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The Effect of Feeding VVC Premix in Nursery Diets for Pigs from Sows Fed With and Without VVC Premix in Lactation on Nursery Growth Performance and Fecal Dry Matter

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Summary

A total of 360 mixed-sex weanling pigs (DNA 241 × 600; initial BW of 12.6 ± 0.04 lb) were used in a 45-d growth trial to evaluate the effects of previous sow lactation feed treatment (control vs. VVC Premix; dsm-firmenich, Animal Nutrition & Health, LLC, Pendergrass, GA) and nursery diets formulated with or without VVC Premix on growth performance and fecal dry matter. Pigs were weaned at approximately 18 d of age from sows fed lactation diets with or without VVC Premix at an inclusion of 7 lb/ton and allotted to pens of five pigs according to their dam's lactation treatment. Pens were assigned to one of two nursery treatments in a generalized randomized block design with BW as a blocking factor with 18 replications per treatment. Nursery diets followed a 3-phase schedule and consisted of either a control diet or the control diet with VVC Premix included at 7 lb/ton at the expense of corn. Pigs used for this trial were from one of three groups of sows as part of the lactation portion of the trial and although there was no overall impact of sow treatment on weaning weight, offspring from sows fed the control diet in lactation from this group of sows were heavier ($P < 0.001$) at weaning compared with those from the sows fed diets with VVC Premix, and this weight advantage was maintained throughout the study ($P \leq 0.031$). Sow × nursery interactions were observed for d 10 BW and d 0 to 10 ADG and F/G, where pigs from sows fed the control diet in lactation that were also fed the control diet in the nursery were heavier ($P < 0.05$) on d 10 and had an improved ($P \leq 0.05$) ADG and F/G compared with pigs from sows fed VVC Premix and subsequently fed the control diet in the nursery, with the other treatment combinations showing an intermediate response. From d 10 to 24 and d 24 to 45, no sow × nursery interactions were observed. However, main effects of nursery diet were observed for d 10 to 24 growth performance, where pigs fed VVC Premix in the nursery had a reduced ($P = 0.011$) ADG driven by reduced ($P < 0.001$) ADFI, but had an improved ($P = 0.009$) F/G. From d 24

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to 45, pigs from sows fed the control diet had an improved ($P = 0.036$) F/G compared with pigs from sows fed VVC, whereas pigs fed VVC in the nursery had improved ($P = 0.008$) F/G compared with pigs fed the control diet. A tendency for a main effect of sow diet on d 24 to 45 ADG was also observed where pigs from sows fed the control diet tended to have improved ($P = 0.085$) ADG. No sow × nursery interactions were observed in the overall period; however, pigs from sows fed the control diet had increased ($P = 0.026$) ADG and improved ($P = 0.002$) F/G, while feeding VVC Premix in nursery diets reduced ($P = 0.036$) ADFI and improved ($P < 0.001$) F/G. For fecal DM, no significant interactions or main effect treatment differences were observed. In conclusion, including VVC Premix in nursery diets improved feed efficiency of weanling pigs. For this group of pigs, offspring from sows fed VVC Premix in lactation had reduced nursery performance and were lighter at weaning, which was not evident during the overall sow lactation trial that included two other groups of weaned pigs.

Introduction

Maternal nutritional strategies to prepare weanling pigs for the stressful transition from milk to solid feed may be influential in promoting gut development, performance, and health of nursery pigs. VVC Premix (dsm-firmenich, Animal Nutrition & Health, LLC, Pendergrass, GA) is a blend of benzoic acid (VevoVitall) and essential oils (CRINA) commonly included in sow diets for its in-feed antiviral properties against porcine epidemic diarrhea virus (PEDV)[3], African swine fever virus (ASFV)[4], and porcine reproductive and respiratory syndrome virus (PRRSV)[5]. Additionally, organic acids are known to support intestinal function by reducing pH of the feed and digesta, ultimately aiding in improved nutrient digestion and absorption. Essential oils provide flavor and smell that may stimulate feed intake and digestive enzyme secretion. Although there are many studies published on the effects of dietary acidifiers or essential oils on nursery pig growth performance, limited knowledge about their downstream influence from sow to offspring performance throughout the nursery phase is available. Therefore, the objective of this study was to determine the effects of VVC Premix on the growth performance and fecal dry matter of nursery pigs weaned from sows fed lactation diets with or without VVC Premix.

