chlortetracycline hydrochloride and 31.2 mg/kg tiamulin) and C + 0.5% BA (**BA**). Pigs had free access to diets and water for six weeks. Feed intake and BW were taken weekly to calculate ADG, ADFI and FCR. Fecal scores were taken from d 8-14 post-weaning to assess incidence and severity of diarrhea and grab fecal samples taken for fecal DM content. The severity of diarrhea was assessed using a fecal consistency scoring (1, normal; 2, soft feces; 3, mild diarrhea; 4, severe diarrhea). In wk 2, pigs fed BA showed greater ($P = 0.04$) ADG than C fed pigs which in turn had similar ADG to AB fed pigs. However, in wk 4 and 5, pigs fed AB showed greater ($P < 0.05$) ADG than C whereas BA fed pigs had intermediate and similar ($P > 0.10$) ADG to C or AB fed pigs. The overall (wk 1-6) ADG and final BW were greater ($P < 0.05$) for AB and tended to be higher ($P = 0.07$) for BA fed pigs than for C fed pigs. However, ADG and final BW for pigs fed AB and BA was similar ($P > 0.10$). The overall ADG was 494, 533, 528 g/d for C, AB and BA, respectively and corresponding final BW was 26.9, 28.6 and 28.2 kg, respectively. There was no effect ($P > 0.05$) of diets on feed intake. In the overall, pigs fed AB (1.58) and BA (1.54) had better ($P < 0.05$) FCR compared to C (1.64) fed pigs. Treatment effects ($P < 0.05$) on fecal score was only observed on d 12 in which case pigs fed AB and BA showed lower score than C fed pigs. In the overall, the mean fecal score was 2.5, 2.2 and 2.3 for C, AB and BA, respectively. There was no diet effect ($P > 0.05$) on fecal DM content; the overall mean values were 22.3, 23.9 and 23.6%, respectively. In conclusion, benzoic acid supported piglet growth to the same extent as AB growth promoter.

Key Words: Piglets growth performance, Benzoic acid, Antimicrobial growth promoter

211 Effect of Bacillus subtilis C-3102 on Nursing Piglet Fecal Microflora, Fecal Consistency and Growth Performance.

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A total of 26 lactating sows (DNA 241, DNA Genetics) and litters were used in a discovery study to evaluate the effects of a direct-fed microbial containing *Bacillus subtilis* C-3102 (Calsporin®, Calpis Co. Ltd., Tokyo, Japan) on fecal microflora of nursing pigs. Sows were randomly assigned to treatments based on farrowing date, parity, and initial BW. Treatments provided a daily oral dose of a placebo (n=14 litters) or Calsporin (n=12 litters) to nursing piglets from d 2 after birth until weaning on d 19. Daily Calsporin dosage was 45.0×10^6 CFU/mL (d 2-10), 77.5×10^6 CFU/mL (d 10-17), and 108.3×10^6 CFU/mL (d 17-19) administered via a 1 mL liquid suspension. Fecal scoring was conducted to categorize the consistency of feces using a scale from 1 to 5. Fecal samples were collected from piglets for microbial analysis. Data were recorded on d 2, 10, and 17 for fecal variables, and additionally on d 19 for performance variables. Fecal score and microbial analysis were analyzed as repeated measures. Data were analyzed using a linear mixed model (PROC GLIMMIX, SAS®) with litter as the experimental unit. There was no evidence for differences ($P>0.05$) on sow performance (BW and ADFI) or litter performance (BW, ADG, mortality, and litter size). Also, there was no evidence for treatment differences ($P>0.05$) for fecal score on d 2, 10, and 17. Microbial analysis revealed a treatment×day interaction ($P<0.001$) in total *Bacillus* sp., with increased levels in Calsporin compared to placebo on d 10 and 17, and increasing levels over time in placebo pigs while remaining constant after d 10 in Calsporin pigs. Total aerobes decreased ($P<0.05$) in litters treated with Calsporin. There was no evidence for differences ($P>0.05$) in number of *Lactobacillus* sp., *Enterococcus* sp., *Clostridium perfringens*, Enterobacteriaceae, and total anaerobes between placebo- and Calsporin-treated litters. In conclusion, once per day supplementation of Calsporin to nursing pigs resulted in slight changes in

	Placebo			Calsporin		
	d 2	d 10	d 17	d 2	d 10	d 17
Piglet BW, kg	1.6 ± 0.04	3.0 ± 0.08	4.9 ± 0.13	1.5 ± 0.04	2.9 ± 0.08	4.7 ± 0.14
Fecal score	2.1 ± 0.20	1.7 ± 0.14	2.1 ± 0.20	2.1 ± 0.22	1.5 ± 0.15	2.4 ± 0.22
Total *Bacillus* sp.[1]	2.4 ± 0.13^{x}	3.3 ± 0.10^{ya}	3.7 ± 0.12^{za}	2.7 ± 0.13^{x}	5.5 ± 0.11^{yb}	5.7 ± 0.12^{yb}
Total aerobes[2]	9.3 ± 0.09	8.6 ± 0.09	8.4 ± 0.09	9.3 ± 0.10	8.4 ± 0.10	8.2 ± 0.10

Values: mean±SEM.

[1]Treatment×day interaction, [x,y,z] $P<0.05$ between days within treatment, [a,b] $P<0.05$ between treatments within day.

[2] Treatment effect, $P<0.05$.

[1,2]Units: $\log_{10}$ CFU/g.

fecal microflora, but there was no influence on nursing pig fecal consistency or performance.

