EFFECTS OF PORCINE CIRCOVIRUS TYPE 2 AND *Mycoplasma hyopneumoniae* VACCINATION TIMING AND STARTER DIET SOURCE ON GROWTH PERFORMANCE OF NURSERY PIGS

E. M. Kane[1], M. L. Potter[1], J. R. Bergstrom, S. S. Dritz[1], M. D. Tokach, J. M. DeRouchey, R. D. Goodband, J. L. Nelssen

Summary

A total of 400 nursery pigs (initially 12.5 lb) were used in a 20-d study to evaluate the effects of varying porcine circovirus type 2 (PCV2) and *Mycoplasma hyopneumoniae* vaccination timing on growth performance of pigs fed commercial segregated early weaning (SEW) and transition diets from 4 different sources. At weaning (d 0), pigs were blocked by weight and randomly allotted to 1 of 8 treatments. Treatments were arranged in a 2 × 4 factorial on the basis of vaccination timing (0 or 8 d after weaning) and diet source (A, B, C, or D). There were 5 pigs per pen and 10 pens per treatment. Initially, SEW and transition diets were budgeted at 1 and 5 lb/pig, respectively. The SEW and transition diets were formulated to similar Kansas State University specifications but made by different manufacturers. Feeders were emptied on d 8, and a common phase 2 diet was fed for the remainder of the trial. On d 0, 4, 8, and 20, pigs were weighed and feed disappearance was measured to determine ADG, ADFI, and F/G. Diet source influenced ($P < 0.001$) ADG during the first 4 d of the trial. Pigs fed diet B had increased ($P < 0.001$) BW (d 4) and ADG (d 0 to 4) compared with pigs fed all other diets, and diet D pigs exhibited increased ADG compared with pigs fed diet C. On d 8, diet source effects remained significant ($P \leq 0.02$) for pig weights (d 8) as well as ADG and ADFI (d 4 to 8 and 0 to 8). Pigs fed diet A had increased ($P < 0.01$) ADG (d 4 to 8) compared with pigs fed the other 3 diet sources. Pigs fed diets A and B had similar ADFI, but their ADFI (d 4 to 8) was greater ($P \leq 0.02$) than that of pigs fed diets C and D. There were no effects of diet source from d 8 to 20. Pigs vaccinated on d 0 had lower ($P < 0.01$) BW (d 8) and ADG and ADFI (d 4 to 8 and d 0 to 8) than pigs vaccinated on d 8. From d 8 to 20, pigs vaccinated on d 8 had lower ($P = 0.05$) ADG. Overall (d 0 to 20), diet source and vaccine timing did not influence growth performance, although pigs fed diet C had a numeric decrease ($P = 0.06$) in ADFI. Nursery pigs in this trial were initially affected by both SEW/transition diet source and vaccination timing, but the influence of these factors lessened with time. Despite the transient nature of these effects, however, data obtained during this trial indicate that nursery pig growth performance is affected by diet source and vaccine timing immediately postweaning, and these factors should be taken into consideration when managing weaning groups.

Key words: PCV2, segregated early weaning, swine, vaccination

[1] Food Animal Health and Management Center, College of Veterinary Medicine, Kansas State University.

Introduction

Positive growth performance of nursery pigs is an essential component of successful swine production. However, recent reports from field observations indicate that some producers have experienced difficulty in starting or maintaining weaned pigs on feed, which results in decreased performance and production. These reports seem to coincide with widespread adoption of porcine circovirus type 2 (PCV2) vaccination in growing pigs. Many weaned pigs receive PCV2 and other vaccinations at or near the time of weaning, though vaccination timing is not consistent in the swine industry. Other management factors affect pig performance and have been well characterized in research reports. For instance, it is well known that different diet formulations affect pig performance in the nursery. However, there is limited data on the potential effect of diet source. It has been suggested that nursery diet sources and vaccination timing may be important factors influencing this postweaning problem. The objective of this study was to investigate the effects of diet source as well as PCV2 and *Mycoplasma hyopneumoniae* (Mpp) vaccination timing on pig growth performance.