Procedures

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in this experiment. The study was conducted at the Kansas State University Swine Teaching and Research Center. All diets were manufactured at the Kansas State University O.H. Kruse Feed Technology Innovation Center. Each pen

[3] Gebhardt, J. T., J. C. Woodworth, C. K. Jones, M. D. Tokach, P. C. Gauger, R. G. Main, J. Zhang, Q. Chen, J. M. DeRouchey, R. D. Goodband, C. R. Stark, J. R. Bergstrom, J. Bai, and S. S. Dritz. 2019. Determining the impact of commercial feed additives as potential porcine epidemic diarrhea virus mitigation strategies as determined by polymerase chain reaction analysis and bioassay. Transl. Anim. Sci. 3:93–102. doi:10.1093/tas/txy100.

[4] Zhai, H., C. Ji, M. C. Walsh, J. Bergstrom, S. Potot, and H. Wang. 2021. The addition of nature-identical flavorings accelerated the virucidal effect of pure benzoic acid against African swine fever viral contamination of complete feed. Animals 11:1124. doi:10.3390/ani11041124.

[5] Dee, S., A. Shah, C. Jones, A. Singrey, D. Hanson, R. Edler, G. Spronk, M. Niederwerder, and E. Nelson. 2022. Evidence of viral survival in representative volumes of feed and feed ingredients during long-distance commercial transport across the continental United States. Transbound. Emerg. Dis. 69:149–156. doi:10.1111/tbed.14057.

was equipped with a 4-hole, dry self-feeder and nipple waterer to provide ad libitum access to feed and water.

Animals and diets

A total of 360 mixed-sex weanling pigs (DNA 241 × 600; initial BW of 12.6 ± 0.04 lb) were used in a 45-d growth trial. Pigs were weaned at approximately 18 d of age from one of three groups of sows that were fed either a control diet or a diet containing VVC Premix included at 7 lb/ton for a lactation experiment from d 110 of gestation until weaning. Pigs were grouped by dam's lactation treatment, and then randomly allotted to pens of light, medium, or heavy weight blocks. Pens of pigs were then allotted to one of two dietary treatments in a generalized randomized block design. Treatment structure was thus arranged in a 2 × 2 factorial with main effects of dam's lactation treatment (control vs. VVC Premix) and nursery treatment (control vs. VVC Premix).

Treatment diets were fed in mash form in three phases (d 0 to 10, 10 to 24, and 24 to 45, respectively) with VVC Premix included at the expense of ground corn at 7 lb/ton in all phases. Phase 1 and 2 diets were formulated to 1.35% SID Lys and phase 3 was formulated to 1.30%. All other nutrients were formulated to meet or exceed NRC[6] recommendations. Pigs and feeders were weighed on d 10, 17, 24, 31, 38, and 45 to determine ADG, ADFI, and F/G. Fecal samples were collected from three pigs per pen at the midpoint of phase 2 (d 17) to determine fecal DM. Using a cotton-tipped applicator to stimulate defecation, fecal samples were collected into plastic bags and frozen at - 4°F until fecal DM analysis. For DM analysis, samples were placed in a drying oven set at 131°F for 48 h.

Statistical analysis

Performance and fecal DM data were analyzed using R software (version 4.5.0, R Foundation for Statistical Computing, Vienna, Austria). Data were analyzed as a generalized randomized block design with pen considered as the experimental unit. Sow treatment, nursery treatment, the interaction of sow treatment and nursery treatment, and weight block served as fixed effects. The significance of sow treatment, nursery treatment, and their interaction was evaluated. Results were considered significant at $P \leq 0.05$ and marginally significant at $0.05 < P \leq 0.10$.

