T280 Chemical treatment of corn stover with calcium hydroxide increases its energy value for swine. Victor G. Perez*, Lester Pordesimo, Amanda Knorr, and Terry Radke, *ADM Animal Nutrition, Quincy, IL.*

The objective was to estimate DE and ME content in corn stover (CS) and CS treated (CST) with $Ca(OH)_2$ for swine. The $Ca(OH)_2$ was added to CS in the amount of 6.6% of the DM in CS, with enough water to raise moisture content in CST to 50% (wet basis). After 7 d, CST was sun dried and both CS and CST were pelleted (9 mm). Dietary treatments were a basal diet (97.28% corn), and the basal diet with 30% of either CS or CST added at the expense of corn. The experiment was a RCBD based on initial BW, and each treatment had 8 block replicates (barrows; 90 ± 0.7 kg BW). Feed was offered to provide 2.5 times the energy maintenance requirement. It was assumed that CST had 10% more energy than CS, based on preliminary data from an in vitro organic matter digestibility (Boisen and Fernandez, 1997). Pigs were placed in metabolic crates and allowed 7 d of adaptation, followed by 4 d of total collection of feces and urine. The DE and ME values in ingredients were calculated by the difference procedure. Data were analyzed using the PROC GLM procedure of SAS. Pairwise comparisons were used for treatment means separation. Measured DE and ME values in corn (Table 1) were 2% smaller or less than published values (NRC, 2012). Feed intake was not different between CS and CST. Chemical treatment of CS increased ($P \leq 0.06$) its DE and ME by 43 and 34%, respectively (Table 1), perhaps because it increased ($P < 0.05$) digestibility of dietary NDF (17.7 vs. 29.2%; SEM = 3.22) and ADF (17.5 vs. 35.7%; SEM = 2.20). In conclusion, chemical treatment of CS with $Ca(OH)_2$ increases its energy value in swine.

Table 1 (Abstr. T280). Energy value (kcal/kg DM) of corn, corn stover (CS), and CS treated with $Ca(OH)_2$ (CST) in pigs (90 ± 0.7 kg BW)

Item	Corn	CS	CST	SEM	CS vs. CST, kcal (%)
DE	3,864[a]	914[b]	1,306[c]	106	392 (43%)
ME	3,758[a]	917[b]	1,229[c]	105	312 (34%)

[a–c]Within rows, means with different superscript differ ($P \leq 0.06$)

Key Words: corn stover, sow, metabolizable energy

T281 Hammer status in hammer mill affects feed particle size and piglet performance after weaning. David Solà-Oriol, Laia Blavi*, and Roser Sala, *Animal Nutrition and Welfare Service, Department of Animal and Food Sciences, Universitat Autònoma de Barcelona, Bellaterra, Spain.*

Hammers of hammer mill are changed when working edges are worn but, often this is not decided according to the quality standards of feed and their possible effects on performance. The aim of the present work was to study the effect of different hammer status (new; N or worn; W) on particle size distribution of ground diets and the performance of weaned piglets. One hundred sixty 28-d-old piglets [Pietrain × (Landrace × Large White)] were distributed into 16 pens according to their initial BW following a RCBD. A pre-starter (PS; 0 to 14d) and a starter (ST; 14 to 35d) diet was formulated to contain 2.63 Mcal/kg NE, 20.2% CP, 1.37 Lys and 2.48 Mcal/kg NE, 15.1% CP, 1.20 Lys, respectively. Two experimental treatments were performed according to the hammer status N or W. PS and ST diets were ground at Ø = 2 and Ø = 3 mm, respectively. Feed was offered ad libitum in mash form. Individual animal weight and feed disappearance were recorded at 0, 14, and 35 d post-weaning to calculate average daily feed intake (ADFI) and average daily gain (ADG). Data were analyzed with ANOVA taking into account block of BW and hammer status as main factors. Feed particle size distribution was determined as % of particles ≥1 mm, ≥0.75 mm, ≥0.5 mm and <0.5 mm. Different size distribution was mainly observed for ST. The W diets showed 21% and 3.7% more particles of ≥ 1mm and ≥ 0.5mm, but 8.5% and 9.3% less of ≥0.75 mm and <0.5 mm, respectively than N diet. For PS period, no different BW, ADG and ADFI was observed ($P > 0.05$). However, higher ADFI (666 vs 619 g/d; $P = 0.03$) and a tendency to higher ADG (418 vs 387 g/d: $P = 0.10$) were observed for the animals fed the N diet for ST period. Considering the entire period (0 to 35d), higher BW (18.9 vs 18.1 kg; $P = 0.03$), ADFI (505 vs 471 g/d; $P = 0.01$) and ADG (318 vs 295 g/d: $P = 0.03$) were observed for the animals fed the N diets. It is concluded that hammer status affects particle size and piglet performance in weanling diets in a larger extend in ST than PS diets.

