < 0.001) as the dietary lysine level increased. With the increasing dietary lysine content, pigs had lower UBF (Ln, P < 0.001) and higher serum urea N (Ln, P < 0.001) at the end of the G phase. However, during the F1 and F2 phases, pigs grew faster (Ln, P < 0.01 and P = 0.07, respectively) and more efficiently (Ln, P < 0.05) as the lysine content of the G diets decreased, resulting in no differences in overall growth performance or carcass and meat characteristics. The SL pigs grew faster (P < 0.01), and had lower 10th rib backfat (P < 0.001) and larger longissimus muscle area (P = 0.08) than the CL pigs, which were reflected in higher estimated daily lean gain (P < 0.001). The SL pigs had lower meat color (P < 0.05) and firmness (P = 0.07) scores. These results indicate that pigs exhibited compensatory growth after dietary lysine restrictions during the G phase, and were able to compensate fully. Although SL pigs had superior growth rate and body composition, both genetic lines responded similarly to the dietary restrictions.

Key Words: Pigs, Genotype, Compensatory growth

280 Lysine level required to optimize the growth response of Paylean^{TM} in PIC pigs. R. D. Boyd*[1], M. E. Johnston[1], J. L. Usry[2], C. E. Fralick[3], A. A. Sosnicki[1], and B. Fields[1], [1]*PIC USA, Franklin, KY,* [2]*Heartland Lysine Inc, Chicago, IL,* [3]*Swine Tek, Van Wert, OH.*

A trial was conducted with 456 PIC 337 × C22 pigs to determine the lysine level that allows full growth expression to Paylean^{TM} (9g/909 kg). This dose was expected to yield about 70-85% of the maximum growth and carcass response. Females (240) and castrated males (216) were allocated by gender and weight to groups of 10 or 9 pigs/pen, respectively. Individual weights were taken at the start (92±.3 kg) and at the end of the 28 day trial. Corn-soy diets were used to formulate to 0.78% total lysine (Control, without Paylean^{TM}) and with Paylean^{TM} (diets 2-5) having 0.78%, 0.90%, 1.02% or 1.14% lysine from intact protein. Diets 6 and 7 also contained Paylean^{TM}, but were formulated to 0.90% and 1.02% total lysine using 0.225%, 0.030% and 0.077% synthetic lysine, methionine and threonine, respectively. Pigs fed the Control diet had an ADG of 1.095 kg/d and a feed conversion ratio (G:F)of 0.34. The G:F ratio was improved (P<.01) with addition of Paylean^{TM} to the 0.78% lysine diet (2). However, ADG was not improved when compared to pigs fed the Control diet. A linear improvement in ADG (P<.05) and G:F (P<.01) was observed for pigs fed diets containing Paylean^{TM} with increasing lysine (diets 2-5): 1.145 and 0.371; 1.250 and 0.393; 1.195 and 0.398; 1.268 and .407, respectively. Pigs fed diets formulated with intact protein (3, 4) performed identical to those formulated with practical levels of synthetic amino acids (6, 7, P>.50). The lysine level that optimized growth declined in a step-wise manner. Using G:F ratio: week 1, 1.14% (0.562 vs 0.400); week 2, 1.02% (0.439 vs 0.366); week 3, 0.90% (0.327 vs 0.287); 0.90% total lysine approximated the requirement for the 28 day period. This level resulted in about 4 kg of added body weight and 1.8% carcass yield with 1.5 mm less backfat. Response to Paylean^{TM} is dependent on adequate amino acid intake. The decreasing lysine requirement coincides with a declining response to Paylean^{TM} with time.

