Nutrient supplementation effects on pig performance and sickness behavior during a porcine reproductive and respiratory syndrome virus infection

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Summary

Objective: Investigate how nutrient additive inclusion impacts performance and sickness behavior in pigs infected with porcine reproductive and respiratory syndrome virus (PRRSV).

Materials and methods: At 10 weeks of age, 108 PRRSV naïve barrows (mean [SD] body weight: 31 [1.4] kg) were allotted into 18 pens in a commercial barn and enrolled in a 35-day PRRSV challenge study. After a 5-day acclimation period, all pigs were inoculated intranasally and intramuscularly with a field strain of PRRSV and began nutrient supplement treatments. Treatments included no nutrient supplement (control; n = 6 pens), water nutrient supplement (water; n = 6 pens), and water and feed nutrient supplement (water+feed; n = 6 pens). Pen performance was recorded weekly at 0, 7, 14, 21, 28, and 35 days post inoculation (dpi). Pig home-pen behavior was recorded on -1, 3, 6, 9, 12, 15, and 18 dpi.

Results: Over the 35-day challenge, no significant differences in pig viremia or performance were reported due to treatment. Compared to control, water+feed additive increased sitting in pigs; however, no other sickness behavior treatment differences were observed. Decreased activity was observed 6 and 9 dpi. Eating was decreased 6 dpi whereas drinking was decreased from 6 dpi throughout the rest of the behavioral observation period at 18 dpi.

Implications: The addition of a nutrient additive in water and water+feed had minimal effect on sickness behavior and no observed effect on viremia or performance of PRRSV-infected pigs. Decreased activity, eating, and drinking may help caretakers identify health-challenged pigs.

Keywords: swine, porcine reproductive and respiratory syndrome virus, sickness behavior, welfare, growth

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Resumen - Efectos de la suplementación de nutrientes en el rendimiento del cerdo y el comportamiento de la enfermedad durante una infección por el virus del síndrome reproductivo y respiratorio

Objetivo: Investigar cómo la inclusión de aditivos nutritivos impacta el rendimiento y el comportamiento de enfermedad en cerdos infectados con el virus del síndrome reproductivo y respiratorio porcino (PRRSV).

Materiales y métodos: A las 10 semanas de edad, 108 corrales de machos libres del PRRSV (peso corporal medio [DE]: 31 [1.4] kg) se asignaron a 18 corrales en un edificio comercial y se asignaron a un estudio de desafío del PRRSV con duración de 35 días. Después de un período de aclimatación de 5 días, todos los cerdos se inocularon por vía intranasal e intramuscular con una cepa de campo del PRRSV e iniciaron los tratamientos con suplementos nutricionales. Los tratamientos incluyeron: ningún suplemento de nutrientes (control; n = 6 corrales), suplemento de nutrientes en agua (agua; n = 6 corrales) y suplemento de nutrientes en agua y alimento (agua+alimento; n = 6 corrales). El rendimiento en los corrales se registró semanalmente a los 0, 7, 14, 21, 28 y 35 días post-inoculación (dpi). El comportamiento de los cerdos por corral se registró los días -1, 3, 6, 9, 12, 15 y 18 dpi.

Resultados: Durante el periodo de desafío de 35 días, no se detectaron diferencias significativas en la viremia o en el rendimiento de los cerdos debido al tratamiento. En comparación con el control, el aditivo de agua+alimento aumentó el sentado en los cerdos; sin embargo, no se observaron otras diferencias de tratamiento en el comportamiento debido a la enfermedad. Se observó disminución en la actividad los días 6 y 9 pi. El consumo de alimento disminuyó el día 6 pi mientras que el consumo de agua disminuyó a partir del día 6 pi y durante el resto del período de observación conductual a 18 dpi.

Implicaciones: Agregar un aditivo de nutrientes en agua y agua+alimento tuvo un efecto mínimo sobre el comportamiento de la enfermedad y no se observó ningún efecto sobre la viremia o el rendimiento de los cerdos infectados con el PRRSV. La disminución de la actividad, consumo de alimento y agua de bebida puede ayudar a los trabajadores a identificar cerdos con problemas de salud.

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Résumé - Effets de suppléments nutritifs sur les performances de porcs et leur comportement maladif durant une infection par le virus du syndrome reproducteur et respiratoire porcin

Objectif: Étudier comment l'inclusion de suppléments nutritifs affecte les performances et le comportement maladif de porcs infectés par le virus du syndrome reproducteur et respiratoire porcin (PRRSV).

