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Effects of Antimicrobial or Probiotic Treatments on Growth Performance of 13- to 56-lb Nursery Pigs

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Effects of Antimicrobial or Probiotic Treatments on Growth Performance of 13- to 56-lb Nursery Pigs

Abstract

A total of 612 nursery pigs (21-d of age; Line 241 × 600; DNA, Columbus, NE) were used in two 44-d experiments to determine effects of antibiotic or different probiotic products on nursery pig performance and fecal consistency. In Experiment 1, 297 pigs (initially 12.8 lb) were used with 6 replications per treatment and 5 or 6 pigs per pen. In Experiment 2, 315 pigs (initially 13.3 lb) were used with 7 replications per treatment and 5 pigs per pen. In both experiments, pens were randomly allotted to 1 of 9 dietary treatments in a randomized complete block design. The nine treatment diets included a control diet, or the control diet with either carbadox (Mecadox-2.5 Phibro Animal Health, Teaneck, NJ) at 50 g/ton, BioPlus 2B (Chr. Hansen USA, Inc., Milwaukee, WI) with an inclusion rate of 0.05%, or 1 of 6 DSM Probiotic products (DSM Nutritional Products, Inc., Parsippany, NJ) with an inclusion rate of 0.20%.

For Experiment 1, pigs fed the diet containing carbadox had increased ($P < 0.05$) ADG compared to pigs fed the control diet or diets containing DSM Probiotic 1, 2, 3, or 6, with the other probiotic treatments intermediate. Pigs fed the diet with carbadox had greater ($P < 0.05$) ADFI compared to those fed the control or diets containing DSM Probiotic 1, 2, or 3, with the other probiotic treatments intermediate. Feed efficiency was not affected by treatment. For fecal consistency, there was no evidence to indicate a treatment effect ($P > 0.05$) or treatment × day interaction ($P = 0.951$).

For Experiment 2, pigs fed carbadox had greater ($P < 0.05$) ADG than all other treatments. Pigs fed BioPlus 2B had greater ($P < 0.05$) ADG compared to those fed the diet containing DSM Probiotic 3, with the control and all other probiotic treatments intermediate. Pigs fed carbadox had increased ($P < 0.05$) ADFI compared to the control and DSM Probiotics, with BioPlus 2B intermediate. There was no evidence of difference to indicate that dietary treatment influenced F/G nor to indicate a treatment effect for fecal consistency.

In summary, pigs fed diets containing carbadox consistently had increased ADG and ADFI compared to pigs fed any of the other dietary treatments. There was no evidence the probiotics improved performance based on these results; however, the DSM probiotic 4 had the highest numerical ADG of all the DSM products relative to the nonmedicated control diet in both experiments.

Keywords

antibiotic, fecal consistency, growth, nursery pig, probiotic

Authors

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Summary

A total of 612 nursery pigs (21-d of age; Line 241 × 600; DNA, Columbus, NE) were used in two 44-d experiments to determine effects of antibiotic or different probiotic products on nursery pig performance and fecal consistency. In Experiment 1, 297 pigs (initially 12.8 lb) were used with 6 replications per treatment and 5 or 6 pigs per pen. In Experiment 2, 315 pigs (initially 13.3 lb) were used with 7 replications per treatment and 5 pigs per pen. In both experiments, pens were randomly allotted to 1 of 9 dietary treatments in a randomized complete block design. The nine treatment diets included a control diet, or the control diet with either carbadox (Mecadox-2.5 Phibro Animal Health, Teaneck, NJ) at 50 g/ton, BioPlus 2B (Chr. Hansen USA, Inc., Milwaukee, WI) with an inclusion rate of 0.05%, or 1 of 6 DSM Probiotic products (DSM Nutritional Products, Inc., Parsippany, NJ) with an inclusion rate of 0.20%.

