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

doi: 10.2527/msasas2016-298

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. K. Coble*[1], D. Burnett[1], R. D. Goodband[1], J. M. Gonzalez[1], J. L. Usry[2], M. D. Tokach[1], J. Pluske[3], J. M. DeRouchey[1], J. C. Woodworth[1], S. S. Dritz[1], J. R. Flohr[1], M. A. Vaughn[1], *[1]Kansas State University, Manhattan, [2]Micronutrients, Indianapolis, IN, [3]Murdoch University, Western Australia, Australia.*

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)

Table 300.

Item	Treat LCa	Treat MCa	Treat HCa	Pooled SEM	*P*-Value
BW d7, Kg	8.43[a]	8.33[ab]	8.21[b]	0.06	0.041
BW d14, kg	10.72[a]	10.6[a]	10.16[b]	0.08	0.0001
ADG 0–7d, g/d	106.94[a]	91.25[ab]	74.62[b]	8.37	0.044
ADFI 0–7d, g/d	162.51	148.45	149.69	8.05	0.411
G:F 0–7d	0.654[a]	0.616[a]	0.481[b]	0.04	0.014
ADG 0–14d, g/d	219.19[a]	207.25[a]	176.76[b]	5.72	0.0002
ADFI 0–14d, g/d	342.35	323.01	314.64	9.04	0.113
G:F 0–14d	0.640[a]	0.645[a]	0.561[b]	0.01	0.0003

Table 301.

Item[1]	$ZnSO_4$, ppm 50	$ZnSO_4$, ppm 100	$ZnSO_4$, ppm 150	Zn Hydroxychloride, ppm 50	Zn Hydroxychloride, ppm 100	Zn Hydroxychloride, ppm 150	Zn source	*P* < Level Linear	*P* < Level Quadratic
ADG, kg	0.94	0.96	0.94	0.95	0.97	0.94	0.555	0.951	0.007
ADFI, kg	2.46	2.50	2.49	2.47	2.56	2.53	0.163	0.168	0.126
G/F[2]	0.382	0.385	0.380	0.386	0.381	0.374	0.318	0.006	0.270
Yield, %	73.63	74.08	74.53	74.03	74.68	74.36	0.240	0.027	0.329
HCW, kg	92.65	95.04	93.66	94.35	96.90	94.51	0.041	0.494	0.006

[1]SEM: ADG = 0.009, ADFI = 0.032, G:F = 0.0026, Yield = 0.003, HCW = 0.883
[2]Zn source × level interaction (linear; $P = 0.069$)

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

doi: 10.2527/msasas2016-299

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300 Low calcium levels improve growth in piglets after weaning. L. Blavi*, D. Solà-Oriol, J. F. Pèrez, *Animal Nutrition and Welfare Service, Department of Animal and Food Sciences, Universitat AutÚnoma de Barcelona, Bellaterra (08193), Spain.*

Piglets have a low acidification capacity that may promote digestive disorders and diarrhea. The inclusion of $CaCO_3$ and ZnO with high acid-binding capacity in weanling diets diets can aggravate the problem. It was hypothesized that reducing the levels of Ca from 0.95% to 0.35% (no addition of $CaCO_3$) may improve the growth of piglets after weaning. A total of 240 piglets were distributed into 3 treatments during the pre-starter phase (0 to 14 d postweaning; 8 replicates per treatment). Treatments were based on 3 different Calcium levels: High (HCa) with 0.95% of Ca (1.55% $CaCO_3$), Medium (MCa) with 0.65% of Ca (0.78% $CaCO_3$) and Low (LCa) with 0.35% of Ca (0% $CaCO_3$). The diets contained 2520 Kcal NE/kg, 19.7% CP, and 1.39 Lys. Feed Intake and individual BW were registered on d 0, 7, and 14. The initial BW was 7.69 ± 0.01 kg for each treatment. Piglets fed HCa showed lower BW, ADG and G:F ratio than piglets with LCa and MCa (Table 300). These results show that feeding piglets low inclusion or no $CaCO_3$ increased growth, suggesting that the reduction of $CaCO_3$allow a better digestion of feed during the pre-starter phase.