Matériels et méthodes: À 10 semaines d'âge, 108 castrats naïfs pour le PRRSV (moyenne de poids corporel [SD]: 31 [1.4] kg) furent répartis dans 18 enclos dans une porcherie commerciale et recrutés pour une étude sur une infection défi avec le PRRSV. À la suite d'une période d'acclimatation de 5 jours, tous les porcs furent inoculés par voies intranasale et intramusculaire avec une souche sauvage de PRRSV et ont débuté les traitements avec les suppléments nutritifs. Les traitements incluaient aucun supplément nutritif (témoin; n = 6 enclos), supplément nutritif dans l'eau (eau; n = 6 enclos), et supplément nutritif dans l'eau et les aliments (eau+aliments; n = 6 enclos). Les performances par enclos furent notées de manière hebdomadaire à 0, 7, 14, 21, 28, et 35 jours post-inoculation (dpi). Le comportement des porcs dans l'enclos fut noté aux jours -1, 3, 6, 9, 12, 15, et 18 dpi.

Résultats: Durant les 35 jours de l'essai, aucune différence significative dans la virémie ou les performances des porcs ne fut rapportée due au traitement. Comparativement aux témoins, le supplément eau+aliment augmenta la position assise chez les porcs; toutefois, aucune autre différence dans le comportement maladif ne fut notée. Une diminution de l'activité fut observée aux jours 6 et 9 dpi. Laprise d'aliment était diminuée au jour 6 dpi alors que la prise d'eau était diminuée à compter du jour 6 dpi jusqu'à la fin de la période d'observation du comportement au jour 18 dpi.

Implications: L'ajout de suppléments nutritifs dans l'eau et dans l'eau+aliment avait un effet minimal sur le comportement maladif et aucun effet observable sur la virémie ou les performances des porcs infectés avec le PRRSV. Une diminution de l'activité, de la prise d'aliment et d'eau pourrait aider les personnes soignant les animaux à identifier les porcs dont la santé est affectée.

Improving swine health is essential for increasing swine welfare and sustainable pork production. Swine health can be challenged by common pathogens such as porcine reproductive and respiratory syndrome virus (PRRSV), costing the US swine industry approximately $664 million per year.[1] These losses are partially explained by reduced growth performance, feed intake, and feed efficiency,[2-4] and the increased occurrence of secondary viral and bacterial infections.[5,6] Little is known about how swine health impacts nutrient utilization; thus, sick pigs may have altered nutrient requirements.[7] An improved understanding of the nutrient requirements of health-challenged pigs can aid in developing solutions for improving swine health and productivity.

Production losses in health-challenged pigs can be partially explained by changes in swine behavior.[8] Sickness behavior is linked to secretion of cytokines which motivate a sick animal to rest and recover.[9] Swine sickness behaviors often include decreased activity and exploratory behaviors, decreased maintenance behaviors such as eating, drinking, and grooming, and increased thermoregulatory behaviors such as huddling and shivering.[10] These behaviors can be important for recovering from immune system challenges.[8] While general swine sickness behavior is well described, little is known about how PRRSV specifically impacts pig behavior. Since reduced eating and drinking behaviors are common in sick pigs, these behavioral differences could alter the efficacy of delivering nutrient additives through feed and water. Further, an improved understanding of the progression of PRRSV sickness behavior could be a valuable tool for early identification of sick pigs.

The objectives of this study were to 1) investigate how nutrient additive inclusion impacts viremia, growth performance, and sickness behavior of pigs infected with PRRSV and 2) evaluate the progression of pig sickness behavior over time during a PRRSV infection.

Materials and methods

Experimental procedures were approved by the Iowa State University Animal Care and Use Committee (IACUC No. 4-15-7993-S). Pigs were housed in a conventional confinement unit with curtain sides and slatted concrete flooring. One hundred eight barrows (PIC Cambro × Landrace and Landrace × PIC Cambro, 31 [1.4] kg mean [SD] body weight [BW], 10-week old, and negative for PRRSV) were evenly blocked by BW and genetics (2 genetic lines were used in this study) into 18 pens (6 pigs/pen). Each pen measured 1.8 × 2.4 m and contained one 0.3 m wide feeder and 1 cup system waterer. Pigs were maintained at thermal neutral temperatures and had *ad libitum* access to feed and water. The diet was formulated to meet or exceed the NRC nutrient and energy requirements for this size pig.[7]