For Experiment 1, pigs fed the diet containing carbadox had increased ($P < 0.05$) ADG compared to pigs fed the control diet or diets containing DSM Probiotic 1, 2, 3, or 6, with the other probiotic treatments intermediate. Pigs fed the diet with carbadox had greater ($P < 0.05$) ADFI compared to those fed the control or diets containing DSM Probiotic 1, 2, or 3, with the other probiotic treatments intermediate. Feed efficiency was not affected by treatment. For fecal consistency, there was no evidence to indicate a treatment effect ($P > 0.05$) or treatment × day interaction ($P = 0.951$).

For Experiment 2, pigs fed carbadox had greater ($P < 0.05$) ADG than all other treatments. Pigs fed BioPlus 2B had greater ($P < 0.05$) ADG compared to those fed the diet containing DSM Probiotic 3, with the control and all other probiotic treatments intermediate. Pigs fed carbadox had increased ($P < 0.05$) ADFI compared to the control and DSM Probiotics, with BioPlus 2B intermediate. There was no evidence of difference to indicate that dietary treatment influenced F/G nor to indicate a treatment effect for fecal consistency.

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In summary, pigs fed diets containing carbadox consistently had increased ADG and ADFI compared to pigs fed any of the other dietary treatments. There was no evidence the probiotics improved performance based on these results; however, the DSM probiotic 4 had the highest numerical ADG of all the DSM products relative to the non-medicated control diet in both experiments.

Introduction

Antimicrobials have been commonly used in nursery pig diets to promote ADG and ADFI. Antibiotics such as carbadox (Mecadox, Phibro Animal Health, Teaneck, NJ) have shown to improve growth and feed intake.[2] With changing public perception of feed grade antibiotics, new technology has been introduced to potentially replace the growth promoting effects of antimicrobials.

Probiotics have been shown to improve gut health by modifying the microflora in the gut and improving nutrient availability.[2] BioPlus 2B (Chr. Hansen USA, Inc., Milwaukee, WI) is a commercially available probiotic. Wang et al.[3] observed that nursery pigs fed diets containing BioPlus 2B tended to have improved ADG as the inclusion rate of Bioplus 2B increased up to 0.20%. DSM Nutritional Products, Inc. (Parsippany, NJ) has developed a series of new probiotic products for potential use in swine diets; however, their impact on growth performance has not been evaluated. Therefore, the objective of this experiment was to compare the growth performance of nursery pigs fed an antimicrobial, or diets containing different experimental probiotic products.

Procedures

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in these experiments. Two experiments were conducted at the Kansas State University Swine Teaching and Research Center in Manhattan, KS. Each pen was equipped with a 4-hole, dry self-feeder and a nipple waterer to provide ad libitum access to feed and water.

All experimental diets were manufactured at the Kansas State University O.H. Kruse Feed Technology Innovation Center, Manhattan, KS. Dietary treatments were corn-soybean meal-based. Treatment diets were fed in three phases with dietary phases formulated for 12 to 15, 15 to 26, and 26 to 55 lb BW ranges (Table 1). The nine treatment diets in both experiments included a control diet, or the control diet with either carbadox (Mecadox-2.5; Phibro Animal Health, Teaneck, NJ) at 50 g/ton, BioPlus 2B (Chr. Hansen USA, Inc., Milwaukee, WI) with an inclusion rate of 0.05%, or 1 of 6 DSM Probiotic products (DSM Nutritional Products, Inc., Parsippany, NJ) with an inclusion rate of 0.20% (Table 1). BioPlus 2B and the DSM Probiotics were added to diets at manufacturer's recommendations. Diet samples were collected at the mill and from feeders and subsampled. Subsamples were analyzed for DM, CP, Ca, and P (Ward Laboratories, Inc., Kearney, NE).

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[2] T.P. Keegan, J.M. DeRouchey, J.L Nelssen, M.D. Tokach, R.D. Goodband, S.S. Dritz, and C.W. Hasted. 2003. Comparison of antimicrobial alternatives in diets for nursery pigs. Kansas Swine Industry Day Report of Progress 920.