Key Words: calcium, pigs, weaning

doi: 10.2527/msasas2016-300

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301 Effects of increasing zinc from zinc sulfate or zinc hydroxychloride on finishing pig growth performance and carcass characteristics. C. B. Carpenter*[1], K. Coble[1], J. C. Woodworth[1], J. M. DeRouchey[1], M. D. Tokach[1], R. D. Goodband[1], S. S. Dritz[1], J. L. Usry[2], *[1]Kansas State University, Manhattan, [2]Micronutrients, Indianapolis, IN.*

A variety of zinc sources are available for use in swine trace mineral premixes. However, more research is needed to compare zinc sources and dietary levels in growing and finishing pigs in a commercial environment. A total of 1008 pigs [TR4 × (Fast Large White × L02 PIC); initially 32.1 kg BW)] were used in a 103-d growth study to determine the effects of Zn source and level on finishing pig growth performance and carcass characteristics. The 6 dietary treatments were arranged as a 2 × 3 factorial with main effects of Zn source ($ZnSO_4$ Agrium Advance Technology, Loveland, CO or Zn Hydroxychloride; IntelliBond Z®; Micronutrients, Indianapolis, IN) or level (50, 100, or 150 ppm added Zn). There was no additional Zn provided from the trace mineral premix. There were 21 pigs per pen and 8 pens per treatment. Overall, there were no Zn source × level interactions observed for ADG or ADFI, however G:F tended (linear, P = 0.069) to be poorer when pigs were fed increasing levels of Zn from $ZnSO_4$. Overall, there were no Zn source effects for growth performance observed. For Zn level main effects, ADG was maximized (quadratic, P = 0.007) and ending BW was heaviest (quadratic, P = 0.011) when diets contained 100 ppm of Zn. Feed efficiency was poorer (linear, P = 0.006) when pigs were fed increasing levels of Zn. For carcass characteristics, pigs fed diets with Zn Hydroxychloride had heavier (P = 0.041) HCW than those fed $ZnSO_4$. Also carcass yield increased (linear, P = 0.027) when pigs were fed increasing levels of Zn and HCW was maximized (quadratic, P = 0.006) when diets contained 100 ppm of Zn. These results suggest that a total of 100 ppm added Zn is enough to maximize ending BW, ADG and HCW, but G:F worsened as Zn level increased. Zn source did not impact growth performance; however, pigs fed Zn Hydroxychloride had increased HCW compared to those fed $ZnSO_4$.

Key Words: finishing pig, zinc sulfate, zinc hydroxychloride

doi: 10.2527/msasas2016-301

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302 Lysozyme as an alternative to antibiotics in swine feed. W. T. Oliver*, J. E. Wells, *USDA, ARS, U.S. Meat Animal Research Center, Clay Center, NE.*

Antibiotics have been fed at subtherapeutic levels to swine as growth promoters for more than 60 yr, and the majority of swine produced in the U.S. receive antibiotics in their feed at some point in their production cycle. These compounds benefit the producers by minimizing production losses by increasing feed efficiency and decreasing susceptibility to bacterial infection and disease. However, many countries, including all of the European Union, have banned the use of antibiotics as growth promotants in animal agriculture. Due to the perceived risk of bacterial resistance to antibiotics important in human medicine, swine producers are currently under tremendous pressure to eliminate subtherapeutic antibiotic use. Recent Federal Drug Administration guidance (No. 209 and 213) are designed to limit the use of medically important antibiotics in animal agriculture in the U.S. Lysozyme, also known as muramidase, is a naturally occurring enzyme found in bodily secretions such as tears, saliva, and milk and is a good replacement for traditional antibiotics. It functions as an antimicrobial agent by cleaving the peptidoglycan component of bacterial cell walls, which leads to cell death. While the