All pigs were PRRSV negative (virus and antibodies) before the start of the study. After a 5-day acclimation to treatment pens, all pigs were inoculated intranasally and intramuscularly with 775 million genomic units of a live field strain of PRRSV (open reading frame 5 sequence 1-18-4) on 0 day post inoculation (dpi). Three nutrient supplement treatments were evaluated: 1) no nutrient supplement (control; n = 6 pens), 2) water nutrient supplement (water; n = 6 pens), and 3) water and feed nutrient supplement (water+feed; n = 6 pens). The water and feed supplements consisted of a liquid nutrient and electrolyte suspension or a dry supplement powder, respectively. Both supplements on a dry matter basis consisted of a proprietary blend of sugar foods by-products, betaine, soy protein isolates, monosodium glutamate, sodium saccharin, L-lysine, DL-methionine, L-threonine, isoleucine, phenylalanine, aspartic acid, valine, ascorbic acid, zinc oxide, and artificial flavors (Techmix LLC). The proprietary liquid suspension stock was suitable for delivery through a 1:128 water medicator and the dry supplement was used per the manufacturer's instructions. The liquid stock was 8.53% crude protein and the powder 32.25% crude protein.

Figure 1 outlines the timeline of PRRSV inoculation and administration of treatments. The control treatment received no added supplement throughout the study. Water additive was provided from 1 to 4 dpi at 1:128 inclusion (1 ounce stock liquid per gallon of water) and increased to 3% inclusion (3.8 ounces stock liquid per gallon of water) from 5 dpi to 8 dpi to account for expected changes in water intake. Water treatment received no supplement from 9 to 13 dpi. A liquid supplement (55% stock plus 45% water) was included at 3% of water intake from 14 to 18 dpi. Water treatment received no nutrient supplementation thereafter. The water+feed treatment received the same 1:128 inclusion of the liquid stock in the water from 1 to 4 dpi and the 3% inclusion rate of liquid stock from 5 to 8 dpi. From 9 to 35 dpi, water+feed treatment was top-dressed with the dry powder at 1.25% of diet or 25 lbs/ton per manufacturer's instructions by hand mixing it into

Figure 1: Water and water+feed treatment nutrient additive schedule. The gray shaded numbers indicate the dpi where sickness behavior was analyzed. The black shaded numbers indicate the dpi where pen feed disappearance, pig BW, and blood samples were collected. Dpi = days post inoculation; BW = body weight.

Treatment	Additive inclusion																								
Water			1:128 Water				3% Water				None					3% of a 55% Diluted water					None				
DPI	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	28	35
Water+ Feed			1:128 Water				3% Water				1.25% Feed														

the mash feed. The top-dress began later (9 dpi) to test if extra nutrients in the diet would enhance pig performance post peak viremia and into recovery as average daily feed intake (ADFI) would increase.

Pigs were snared weekly and blood samples were collected (10 mL) via jugular venipuncture for analysis on 7, 14, 21, 28, and 35 dpi. Blood was allowed to clot and then centrifuged at 2000*g* for 10 minutes at 4° C. Serum was stored at -80° C until analysis at the Iowa State University Veterinary Diagnostic Laboratory for PRRSV serology. Briefly, reverse transcription-polymerase chain reaction (RT-PCR) and serum antibody testing for PRRSV was performed using commercial reagents (VetMAX NA and EU PRRSV RT-PCR, Thermo Fisher Scientific) and a commercial ELISA kit (HerdCheck PRRS X3, IDEXX Laboratories, Inc), respectively. A negative serum viremia cycle threshold (Ct) was ≥ 37 and serology antibody was considered negative with a sample to positive ratio (S:P) ≤ 0.40.

Pig BW and pen feed disappearance was recorded at 7, 14, 21, 28, and 35 dpi. Pig BW was averaged by pen and pen feed efficiency (G:F) was calculated. No pig mortalities occurred over the performance period studied and during the PRRSV challenge.