[3] Y. Wang, J.H. Cho, Y.J. Chen, J.S. Yoo, Y. Huang, H.J. Kim, I.H. Kim, The effect of probiotic BioPlus 2B® on growth performance, dry matter and nitrogen digestibility and slurry noxious gas emission in growing pigs. 2009 Livestock Science. 1871-1413.

In both experiments, pigs (Line 241 × 600; DNA, Columbus, NE) were weaned at 21-d of age and used in 44-d experiments. Fecal scoring of pens occurred by visual assessment of the pen floor. Fecal scores were recorded prior to weighing the pens on each weigh day and were replicated by 3 individuals each day. Pens were scored on a scale from 0 to 3 with 0 indicating firm, dry feces; 1 indicating soft, moist feces; 2 indicating shapeless, moist feces; and 3 indicating liquid feces.

Experiment 1
A total of 297 pigs were allotted to pens based on gender and BW with 6 replications per treatment with 3 replications having 5 pigs and 3 replications with 6 pigs per pen. Pens of pigs were weighed and feed disappearance recorded on d 12, 19, 25, 32, 39, and 44 to determine ADG, ADFI, and F/G.

Experiment 2
A total of 315 pigs were allotted to pens of 5 based on gender and BW with 7 replications per treatment. Pens of pigs were weighed and feed disappearance recorded on d 11, 18, 25, 32, 39, and 44 to determine ADG, ADFI, and F/G.

Growth data and fecal consistency scores for both experiments were analyzed as a completely randomized block design using PROC GLIMMIX in SAS version 9.4 (SAS Institute, Inc., Cary, NC) with pen as the experimental unit. Day and treatment interactions were tested for fecal consistency scores. Individual treatment means of the growth and fecal consistency data were separated using the Tukey-Kramer multiple comparison test. In Experiment 1, one pen of pigs fed DSM Probiotic 4 was considered an outlier due to health concerns and was removed from the data set. Results were considered significant at $P \leq 0.05$ and marginally significant between $P > 0.05$ and $P \leq 0.10$.

Results and Discussion
For Experiments 1 and 2, chemical analyses indicated that Ca, P, and CP of the treatment diets were similar to formulated values (Tables 2 and 3).

Experiment 1
From d 0 to 12, there was no evidence of difference to indicate that dietary treatment affected ADG, ADFI, F/G, and d 12 BW (Table 4).

From d 12 to 25, pigs fed the control diet or diets containing DSM Probiotic 1, 2, 3, 5, or 6 had decreased ($P < 0.05$) ADG compared to pigs fed the diet with carbadox, with pigs fed the BioPlus 2B and DSM Probiotic 4 diets intermediate. Pigs fed the diet with carbadox had greater ($P < 0.05$) ADFI compared to the control or pigs fed diets containing DSM Probiotic 1, 2, or 3, with the other probiotic treatments intermediate. Feed efficiency was not affected by treatment. Pigs fed the control or diets containing DSM Probiotic 1, 2, 3, or 6 had decreased ($P < 0.05$) d 25 BW compared to pigs fed the diet containing carbadox, with the others intermediate.

From d 25 to 44, pigs fed the diet with carbadox had greater ($P < 0.05$) ADFI compared to pigs fed the diet containing DSM Probiotic 2, with all others intermediate. There was no evidence of difference to indicate that dietary treatment influenced ADG or F/G. Pigs fed the control or diets containing DSM Probiotic 1, 2, 3, or 6 had decreased ($P < 0.05$) d 44 BW compared to pigs fed carbadox, with others intermediate.

Overall, pigs fed the diet containing carbadox had greater ($P < 0.05$) ADG compared to pigs fed the control diet or diets containing DSM Probiotic 1, 2, 3, or 6, with pigs fed probiotic treatments 4 or 5 intermediate. Pigs fed the diet with carbadox had greater ($P < 0.05$) ADFI compared to the control or pigs fed diets containing DSM Probiotic 1, 2, or 3, with the other probiotics treatments intermediate. Feed efficiency was not affected by treatment.

