

perhaps exacerbating the anemic condition. The objective was to determine the effect of iron at weaning on growth in pigs fed diets supplemented with copper. Pigs received 100 mg iron i.m. within 24 h after birth. At weaning (21 d of age) pigs were classified as large ($n = 72$; 8.3 ± 0.1 kg) or small ($n = 72$; 5.8 ± 0.1 kg) and one-half of pigs of each size received a second i.m. 100 mg iron injection. Pigs were placed three pigs/pen and allotted to a 2 x 2 x 2 factorial arrangement of treatments, main factors being size (large vs. small), iron injections (one vs. two) and diet (control vs. 250 ppm copper) ($n = 6$ /treatment combination). Growth was determined, and hematocrit assessed (one pig/pen) at weaning (d 0) and d 7 and 49 post-weaning. At d 0 ($P < 0.01$) but not d 7 ($P = 0.16$) or 49 ($P = 0.99$), hematocrit was greater for small (35.4%) than large (30.9%) pigs (size x day, $P < 0.01$). Hematocrit was greater ($P = 0.08$) on d 7 in pigs receiving two injections (37.6%) compared to those that received one (34.3%), but was similar ($P = 0.97$) between groups on d 0 and 49 (injection number x day, $P = 0.08$). Between d 0 and 7, ADG in copper-fed pigs was greater ($P = 0.06$) for animals receiving two (103.0 g/d) vs. one (56.8 g/d) injection (injection number x diet, $P = 0.06$). Pigs fed copper had greater ($P < 0.01$) ADFI than control-fed pigs (254.2 vs. 220.3 g/d) from d 0 to 7. Gain-to-feed ratio (d 0 to 7) was affected by injection number x diet ($P = 0.06$) and for copper fed animals was greater ($P = 0.06$) for pigs receiving two (0.39) vs. one (0.22) injection. From d 0 to 49, ADG ($P = 0.05$) and ADFI ($P = 0.04$), but not G:F ($P = 0.74$) were affected by injection number x diet and within copper-fed individuals ADG (531.8 vs. 476.9 g/d; $P = 0.07$) and ADFI (929.5 vs. 833.3 g/d; $P = 0.05$) was greater for pigs receiving two vs. one injection. A second injection of iron at weaning enhanced growth performance in pigs consuming diets supplemented with dietary copper. (National Pork Board Project #17-052)

Key Words: iron, copper, pigs

249 Effects of Feeding a Mineral Amino Acid Complex from Nursery to Second Parity on Sow Productivity and Gait Analysis. A. Tinkle^{*1}, M. E. Wilson², Z. J. Rambo³, K. Parham¹, C. M. De Mille¹, K. J. Duberstein¹, M. J. Azain¹, C. R. Dove¹, ¹University of Georgia, Athens, GA, ²Zinpro Corp., Eden Prairie, MN, ³Zinpro Corporation, Eden Prairie, MN

Seventy True Choice Genetics (CG32) gilts were allotted to two treatments at weaning (28-35 d) and were fed experimental diets from nursery through their second

parity. Treatments were a control diet and the control diet plus a mineral amino acid complex (MAAC) (Avalia[®]Sow fed at 750 g/metric ton). Gilts were grown under standard conditions and then followed for their first two parities. Litter size, piglet birthweight and piglet weaning weight were recorded for each parity. The gilt's gait was captured while walked through a dog bone track (7.5 m long) using a gait mat (GAIT4Dog[®]) pre-parturition (45-70 days pregnant) for both parities. Each gilt was walked until 6 usable repetitions were acquired. Data were analyzed for stance, swing, velocity, stride length, percent stance, cycle time and total pressure index. Claws and dewclaws were measured and recorded after walking. Data were analyzed in SAS 9.4 PROC MIXED repeated measures model. There were no differences in litter performance parameters the first two parities. Velocity increased in the treated sows the second parity ($P < 0.03$; 98.32, 107.17 cm/s, control and treated, respectively). Cycle time decreased in the treated sows for the second parity for both the front and rear legs (front $P < 0.007$; 1.00, 0.94 s; rear $P < 0.002$; 1.02, 0.93 s, control and treated respectively). Swing time second parity was decreased in the treated animals compared to the controls for both the front and rear legs (front $P < 0.002$; 0.33, 0.31 s; rear $P < 0.001$; 0.38, 0.36 s; control and treated respectively). Stance time decreased in the second parity for treated sows compared to control both the front and rear legs (front $P < 0.003$; 0.69, 0.62 s; rear $P < 0.004$; 0.64, 0.58 s; control and treated respectively). For the second parity percent stance decreased in the treated sows for the front legs (front $P < 0.04$; 66.58, 65.34 %) but was not significant for the rear legs. The total pressure index indicated that treated sows placed more weight on rear legs than control sows second parity (front $P < 0.02$; 58.11, 57.44%; rear $P < 0.02$; 41.90, 42.56%, control and treated respectively). There were no significant differences for claw lengths or sow productivity between the control and treatment. These differences provide evidence that adding MAAC impacts locomotion by improving gait quality in sows as they age.