Home-pen behavior of 10 pens of pigs (control n = 3 pens; water n = 3 pens; water+feed n = 4 pens) was recorded with color cameras (Panasonic, Model WV-CP-484, Matsushita Co LTD) that were positioned above the pens. The cameras fed into a multiplexer using Noldus Portable Lab (Noldus Information Technology, Wageningen, The Netherlands) and time-lapse video was collected onto a computer using HandyAVI (version 4.3, Anderson's AZcendant Software) at 10 frames/s. Video was collected on -1, 3, 6, 9, 12, 15, and 18 dpi (Figure 1). Video observations were recorded using a 10-minute scan sampling interval from 7:00 AM to 7:00 PM daily by one trained observer who was blind to treatments. Percent of pigs standing, lying, sitting, eating, and drinking within each pen was collected (Table 1).

Shapiro-Wilk test and Q-Q plots were used to evaluate the data for normality in SAS (SAS version 9.4, SAS Institute Inc). Performance and serology data were analyzed using the Mixed procedure with treatment, dpi, and the interaction of treatment and dpi used as fixed effects, and pen was the experimental unit. Behavior data were analyzed using the Glimmix procedure of SAS with a beta distribution. Treatment, dpi, and their interaction were included as fixed effects and the number of pigs visible per pen on camera was used as a covariate. Pen was used as a random effect and was considered the experimental unit. Data are reported as treatment least squares means and the significance level was fixed at $P < .05$.

Results

Pig viremia and serology

Pig viremia and antibody titer data are presented in Table 2. All animals were naïve for PRRSV prior to starting the trial. At 7 dpi, all pigs were positive for PRRSV as determined by RT-PCR Ct values on serum samples. There was an effect of dpi on PRRSV titers ($P < .001$), where Ct was the lowest at 7 dpi. The S:P ratio was used to assess PRRSV antibody in the serum. There was an effect of dpi ($P < .001$) on antibody levels where there was no circulating antibody at 7 dpi, but antibody was present from 14 dpi and weekly thereafter. There was no effect of treatment or an interaction on PRRSV titers ($P \geq .12$) or serology ($P \geq .24$, Table 2).

Pig performance and behavior

There was no difference in BW, average daily gain (ADG), ADFI, or G:F during weekly or overall performance among treatments ($P \geq .07$; Table 3). Water+feed treatment pens were observed sitting more than control pens ($P = .008$); however, water treatment did not differ from control or water+feed treatments ($P \geq .13$; Figure 2). No other postures or activities differed by treatment ($P \geq .51$). A dpi by treatment interaction was observed for lying ($P = .01$), but no other dpi by treatment interactions were observed ($P \geq .08$).

Lying, sitting, and standing postures differed across dpi ($P < .001$). On -1 dpi, 75.5% of pigs per pen were observed lying, 0.8% of pigs per pen were observed sitting, and 22.7% of pigs per pen were observed standing. No posture differences were observed from -1 to 3 dpi ($P \geq .19$). Compared to -1 dpi, lying increased and standing decreased 6 and 9 dpi ($P < .001$), and both returned to pre-inoculation rates by 12 dpi ($P \geq .38$; Figure 3A and B). Sitting 3 to 12 dpi was similar to pre-inoculation rates ($P \geq .19$) and increased on 15 and 18 dpi compared to -1 dpi ($P \leq .02$; Figure 3C). Eating and drinking behaviors differed across dpi ($P < .001$). On -1 dpi, 11.5% of pigs per pen were observed eating and 4.1% of pigs per pen were observed drinking. No differences in eating behavior were observed from -1 to 3, 9, 12, or 15 dpi ($P \geq .08$). Compared to -1 dpi, eating decreased at 6 dpi and increased at 18 dpi ($P \leq .02$; Figure 4A). Drinking behavior was similar to pre-inoculation rates on 3 dpi ($P = .67$) but was decreased 6 through 18 dpi compared to -1 dpi ($P \leq .02$; Fig. 4B).

Discussion

It was hypothesized that the addition of a nutrient and electrolyte additive through the water or top-dressed in the feed would reduce the negative impact of PRRSV. However, the nutrient additive had minimal effects on sickness behavior and no observed effects on viremia or performance of pigs infected with PRRSV. The ability of diets and feed additives to modulate PRRSV-challenged

Table 1: Ethogram of behaviors recorded via 10-minute scan sampling

Behavior	Definition
Standing	All four hooves were on the pen floor with limbs extended or the pig was walking with limbs in both extension and flexion.
Lying	The pig's body and limbs were in contact with the pen floor.
Sitting	The front limbs were extended and bearing weight and the rear limbs and body were in contact with the pen floor.
Eating	The pig's mouth and nose were inside the feeder.
Drinking	The pig's mouth and nose were inside the waterer.