For fecal consistency, there was no evidence of difference to indicate a treatment effect or a treatment × day interaction. However, there was a day effect observed ($P < 0.001$; Table 6) with pigs exhibiting softer stools on d 12, 19, and 25 and firmer stools on d 32, 39, and 44.

Experiment 2

From d 0 to 11, pigs fed the diet containing carbadox had greater ($P < 0.05$) ADG than pigs fed the other dietary treatments (Table 5). Pigs fed the control or DSM Probiotic 1, 2, 3, or 5 had decreased ($P < 0.05$) ADFI compared to pigs fed carbadox, with probiotic treatments 4 and 6 intermediate. There was no evidence of difference to indicate dietary treatment affected F/G. Pigs fed carbadox had greater ($P < 0.05$) d 11 BW than pigs fed the control or DSM Probiotic 1, 3, or 5, with others probiotic treatments intermediate.

From d 11 to 25, pigs fed the diet containing carbadox had greater ($P < 0.05$) ADG compared to pigs fed the control or the DSM Probiotics, with pigs fed BioPlus 2B intermediate. Pigs fed the control or DSM Probiotic 3, 5, or 6 had lower ($P < 0.05$) ADFI compared to pigs fed carbadox, with others intermediate. No treatment effect was observed for F/G. Pigs fed carbadox had greater ($P < 0.05$) d 25 BW than pigs fed other treatments.

From d 25 to 44, pigs fed carbadox had greater ($P < 0.05$) ADG and ADFI compared to those fed the control or DSM Probiotics with those fed BioPlus 2B intermediate. Feed efficiency was not affected by dietary treatment. Pigs fed carbadox had greater ($P < 0.05$) d 44 BW than pigs fed other treatments.

Overall, pigs fed carbadox had greater ($P < 0.05$) ADG than all other treatments. Pigs fed BioPlus 2B had greater ($P < 0.05$) ADG compared to the DSM Probiotic 3 treatment, with the control and all other probiotic treatments intermediate. Pigs fed carbadox had improved ($P < 0.05$) ADFI compared to pigs fed the control or DSM Probiotics, with BioPlus 2B intermediate. There was no evidence of difference to indicate that dietary treatment influenced F/G. For final BW, pigs fed carbadox were 12 lb heavier ($P < 0.05$) than those fed the control diet.

For fecal consistency, there was a tendency for a treatment × day interaction ($P = 0.084$; Table 7) with pigs fed DSM Probiotic 4 exhibiting lower fecal scores until d 18 and pigs fed DSM Probiotic 3 exhibiting higher fecal scores until d 18 but both products having similar fecal scores from d 25 to 44. There was no evidence of difference between other dietary treatments. The day of collection did affect ($P < 0.001$) fecal consistency with pigs exhibiting softer stools on d 18, 32, and 39 and firmer stools on d 25.

In conclusion, pigs fed carbadox consistently had improved ADG and ADFI compared to pigs fed other probiotics. In both experiments, pigs fed DSM probiotic 4 had numerical improvements in ADG compared to pigs fed the other DSM probiotics and the control. This study would indicate that DSM Probiotic 4 merits further research to determine the repeatability of response and optimal dose and duration of feeding.