Key Words: hammer mill, particle size, piglet

T282 Effect of salt particle size and extended mixing times on the mixing uniformity of a corn-soy swine diet. Marut Saensukjaroenphon*[1], Cassandra K. Jones[1], Charles H. Fahrenholz[2], Kessinee Chitakasempornkul[1], and Charles R. Stark[1], *[1]Kansas State University, Manhattan, Kansas, [2]Phibro Animal Health Corporation, Manhattan, Kansas.*

The uniformity of a feed mixture is determined from the coefficient of variation (CV) of 10 samples in a single batch of feed. The feed industry standard is a CV of <10% using a single source tracer such as salt, trace minerals, or iron filings. The uniformity of mix can be affected by many factors, including mixer design, particle size of the ingredients, and mixing time. Previous research has determined the minimum mix time to maximize the mixing efficiency, but some hypothesize that over-mixing may lead to ingredient segregation. However, there is limited data regarding the effects of extended mixing or of the analytical marker appropriate for maximum precision of the assay. The objectives of this experiment were to determine (1) the effects of extended mix time, and (2) particle size of the marker on the CV in a corn-soy swine diet. Treatments were arranged in a 3 × 7 factorial design with 3 salt particle sizes: fine (350 μm), medium (464 μm), and coarse (728 μm) and 7 mix times: 2, 3, 5, 15, 30, 45 and 60 min. There were 3 replicates per treatment and 10 samples per replicate. Salt concentrations were determined using a Quantab Chloride Titrator. Data were analyzed using the GLIMMIX procedure of SAS. There was no interaction between mix time and salt particle size ($P > 0.60$). The extended mix time did not result in segregation ($P > 0.30$; 9.6, 11.5, 11.8, 11.2, 12.50, 10.6, and 10.1% CV for 2, 3, 5, 15, 30, 45, and 60 min, respectively). Particle size of the salt significantly affected the uniformity of mix ($P < 0.01$; 20.7, 8.4, and 7.7% CV for the coarse, medium, and fine salt, respectively). These results indicate that feed did not segregate after mixing for one hour and that greater number of particles per gram increased the precision of the analysis, likely due to an increased probability that the tracer was present in proportionate quantities in the sample tested. More research is needed to determine if sample size or number of samples

per batch should be increased, as well as the effect of diet particle size on uniformity of mix.

Key Words: mixing uniformity, mixing time, particle size

T283 Optimization of different probiotics on improving the quality of cottonseed meal fermentation using response surface methodology. X. M. Liu[1], C. W. Yang*[2], Z. Y. Li[3], Z. B. Yang[1], and Y. Wang[4], *[1]College of Animal Science, Shandong Agricultural University, Shandong, China, [2]College of Life science, Shandong Agricultural University, Shandong, China, [3]CRVAB Bio-tech Group, Shanghai, China, [4]Agriculture and Agri-Food Canada, Lethbridge Research Centre, Lethbridge, AB, Canada.*