Procedures

A total of 400 weaned pigs (31 gilts and 369 barrows) were used in a 20-d growth trial. Pigs were blocked by weaning weights (12.5 lb average) and randomly allotted to 1 of 8 treatments. Because of the uneven number of gilts, 7 of the 8 treatments groups within 1 block contained 4 gilts each, and the remaining group contained 3 gilts. Initially, each pen contained 5 pigs, and there were 10 pens per treatment. Treatments included segregated early weaning (SEW)/transition diet source (A, B, C, or D) and vaccination timing (0 or 8 d after weaning). The SEW and transition diets were obtained from 4 commercial sources, and each diet was formulated to similar specifications (Table 1). At weaning (d 0), each pen received 1 lb/pig of SEW diet, and SEW diets were placed in the feeders at allotment. Transition diets were added to the feeders on top of the SEW diet and fed until d 8 (approximately 3 lb/pig). On d 8, feeders were emptied and refilled with a common phase 2 diet, which was fed for the duration of the trial. Pigs were vaccinated intramuscularly with commercially available PCV2 (Circumvent, Intervet) and Mpp (Respisure 1; Pfizer) vaccines on d 0 or 8 after weaning. The vaccines were administered according to label instructions. Pigs were weighed on d 0, 4, 8, and 20, and feeders were weighed on d 4, 8, and 20 to determine feed disappearance. From this data, ADG, ADFI, and F/G were calculated.

Data were analyzed as a randomized complete block design by using the PROC GLIMMIX procedure of SAS. Pen was considered the experimental unit for this analysis. Differences between treatments were determined by using least squares means ($P < 0.05$).

Results and Discussion

There were no significant ($P < 0.05$) interactions observed between diet source and vaccine timing during this trial (Table 2). However, there was a trend ($P = 0.07$) toward a diet source and vaccine timing interaction effect on F/G between d 0 and 8. For pigs fed diet B, the d 0 vaccinates had improved F/G compared with pigs that were not vaccinated until d 8. In contrast, d 0 vaccinates fed diets A and C demonstrated poorer F/G during the first 8 d of the trial compared with their counterparts that were vaccinated on day 8. This interaction trend disappeared after d 8, and no additional trends or significant interactions were observed during the remainder of the trial.

From d 0 to 4, pigs fed diet B had greater ($P < 0.001$) ADG than pigs fed the other 3 diet

sources (Table 3). Pigs fed diet D also had greater ($P < 0.05$) ADG than pigs fed diet C, with pigs fed diet A being intermediate. The improved gain resulted in pigs fed diet B having heavier ($P < 0.001$) average weights on d 4 than pigs fed the other diets. From d 4 to 8, pigs fed diet A had greater ADG ($P < 0.002$) than pigs fed the other 4 diets. Pigs fed diets A and C had greater ($P < 0.02$) ADFI than pigs fed diets B and D. For the overall period when SEW and transition diets were fed (d 0 to 8), pigs fed diet C had lower ($P < 0.001$) ADG and ADFI than pigs fed diets A and B, with pigs fed diet D being intermediate. As a result of the differences in ADG, pigs fed diets A and B were heavier ($P < 0.001$) on d 8 than pigs fed diet C. Diet sources fed from d 0 to 8 did not influence pig performance from d 8 to 20, when all pigs were fed a common diet. Although a trend ($P = 0.06$) was observed for a diet effect from d 0 to 20 for ADFI (indicating increased intake for pigs fed diet A and B compared with pigs fed diet C), the differences between diets sources from d 0 to 8 were not substantial enough to cause a lasting effect on pig performance in the second phase of the trial or overall. Because SEW and transition diets were formulated to similar specifications, the transient effects of diet source seen in the first phase of the trial may be due to diet ingredient quality and source as well as manufacturing differences between the commercial suppliers.

Vaccinating pigs with PCV2 and Mpp vaccines on d 0 decreased ($P \leq 0.01$) ADG and ADFI from d 4 to 8 and 0 to 8 and pig weights (d 8; Table 4). From d 8 to 20 after weaning, the pigs vaccinated on d 8 grew slower ($P = 0.05$) than those vaccinated at weaning (d 0). According to this data, vaccination caused a temporary reduction in the growth performance of both d 0 and 8 vaccinates. Because of the stresses of vaccination, this transient decrease in performance is expected, but because the pigs were not weighed as often during phase 2 (day 8 to 20) as during phase 1 (day 0 to 8), it is not possible to determine whether one vaccine timing treatment group was more severely affected immediately postvaccination. However, because previous research has indicated that growth performance in the first week after weaning is a risk factor for subsequent nursery performance, we speculate that the decrease in performance around the time of weaning may have a greater potential for longer term effects than a decrease in performance in subsequent phases of the nursery period.

Overall (d 0 to 20), diet source and vaccination timing did not significantly affect growth performance of nursery pigs. However, performance was significantly affected by both of these factors throughout the first phase of the trial, indicating that diet source and vaccination do play a role in growth of nursery pigs during certain periods. Because pig weight and feed disappearance data were not collected as often during phase 2 as during phase 1, further studies investigating diet source and vaccine timing should be conducted to gain a better understanding of their effects on growth performance. It is evident that these factors do influence nursery pig growth performance to some extent; thus, vaccine timing and diet source should be considered when making health and management decisions for weaning groups.