Results and Discussion

The overall sow data composed of three groups of sows did not indicate any effects of feeding VVC Premix to sows on piglet weaning weight. However, for the pigs used in this trial, which originated from only one of the groups used for a sow lactation trial, pigs from sows fed the control diet had an increased ($P < 0.001$) weaning weight compared with pigs from sows fed VVC Premix, and these differences in BW were maintained throughout the nursery trial ($P \leq 0.031$). A significant sow × nursery interaction was observed for d 10 BW, ADG, and F/G ($P \leq 0.024$), and tended to be observed for ADFI ($P = 0.062$), where pigs from sows fed the control diet and fed the control diet in the nursery had improved ($P < 0.05$) performance compared with pigs from sows fed VVC Premix and fed the control diet in the nursery, while the other treatments were intermediate.

[6] National Research Council. 2012. Nutrient Requirements of Swine: Eleventh Revised Edition, Washington, DC: The National Academies Press. doi./10.17226/13298.

No significant sow × nursery interactions were observed during d 10 to 24 or d 24 to 45 for ADG, ADFI, or F/G. Main effects of nursery diet were observed during d 10 to 24 for ADG, ADFI, and F/G, where pigs fed VVC Premix in the nursery had a reduced ($P = 0.011$) ADG driven by reduced ($P < 0.001$) ADFI, but improved ($P = 0.009$) F/G. From d 24 to 45, pigs from sows fed the control diet had improved ($P = 0.036$) F/G compared with pigs from sows fed VVC, whereas pigs fed VVC in the nursery had improved ($P = 0.008$) F/G compared with pigs fed the control diet. A tendency for a main effect of sow diet on ADG was also observed from d 24 to 45, where pigs from sows fed the control diet tended to have improved ($P = 0.085$) ADG.

Overall, no significant sow × nursery interactions were observed. However, significant main effects of sow diet were observed on ADG and F/G, where pigs from sows fed VVC Premix in lactation had reduced ($P \leq 0.026$) ADG and poorer F/G. Main effects of nursery diet were also observed, where pigs fed VVC Premix in the nursery had reduced ($P = 0.036$) ADFI and an improved ($P < 0.001$) F/G. Lastly, no significant interactions or main effect treatment differences were observed for fecal DM.

In conclusion, including VVC Premix in nursery diets improved feed efficiency of weanling pigs. For this group of pigs, offspring from sows fed VVC Premix in lactation had a lighter weaning weight and reduced nursery performance, but the difference in weaning weight was not observed during the overall sow lactation trial.

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Table 1. Diet composition (as-fed basis)[1]

	Phase 1		Phase 2		Phase 3	
Ingredients, %	Control	VVC	Control	VVC	Control	VVC
Corn	49.58	49.20	57.75	57.35	64.49	64.11
Soybean meal, 46.5% CP	15.94	15.97	23.91	23.94	31.36	31.38
Spray-dried whey powder	21.25	21.25	10.00	10.00	---	---
Microbially enhanced SBM[2]	6.25	6.25	3.75	3.75	---	---
Bovine plasma	2.50	2.50	---	---	---	---
Soybean oil	1.00	1.00	0.50	0.50	0.50	0.50
Monocalcium phosphate, 21.5% P	0.85	0.85	1.00	1.00	0.85	0.85
Calcium carbonate	0.63	0.63	0.65	0.65	0.75	0.75
Sodium chloride	0.28	0.28	0.58	0.58	0.60	0.60
L-Lys-HCl	0.36	0.36	0.50	0.50	0.45	0.45
DL-Met	0.24	0.24	0.25	0.25	0.19	0.19
L-Thr	0.15	0.15	0.23	0.23	0.21	0.21
L-Trp	0.02	0.02	0.05	0.05	0.04	0.04
L-Val	0.06	0.06	0.13	0.13	0.10	0.10
Trace mineral premix	0.15	0.15	0.15	0.15	0.15	0.15
Vitamin premix	0.25	0.25	0.25	0.25	0.25	0.25
Choline chloride	0.05	0.05	---	---	---	---
Phytase[3]	0.06	0.06	0.06	0.06	0.06	0.06
Zinc oxide	0.39	0.39	0.25	0.25	---	---
VVC Premix	---	0.35	---	0.35	---	0.35
Total	100.0	100.0	100.0	100.0	100.0	100.0
Calculated analysis						
SID AA, %						
Lys	1.35	1.35	1.35	1.35	1.30	1.30
Ile:Lys	60	60	57	57	57	57
Leu:Lys	121	120	114	114	118	118
Met:Lys	38	38	39	39	36	36
Met and Cys:Lys	58	58	58	58	58	58
Thr:Lys	65	65	65	65	65	65
Trp:Lys	20.0	20.0	20.0	20.0	20.0	20.0
Val:Lys	70	70	70	70	70	70
SID Lys:NE, g/Mcal	5.32	5.34	5.46	5.48	5.30	5.33
NE, kcal/lb	1,151	1,147	1,123	1,118	1,112	1,107
CP, %	21.2	21.1	20.9	20.9	21.1	21.1
Ca, %	0.69	0.69	0.68	0.68	0.65	0.65
P, %	0.63	0.63	0.62	0.62	0.57	0.57
STTD P, %	0.57	0.57	0.52	0.52	0.45	0.45