Central composite design of response surface methodology (RSM) was employed to optimize *Lactobacillus* content (X_1: 4.5×10^6 to 5.5×10^6 cfu/g), *Bacillus subtilis* content (X_2: 9.0×10^6 to 1.1×10^7 cfu/g) and yeast content (X_3: 5.50×10^6 to 7.0×10^6 cfu/g) of solid-state fermentation (SSF) cottonseed meal with low pH value, high dry matter recovery (DMR) and high the reducing-sugar content. Results indicated that the data were adequately fitted into 3 s-order polynomial models. The *Lactobacillus* content, *Bacillus subtilis* content, and yeast content were found to have significant linear, quadratic and interaction effects on pH value, the DMR and the reducing-sugar. The optimal extraction conditions were predicted to be lactobacillus content of 5.50×10^6 cfu/g, *Bacillus subtilis* content of 1.08×10^7 cfu/g and yeast content of 6.08×10^5 cfu/g. The pH value, DMR and the reducing sugar predicted by RSA were 5.01, 91.8% and 1.69%, respectively. The detection index obtained experimentally was close to its predicted values. The establishment of such model provides a good experimental basis employing RSM for optimizing the quantity of inoculation of *Lactobacillus*, *Bacillus subtilis*, and yeast on fermentation.

Key Words: quantity of inoculation, pH, dry matter recovery

T284 Effects of ginger root, star anise, and *Salvia miltiorrhiza* on growth performance, antioxidant status and serum metabolites in growing pigs. Z. B. Yang*[1], X. Y. Li[1], S. Z. Jiang[1], and C. W. Yang[2], *[1]College of Animal Science, Shandong Agricultural University, [2]College of Life Science, Shandong Agricultural University.*

To compare the effects of ginger root (*Zingiber officinale*), star anise (*Illicium verum*) and dan-shen root (*Salvia miltiorrhiza*) that were processed to particle sizes of 300 µm on growth performance, serum antioxidant status and serum metabolites of growing pigs, 24 Laiwu pigs at 70-d old were randomly allocated to 4 treatments with 6 replicates in a complete randomized design. The 4 treatments (TRT) were (1) TRT 1, pigs were fed corn-soybean meal based diets; (2) TRT 1 + 10 mg/kg ginger; (3) TRT 1 + 5 g/kg star anise; (4) TRT 1 + 10 g/kg dan-shen. ADG, ADFI and feed conversion rate of each replicate were measured weekly. At d35 of the experiment, blood samples were obtained from 6 pigs per treatment to determine antioxidant enzymatic activities and metabolites in the serum. All dates were subjected to ANOVA using the one-way of SAS program software (version 9.2). Differences among treatments were tested using Duncan's multiple-range test. All pigs had similar ADFI, ADG, feed conversion rate and concentrations of malondialdehyde in serum over the entire experimental period. However, comparing to TRT 1, supplementation of ginger, star anise and dan-shen increased activities of total antioxidant capacity and superoxide dismutase ($P = 0.003$, $P < 0.001$, respectively). The activity of superoxide dismutase in TRT 2 was higher ($P < 0.05$) than TRT 4. Concentration of glutathione in serum was higher ($P < 0.05$) with dietary supplementation of star anise and dan-shen than TRT 1 and TRT 2. As compared with that of TRT 1, supplementation of 3 botanical additives reduced ($P < 0.05$) concentrations of total cholesterol but had same concentrations of total protein, globulin and low density lipoprotein in serum of growing pigs. Supplementation of star anise increased ($P < 0.05$) concentrations of albumin and high-density lipoprotein comparing to TRT 1. Concentration of high-density lipoprotein in serum of ginger-supplemented pigs was higher ($P < 0.05$) compared with that of TRT1. Dietary supplementation of ginger, star anise and dan-shen may improve serum antioxidant status and serum metabolites of growing pigs in a certain degree.

Key Words: ginger, star anise, dan-shen root (*Salvia miltiorrhiza*)

T285 Effect of oregano essential oil supplementation on oxidative stability of eggs enriched with polyunsaturated fatty acids during storage. Ronnal E. Ortiz*[1,2], Germán Afanador-Tellez[2], Diana R. Vásquez[1], and Claudia Ariza-Nieto[1], *[1]Corporación Colombiana de Investigación Agropecuaria, Bogotá, Cundinamarca, Colombia, [2]Universidad Nacional de Colombia, Bogotá, Cundinamarca, Colombia.*

