RESEARCH REPORT
ANIMAL SCIENCE

Title: Evaluating nutritional strategies to mitigate the negative impact PRRS has on grow-finisher pig performance – **NPB #15-099**

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Industry Summary: Of the health challenges the swine industry face, Porcine Reproductive and Respiratory Syndrome (PRRS) virus is arguably one of the most economically costly viruses to U.S. and world pork production. In addition to mortality losses and costs of interventions, this virus may reduce lean tissue accretion and feed efficiency in growing pigs from weaning to market. Therefore, our objective was to determine the growth performance and tissue accretion of pigs given nutritional supplement via water or feed additive during a PRRSV challenge. Thus, this project aimed to test and identify applied nutritional mitigation strategies for feeding PRRS challenged pigs and to mitigate the decrease in growth and feed efficiency caused by PRRS. One hundred and eight PRRS naïve maternal line barrows were allotted to 1 of 3 treatments, 6 pens per treatment and six pigs per pen. The treatments included: 1) PRRSV Control diet, 2) As #1 + water additive, and 3) As #1 + feed additive. Water and feed additive were produced by TechMix LLC and contained a proprietary combination of proteins, amino acids, carbohydrates and electrolytes which included betaine, soy protein isolates, monosodium glutamate, and high fructose corn syrup. All pigs were inoculated with a field strain of PRRSV at day post inoculation (dpi) 0 and performance monitored weekly for approximately 42 days. Pig sickness behavior and blood metabolites and immune markers were also assessed over the challenge period. The results of this project are:

- As expected, all pigs became PRRSV positive and seroconverted in a time dependent manner. No treatment or treatment by time interaction was observed.
- There was no treatment difference in ADG, ADFI, or G:F during weekly performance or overall performance among treatments. From 0 – 14 dpi, all treatments were on average gaining 37% less and

By dpi 28-35, all pigs irrespective of treatment were on average performing similar to predicted performance for pigs 25 – 50 kg (NRC, 2012).

- Pigs whole body, bone mineral content, fat, lean, and protein accretion rates, there was no difference ($P > 0.05$) among water or feed treatments. All treatments, on average, had protein accretion rates that were 51% less than those predicted for 25-50 kg pigs (NRC, 2012).
- No treatment differences in serum glucose, glucagon, insulin, haptoglobin, NEFA, and BUN were observed.
- No differences in sickness behavior (eating, drinking, and sitting) were observed until 6 dpi (less active and reduced eating and drinking behavior). Furthermore, the nutrient supplement treatments had minimal effect on sickness behaviors of PRRS infected pigs
- These nutritional top-dress strategies during peak PRRS infection did not alter grow-finisher pig performance.

Keywords: grower pig, nutrition, PRRS, tissue accretion,

Scientific Abstract: Porcine Reproductive and Respiratory Syndrome (PRRS) virus is a significant respiratory pathogen in grow-finish pigs. Our objective was to determine the growth performance and tissue accretion of pigs given nutritional supplement via water or feed additive during a PRRSV challenge. A 108 PRRSV naïve maternal line (PIC Cambro x Landrace and Landrace x PIC Cambro) barrows (BW 69 ± 3.1 lbs) were weighed and evenly stratified by BW and genetics across 18 pens (6 pens/trt and 6 pigs/pen). Pigs were housed at a commercial barn during the summer months that contains 1 room of 18 pens with curtain-sided ventilation. All pigs were allowed a 5 d adaptation to their environment prior to treatment. Pens were allotted to 1 of 3 treatments: 1) PRRSV Control diet, 2) As #1 + water additive, and 3) As #1 + feed additive. Water and feed additive were produced by TechMix LLC and contained a proprietary combination of proteins, amino acids, carbohydrates and electrolytes which included betaine, soy protein isolates, monosodium glutamate, and high fructose corn syrup. The water and feed additive contained 8.53 and 35.4% CP, respectively. Water additive provided from 1 dpi to 4 dpi at 1:128 inclusion and increased to 3% inclusion from 4 dpi to 8 dpi. Treatment 3 treatment didn't receive water additive after 8 dpi. A 55% water additive (45% water) was included at 3% from 14 dpi to 18 dpi for treatment 2 only. Feed additive was included at 1.25% of ration and was hand mixed into ration from 8 dpi to 35 dpi for treatment 3 only. From dpi 35 – 42, all pigs were on the same water and diet. Water intake was measured for each treatment using water meters on the water line that went to each treatment. Feed intake, BW and G:F were calculated weekly for 42 days dpi. Two days prior to inoculation and again at