Table 2: Viremia and antibody titers of barrows inoculated with PRRSV and supplemented with a water only or water and feed additive

		Additive			*P**		
Parameter	Control	Water†	Water+Feed†‡	SEM	TRT	DPI	TRT × DPI
PRRSV titer (RT-PCR Ct§)							
7 dpi	20.47[c]	20.78[c]	20.92[c]	0.53	.12	< .001	.99
14 dpi	29.08[b]	31.22[b]	30.90[b]				
21 dpi	29.58[b]	30.88[b]	30.98[b]				
28 dpi	35.92[a]	36.02[a]	36.62[a]				
35 dpi	35.65[a]	36.85[a]	36.63[a]				
PRRSV antibody (S:P ratio¶)							
7 dpi	0.38[b]	0.52[b]	0.36[b]	0.10	.24	< .001	.69
14 dpi	1.91[a]	1.77[a]	1.91[a]				
21 dpi	1.91[a]	1.75[a]	1.98[a]				
28 dpi	2.00[a]	1.82[a]	1.94[a]				
35 dpi	1.90[a]	1.79[a]	1.90[a]				

* Data were analyzed using the Mixed procedure of SAS with treatment, dpi, and the interaction of treatment and dpi used as fixed effects, and pen was the experimental unit.

† Water additive provided from 1 to 4 dpi at 1:128 inclusion, increased to 3% inclusion from 5 to 8 dpi. A 55% additive (45% water) was included at 3% from 14 to 18 dpi. Water+feed treatment did not receive water additive after 8 dpi.

‡ Feed additive was included at 1.25% of diet. It was hand mixed into diet from 9 to 35 dpi.

§ A Ct ≥ 37 is considered negative.

¶ An S:P ratio ≤ 0.40 is considered negative.

a,b,c Values followed by different superscripts differ statistically ($P < .05$).

PRRSV = porcine reproductive and respiratory syndrome virus; SEM = standard error of the mean; TRT = treatment; dpi = days post inoculation; RT-PCR = reverse transcription-polymerase chain reaction; Ct = cycle threshold; S:P = sample to positive ratio.

pig growth performance,[11-13] viremia, and seroconversion have had mixed results. Studies evaluating the impact of dietary modifications on PRRSV observed improved immune response of pigs receiving high soybean meal diets[11] and soy-derived isoflavones.[12,14,15] In the current study, however, there was no effect of treatment or an interaction on PRRSV titers or serology, which is consistent with other work from our group.[13] The results of the current study could be due to inadequate additive dosage, timing, or nutrient blend.

All animals were naïve for PRRSV prior to starting the trial. At 7 dpi, all pigs were positive for PRRSV as determined by RT-PCR Ct values on serum samples. Cycle threshold was the lowest at 7 dpi, indicating greater virus present in serum at 7 dpi compared with all other time points. Peak PRRSV viremia is typically within the first 7 dpi,[16] but can persist up to 15 dpi.[17] There was no circulating antibody at 7 dpi, but antibody was present from 14 dpi and weekly thereafter. This is consistent with other studies evaluating PRRSV antibody production.[18,19] Circulating antibodies have been detected for PRRSV as early as 9 dpi and have persisted through 105 dpi.[17]

From 0 to 7 dpi, all treatments were on average gaining 46% less and consuming 32% less than the predicted ADG and ADFI, respectively for 25 to 50 kg pigs.[7] This agrees with data where 0 to 14 dpi ADG and ADFI was reduced by 43% and 30%, respectively in pigs challenged with PRRSV compared with naïve pigs.[18] From 7 to 14 dpi, all treatments were improving performance, but were still

Table 3: Growth performance of barrows inoculated with PRRSV and supplemented with a water only or water and feed additive