Table 1. Diet composition (Experiments 1 and 2, as-fed basis)[1]

Ingredient, %	Phase 1	Phase 2	Phase 3
Corn	39.93	52.75	62.88
Soybean meal	19.73	29.14	32.56
Fish meal	6.00	4.00	---
Dried whey	12.50	5.00	---
Dairylac 80[2]	11.25	5.00	---
HP 300[3]	6.00	---	---
Choice white grease	2.00	1.00	1.00
Limestone	0.38	0.58	0.95
Monocalcium phosphate, 21% P	0.60	0.80	1.18
Sodium chloride	0.35	0.55	0.35
L-Lys HCl	0.35	0.35	0.35
DL-Met	0.21	0.18	0.15
L-Thr	0.17	0.16	0.13
L-Trp	0.02	0.02	0.01
L-Val	0.08	0.07	0.04
Choline chloride, 60%	0.04	---	---
Phytase[4]	0.02	0.02	0.02
Trace mineral premix	0.15	0.15	0.15
Vitamin premix	0.25	0.25	0.25
Feed additive[5,6,7]	---	---	---
Total	100	100	100

continued

Table 1, *continued*. Diet composition (Experiments 1 and 2, as-fed basis)[1]

Ingredient, %	Phase 1	Phase 2	Phase 3
Calculated analysis			
Standardized ileal digestible (SID) AA,[8] %			
Lys	1.40	1.35	1.25
Ile:Lys	59	59	61
Leu:Lys	112	117	125
Met:Lys	39	37	35
Met and Cys:Lys	58	58	58
Thr:Lys	63	63	62
Trp:Lys	18.5	18.5	18.5
Val:Lys	69	69	69
Total Lys, %	1.56	1.51	1.40
NE kcal/lb	1,180	1,130	1,113
CP, %	22.3	22.1	21.3
Ca, %	0.74	0.71	0.70
P, %	0.72	0.68	0.65
Available P, %	0.57	0.49	0.42

[1] Experimental diets were fed in three phases with dietary phases formulated for 12 to 15, 15 to 26, and 26 to 55 lb BW ranges.

[2] International Ingredients, Inc., St. Louis, MO.

[3] Hamlet Protein, Findlay, OH.

[4] HiPhos 2700 (DSM Nutritional Products, Inc., Parsippany, NJ), providing 184.3 phytase units (FTU)/lb and an estimated release of 0.10% available P.

[5] Mecadox-2.5 (Phibro Animal Health, Teaneck, NJ) included at 1% to add 50 g/ton of carbadox.

[6] BioPlus 2B (Chr. Hansen USA, Inc., Milwaukee, WI) included at 0.05% at the expense of corn.

[7] Experimental probiotics 1 to 6 (DSM Nutritional Products, Inc., Parsippany, NJ) included at 0.20% at the expense of corn.

[8] AA = amino acids.

Table 2. Chemical analysis of experimental diets (Experiment 1, as-fed basis)[1]

			BioPlus	DSM probiotic product[4]					
Item, %	Control	Mecadox[2]	2B[3]	1	2	3	4	5	6
Phase 1 diets									
DM	90.39	90.43	91.48	90.99	90.85	91.47	91.29	91.79	90.90
CP	21.7	22.1	21.3	21.6	22.1	22.2	22.0	21.7	21.9
Ca	1.07	1.17	1.12	1.10	1.18	1.10	1.08	1.06	1.17
P	0.76	0.82	0.78	0.74	0.79	0.77	0.76	0.74	0.80
Phase 2 diets									
DM	89.76	89.89	89.00	89.26	89.99	89.44	90.47	89.36	89.93
CP	20.9	21.9	21.6	20.3	19.3	21.1	20.4	22.3	21.5
Ca	1.03	0.86	0.93	1.08	1.04	0.96	1.05	0.96	1.01
P	0.75	0.66	0.64	0.76	0.69	0.70	0.75	0.71	0.72
Phase 3 diets									
DM	88.73	88.11	89.64	88.92	88.92	89.12	88.00	88.51	88.83
CP	20.9	20.4	19.5	19.2	21.5	20.1	21.2	20.3	20.0
Ca	0.87	0.90	0.97	1.00	0.81	0.98	0.77	0.92	0.77
P	0.63	0.59	0.64	0.67	0.59	0.63	0.57	0.65	0.56

[1] Multiple samples were collected from each diet throughout the study, homogenized, and then subsampled for analysis (Ward Laboratories, Inc., Kearney, NE).