dpi 42, a subset of 36 pigs (2 pigs/pen) of the same genetic line and similar to the average pig weight within pen were scanned via dual x-ray absorptiometry (DXA) to determine initial and then final whole body composition and tissue accretion rates then calculated. As expected, all pigs became PRRSV positive and seroconverted in a time dependent (dpi) manner ($P < 0.05$). However, no treatment or treatment by time interaction was observed. No treatment differences in serum glucose, glucagon, insulin, haptoglobin, NEFA, and BUN were observed. In response to the PRRSV challenge, there was no difference ($P< 0.05$) in ADG, ADFI, or G:F during weekly performance or overall performance among treatments. From 0 – 14 dpi, all treatments were on average gaining 37% less and consuming 30% less than the predicted ADG and ADFI, respectively for 25-50 kg pigs (NRC, 2012). By dpi 28-35, all pigs irrespective of treatment were on average performing similar to predicted performance for pigs 25 – 50 kg (NRC, 2012).

Total body, bone mineral content, fat, lean, and protein accretion rates were not difference ($P > 0.05$) among dietary treatments over the 42 dpi challenge period. However, all treatments had protein accretion rates that were 51% less than those predicted for 25-50 kg pigs (NRC, 2012). Further, sickness behavior (eating, drinking, and sitting) differences were not observed until 6 dpi. However, the nutrient supplement treatments had minimal effect on sickness behaviors of PRRS infected pigs. In conclusion, the addition of water and feed supplementation during a PRRSV challenge did not improve (maintain) growth performance or tissue accretion compared with PRRSV control. In addition, serum metabolites were not altered by the addition of either supplementation. It is possible that composition or inclusion of this proprietary water or feed additive may not have been best suited for PRRSV challenge and further work is needed to most likely optimize the amino acid profiles of such supplements.

Introduction: Porcine respiratory and reproductive syndrome (PRRS) causative agent is PRRS virus (PRRSV) and causes clinical signs of reproductive failures, pneumonia, decrease growth performance, and mortality (Neumann et al., 2005). It has been estimated that in the growing pig herd alone, PRRSV causes the pork industry an estimated $360 million annually (Holtkamp et al., 2013). This is due in part to less pigs that are lighter at market when farms are PRRSV positive. In growing pigs, PRRSV has been shown to decrease growth performance and feed efficiency (Escobar et al., 2004; Schweer et al., 2015). In addition, PRRSV has been shown to reduce lean tissue accretion (Gabler et al., 2013). Altering diet composition and nutrient consumption during an immune challenge to promote recovery, performance, or reduce pathogen load is not a new concept (Wellock et al., 2008; Kiarie et al., 2013; Rochell et al., 2015). However, the direct comparison of nutrient delivery during a PRRSV challenge is novel. Our objective was to determine the growth performance and tissue accretion of pigs fed a water additive or water and feed additive during a PRRSV challenge. We hypothesized

that providing additional nutrients during peak PRRS infection either via water or feed delivery would improve growth performance in PRRSV challenged pigs and that this would translate into improved lean accretion. Our experimental approach included longitudinal dual x-ray absorptiometry (DXA) and growth performance assessment of grow-finisher pigs reared in a commercial barn in central Iowa that have been infected with PRRSV.

Objectives: The economic losses caused by Porcine Reproductive and Respiratory Syndrome virus (PRRS) infection are estimated to cost the U.S. swine industry more than $664 million annually (Holtkamp et al., 2013). While significant advances have been made through research efforts to enhance our understanding of PRRS at the animal health and genomic level, this disease still remains a significant issue in the U.S. swine industry. Although we clearly know that PRRSV attenuates ADG of production pigs, we have shown that PPRS infection directly impacts whole body on protein and fat accretion, nutrient and energy digestibility and subsequent carcass quality (NPB 12-162). Most of this negative impact occurs over the first four to six weeks of infection. Therefore, using nutritional strategies to alleviate these negative performance and economic effects of PRRS infection is warranted. Based on data obtained from IPPA 12-113 and NPB 12-162 grants, the objectives of the proposed research are to:

1) *Determine the ability of two nutritional strategies (one feed and one water delivered) on reducing the negative impact PRRS virus infection has on growth performance, tissue accretion and feed efficiency in grower pigs;*

2) *Determine if either of these nutritional strategies during peak PRRS infection alters lifetime grow-finisher pig performance and improves carcass quality.*

Materials & Methods: All experimental protocols herein have been approved by the Institutional Animal Care and Use Committee at Iowa State University, Ames, IA (IACUC #).