Key Words: Pigs, Ractopamine, Lysine

281 Effects of supplemental trace mineral levels on carcass characteristics and carcass value. E. van Heugten*[1], P. R. O'Quinn[2], D. W. Funderburke[2], W. L. Flowers[1], and J. W. Spears[1], [1]*North Carolina State University, Raleigh,* [2]*Cape Fear Consulting LLC, Warsaw, NC.*

A total of 6,024 pigs was used to determine whether reducing supplemental trace mineral (TM) levels during the grower-finisher phase has a negative impact on carcass traits and economic value. Pigs were randomly distributed into 4 blocks of 2 barns, ensuring that each block of barns was filled at the same time. Barns were then allotted within block to receive either diets with low or high TM supplementation. Four diet phases were fed with 135, 125, 105, and 85 ppm added Zn, 13.5, 12.5, 10.5, and 8.5 ppm added Cu, and 113, 104, 87.5, and 70 ppm added Fe for the high TM diets and 30 ppm added Zn, 6 ppm added Cu, and 30 ppm added Fe for all low TM diets. Diets were analyzed to contain 181, 155, 142, and 135 ppm Zn, 17, 21, 19, and 18 ppm Cu, and 506, 477, 352, and 299 ppm Fe for the high TM diets and 80, 75, 79, and 80 ppm Zn, 12, 8, 10, and 10 ppm Cu, and 389, 368, 270, and 271 ppm Fe for the low TM diets. Pigs averaged 19.1 and 21.2 kg for the high and low TM treatments, respectively (P=0.19), at placement. Pigs were slaughtered at a commercial plant and sex and carcass data were determined for each individual pig. Data were analyzed by split-plot analysis using treatment as whole plot and sex as split-plot. Barrows had greater carcass weight (90.1 vs 87.7 kg; P<0.003), fat depth (20.1 vs 17.3 mm; P<0.001), carcass weight payment ($110.52 vs 108.55; P< 0.04) and lower % lean (53.6 vs 55.4%; P<0.001) and lean premium payment ($1.50 vs 3.55; P<0.001). Pigs fed low TM diets had greater carcass weight (89.5 vs 88.3 kg; P< 0.06), carcass weight payment ($110.54 vs 108.53; P<0.04), and total payment ($112.98 vs 111.07; P<0.02) compared to pigs fed high TM diets. Backfat thickness, loin depth, % lean, and lean premium payment were not affected (P>0.10) by dietary treatments. Results indicate that reducing trace mineral levels in diets for grower-finisher pigs had no negative effects on carcass characteristics or value of the carcass.

Key Words: Swine, Minerals, Carcass

282 Differential response from feeding high levels of vitamin E on quality of stored pork from two genotypes. J. L. Hasty*, E. van Heugten, and M. T. See, *North Carolina State University, Raleigh*.

This study examined the effects of feeding high levels of vitamin E on the quality of stored pork from different genotypes. Pigs (n=240; initial BW=87 kg) were allotted by weight to one of ten treatments (8 pens/trt, 3 pigs/pen) in a 2 x 5 factorial arrangement. Factors included: 1) genotype (Berkshire sired and Hampshire sired) and 2) supplemental levels of vitamin E (0, 75, 150, 300 and 600 mg/kg). Corn-SBM basal diets containing 2.5% added fat, 0.83% lysine and 15 mg/kg vitamin E were fed for 6 weeks. Drip loss, color, and TBARS were measured in loin chops displayed for 0, 2, 4, 6, and 8 d at 4C. Drip loss from Hampshire crosses was greater (3.16 vs. 1.77%; $P < 0.001$) compared to Berkshire crosses, but was not affected by vitamin E level ($P > 0.10$). Chops from Berkshire crosses were darker (L*: 52.4 vs. 54.3; $P < 0.05$), less red (a*: 7.87 vs. 8.94; $P < 0.001$), and less yellow (b*: 7.87 vs. 8.71; $P < 0.05$) compared to Hampshire crosses, but were not affected by vitamin E level ($P > 0.10$). Greater oxidation (TBARS) occurred in Hampshire cross display chops (day x genotype; $P < 0.01$) on d 0 (0.77 vs. 0.65; $P < 0.02$), d 4 (1.09 vs. 0.83; $P < 0.001$), d 6 (0.62 vs. 0.47; $P < 0.002$) and d 8 (1.31 vs. 1.17 mg MDA/kg sample; $P < 0.01$). TBARS (day x vitamin E; $P < 0.06$) decreased linearly on d 4 (1.13 to 0.79; $P < 0.001$), d 6 (0.76 to 0.48; $P < 0.02$) and d 8 (1.40 to 1.04 mg MDA/kg sample; $P < 0.001$) with increasing levels of vitamin E. TBARS in display chops from Hampshire cross (genotype x vitamin E; $P < 0.02$) decreased linearly (from 1.02 to 0.66 mg MDA/kg sample; $P < 0.001$) with increasing vitamin E level. These data reinforce that Hampshire crosses produce paler, more exudative pork that is more susceptible to oxidation than Berkshire crosses. However, increasing supplemental vitamin E levels will improve storage as indicated by reduced oxidation of lower quality pork, but will not impact oxidation in higher quality pork.