Table 1. Composition of segregated early weaning (SEW) and transition diets

	Diet type				
Ingredient, %	SEW (diet sources A, B, and C)	SEW (diet Source D)[1]	Permeate transition[2] (diet sources A, B, and C)	Whey transition[2] (diet sources A, B, and C)	Transition (diet source D)[1]
Corn	33.70	25.60	37.70	37.25	26.35
Soybean meal (46.5%)	12.55	12.70	20.00	20.00	21.55
Spray-dried animal plasma	6.70	6.70	2.50	2.50	2.50
Select menhaden fish meal	6.00	6.00	5.80	5.00	6.00
Spray-dried blood cells	1.65	1.65	1.25	1.25	1.25
Spray-dried whey	25.00	---	12.50	25.00	---
DairyLac 80 or deproteinized whey	6.00	25.00	11.25	---	20.00
Pulverized oat grouts	---	15.00	---	---	15.00
Choice white grease	5.00	3.00	5.00	5.00	3.00
Monocalcium phosphate (21% P)	0.30	0.50	0.60	0.70	0.60
Limestone	0.45	0.60	0.45	0.45	0.60
Salt	0.25	0.25	0.30	0.30	0.30
Zinc oxide	0.36	0.36	0.36	0.36	0.36
Vitamin premix with phytase	0.25	0.25	0.25	0.25	0.25
Trace mineral premix	0.15	0.15	0.15	0.15	0.15
Lysine HCl	0.15	0.30	0.30	0.26	0.30
DL-Methionine	0.15	0.23	0.20	0.18	0.19
L-Threonine	0.08	0.14	0.15	0.13	0.16
L-Isoleucine	---	0.15	---	---	0.05
Antibiotic 1	1.00	1.00	1.00	1.00	1.00
Acidifier	0.20	0.35	0.20	0.20	0.35
Vitamin E, 20,000 IU	0.05	0.05	0.05	0.05	0.05
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
Standardized ileal digestible amino acids					
Lysine, %	1.57	1.57	1.50	1.51	1.50
Methionine:lysine ratio, %	30	34	35	33	35
Met & Cys:lysine ratio, %	55	57	56	55	56
Threonine:lysine ratio, %	64	62	62	63	62
Tryptophan:lysine ratio, %	17	18	17	17	18
Total lysine, %	1.71	1.69	1.63	1.65	1.63
ME, kcal/lb	1,587	1,556	1,583	1,575	1,548
Protein, %	22.8	22.5	21.8	22.2	22.7
Ca, %	0.82	0.84	0.82	0.83	0.85
P, %	0.76	0.79	0.75	0.77	0.77
Available P, %	0.59	0.58	0.54	0.55	0.52

[1] Source D SEW and transition diets were formulated differently from diets supplied by other sources because of higher costs of whey at the time of formulation.
[2] Diet sources A, B, and C supplied identically formulated SEW diets but had the option of using either the permeate or whey formula for their transition diets.

Table 2. Interactions between diet source and vaccine timing and their effect on nursery pig growth performance[1]

	Diet source									Source × Timing
	A		B		C		D			
Vaccine timing, d	0	8	0	8	0	8	0	8	SE	*P*
Item										
d 0 to 4										
ADG, lb	0.38	0.42	0.48	0.48	0.36	0.36	0.40	0.45	0.03	0.67
ADFI, lb	0.24	0.24	0.26	0.29	0.23	0.22	0.30	0.26	0.03	0.71
F/G	0.64	0.59	0.56	0.61	0.63	0.65	0.82	0.58	0.14	0.44
d 4 to 8										
ADG, lb	0.51	0.57	0.47	0.48	0.38	0.47	0.39	0.49	0.04	0.54
ADFI, lb	0.55	0.56	0.54	0.60	0.45	0.50	0.38	0.55	0.06	0.25
F/G	1.08	1.00	1.17	1.25	1.25	1.10	1.47	1.13	0.27	0.76
d 0 to 8										
ADG, lb	0.44	0.49	0.47	0.48	0.37	0.41	0.39	0.47	0.03	0.43
ADFI, lb	0.39	0.40	0.40	0.45	0.34	0.36	0.34	0.40	0.03	0.51
F/G	0.88	0.82	0.85	0.93	0.92	0.88	0.87	0.86	0.04	0.07
d 8 to 20										
ADG, lb	0.69	0.68	0.69	0.67	0.74	0.65	0.72	0.71	0.03	0.25
ADFI, lb	0.93	0.95	0.94	0.92	0.93	0.88	0.95	0.95	0.03	0.50
F/G	1.35	1.40	1.37	1.36	1.27	1.37	1.32	1.35	0.05	0.48
d 0 to 20										
ADG, lb	0.59	0.60	0.60	0.60	0.59	0.55	0.59	0.61	0.02	0.30
ADFI, lb	0.71	0.73	0.72	0.73	0.69	0.67	0.70	0.73	0.03	0.57
F/G	1.21	1.21	1.20	1.22	1.18	1.22	1.20	1.20	0.03	0.72
Weight, lb										
d 0	12.5	12.5	12.5	12.6	12.5	12.6	12.5	12.5	0.6	0.82
d 4	14.0	14.2	14.5	14.5	13.9	14.0	14.1	14.3	0.7	0.87
d 8	16.1	16.5	16.3	16.4	15.5	15.9	15.7	16.3	0.7	0.52
d 20	24.3	24.6	24.3	24.5	24.1	23.7	24.3	24.5	1.0	0.79