This study evaluated the inclusion of oregano essential oil (OEO) *Lippia origanoides* Kunth in diets enriched with polyunsaturated fatty acids (PUFA) on oxidative stability of eggs during storage. A total of 144 Babcock Brown hens 48-week-old were assigned to a completely randomized factorial design 2 × 2; Factor A oil type (palm and fish), Factor B OEO level (0 and 100 g/Ton) with the repeated measures of days of storage (0, 30, 60 d). The statistical model included the fixed effects of oil type, OEO level, day of storage and their interactions. At the end of the period (8 weeks) 6 eggs per replicate were collected; 2 eggs were analyzed as fresh, the remaining 4 were storage at 4°C; 2 for 30days and 2 for 60 d. Egg yolks were used for the analysis of PUFA and thiobarbituric acid reactive substances (TBARS) that measures malonaldehyde concentration (MDA). Results showed no significant interactions effect ($P > 0.05$). In fish oil groups, the concentration of PUFA and docosahexaenoic acid (DHA) increased (+16.8 and +1.4%, respectively) ($P < 0.05$). The concentration of MDA was higher in fish oil groups (41.6 ng/g yolk) compared with palm oil groups (32.6 ng/g yolk). The groups supplemented with OEO improved oxidative stability during storage (MDA 31.1 ng/g yolk) compared with the groups without supplementation (MDA 34.1 ng/g yolk). Concentration of MDA showed an effect on storage time ($P < 0.05$); on day zero egg yolks had lower MDA (28.3 ng/g yolk), whereas on d 30 and 60 of storage MDA increased (31.4 and 38 ng/g yolk, respectively). The OEO showed potential as a natural antioxidant in the diet of layers hens improving the oxidative stability of eggs stored at 4°C up to 60 d.

Key Words: layer hen, lipid peroxidation, egg yolk

T286 Effects of dietary inclusion of *Lactobacillus acidophilus* on growth performance, health, and carcass traits of growing-finishing pigs. A. S. Loftus*, I. Park, N. E. Manzke, and S. W. Kim, *Department of Animal Science, North Carolina State University, Raleigh, NC.*

The objective of this study was to determine the effect of a single strain direct-fed microbial (DFM, *Lactobacillus acidophilus* 1×10^9 cfu/g) on growth performance and carcass traits of growing-finishing pigs. Sixty pigs (30 gilts and 30 barrows) with initial BW of 44.4 kg ± 1.8 kg were allotted to 2 dietary treatments in a randomized complete block design with sex and initial BW as blocks. Experimental diets met the NRC 2012

nutrient requirements. The inclusion levels of DFM were 0.28, 0.24, and 0.20% during phase 5 (d 0 to 28), phase 6 (d 28 to 49), and phase 7 (d 49 to 70), respectively. Growth performance was measured for 10 wk. Blood samples were collected at wk 9 to measure TNFα and blood urea nitrogen (BUN). At wk 10, pigs were slaughtered at a local abattoir to evaluate carcass and loin quality including HCW, CCW, backfat thickness (1st, 10th, and last rib), loin weight, loin color (Minolta colorimeter), loin marbling score (1 to 10, NPPC scale), drip loss (48 h), loin eye area, and chemical composition. Data were analyzed using Proc Mixed of SAS with treatment and sex as fixed effects and initial BW block as a random effect. P value less than 0.05 was considered significant and less than 0.10 tendency. The ADG, ADFI, and G:F were not different between treatments. Backfat thickness of pigs with DFM was smaller ($P < 0.05$, 24.5 vs. 29.6 mm) at the last rib and tended to be smaller ($P = 0.088$, 30.1 vs 34.4 mm) at the 1st rib than pigs without DFM. Loin of pigs with DFM tended to be redder ($P = 0.084$, a* value for redness: 7.22 vs. 6.35) than pigs without DFM. Chemical composition, drip loss, TNFα, BUN, and intestinal morphology did not differ between treatments. Collectively, dietary supplementation of a single strain DFM, *Lactobacillus acidophilus* to grower-finisher feeds reduced backfat thickness of pigs without affecting growth performance and loin quality.

