ing GLM procedure of SAS. All diets were Corn-SBM- 10% DDGS based, fed in pellet form (3.17 mm), and formulated to contain 1.25% SID LYS. The dietary TRT were; 1) Control (C), 10 ppm Cu sulfate; 2) C + 142.5 ppm TBCC; 3) C + 0.05% YFP; 4) C +142.5 ppm TBCC + 0.05% YFP; 5) C + 19.91 ppm NAR; 6) C + 142.5 ppm TBCC + 0.05% YFP + 19.91 ppm NAR. Overall (Table 295), pigs fed TRT 6 had the greatest ADG, followed by TRT 2, 4, and 5, with TRT 1 and 3 being the poorest. Pigs fed TRT 6 had the highest ADFI ($P <$ 0.05) compared with pigs fed TRT 3, with all other TRT being intermediary. Feed efficiency was greatest ($P < 0.05$) for pigs fed TRT 6 and poorest for pigs fed TRT 1 and 3. Pigs fed TRT 2 and 5 had similar ($P < 0.05$) GF to TRT 6 and 4, but TRT 4 was not similar ($P > 0.05$) to TRT 6. In summary, feeding TBCC or NAR alone can increase growth performance compared with pigs fed the C and YFP, while the combination of TBCC, NAR, and YFP were additive and resulted in the greatest improvement in ADG, ADFI, and GF.

Key Words: pig, copper, narasin

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296 Evaluation of interactive effects of vitamin E and linseed oil as a source of omega-3 fatty acids on growth performance, blood characteristics and meat quality of finishing pigs. S. D. Upadhaya*, T. S. Li, Y. M. Kim, I. H. Kim, *Department of Animal Resource & Science, Dankook University, Cheonan, South Korea.*

Omega-3 and vitamin E are the essential nutrients which possess anti-inflammatory properties and have many health benefits for both human and animals. This study was conducted to evaluate the effects of supplementation of vitamin E and omega-3 fatty acid to corn soybean meal based diet on the growth performance, nutrient digestibility, blood profiles and meat quality of finishing pigs for a period of 12 wk. A total of 140 finishing pigs [(Yorkshire × Landrace) × Duroc] with an average initial BW of 46.5 kg were blocked and stratified based on sex and body weight to a 2 × 2 factorial design with the respective factors being 1) with and without 300 IU vitamin E (Vit E), and 2) with and without 0.75% of linseed oil as a source of omega-3 fatty acid (*n*-3 FA). Each treatment consisted of 7 replicate pens with 5 pigs (3 barrows and 2 gilts) per pen. The supplementation of Vit E improved ($P < 0.05$) overall ADG (828 g) compared with non supplemented group (800 g). The digestibility of nitrogen (N) tended to improve ($P = 0.07$) with the addition of Vit E in the diet. At wk 12, the concentration of IgG increased ($P < 0.01$) with the addition of Vit E (704 mg/dL vs. 660 mg/dL) in the diet whereas the concentration of cortisol was reduced ($P < 0.05$) with the addition of Vit E (1.1 µg/dL vs. 1.4 µg/dL) or *n*-3 FA (1.2 µg/dL vs. 1.4 µg/dL). Moreover there was an additive effect ($P = 0.03$) of the combined supplementation of Vit E and *n*-3 FA on cortisol concentration. Surface LM color (a*) scored higher (($P < 0.05$) with the supplementation of Vit E (17.1 vs. 16.6) However, the score of color based on sensory evaluation was lower ($P < 0.05$) in Vit E supplemented group (3.4 vs. 3.7) and drip loss was lower ($P < 0.05$) in Vit E supplemented groups (16.5% vs. 19.2%) on Day 5. In conclusion, vitamin E independently influenced overall daily gain, IgG and meat quality. However, additive effects of Vitamin E and omega-3 fatty acids were observed for cortisol concentration.