[2] Mecadox-2.5 (Phibro Animal Health, Teaneck, NJ).

[3] BioPlus 2B (Chr. Hansen USA, Inc., Milwaukee, WI).

[4] Experimental probiotics (DSM Nutritional Products, Inc., Parsippany, NJ).

Table 3. Chemical analysis of experimental diets (Experiment 2, as-fed basis)[1]

			BioPlus	DSM probiotic product[4]					
Item, %	Control	Mecadox[2]	2B[3]	1	2	3	4	5	6
Phase 1 diets									
DM	91.97	91.48	91.99	90.89	91.25	90.84	91.76	91.37	91.42
CP	21.9	21.6	22.8	22.0	22.8	22.0	22.5	22.1	23.5
Ca	1.16	1.09	1.15	1.12	1.23	1.21	1.20	1.14	1.18
P	0.82	0.79	0.81	0.79	0.83	0.83	0.85	0.81	0.80
Phase 2 diets									
DM	89.29	89.96	90.74	89.81	89.93	90.03	89.86	90.67	90.12
CP	21.4	19.6	20.1	20.8	21.5	20.5	22.3	19.3	20.1
Ca	1.02	0.93	1.05	0.92	1.06	1.01	1.02	1.10	0.96
P	0.72	0.65	0.69	0.66	0.73	0.69	0.75	0.69	0.70
Phase 3 diets									
DM	89.03	88.64	88.87	88.74	88.56	90.09	90.41	89.62	89.82
CP	22.4	21.4	21.1	22.1	19.1	22.7	22.6	20.8	22.3
Ca	0.95	0.77	0.81	0.85	1.05	0.85	1.03	0.90	0.71
P	0.61	0.53	0.57	0.62	0.56	0.64	0.66	0.60	0.61

[1] Multiple samples were collected from each diet throughout the study, homogenized, and then subsampled for analysis (Ward Laboratories, Inc., Kearney, NE).

[2] Mecadox-2.5 (Phibro Animal Health, Teaneck, NJ).

[3] BioPlus 2B (Chr. Hansen USA, Inc., Milwaukee, WI).

[4] Experimental probiotics (DSM Nutritional Products, Inc., Parsippany, NJ).

Table 4. Effects of different probiotic products or carbadox on the growth performance of nursery pigs, Experiment 1[1]

			BioPlus	DSM probiotic product[4]						
Item	Control	Mecadox[2]	2B[3]	1	2	3	4	5	6	SEM[5]
d 0 to 12 (phase 1)										
ADG, lb	0.17	0.26	0.17	0.19	0.16	0.16	0.21	0.18	0.18	0.021
ADFI, lb	0.34	0.42	0.33	0.34	0.35	0.34	0.38	0.37	0.36	0.021
F/G	2.19	1.64	2.17	1.84	2.27	2.23	1.82	2.17	2.01	0.173
d 12 to 25 (phase 2)										
ADG, lb	0.84[b]	1.13[a]	0.96[ab]	0.87[b]	0.87[b]	0.88[b]	0.99[ab]	0.94[b]	0.92[b]	0.041
ADFI, lb	1.12[b]	1.51[a]	1.27[ab]	1.13[b]	1.14[b]	1.24[b]	1.32[ab]	1.31[ab]	1.27[ab]	0.061
F/G	1.34	1.34	1.32	1.31	1.32	1.41	1.35	1.39	1.37	0.039
d 25 to 44 (phase 3)										
ADG, lb	1.34	1.48	1.38	1.28	1.29	1.32	1.42	1.37	1.30	0.050
ADFI, lb	2.03[ab]	2.32[a]	2.11[ab]	2.01[ab]	1.99[b]	2.03[ab]	2.21[ab]	2.14[ab]	2.03[ab]	0.079
F/G	1.52	1.56	1.53	1.58	1.55	1.54	1.55	1.56	1.56	0.025
d 0 to 44										
ADG, lb	0.87[b]	1.04[a]	0.93[ab]	0.86[b]	0.85[b]	0.88[b]	0.96[ab]	0.91[ab]	0.88[b]	0.033
ADFI, lb	1.29[b]	1.56[a]	1.38[ab]	1.29[b]	1.28[b]	1.34[b]	1.45[ab]	1.40[ab]	1.35[ab]	0.051
F/G	1.50	1.49	1.49	1.50	1.51	1.53	1.50	1.54	1.53	0.023
BW, lb										
d 0	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	0.212
d 12	14.8	15.9	14.8	15.1	14.8	14.8	15.4	15.1	15.1	0.377
d 25	25.6[b]	30.6[a]	27.3[ab]	26.5[b]	26.1[b]	26.2[b]	28.2[ab]	27.3[ab]	27.0[b]	0.750
d 44	51.1[b]	58.7[a]	53.5[ab]	51.3[b]	52.3[b]	51.4[b]	55.2[ab]	53.4[ab]	51.8[b]	1.324
Fecal consistency[6]	1.19	1.08	1.08	1.21	1.21	1.29	1.17	1.35	1.47	0.112