Key Words: direct-fed microbial, growing-finishing pig, carcass trait

T287 Nutrient digestibility of high oleic soybean meal by broilers. Guilherme Hosotani*, Monty S. Kerley, and Marcia C. Shannon, *University of Missouri, Columbia, MO.*

Two 21-d experiments were conducted to compare soybean meal (SBM) from high oleic to parent soybean cultivars on growth performance, ileal AA (IAA) digestibility, and apparent metabolizable energy (AME). Soybean meal was prepared by laboratory-scale mechanical extraction. In Exp. 1, growth performance was evaluated. Fifty 1-d-old male broilers (Ross 308) were randomly placed in battery cages and allocated to 2 dietary treatments with 5 replicates and 5 birds per replicate. The SBM sources consisted of cold-pressed conventional SBM (CON) and cold-pressed high oleic SBM (HO). All SBM sources were heated in a forced-air oven at 120°C for 20 min. Diets were formulated to meet or exceed NRC (1994) requirements. Broilers were weighed and feed disappearance measured on d 7, 14, and 21. In Exp. 2, IAA digestibility and AME were estimated using 100 one-d-old broilers randomly allotted to 3 dietary treatments with 10 replicates and 5 birds per replicate. Chicks were fed a corn-SBM based diet for 17 d, and a diet was developed by substituting the soybean cultivars at 48% in a corn starch-dextrose basal diet and fed from d 18 to 21. A nitrogen-free diet was fed to determine ileal endogenous AA losses. Titanium dioxide (0.5%) was included in all diets as a digesta flow marker. Excreta were collected from d 19 to 21 and ileal content at d 21. Statistical analyses were performed as a randomized complete block design using PROC GLM of SAS with significance level set at $P \leq 0.05$. Chicks fed diets containing HO had decreased ADG ($P < 0.05$; 25.3 vs. 29.4 g) and increased feed conversion ratio ($P < 0.05$) from d 0 to 14 (1.71 vs. 1.56) and d 0 to 21 (1.54 vs. 1.47), compared with CON. Amino acid digestibility did not differ among all essential AA. There were no differences in AME (kcal per g) from SBM indirectly calculated between CON and HO, with values of 2,330 and 2,161, respectively. In conclusion, although there were no differences in nutrient digestibility, broilers fed HO had impaired performance compared with CON.

Key Words: broiler, soybean, high oleic acid

T288 Effect of dietary quercetin and oregano essential oil on growth performance, carcass characteristics, meat quality and antioxidant properties in pigs under transport stress conditions. Yi Zou, Yuanfei Zhou*, Hongkui Wei, and Jian Peng, *Department of Animal Nutrition and Feed Science, College of Animal Science and Technology, Huazhong Agricultural University, Wuhan, Hubei, China.*

The current study was conducted to investigate the effects of dietary oregano essential oil and quercetin supplementation on growth performance, meat quality and antioxidant property in transported pigs. A total of 336 finishing pigs (Large White × Landrace) with an initial body weight of 72 ± 4.0 kg were randomly allotted to 4 groups (5 replicate pens per treatment, 17 pigs per pen). Animals in these 4 groups consumed basal diet (control), basal diet supplemented with 100 mg/kg of vitamin E (VE), or 25 mg/kg of oregano essential oil (OEO) or 25 mg/kg quercetin for 4 wk, respectively. After 4 wk feeding period, 144 pigs were transported for 7 h by high stocking density (275kg/m^2). Pigs were slaughtered to determine meat quality at 45 min and 24 h postmortem from the M. longissimus dorsi muscles. Blood samples were also collected for measurement of glutathione peroxidase (GSH-Px), total superoxide dismutase (T-SOD), malondialdehyde (MDA) and reactive oxygen species (ROS) levels. Statistical analysis was performed using the GLM procedure (SAS Inst. Inc., Cary, NC). Pen was the experimental unit, and the mean differences were determined using Fisher's test of LSD. The level of statistical significance was taken at $P < 0.05$ or $P < 0.01$. Compared with control group, both OEO and quercetin groups had significant higher average daily gain (ADG), whereas only OEO group had higher final body weight and lower feed intake/gain ($P < 0.05$). Hot carcass weights and dressing percentage was higher in OEO group than those in control and VE groups ($P < 0.05$). The OEO and quercetin groups had significant ($P < 0.05$) lower drip loss and MDA levels but higher ($P < 0.01$) pH value and lightness value in meat compared with control group. In serum, compared with the control group, OEO and quercetin group had increased activation of GSH-Px and T-SOD ($P < 0.01$), and decreased MDA and ROS levels ($P < 0.01$). Moreover, compared with quercetin and VE groups, OEO group had a higher GSH-Px activity in serum. In general, dietary OEO and quercetin may protect against transport stress and improve redox status in transported pigs.

