	Cu, ppm			CTC, ppm			
	0	200	P<	0	440	P<	SEM
d 0 to 14							
ADG, g	271	294	0.025	262	303	0.001	7.9
ADFI, g	362	388	0.011	360	390	0.004	7.0
G:F	0.750	0.756	0.546	0.728	0.778	0.001	0.009
d 14 to 28							
ADG, g	596	600	0.693	574	622	0.001	7.6
ADFI, g	884	895	0.386	857	922	0.001	11.8
G:F	0.674	0.671	0.518	0.671	0.675	0.486	0.004

fed for 7 d after weaning. Pens were allotted to dietary treatments based on BW and location in a randomized complete block design with 5 pigs per pen and 8 replications per treatment (each replication as a pair of adjoining pens). Treatments were a 2 × 2 factorial with added Cu (0 vs. 200 ppm Cu sulfate) and CTC (0 vs. 440 ppm). Data were analyzed using a linear mixed model (PROC GLIMMIX, SAS®). There was no evidence for interactive effects of Cu and CTC on growth performance. From d 0-14, added Cu increased (*P*<0.05) ADG and ADFI and added CTC improved (*P*<0.01) ADG, ADFI, and G:F. From d 14-28, addition of CTC to the diet improved (*P*<0.01) ADG and ADFI, but there was no evidence for Cu effect. Overall, d 0-28, pigs fed diets with CTC had improved (*P*<0.05) ADG, ADFI, and G:F, but there was no evidence for Cu effect. The inclusion of Cu or CTC increased (*P*<0.05) BW on d 14 (11.2 vs. 11.5 kg, for Cu; 11.1 vs. 11.6 kg, for CTC) and d 28 (19.5 vs. 20.0 kg, for Cu; 19.2 vs. 20.3 kg, for CTC). In conclusion, these findings characterize a beneficial effect of feeding Cu for 14 d on growth performance of young pigs (7-12 kg BW) and a growth promoting effect of therapeutic levels of CTC in nursery diets. The lack of interactive effects between Cu and CTC suggests the responses on growth performance of nursery pigs are similar when fed alone or in combination.

Key Words: chlortetracycline, weanling pig, copper

224 Evaluation of Elarom SES with or without Tribasic Copper Chloride on Nursery Pig Growth Performance. H. E. Williams*, J. C. Woodworth, J. M. DeRouchey, S. S. Dritz, M. D. Tokach, R. D. Goodband, *Kansas State University, Manhattan, KS*

Weanling pigs (n=360, initially 6.0 ± 0.13 kg BW) were used in a 42-d study evaluating the effects of feeding Elarom SES in combination with increasing tribasic copper chloride on growth performance and fecal consistency. Elarom SES (Trouw Nutrition USA, Highland, IL) is a proprietary blend of functional ingredients designed to enhance growth performance and gut health. Tribasic copper chloride (TBCC, Intellibond C, Micronutrients USA, LLC., Indianapolis, IN) is a form of Cu that has the potential for improved bioavailability and enhanced growth performance. Pigs were weaned at approximately 21 d and allotted to pens based on initial BW in a completely randomized block design with 5 pigs per pen and 12 replications per treatment. Experimental diets were fed in 3 phases (Phase 1, d 0 to 7; Phase 2, d 7 to 21; and Phase 3, d 21 to 42 post-weaning) in meal form. Treatments were arranged as a 2 × 3 factorial with main effects of Elarom SES (none vs. 0.2% in all phases) and TBCC (none, 108, or 183 ppm of Cu in Phase 3 only). Pen fecal consistency score was determined on d 0, 4, 7, 14, 21, 28, 35, and 42 on a scale from 1 to 5. A score of 1 indicated hard, pellet type feces and a score of 5 indicated watery, liquid feces. All diets contained 17 mg/kg of Cu from the trace mineral premix. Overall, there was no evidence for treatment differences observed for ADG, ADFI, or fecal consistency; however, a marginal effect for an Elarom SES×TBCC interaction was observed for G:F (quadratic, P=0.058). This was the result of G:F improving at the intermediate level of TBCC without Elarom SES, yet G:F was improved at the highest level of TBCC when Elarom SES was present. Overall, no consistent benefit was observed from feeding Elarom SES or different levels of TBCC on growth performance or fecal consistency of weaned pigs.

	-Elarom SES			+Elarom SES			
	TBCC, ppm			TBCC, ppm			
	0	108	183	0	108	183	SEM
d 0 to 21							
ADG, g	241	262	256	245	253	248	12.26
G:F	0.773	0.810	0.793	0.799	0.780	0.802	0.015
d 21 to 42							
ADG, g	610	621	612	604	631	638	13.29
G:F	0.667	0.67	0.655	0.667	0.673	0.680	0.008
d 0 to 42							
ADG, g	425	441	433	424	440	443	10.69
G:F[a]	0.694	0.706	0.691	0.700	0.701	0.710	0.006

[a]Elarom SES×TBCC (quadratic; *P*=0.058)

Key Words: feed additive, growth performance, nursery

225 Effects of Zinc Oxide, Zinc Hydroxychloride, and Tribasic Copper Chloride on Nursery Pig Performance. H. S. Cemin*[,1], J. C. Woodworth[1], M. D. Tokach[1], S. S. Dritz[1], J. M. DeRouchey[1], R. D. Goodband[1], J. L. Usry[2], [1]*Kansas State*