[ab] Means with different superscripts differ $P < 0.05$.

[1] A total of 297 pigs (Line 241 × 600; DNA, Columbus, NE; 21 d of age) were used in a 44-d with 6 replications per treatment.

[2] Mecadox-2.5 (Phibro Animal Health, Teaneck, NJ) fed at 50 g/ton.

[3] Bioplus 2B (Chr. Hansen USA, Inc., Milwaukee, WI).

[4] Experimental probiotics (DSM Nutritional Products, Inc., Parsippany, NJ).

[5] SEM = standard error of the mean.

[6] Fecal scores were recorded prior to weighing the pens on each weigh day and were replicated by 3 individuals each day; those scores were then averaged and reported as the pen means for the overall and each collection day. Pens were scored on a scale from 0-3 with 0 indicating firm, dry feces; 1 indicating soft, moist feces; 2 indicating shapeless, moist feces; and 3 indicating liquid feces.

Table 5. Effects of different probiotic products on the growth performance and fecal consistency of nursery pigs, Experiment 2[1]

			BioPlus	DSM probiotic product[4]						
Item	Control	Mecadox[2]	2B[3]	1	2	3	4	5	6	SEM[5]
d 0 to 11 (phase 1)										
ADG, lb	0.11[b]	0.33[a]	0.15[b]	0.13[b]	0.16[b]	0.11[b]	0.17[b]	0.10[b]	0.17[b]	0.029
ADFI, lb	0.24[b]	0.41[a]	0.29[ab]	0.26[b]	0.27[b]	0.22[b]	0.32[ab]	0.25[b]	0.29[ab]	0.028
F/G	6.93	1.26	2.09	1.40	1.93	3.41	2.09	3.10	1.84	1.745
d 11 to 25 (phase 2)										
ADG, lb	0.86[b]	1.09[a]	0.92[ab]	0.86[b]	0.85[b]	0.79[b]	0.88[b]	0.83[b]	0.84[b]	0.040
ADFI, lb	1.14[b]	1.44[a]	1.23[ab]	1.23[ab]	1.20[ab]	1.11[b]	1.21[ab]	1.11[b]	1.16[b]	0.058
F/G	1.33	1.32	1.34	1.43	1.41	1.41	1.38	1.34	1.40	0.039
d 25 to 44 (phase 3)										
ADG, lb	1.43[b]	1.78[a]	1.60[ab]	1.51[b]	1.47[b]	1.42[b]	1.51[b]	1.48[b]	1.48[b]	0.047
ADFI, lb	2.24[b]	2.80[a]	2.54[ab]	2.34[b]	2.35[b]	2.30[b]	2.42[b]	2.40[b]	2.39[b]	0.077
F/G	1.56	1.57	1.59	1.55	1.61	1.63	1.61	1.63	1.63	0.032
d 0 to 44										
ADG, lb	0.91[cb]	1.20[a]	1.02[b]	0.96[cb]	0.94[cb]	0.87[c]	0.97[cb]	0.93[cb]	0.95[cb]	0.034
ADFI, lb	1.37[b]	1.77[a]	1.56[ab]	1.47[b]	1.45[b]	1.37[b]	1.51[b]	1.45[b]	1.48[b]	0.050
F/G	1.51	1.48	1.53	1.53	1.55	1.58	1.55	1.57	1.56	0.027
BW, lb										
d 0	13.3	13.3	13.3	13.3	13.3	13.3	13.2	13.3	13.3	0.309
d 11	14.5[b]	17.0[a]	15.1[ab]	14.8[b]	15.0[ab]	14.6[b]	15.3[ab]	14.4[b]	15.1[ab]	0.465
d 25	26.7[b]	32.3[a]	28.0[b]	26.7[b]	26.9[b]	25.7[b]	27.4[b]	26[b]	26.9[b]	0.864
d 44	54.0[b]	66.0[a]	58.4[b]	55.5[b]	54.8[b]	53.3[b]	56.0[b]	54.1[b]	54.9[b]	1.461
Fecal consistency[6]	1.46	1.25	1.39	1.44	1.33	1.56	1.29	1.55	1.37	0.070