Key Words: finishing pig, transport stress, meat quality

T289 Effect of vitamin E supplementation on performance of male broiler chickens—A meta-analytic approach. M. A. Pompeu*[1], L. F. L. Cavalcanti[2], and F. L. B. Toral[1], *[1]Universidade Federal de Minas Gerais, Belo Horizonte, MG, Brazil, [2]CNPq, RHAE, Seva Engenharia, Projeto Intergado, Contagem, MG, Brazil.*

Vitamin E (VE) is broadly recognized by its effects on immune response and meat quality of broiler chickens. However, studies have presented controversial results of VE effects on broiler performance. A meta-analysis was conducted to estimate the linear effect of VE supplementation on body weight (BW, 39–49 d of age), daily weight gain (DWG), daily feed intake (DFI) and feed conversion ratio (FCR) of male broiler chickens, using a data set composed by 33 peer-reviewed journal articles from 2010 to 2014. Data were analyzed by linear mixed models approach, where studies (s) were assumed as random effect whereas VE total amount on diet as fixed effect. VE levels in the database were: mean = 91.89 ± 106.6 mg/kg, min = 0 mg/kg, max = 400 mg/kg, while the response variables presented the following averages and observations: BW = 2.16 ± 0.66 kg, n = 41, s = 12; DWG = 61.6 ± 16.02 g, n = 44, s = 13; DFI = 91.7 ± 19.6 g, n = 49, s = 13; FCR = 1.78 ± 0.18 g/g, n = 56, s = 16. The neces-

sity to model error heteroscedasticity was evaluated based on Akaike's information criterion and Schwarz criterion. Significance was declared at $P \leq 0.05$. None of the analyzed variables was linearly influenced by VE supplementation, where the estimated slopes were not different from zero with *P*-values equal to: 0.99, 0.80, 0.22, 0.40, for BW, DWG, DFI and FCR, respectively. The absolute value of correlation between random terms (i.e., intercept and slope) was never greater than 0.27, what indicates that VE effect is independent of variables' values range, with the exception of DFI (r = −0.86). Although 33 studies were evaluated in this research, few of them presented all performance variables simultaneously, what could have reduced the meta-regression power of analysis. Moreover, most studies presented a small range and few VE levels (i.e., less than 4 levels). More standardized and integrated research should be conducted to investigate possible effects of VE on broilers performance; nevertheless, there is not yet, in the current literature, any evidence indicating that the non-effect hypothesis should be rejected.

Key Words: meta-regression, nutrition, poultry

T290 The duration required to detect differences in bone mass accumulation in young pigs fed diets with varied vitamin D, Ca, and P concentrations. Lynzie M. Miller*, Laura A. Amundson, and Thomas D. Crenshaw, *University of Wisconsin, Madison, Wisconsin.*

The time course for accumulation of bone mass was established in 49 pigs (~28 d of age) fed diets with either low (LCaP; 75% Ca; 95% P) or high (HCaP; 150% Ca; 120% P) Ca and P (expressed as a percentage of requirements) each formulated without (-D; 0 IU D/kg) or with (+D; 280 IU D/kg) supplemental vitamin D_3. Bone mass was measured by dual-energy x-ray absorpitometry (DXA). Accumulation of skeletal mass was calculated from DXA scans at weekly intervals for the first 3-wk period, then at 2-wk intervals for the next 4 wk. Animals were fed a recovery diet (+D HCaP) during the last 4 wk. Growth and skeletal mass traits were analyzed as randomized block design for each weekly interval with inferences about diet differences based on orthogonal contrasts for main effects of CaP or vitamin D and the CaP × D interaction. Differences ($P < 0.01$) in skeletal mass due to dietary Ca and P were detected after 1 wk, but differences ($P < 0.01$) due to vitamin D effects were not detected until 2 wk. However, during the recovery phase the initial dietary vitamin D treatments affected recovery responses, not dietary Ca and P. Pigs fed diets without vitamin D failed ($P < 0.01$) to regain skeletal mass over the 4-wk recovery period, but pigs previously fed diets supplemented with vitamin D recovered skeletal mass equal to that of control pigs. In conclusion, DXA provides an effective method to detect differences in bone mineral content gain (gBMC, g/d). Young pigs responded to dietary depletions of Ca and P earlier than to vitamin D, but recovery from a vitamin D depletion was not detected after a 4-wk period.