Key Words: sow diet, mineral supplementation, sow production

250 Effects of Feeding Increasing Levels of Iron from Iron Sulfate or a Novel Source of Dietary Iron on Nursery Pig Growth Performance and Blood Parameters. H. E. Williams^{*1}, J. C. Woodworth¹, J. M. DeRouchey¹, S. S. Dritz¹, M. D. Tokach¹, R. D. Goodband¹, J. L. Usry², ¹Kansas State University, Manhattan, KS, ²Micronutrients, Inc., Indianapolis, IN

	Negative Control	FeSO ₄ , ppm			FeCO ₃ , ppm		
		10	30	50	10	30	50
d 0 to 32 ¹							
ADG, g ^a	112	190	167	240	179	141	236
G:F ^a	0.549	0.752	0.628	0.798	0.686	0.588	0.754
d 32 ¹							
Hgb, g/dl ^a	6.93	7.33	7.55	8.50	7.13	7.35	8.23
Hct, % ^a	24.8	26.6	26.9	29.8	26.0	26.5	29.5

¹SEM: ADG (22.0), G:F (0.05), Hgb (0.545), and Hct (1.69)

^aLevel main effect (linear, $P < 0.05$)

A total of 140 weanling pigs (DNA 241 × 600, initially 5.53 ± 0.01 kg) were used in a 32-d study evaluating the effects of feeding increasing levels of iron from either iron sulfate (FeSO₄) or a micronized, agglomerated ferrous carbonate (FeCO₃) on nursery pig growth performance and blood parameters. Pigs used for this trial did not receive an iron injection at birth. Pigs were weaned at approximately 21 d and were allotted to pens based on BW in a randomized complete block design. 5 pigs were placed in each pen with 4 pens per treatment. Treatments were arranged as a 2 × 3 + 1 factorial with main effects of iron source (FeSO₄ vs. FeCO₃) and level (10, 30, or 50 ppm) plus a control with no additional iron. The basal diet was formulated to contain 40 ppm total dietary iron based on ingredient contributions and was formulated with an iron-free trace mineral premix. Treatment diets were formulated below the pigs assumed iron requirement based on the NRC (2012). Experimental diets were fed in pellet form for the duration of the trial. The negative control was included in linear and quadratic contrast analysis. From d 0 to 32, there were no iron source × level interactions observed. Feeding increasing levels of either FeSO₄ or FeCO₃ improved (linear; $P < 0.05$) ADG, G:F, Hemoglobin (Hgb), and Hematocrit (Hct) compared to the negative control. Overall, increasing dietary levels of either FeSO₄ or FeCO₃ improved nursery pig growth performance and blood parameters. There was no evidence of difference ($P > 0.05$) for an iron source effect on blood parameters measured. Therefore, it can be assumed that the bioavailability of the micronized source of FeCO₃ is similar to that of FeSO₄.

Key Words: Growth performance, Iron, Nursery pig

251 Determination of the Efficacy of Titrated Levels of Water Soluble Zinc Amino Acid Complex on Growth Performance of Nursery Pigs. P. Aparachita^{*1}, S. D. Carter¹, C. V. Cooper¹, I. Silva Lara¹, A. Sawyer¹, Z. J. Rambo², T. L.

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High dietary concentrations of zinc oxide and copper sulfate are used in weaned pig diets to improve growth performance and feed efficiency, but few studies have investigated the effects of supplementing zinc via water. To evaluate the efficacy of a water soluble zinc amino acid complex “Zinpro LQ” (Zinpro Corporation, Eden Prairie, MN), two hundred eighty crossbred pigs (5.6 kg BW; PIC 337) were randomly allotted to four water treatments (7 pens/treatment; 10 pigs/pen). The water treatments were 0, 20, 40 and 80 mg Zn/L of water. Pigs were fed a common diet with added Zn as ZnO or Cu as CuSO₄ during each dietary phase: Phase 1 (2,500 mg Zn/kg; from d 1-7), Phase 2 (1,750 mg Zn/kg; from d 7-14), Phase 3 (200 mg Cu/kg; from d 14-21), and Phase 4 (200 mg Cu/kg; from d 21-42). All diets were formulated based on corn and soybean meal with no added medications. Pigs and feeders were weighed weekly to determine ADG, ADFI, and G:F. Water meters were used to record and calculate average daily water intake (ADWI). Data were analyzed as a randomized complete block design. Orthogonal polynomial contrasts were used to determine linear, quadratic, and cubic effects. A linear increase ($P < 0.01$) in ADWI ($ADWI = 0.0844 * day + 0.2145$; $R^2 = 0.91$) was observed for d 0-42. Throughout the experiment, there were no differences ($P > 0.05$) in ADFI (550, 550, 570, and 560 g/pig) and ADWI (3.93, 3.92, 3.86, and 4.21 L/pig) among treatments. Daily zinc intake increased with increasing zinc concentration (linear, $P < 0.0001$). During d 0-21, a linear trend ($P < 0.10$) was noted for increased ADG (250, 250, 260, and 280 g/pig) and d 21 BW (11.07, 11.21, 11.27, and 11.74 kg) with increased water zinc intake. Furthermore, increasing zinc intake via water improved (linear, $P < 0.05$) G:F from d 0-21 (0.79, 0.81, 0.83, and 0.84). For d 21-42, increasing zinc intake via water tended to improve ADG (quadratic, $P = 0.10$; 550, 560, 600, and 570 g/pig) and final BW (linear, $P = 0.12$; 21.99, 22.38, 23.30, and 23.30 kg), and improved G:F for the total experiment period (linear, $P < 0.05$; 0.77, 0.79, 0.82, and 0.83). In conclusion, supplementing drinking water of nursery pigs with Zinpro LQ resulted in linear improvements in ADG and G:F for the first 3 weeks post-weaning, and improved G:F for the entire nursery period.

Key Words: Water, Zinc, Nursery pig

252 Effect of Cyclic Heat Stress and Supplemented Inorganic and Organic Zinc Source Levels on Grow-Finish Pig Growth Performance and