[1] Phase 1 diets were fed from d 0 to 10. Phase 2 diets were fed from d 10 to 24. Phase 3 diets were fed from d 24 to 45.

[2] Access Starter Protein (Houdek Manufacturing, Volga, SD).

[3] HiPhorius 2400 (Animal Nutrition & Health, LLC, Pendergrass, GA) included at 1,500 FYT/kg provided an estimated release of 0.12% STTD P.

Table 2. Effects of VVC Premix in sow and nursery diets on nursery pig growth performance and fecal dry matter[1,2]

Item	Sow: Control		VVC[3]			*P* =		
Nursery:	Control	VVC	Control	VVC	SEM	Sow × nursery	Sow	Nursery
BW, lb								
d 0	12.7	12.7	12.5	12.5	0.04	0.920	< 0.001	0.974
d 10	16.6[a]	16.1[ab]	15.5[b]	16.0[ab]	0.20	0.022	0.003	0.991
d 24	30.6	29.2	29.0	28.8	0.39	0.126	0.012	0.060
d 45	64.0	62.3	61.2	61.2	0.85	0.340	0.031	0.317
d 0 to 10								
ADG, lb	0.39[a]	0.34[ab]	0.30[b]	0.34[ab]	0.020	0.018	0.026	0.997
ADFI, lb	0.48	0.42	0.41	0.44	0.021	0.062	0.273	0.412
F/G	1.22[b]	1.26[b]	1.45[a]	1.30[ab]	0.042	0.024	0.003	0.206
d 10 to 24								
ADG, lb	1.00	0.94	0.96	0.92	0.019	0.570	0.141	0.011
ADFI, lb	1.36	1.21	1.30	1.22	0.028	0.214	0.355	< 0.001
F/G	1.36	1.30	1.35	1.33	0.016	0.205	0.415	0.009
d 24 to 45								
ADG, lb	1.59	1.57	1.52	1.54	0.028	0.540	0.085	0.975
ADFI, lb	2.31	2.23	2.26	2.26	0.039	0.581	0.492	0.151
F/G	1.45	1.42	1.48	1.45	0.013	0.973	0.036	0.008
d 0 to 45								
ADG, lb	1.14	1.10	1.07	1.08	0.019	0.208	0.026	0.501
ADFI, lb	1.61	1.51	1.54	1.52	0.028	0.249	0.311	0.036
F/G	1.41	1.37	1.44	1.40	0.010	0.984	0.002	< 0.001
Fecal DM[4], %								
d 17	20.5	20.8	20.7	21.7	0.57	0.546	0.332	0.316

[a,b] Differ, $P < 0.05$

[1] A total of 360 weaned pigs (DNA 241 × 600; initially 12.6 ± 0.04 lb) weaned at approximately 18 d of age were used in a 45-d nursery trial with 18 replicates per treatment and five pigs per pen.

[2] Treatment structure was arranged in a 2 × 2 factorial consisting of pigs from sows fed diets with or without VVC Premix in lactation and pigs fed nursery diets with or without VVC Premix.

[3] Animal Nutrition & Health, LLC, Pendergrass, GA. VVC Premix, a benzoic acid and essential oil blend, was added to the diet at 7.0 lb/ton in phases 1, 2, and 3.

[4] Fecal samples were collected from three pigs per pen (54 pigs per treatment) on d 17 of the study to determine fecal DM.