Table 1 (Abstr. T290). Whole-body bone mineral content gain, g/d

Days	−D LCaP	−D HCaP	+D LCaP	+D HCaP	SEM
0 to 8[a]	0.72	2.43	1.03	2.74	0.33
0 to 16[abc]	1.14	2.84	3.01	6.20	0.30
0 to 24[abc]	1.15	2.58	5.22	8.48	0.30
0 to 55[b]	11.98	12.39	17.92	18.22	0.66

a = CaP effect, $P < 0.01$; b = D effect, $P < 0.01$; c = CaP × D effect, $P < 0.02$.

Key Words: bone mineral, DXA, recovery

T291 Comparison of response criteria used to assess dietary vitamin D_3 requirements in young pigs. Laura A. Amundson* and Thomas D. Crenshaw, *University of Wisconsin, Madison, WI.*

Recent concerns for increased mortality of young pigs attributed to hypovitaminosis D have focused attention on response criteria used to assess vitamin D requirements. The objective of the current experiment was to determine the dose-response relationships between dietary vitamin D_3 and skeleton mineral accumulation and serum 25-OH D_3 in growing pigs. All pigs were fed diets with 95% of the recommended Ca and P, but no supplemental vitamin D for 1 wk post-weaning. At 1 wk after weaning (~25 d), 84 crossbred pigs (n = 4 pigs/pen, 3 pens/diet) were randomly assigned to 1 of 7 diets formulated to supply 95% of the recommended Ca and P concentrations with either 0, 50, 100, 200, 400, 800 or 1,600 IU D_3/kg. Sows that produced the litters were fed the UW Swine Research and Teaching Center standard gestation and lactation diets, both formulated to supply 325 IU vitamin D_3/kg. A segmented 2-phase linear model was applied to regress variables to vitamin D intake. Growth (ADG, kg/d), whole body bone mineral content (BMC, g) and bone mineral density (BMD, g/cm^2) via dual energy x-ray absorpitometry (DXA) scans, femur mechanical properties (bending force, yBM, kg-cm; stress, kg/cm^2) responses at the end of the 28-d trial (n = 6 pigs/diet, 2 pigs/pen) peaked at diet concentrations between 50 to 100 IU vitamin D_3 ($P < 0.05$), but serum 25-OH D_3 concentrations continued to increase as concentrations of dietary vitamin D_3 increased to 1,600 IU Intersections of the 2 regression slopes were 81, 84, and 77 IU vitamin D_3/d for ADG, BMD, and yBM respectively. Slopes for the upper range were not significantly different. No plateau was detected in serum 25-OH D_3 concentrations. Although limited by the number of groups in the lower range, diets with 100 IU vitamin D_3/kg appear adequate to meet requirements of young pigs for growth and skeletal traits. No benefit was attributed to the increased serum 25-OH D_3 concentrations.

Table 1 (Abstr. T291). Effects of supplemental vitamin D_3 on performance

	Vitamin D_3 (IU/kg diet)							
Trait	0	50	100	200	400	800	1,600	SEM
ADG, kg/d	0.338	0.385	0.452	0.472	0.485	0.434	0.486	0.024
BMD, g/cm^2	0.289	0.327	0.371	0.380	0.397	0.366	0.370	0.014
yBM, kg-cm	278	318	463	434	473	451	405	50
25-OH D, ng/mL	2.1	1.9	2.1	5.3	9.5	13.4	18.4	1.0

Key Words: hypovitaminosis D, bone mineral, mechanical test