Parameter	Control	Additive		SEM	*P*‡
		Water*	Water+Feed*†		
Start BW, kg	31.67	31.55	30.92	0.73	.77
0 – 7 dpi					
End BW, kg	34.84	34.59	34.50	0.90	.96
ADG, kg/d	0.45	0.44	0.51	0.06	.63
ADFI, kg/d	1.07	1.08	1.07	0.03	.93
G:F	0.43	0.39	0.48	0.05	.52
7 – 14 dpi					
End BW, kg	38.57	38.70	37.90	0.79	.75
ADG, kg/d	0.54	0.59	0.49	0.05	.34
ADFI, kg/d	1.12	1.17	1.13	0.03	.43
G:F	0.48	0.50	0.43	0.04	.46
14 – 21 dpi					
End BW, kg	43.20	44.18	43.41	0.69	.59
ADG, kg/d	0.66	0.78	0.72	0.05	.30
ADFI, kg/d	1.61	1.63	1.48	0.05	.07
G:F	0.41	0.48	0.48	0.03	.19
21 – 28 dpi					
End BW, kg	52.24	52.87	52.15	0.86	.82
ADG, kg/d	1.29	1.15	1.25	0.06	.27
ADFI, kg/d	2.23	2.05	2.09	0.05	.08
G:F	0.58	0.56	0.60	0.03	.74
28 – 35 dpi					
End BW, kg	58.35	59.80	58.28	0.82	.36
ADG, kg/d	0.88	0.99	0.88	0.05	.14
ADFI, kg/d	2.20	2.28	2.30	0.08	.66
G:F	0.40	0.44	0.38	0.02	.32
Overall (0-35)					
ADG, kg/d	0.76	0.81	0.78	0.02	.25
ADFI, kg/d	1.65	1.65	1.61	0.03	.69
G:F	0.46	0.49	0.49	0.01	.29

* Water additive provided from 1 to 4 dpi at 1:128 inclusion, increased to 3% inclusion from 5 to 8 dpi. A 55% additive (45% water) was included at 3% from 14 to 18 dpi. Water+feed treatment did not receive water additive after 8 dpi.

† Feed additive was included at 1.25% of diet. It was hand mixed into diet from 9 to 35 dpi.

‡ Data were analyzed using the Mixed procedure of SAS with treatment, dpi, and the interaction of treatment and dpi used as fixed effects, and pen was the experimental unit.

PRRSV = porcine reproductive and respiratory syndrome virus; SEM = standard error or the mean; BW = body weight; dpi = days post inoculation; ADG = average daily gain; ADFI = average daily feed intake; G:F = pen feed efficiency.

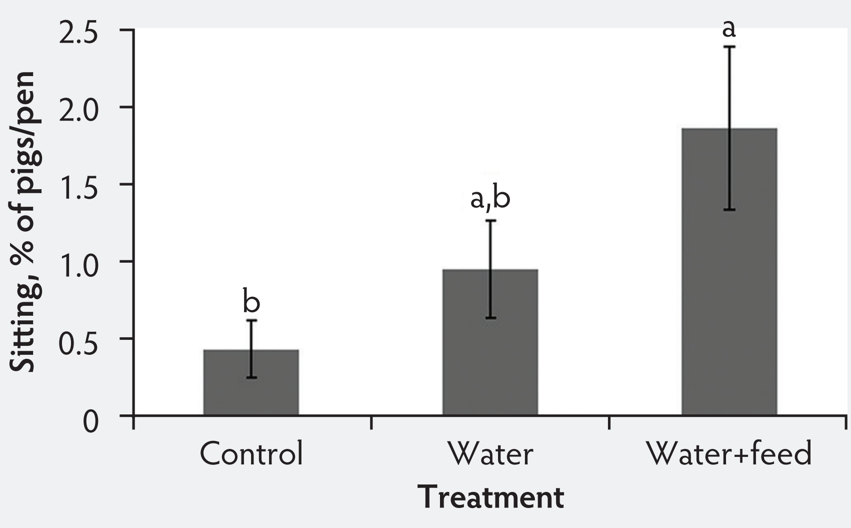
gaining 29% less and consuming 28% less than predicted performance for 25 to 50 kg pigs.[7] This is similar to previous research that has shown PRRSV-infected pigs had decreased ADFI within the first 14 dpi.[11] From 28 to 35 dpi, pigs were on average performing similar to predicted performance for 25 to 50 kg pigs.[7]

Activity differed across dpi, as pigs were observed lying more and standing less on 6 and 9 dpi compared to pre-inoculation rates. Decreased activity is a classic sickness response that is important for facilitating recovery.[8] In the current study, no posture differences were identified until 6 dpi. This is in contrast to a PRRSV infection in 6-week old pigs, where activity differences were observed starting at 2 dpi.[20] As peak viremia occurred 7 dpi in the current study and typically occurs within the first 7 dpi,[16] these postures did not give an early indication of PRRS infection. Sitting was increased on 15 and 18 dpi compared to -1 dpi, which may be related to seroconversion and viral clearance or recovery.