Key Words: Vitamin E, Pork, Quality

283 The effects of niacin on growth performance and meat quality in grow-finish pigs. D. E. Real*[1], J. L. Nelssen[1], M. D. Tokach[1], R. D. Goodband[1], S. S. Dritz[1], J. A. Unruh[1], and E. Alonso[2], [1]*Kansas State University, Manhattan,* [2]*Lonza Inc., Fair Lawn, NJ*.

Two experiments were conducted to determine the effects of additional dietary niacin on growth performance and meat quality in finishing pigs. All pigs were blocked on weight and assigned to one of six dietary treatments. Pigs were housed with 2 pigs per pen (6 pens/treatment/sex) in Exp. 1 and approximately 26 pigs per pen (4 pens/treatment/sex) in a commercial research barn in Exp. 2. In both trials, dietary treatments consisted of a corn-soybean meal-based control diet or the control diet with 27, 55, 83, 110, or 550 mg/kg additional niacin. In Exp. 1, 144 pigs (initially 51.2 kg) were fed diets in two phases from d 0 to 25 and d 25 to 62 that were formulated to 1.00 and 0.75% lysine, respectively. In Exp. 2, 1243 pigs (initially 35.9 kg) were fed diets in four phases (d 0 to 28, d 29 to 56, d 57 to 84, and d 85 to 117). Diets were formulated to 1.25, 1.10, 0.90, and 0.65% lysine in the respective phases and contained 6.0% added fat in the first three phases. In both trials, gilts grew slower ($P<0.001$), were leaner at the tenth rib ($P<0.03$), and had higher fat-free lean percentages ($P<0.01$) than barrows. Overall, in Exp. 1, feeding additional niacin had minimal effects on growth performance. However, niacin tended to increase ($P<0.06$) 24 hr pH (5.44, 5.49, 5.49, 5.46, 5.49, and 5.48). In the commercial environment in Exp. 2, increasing niacin increased (quadratic, $P<0.05$) ADG (760, 775, 762, 775, 754, and 753 g/d) and improved (quadratic, $P<0.01$) G/F (.352, .362, .357, .375, .367, and .366). Niacin supplementation also decreased (linear, $P<0.04$) carcass shrink and drip loss percent (2.00, 1.90, 1.93, 1.90, 1.23, and 0.80) and increased (linear, $P<0.01$) subjective color scores, L* values, and ultimate pH (5.67, 5.73, 5.77, 5.76, 5.85, and 5.94). Results from these two studies show that additional dietary niacin can be fed to pigs to improve pork quality as measured by drip loss, pH, and color.

Key Words: Niacin, Meat quality, Finishing pigs

284 Role of pantothenic acid as a modifier of body composition in pigs. T. S. Stahly and T. R. Lutz*, *Iowa State University, Ames, IA*.