Key Words: finishing pig, omega-3 fatty acid, vitamin E

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297 Effects of dietary zinc source and level on nursery pig performance. K. E. Jordan[1], K. M. Gourley*[1], M. D. Tokach[1], R. D. Goodband[1], S. S. Dritz[1], J. M. DeRouchey[1], J. C. Woodworth[1], J. L. Usry[2], *[1]Kansas State University, Manhattan, [2]Micronutrients, Indianapolis, IN.*

A total of 360 pigs (initially 5.9 ± 0.14 kg BW) were used in a 28-d study to evaluate the effects of dietary Zn source and level on weanling pig growth performance. Pigs were randomly allotted to pen at weaning by initial BW. The pen was assigned in a completely randomized design to 1 of 9 dietary treatments arranged in a 2 × 4 + 1 factorial. There were 8 pens per treatment and 5 pigs per pen. The corn-soybean meal based diets consisted of a control diet containing 110 ppm Zn from $ZnSO_4$ from the trace mineral premix or the control diet with 390, 890, 1890, or 2890 ppm added Zn from either tetrabasic Zn chloride (TBZC; Intellibond Z; Micronutrients, Indianapolis, IN) or ZnO. This provided diets with a total of 500, 1000, 2000, or 3000 ppm added Zn. A 3 phase diet series was used with treatment diets fed during Phase 1 (d 0 to 7), Phase 2 (d 7 to 21) and Phase 3 (d 21 to 28). There were no Zn source × level interactions or Zn source differences observed for growth performance. From d 0 to 21, increasing Zn increased (linear; $P \leq 0.05$) ADG and ADFI with no difference in G:F. From d 21 to 28, pigs fed increasing Zn had increased (linear; $P = 0.018$) ADFI resulting in decreased G:F (quadratic; $P = 0.041$). Overall, from d 0 to 28, increasing Zn increased (linear; $P \leq 0.05$) ADG and ADFI without influencing G:F. On d 28, fecal samples were collected from 3 pigs in each pen and analyzed for DM content. There was a tendency ($P = 0.081$) for a Zn source × level interaction as increasing Zn from TBZC decreased fecal DM, whereas no difference in fecal DM was observed for increasing Zn from ZnO. In conclusion, increasing dietary Zn up to 3000 ppm increased ADG and ADFI but no differences

Table 297.

	Total added dietary Zn, ppm								
	Control	IBZ				ZnO			
Item	110	500	1,000	2,000	3,000	500	1,000	2,000	3,000
D 0 to 28									
ADG, g	285	288	289	300	323	294	273	318	307
G:F, g	0.728	0.712	0.716	0.731	0.729	0.706	0.717	0.733	0.707

SEM = 13.4 for ADG and 0.0144 for G:F

existed between sources evaluated.

Key Words: growth performance, nursery pig, zinc

298 Could zinc citrate supplementation during lactation increase the serum Zn levels at weaning?

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Zinc is essential for normal growth and development in all animals. In our previous studies it was observed that weaning causes a decrease in the serum Zn, and that piglets with low BW (5.5 kg) at weaning had lower Zn levels (0.79 mg/L) than piglets with a higher BW (8.63kg; 0.98 mg of Zn/L). It was hypothesized that supplementing with 6 mg/d of Zn (19.35mg of Zn Citrate) during the last 10 d of lactation may improve the Zn status at weaning (d 28), especially in light piglets. A total of 48 piglets were selected from 12 litters (2 piglets/litter categorized as heavy 5.7 ± 0.2 kg BW, and 2 piglets as light 3.9 ± 0.3 kg BW) on Day 18 of lactation. Experimental treatments consisted on the daily administration of a capsule containing either 0 or 6 mg/d of Zn as Zn Citrate for each piglet and BW category in each sow from d 18 to 28 (12 replicates per treatment and BW category). The 6 mg Zn/d was chosen to be similar to the Zn provided in one kg of sow milk. Body weight was individually recorded on d 18 and 28 of lactation and on d 2, 7, and 14 postweaning (d 28). Blood samples were obtained on Day 18 and 28 of lactation. BW and serum Zn levels were analyzed with ANOVA by using the proc mixed procedure of SAS. All piglets had a drop on the serum levels of Zn, from 0.93 mg/L on Day 18 to a 0.74 mg/L on Day 28, which may reflect that suckling was likely limiting Zn intake. No different average serum Zn levels were observed according to the BW category for the entire period (0.85 and 0.82 mg/L for heavy and light piglets, respectively; $P = 0.26$), and neither between animals supplemented and non-supplemented at weaning (d 28) (0.76 vs. 0.71 mg/L Zn, respectively; $P = 0.40$). However, supplemented piglets had quantitatively higher Zn levels. No different performance was observed due to Zn supplementation for the whole period. In conclusion, supplementing 6 mg/d Zn as Zn citrate for the last 10 d of lactation is not sufficient to prevent the decrease in serum Zn during lactation.