Key Words: probiotic, diarrhea, Bacillus subtilis

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212 Effects of Monosodium Glutamate on Nursery Pig Performance.

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Two experiments were conducted to evaluate the effects of monosodium glutamate (MSG) on nursery pig performance. In Exp. 1, 1,134 nursery pigs (PIC 280 × 1050, initially 5.1 kg BW) were allotted to 6 treatments fed for 48 d. There were 27 pigs/pen and 7 pens/treatment. Dietary treatments contained 0, 0.5, 1.0, 1.5, and 2.0% MSG, or a high salt diet, formulated to an equal Na content as the 1.0% MSG diet. Experimental diets were fed in 3 phases from d 0 to 12, d 12 to 26, and d 26 to 48. During phase 1, no evidence for differences was detected among MSG treatments. In phase 2, increasing MSG decreased (linear, $P<0.045$) ADG, ADFI, and G:F while pigs fed the high salt diet (0.84% added salt) had decreased ($P<0.001$) ADG (254 vs. 317 g; SEM=11.3) and G:F (0.572 vs. 0.674; SEM=0.0154) compared with pigs fed the 1% MSG diet. In phase 3, pigs fed the high salt diet had decreased ($P<0.028$) ADG (528 vs. 561 g; SEM=10.1) and ADFI (797 vs. 851 g; SEM=17.3) compared with those fed the 1% MSG diet. For the overall nursery period, increasing MSG decreased (linear, $P=0.033$) ADG (388, 372, 378, 369, and 370 g for 0 to 2% MSG, respectively; SEM=7.9). Pigs fed the high salt diet had decreased ($P<0.009$) ADG (341 vs. 378 g; SEM=7.9), ADFI (546 vs. 578 g; SEM=12.2), and G:F (0.625 vs. 0.654; SEM=0.0044) compared to those fed 1% MSG. In Exp. 2, 700 nursery pigs (PIC C-29 × 1050, initially 6.2 kg BW) were allotted to 5 treatments fed for 42 d. There were 10 pigs/pen and 14 pens/treatment. Dietary treatments contained 0, 0.5, 1.0, 1.5, and 2.0% MSG and were balanced for Na and Cl using sodium bicarbonate and potassium chloride. Experimental diets were fed in 3 phases from d 0 to 14, d 14 to 28, and d 28 to 42. For ADG and ADFI, there was no evidence for differences within any phase or overall (ADG overall: linear, $P=0.538$; 464, 462, 458, 457, and 461 g, respectively; SEM=5.3). Increasing MSG resulted in poorer G:F (linear, $P=0.003$; 0.670, 0.660, 0.654, 0.654, and 0.645, respectively; SEM=0.0057) for phase 3. Thus, for the overall nursery period, G:F tended (quadratic, $P=0.080$) to be poorer with increasing MSG. In conclusion, MSG did not improve nursery pig performance and MSG may reduce intake and gain when dietary Na is not balanced.

Key Words: growth, monosodium glutamate, nursery pigs

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213 Effects of Different Levels of Hemeprotein Supplementation on Performance and Blood Physicochemical Parameters in Weaned Piglets.

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This experiment was conducted to investigate effects of different levels of hemeprotein (158S) supplementation on performance and blood physicochemical parameters in weaned piglets, and to determine the optimal level of hemeprotein (158S) supplementation in weaned piglet diet. A total of 192 weaned Duroc × Large White × Landrace piglets at 42 d of age (initial BW 10.49 ± 0.06 kg) were selected and were randomly divided into four groups receiving diets containing 0 (control group), 700 ($158S_{700}$ group), 900 ($158S_{900}$ group) and 1200 ($158S_{1200}$ group) mg/kg 158S respectively (4 replicates per group and 12 piglets per replicate). The experiment lasted for 31 d, including 3 d of adaption and 28 d of official trial. All data was analyzed as a randomized complete block design using GLM of SAS (SAS Inst., Inc. Cary, N.C). The results indicated that ADG in the $158S_{900}$ group in the first 14 d (372.24 g/d) was higher than 0、700 and 1200 groups (304.05, 314.40, and 314.52 g/d, respectively) ($P < 0.05$), and the F/G in the $158S_{900}$ group (1.62) was lower than 0、700 and 1200 groups (1.91, 1.87, and 1.78, respectively) ($P < 0.05$), however, ADG in the $158S_{700}$ group was greater than the control group in the last 14 d (512.46 vs 427.90 g/d, $P = 0.011$), but was not different with the $158S_{900}$ group (466.22 g/d, $P = 0.126$). The blood hemoglobin (HGB) in the $158S_{900}$ group (111.67 g/L) rose more than 0、700 and 1200 groups (98.50, 100.75, and 99.88 g/L, respectively, p=0.046) and the hematocit (HCT) was higher than the control group in the 14^{th} d (33.00% vs 29.00%, $P = 0.029$). While in the 28^{th} d, the HGB in the $158S_{900}$ group was greater than the control group (105.22% vs 98.04%) ($P=0.032$). Also, as the 158S supplementation in the diets increased, ferritin (Fn) in the serum in the 14^{th} d was tend to rise ($P = 0.067$), and Fn in the $158S_{900}$ group and $158S_{1200}$ group were higher than the control group ($P = 0.035$ and 0.017, respectively). In conclusion, supplementation of hemeprotein (158S) to the diet can improve the performance and the iron status of weaned piglets, and the optimal supplementation level is 700-900 mg/kg, which is dependent on the weaning age and the iron status of piglets.