[1] A total of 400 weaned pigs, initially 12.5 lb, were used in a 20-d growth trial. Each value is the mean of 5 pigs per pen and 10 pens per treatment.

Table 3. Effects of diet source on growth performance of nursery pigs

Item	Diet source[1]				SE	*P* <
	A	B	C	D		
d 0 to 4						
ADG, lb	0.40^{bc}	0.48^{a}	0.36^{c}	0.42^{b}	0.02	< 0.001
ADFI, lb	0.24	0.28	0.22	0.28	0.02	0.22
F/G	0.61	0.58	0.64	0.70	0.07	0.67
d 4 to 8						
ADG, lb	0.54^{a}	0.48^{b}	0.42^{b}	0.44^{b}	0.03	0.002
ADFI, lb	0.56^{a}	0.57^{a}	0.47^{b}	0.46^{b}	0.03	0.02
F/G	1.04	1.21	1.18	1.30	0.15	0.60
d 0 to 8						
ADG, lb	0.47^{ab}	0.48^{a}	0.39^{c}	0.43^{bc}	0.02	< 0.001
ADFI, lb	0.40^{ab}	0.42^{a}	0.35^{c}	0.37^{bc}	0.02	0.001
F/G	0.85	0.89	0.90	0.87	0.02	0.27
d 8 to 20						
ADG, lb	0.68	0.68	0.69	0.71	0.02	0.52
ADFI, lb	0.94	0.93	0.90	0.95	0.03	0.29
F/G	1.37	1.37	1.32	1.33	0.03	0.29
d 0 to 20						
ADG, lb	0.60	0.60	0.57	0.60	0.02	0.26
ADFI, lb	0.72	0.73	0.68	0.72	0.03	0.06
F/G	1.21	1.21	1.20	1.20	0.02	0.88
Weight, lb						
d 0	12.5	12.5	12.6	12.5	0.6	0.80
d 4	14.1^{b}	14.5^{a}	14.0^{b}	14.2^{b}	0.7	< 0.001
d 8	16.3^{ab}	16.4^{a}	15.7^{c}	16.0^{bc}	0.7	< 0.001
d 20	24.5	24.4	23.9	24.4	0.9	0.35

[1] Diet source refers to the commercial SEW/transition diet source. Initially, each pig received 1 lb SEW and was then fed transition diet until d 8 post weaning. Feeders were emptied on d 8, and a common phase 2 diet was fed for the duration of the trial.

[abc] Within a row, means without a common superscript letter differ ($P < 0.05$).

Table 4. Effects of vaccine timing on growth performance of nursery pigs

	Vaccine timing[1]			
Item	0	8	SE	*P*
d 0 to 4				
ADG, lb	0.40	0.43	0.02	0.20
ADFI, lb	0.26	0.26	0.02	0.94
F/G	0.66	0.61	0.05	0.44
d 4 to 8				
ADG, lb	0.44[b]	0.50[a]	0.02	< 0.01
ADFI, lb	0.48[b]	0.55[a]	0.03	0.01
F/G	1.24	1.12	0.11	0.37
d 0 to 8				
ADG, lb	0.42[b]	0.46[a]	0.02	< 0.01
ADFI, lb	0.37[b]	0.40[a]	0.02	< 0.01
F/G	0.88	0.87	0.02	0.67
d 8 to 20				
ADG, lb	0.71[a]	0.68[b]	0.02	0.05
ADFI, lb	0.94	0.92	0.03	0.44
F/G	1.33	1.37	0.03	0.09
d 0 to 20				
ADG, lb	0.59	0.59	0.02	0.88
ADFI, lb	0.71	0.71	0.02	0.60
F/G	1.20	1.21	0.02	0.34
Weight, lb				
d 0	12.5	12.5	0.6	0.46
d 4	14.1	14.3	0.7	0.15
d 8	15.9[b]	16.3[a]	0.7	< 0.01
d 20	24.3	24.3	0.9	0.78

[1] Vaccine timing refers to the vaccination day (0 or 8 postweaning). Each pig was injected with 2 cc PCV2 and 2 cc Mpp vaccine.