Key Words: Piglets, Zinc Citrate, Zinc Status

299 Effect of diet type and added copper on growth performance, carcass characteristics, total tract digestibility, gut morphology, and mucosal mRNA expression of finishing pigs.

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A total of 757 pigs (PIC 337 × 1050; initially 27.6 kg BW) were used in a 117-d experiment to determine the effects of added Cu (TBCC; tribasic copper chloride, IntelliBond C; Micronutrients, Inc., Indianapolis, IN) and diet type on growth performance, carcass characteristics, energy digestibility, gut morphology, and mucosal mRNA expression of finishing pigs. Pens of pigs were allotted to 1 of 4 dietary treatments, balanced on average pen weight in a randomized complete-block design with 26 to 28 pigs/pen and 7 replications/treatment. Treatments were arranged in a 2 × 2 factorial arrangement with main effects of diet type, a corn-soybean meal-based diet (corn-soy) or a high byproduct diet (byproduct) with 30% distillers dried grains with solubles (DDGS) and 15% bakery meal, and added Cu (0 (10 mg/kg basal) or 150 mg/kg added Cu). There were no Cu×diet type interactions for growth performance. Neither added Cu nor diet type significantly influenced overall growth performance, although adding Cu during the early finishing period tended to increase ($P = 0.076$) ADG compared to pigs fed none (0.85 vs. 0.83). However, NE caloric efficiency was improved ($P = 0.001$) for pigs fed the corn-soy diet compared to the byproduct diet (6.76 vs. 7.15 Mcal intake/kg BW gain). Pigs fed the corn-soy diet had improved carcass yield ($P = 0.007$; 74.33 vs. 73.19%) and HCW G:F ($P = 0.011$; 0.274 vs. 0.266), and tended to have increased HCW ($P = 0.067$; 94.60 vs. 92.65 kg) and HCW ADG ($P = 0.056$; 0.635 vs. 0.615 kg/d) compared to pigs fed the byproduct diet. A Cu×diet type interaction ($P < 0.05$) existed for DM and GE digestibility in phase 2 as added Cu improved digestibility of DM and GE in the corn-soy diet, but not in the byproduct diet. In phase 4, added Cu tended to increase DM and GE digestibility ($P = 0.060$) while pigs fed the byproduct diet had decreased DM and GE digestibility ($P = 0.001$) compared to the corn-soy diet. For gut morphology, pigs fed added Cu had decreased distal small intestine crypt depth ($P = 0.017$; 207 vs. 225 um) compared to those fed no added Cu. Furthermore, pigs fed added Cu had decreased ($P = 0.032$; 0.618 vs. 0.935) relative mRNA expression of intestinal fatty acid binding protein (iFABP) compared to those fed no added Cu. In summary, 150 mg/kg added TBCC did not significantly affect overall growth but did influence diet digestibility and some gut morphology or mRNA expression measurements. Feeding a high byproduct diet decreased yield, caloric efficiency, and diet digestibility.

Key Words: finishing pigs, copper, fiber