Fifteen sets (7 barrows, 8 gilts) of four individually penned, littermate pigs were utilized to determine the effect of pantothenic acid (PA) additions on growth, body composition and meat quality in pigs fed from 10 to 118 kg BW. Pigs from a high lean strain were reared via a SEW scheme and self-fed a diet containing 19 ppm PA from weaning to 10 kg BW. Pigs were then fed a basal diet (analyzed 6 ppm PA) and allotted within litter to one of four dietary additions of PA (0, 30, 60, 120 ppm) from d-calcium pantothenate. The basal diet consisted of a corn-SBM-3% choice white grease mixture and contained 1.5, 1.2, and .95% lysine for pigs fed from BW of 10 to 46, 46 to 80 and 80 to 118 kg, respectively. All vitamins except PA were fortified to 600% of NRC (1998) for each stage of growth. As dietary PA concentration increased, longissimus muscle area increased quadratically (43.9, 48.0, 45.4, 47.5 cm^2, $P<.06$) and tenth rib backfat decreased quadratically (2.25, 2.04, 2.07, 1.95 cm, $P<.05$) resulting in a quadratic increase in fat-free lean (51.4, 53.4, 52.5, 53.6%, $P<.04$). The magnitude of these responses were larger ($P<.09$) for barrows than gilts. Daily body weight gain (933, 916, 940, 914 g) and gain:feed (429, 433, 428, 431 g/kg) were not altered by dietary PA. In addition, measures of meat (longissimus) quality including intramuscular fat content (4.4, 4.2, 4.6, 4.0%), Hunter L (54.5, 54.2, 54.3, 54.3) and Hunter a (8.7, 9.1, 8.9, 8.5) color values and water loss under retail storage (4.7, 4.9, 5.1, 4.7%) at 96 hours post-kill were not ($P>.10$) altered by dietary PA. Based on these data, dietary pantothenic acid at concentrations greater than that required to maximize body weight gain elicits reductions in subcutaneous fat thickness while increasing carcass lean content of market weight pigs without altering meat quality.

Key Words: Pigs, Pantothenic acid, Body composition

285 Impact of a targeted B-Vitamin regimen on rate and efficiency of growth on lean growth genotype pigs from 6 to 110 kilograms of body weight. M. Coelho, B. Cousins*, and W. McKnight, *BASF Corporation*.

Four hundred, four week old pigs (5.5 kg initial BW) were utilized in a 5x2 factorial design (10 reps/treatment) to determine the effects of five B-vitamin (riboflavin, pantothenic acid, niacin, B_{12} and folic acid) fortification levels (NRC, 2X, 4X, 8X, 16X NRC) and two levels of stress (low and moderate) on the performance of 5.5 kg to 110 kg pigs (128 trial days). Diets were formulated to be isocaloric and isonitrogenous. The diets were fed in pellet form. Pigs raised under moderate stress conditions during performance period 1(19 days, 12 kg bw) gained 506^{d}, 533^{cd}, 544^{bcd}, 559^{abc} and 569^{ab} g/day and had corrected feed efficiency of 1.929^{d}, 1.899^{cd}, 1.889^{bcd}, 1.871^{abc} and 1.828^{a} when supplemented with NRC, 2X, 4X, 8X and 16X NRC B-vitamins, respectively. For the overall performance at 128 days pigs raised under moderate stress, had an ADG of 814^{c}, 829^{bc}, 844^{abc}, 850^{ab} and 865^{a} g/day had corrected feed efficiency of 2.583^{c}, 2.499^{b}, 2.466^{ab}, 2.444^{ab} and 2.419^{a} when supplemented with NRC, 2X, 4X, 8X and 16X NRC B-vitamins, respectively. Across stress levels, increasing vitamin supplementation increased loin eye area (39.72^{c}, 40.25^{c}, 42.96^{b}, 44.06^{ab} and 44.96^{a} cm^2) and decreased backfat(16.65^{d}, 16.61^{c}, 16.41^{bc}, 16.06^{a} and 16.02^{a} mm)when supplemented with NRC, 2X, 4X, 8X and 16X, respectively. Pigs fed 16X NRC levels had a \$5.91/pig advantage and 500% return over 2X NRC and \$3.69/pig advantage and 400% return over 4X NRC.

Key Words: Swine, Vitamins, Performance

ASAS/ADSA Breeding and Genetics: Genetic Parameters of Swine and Sheep

286 Relationship between post-weaning performance and reproductive performance in first parity Landrace females. D. Newcom*, P. Chen, J Mabry, and T.J. Baas, *Iowa State University, Ames, Iowa*.

Data from the National Swine Registry STAGES program were used to examine the relationship between the post-weaning performance (growth, backfat, and loin muscle area) of Landrace females and their subsequent first parity reproductive performance. Genetic parameters were estimated from first parity Landrace females (n=5247) for which post-weaning performance had also been recorded. These records rep-