Eating and drinking behaviors differed across dpi. Compared to -1 dpi, eating decreased at 6 dpi and increased at 18 dpi. This is in contrast to 6-week old pigs infected with PRRSV, which exhibited decreased time spent eating and average daily feed intake 1 to 13 dpi.[20] Increased eating behavior at 18 dpi may be related to seroconversion commonly seen by 21 dpi in PRRSV-infected pigs,[4] or a natural change in eating behavior as pigs grew.[21] Drinking behavior was decreased 6 through 18 dpi compared to -1 dpi. Since pigs regained normal eating behavior quicker than drinking behavior, it could suggest that feed delivery of supplements would increase consumption compared to water delivery. However, it is possible that drinking patterns changed as the pigs grew;[21] thus, inclusion of an uninfected, negative control group and water meters affixed to individual pens would have been beneficial. Nevertheless, as water delivery of supplements and medications are common within the swine industry, further investigation of PRRSV impacts on drinking behavior and nutrient delivery are warranted.

In conclusion, the addition of a nutrient and electrolyte additive through the water or top-dressed in the feed had minimal effects on sickness behavior and no observed effects on viremia or performance of pigs infected with PRRSV. However, this study helped improve our understanding of behavioral changes during a PRRSV infection in 10-week old pigs. When behavior was evaluated every 3 days, decreased activity was observed 6 and 9 dpi. While these behaviors did not serve as an early indication of PRRSV infection (ie, before the approximate time of peak viremia), they may help caretakers identify pigs currently undergoing a PRRSV infection. Eating behavior was decreased 6 dpi whereas drinking behavior was decreased from 6 dpi throughout the rest of the behavioral observation period at 18 dpi. Thus, reduced drinking behavior in pigs undergoing a PRRSV infection could impact the efficacy of nutrient supplement delivery.

Figure 2. Percent of pigs observed sitting per pen (least squares means and SE) across all observation days when given no nutrient supplement (control; n = 3 pens), water nutrient supplement (water; n = 3 pens), and water and feed nutrient supplement (water+feed; n = 4 pens). Different superscripts indicate significance at *P* < .05.



Implications

Under the conditions of this study:

- Nutrient additives minimally impacted PRRSV-infected pig performance.
- Nutrient additives minimally impacted PRRSV-infected pig behavior.
- Decreased activity and ingestive behaviors can be indicative of sick pigs.

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Conflict of interest

None reported.

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Figure 3: Percent of pigs observed A) lying, B) standing, and C) sitting per pen (least squares means and SE) across days post inoculation (dpi) with porcine reproductive and respiratory syndrome virus. Different superscripts indicate significance at $P < .05$.