University, Manhattan, KS, [2]Micronutrients, Inc., Indianapolis, IN

Zinc hydroxychloride is expected to have higher bioavailability than Zn oxide, but research on the effects of Zn source with or without tribasic copper chloride is scarce. A total of 1,215 pigs (PIC 280 × 1050, initially 5.3 kg), housed under commercial conditions, were used in a 42-d growth trial to determine the effects of ZnO, Zn hydroxychloride (Intellibond Z, Micronutrients, Indianapolis, IN), and tribasic copper chloride (Intellibond C, Micronutrients, Indianapolis, IN) on growth performance. There were 9 pens per treatment and 27 pigs per pen. Pens were blocked by BW and assigned to 1 of 5 treatments in a randomized complete block design. Treatments consisted of added Zn as ZnO (3,000 ppm in phase 1 and 2,000 ppm in phase 2), Zn hydroxychloride (1,000 ppm in phase 1 and 2), and Cu (200 ppm), alone or in combination, as follows: 1) Cu only; 2) ZnO only; 3) ZnO and Cu; 4) Zn hydroxychloride only; and 5) Zn hydroxychloride and Cu. Experimental diets were fed from d 0-21 and a common diet was fed from d 21-42. Data were analyzed using PROC GLIMMIX of SAS. From d 0-21, there was a marginally significant interaction (P=0.073) between Zn source and Cu for ADG, where the addition of Cu to the ZnO diets increased ADG (209 vs. 201 ± 7.9g) but adding Cu to Zn hydroxychloride diets reduced ADG (187 vs. 198 ± 7.9g). Pigs fed added ZnO had greater ADG (205 vs 193 ± 7.15g, P=0.023), ADFI (316 vs 304 ± 8.03g, P=0.020), and BW on d 21 (9.8 vs. 9.5 ± 0.22kg, P=0.035) compared to those fed added Zn hydroxychloride. There was no evidence for differences in performance when added Cu and added Zn individually were compared, regardless of Zn source (P>0.10). From d 21-42, there was no evidence for differences in growth performance. Overall (d 0-42), feeding pigs diets with added ZnO resulted in greater ADFI (556 vs. 541 ± 8.25g, P=0.049) and marginally improved ADG (379 vs. 369 ± 5.92g, P=0.079) compared to Zn hydroxychloride. The results suggest there are little additive effects of added Zn and Cu and no major differences in performance between pigs fed diets with added Zn or Cu. Pigs fed diets with added ZnO had improved performance compared to those fed added Zn hydroxychloride which may be reflective of differences in source or level of added Zn.

Key Words: zinc, copper, nursery pigs

226 Effect of dietary mineral source on the clearance time of porcine epidemic diarrhea virus in the saliva of commercial gilts. B. Haberl*[,1], K. R. Perryman[2], J. L. Usry[2], [1]*Iowa Select Farms, Iowa Falls, IA,* [2]*Micronutrients, Inc., Indianapolis, IN*

Novel inorganic trace mineral sources, like hydroxychlorides (IntelliBond, Micronutrients, Indianapolis, IN), are now commercially available. Hydroxychloride trace minerals (HTM) have covalent bonds similar to organic mineral sources and better bioavailability than sulfate mineral sources (SUF). Moreover, it is well established that trace minerals like Zn, Cu, and Mn significantly influence immune function. Therefore, trace mineral source might affect how gilts respond to being acclimated to porcine epidemic diarrhea virus (PEDV). Currently, there is little commercial field research investigating the effect of mineral source on PEDV clearance from gilt saliva. Therefore, a study was conducted to determine how feeding different sources of trace minerals to developing gilts affected PEDV saliva concentrations at different time points. In the nursery, gilts were divided into two groups of at least 20,000 pigs. Once separated, 34 rooms were fed diets supplemented with Cu, Zn, and Mn hydroxychloride, and 45 rooms were fed diets supplemented with the same concentration of SUF. Mineral source, day, and their interaction were used as fixed effects. Farm was used as a random effect. Room was the experimental unit. Gilts received treatment diets at the start of the 3rd nursery phase (12.5 to 25 kg BW) and continued for 15 weeks after they were transferred to the gilt developer unit (GDU). Gilts were fed practical, industry-type diets that changed with feeding phase and were formulated to contain 15 ppm Cu, 120 ppm Zn, and 50 ppm Mn. Mineral source was the only difference between treatments. Upon arrival to the GDU, pigs were orally acclimated to PEDV (day 0) through the water line using a water medicator. Beginning at day 7, ropes were placed into each room to collect saliva. After 7 days, ropes were tested for PEDV via real-time PCR (RT-PCR). The virus was deemed clear when 32 RT-PCR cycles were required to detect PEDV. When first measured (14 days), there was a trend (P = 0.066) for HTM fed gilts to require more cycles to detect PEDV than SUF fed gilts. After 42 days, HTM fed gilts required significantly more (P < 0.05) cycles to detect PEDV. Gilts fed diets with HTM reached the clearance threshold of 32 cycles by 42 days, whereas SUF fed gilts reached that threshold one week later. In conclusion, replacing SUF with HTM reduced the time it took the immune system of commercial gilts to clear PEDV from their saliva.

Key Words: PEDV, Minerals, Gilt Developers

227 Determination of the Efficacy of Titrated Levels of Water Soluble Zinc Amino Acid Complex