[abcd] Means with different superscripts differ $P < 0.05$.

[1] A total of 315 pigs (Line 241 × 600; DNA, Columbus, NE) were used in a 44-d study with 5 pigs per pen and 7 pens per treatment.

[2] Mecadox-2.5 (Phibro Animal Health, Teaneck, NJ) fed at 50 g/ton.

[3] BioPlus 2B (Chr. Hansen USA, Inc., Milwaukee, WI).

[4] Experimental probiotics (DSM Nutritional Products, Inc., Parsippany, NJ).

[5] SEM = standard error of the mean.

[6] Fecal scores were recorded prior to weighing the pens on each weigh day and were replicated by 3 individuals each day; those scores were then averaged and reported as the pen means for the overall and each collection day. Pens were scored on a scale from 0-3 with 0 indicating firm, dry feces; 1 indicating soft, moist feces; 2 indicating shapeless, moist feces; and 3 indicating liquid feces.

Table 6. Nursery fecal consistency over time, Experiment 1

Day	Fecal score[1]
12	1.5[a]
19	1.4[a]
25	1.4[a]
32	1.0[b]
39	1.1[b]
44	0.9[b]

[ab] Means with different superscripts differ $P < 0.05$. Treatment × Day interaction ($P = 0.951$) and day effect ($P < 0.001$).

[1] Fecal scores were recorded prior to weighing the pens and were replicated by 3 individuals each day; those scores were then averaged and reported as the pen means for the overall and each collection day. Pens were scored on a scale from 0-3 with 0 indicating firm, dry feces; 1 indicating soft, moist feces; 2 indicating shapeless, moist feces; and 3 indicating liquid feces.

Table 7. Nursery fecal consistency over time, Experiment 2

Day	Fecal score[1]
11	1.3[ab]
18	1.5[a]
25	1.2[b]
32	1.5[a]
39	1.5[a]
44	1.4[ab]

[ab] Means with different superscripts differ $P < 0.05$. Treatment × Day interaction ($P = 0.084$) and day effect ($P < 0.001$).

[1] Fecal scores were recorded prior to weighing the pens on each weigh day and were replicated by 3 individuals each day; those scores were then averaged and reported as the pen means for the overall and each collection day. Pens were scored on a scale from 0-3 with 0 indicating firm, dry feces; 1 indicating soft, moist feces; 2 indicating shapeless, moist feces; and 3 indicating liquid feces.