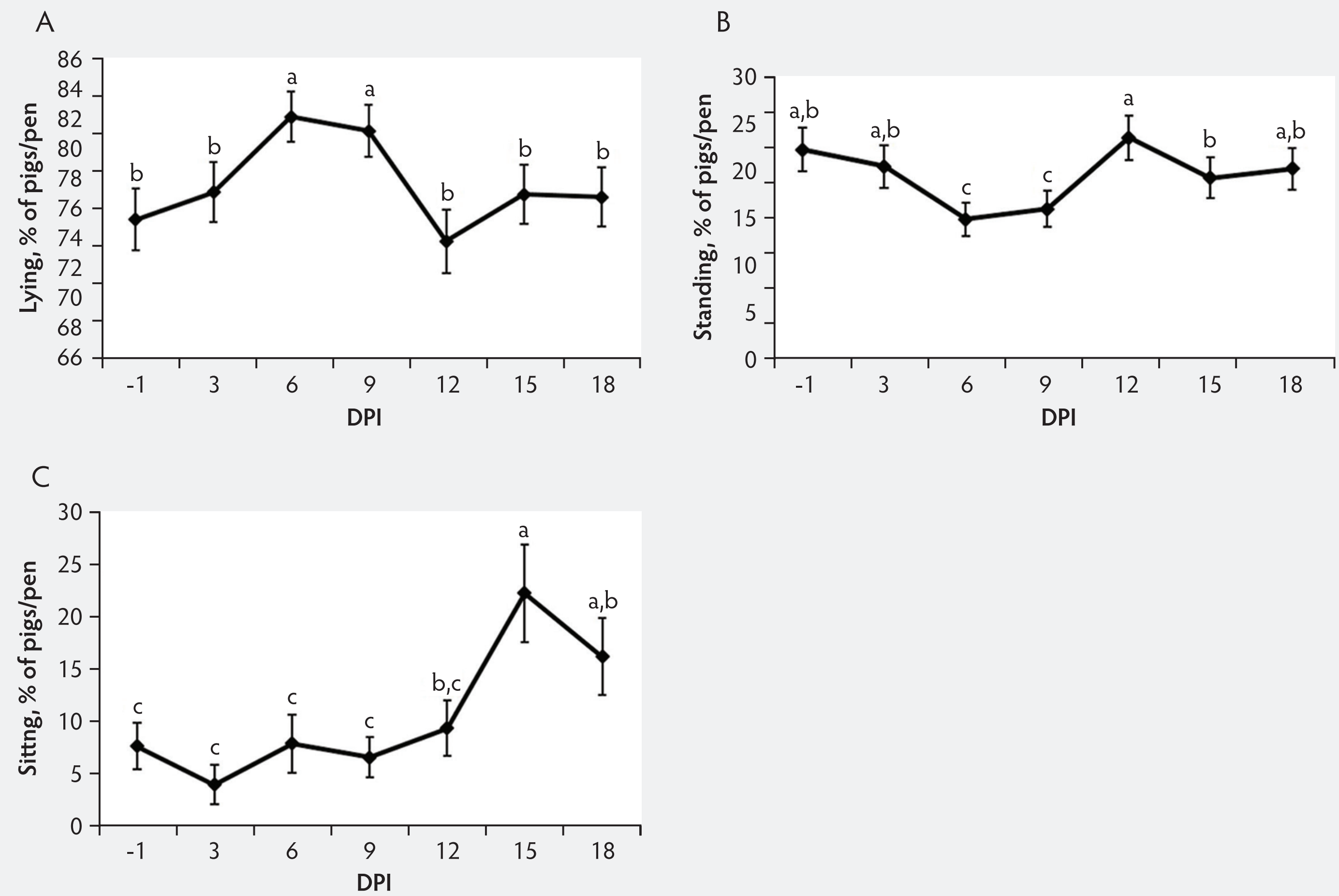
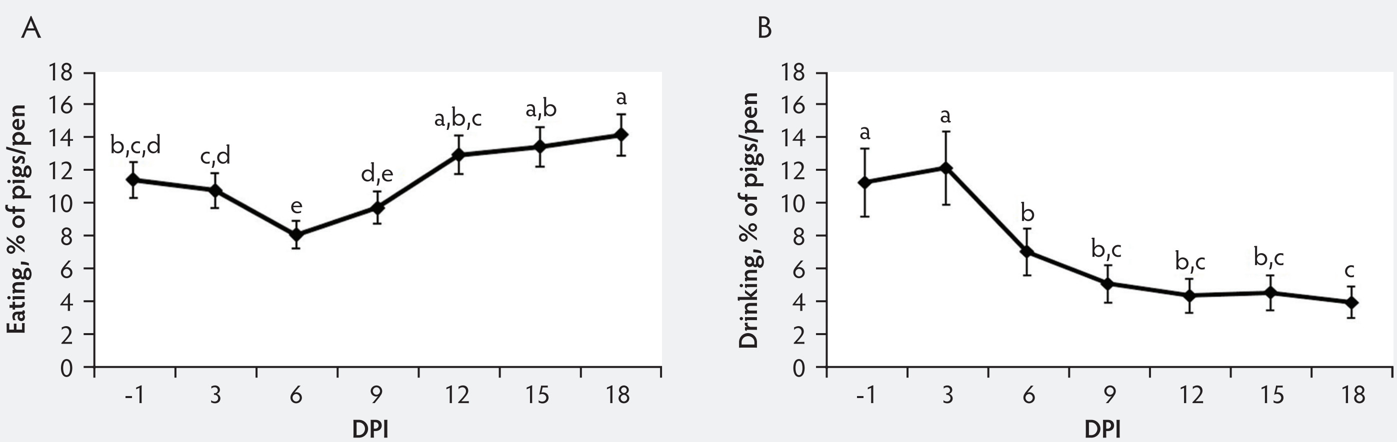


Figure 4: Percent of pigs observed A) eating and B) drinking per pen (least squares means and SE) across days post inoculation (dpi) with porcine reproductive and respiratory syndrome virus. Different superscripts indicate significance at $P < .05$.



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