Animals, Housing Experimental Design, and Diets

A total of 108 maternal line (PIC Cambro x Landrace and Landrace x PIC Cambro) barrows (BW 69 ± 3.1 lbs) that were PRRSV, naïve were weighed and evenly stratified by BW and genetics across 18 pens (6 pigs/pen). Pigs were housed at a commercial barn during the summer months that contains 1 room of 18 pens with curtain-sided ventilation. All pigs were allowed a 5 d adaptation to their environment prior to treatment.

Pens were allotted to 1 of 3 treatments: 1) PRRSV Control, 2) PRRSV + water additive, and 3) (2) + feed additive. Water and feed additive were produced by TechMix LLC and contained a proprietary

combination of proteins, amino acids, carbohydrates and electrolytes which included betaine, soy protein isolates, monosodium glutamate, and high fructose corn syrup. The water and feed additive contained 8.53 and 35.4% CP, respectively. The timeline of PRRSV inoculation and administration of treatments is outlined in Figure 1. Water additive provided from 1 dpi to 4 dpi at 1:128 inclusion and increased to 3% inclusion from 4 dpi to 8 dpi. Treatment 3 treatment didn't receive water additive after 8 dpi. A 55% water additive (45% water) was included at 3% from 14 dpi to 18 dpi for treatment 2 only. Feed additive was included at 1.25% of ration and was hand mixed into ration from 8 dpi to 35 dpi for treatment 3 only. From dpi 35 – 42, all pigs were on the same water and diet. Water intake was measured for each treatment using water meters on the water line that went to each treatment.

Two basal diets (Phase 1 and 2) were formulated to meet or exceed the NRC (2012) nutrient and energy requirements (Table 1). Pigs were allowed free access to diet and water. Phase 1 diet was fed from start to week 4 and phase 2 diet was fed from week 4 to end of trial. The basal diets were analyzed for DM by oven drying at 135°C for 2 h (method 930.15; AOAC Int., 2007). Nitrogen concentration was analyzed via a TruMac N (LECO Corporation, St. Joseph, MO) and CP was calculated by multiplying N by 6.25. Gross energy was determined using bomb calorimetry (Oxygen Bomb Calorimeter 6200, Parr Instrument Company, Moline, IL) and benzoic acid was used as the standard for bomb calorimeter calibration.

Two d prior to inoculation, a subset of 36 pigs (2 pigs/pen) of the same genetic line and similar to the average pig weight within pen were scanned via dual x-ray absorptiometry (DXA; Hologic Discovery A, Bedford, MA) as previously described ((Suster et al., 2003)) to determine initial whole body composition. The DXA output provided whole body bone, fat, and lean tissue mass while correcting for gut fill and blood volume using internally build calibration curves as described by Suster et al. (2003). The following regression equations were used: Live weight, $y = 1.0822x-1.826$, $R^2=0.9970$; Fat, $y = 0.9515x-1.06$, $R^2=0.9308$; Bone mineral ash, $y = 2.1473x-0.1411$, $R^2=0.9219$; Lean, $y = 1.0668x-0.1411$, $R^2=0.9909$; Protein, $y = 0.2206x-0.6611$, $R^2=0.9758$; where x = DXA results and y = chemical proximate on an empty whole body (i.e. no luminal, urine or gall bladder contents).. Pigs were anesthetized via intramuscular injection with telazol:ketamine:xylozene (2:1:2; 4.4 mg/kg and 2.2 mg/kg, respectively) at a dosage rate of 1 ml per 45.5 kg BW. Once anesthetized, the pigs were placed belly down on the DXA scan table with fore and hind legs extended. After recovery, pigs were transported back to their housing facility. On dpi 41, the same 36 pigs were DXA scanned again to determine final body composition and tissue accretion rates were calculated.

Inoculation and Sample collection

On d 0, all pigs were inoculated with 779 thousand geneomic units of live field strain PRRSV (ORF5 1-18-4 Wild type) that was equally administered via I.M. and intranasally. Blood samples were collected (10 ml)

weekly via jugular venipuncture for analysis. Blood was allowed to clot and then centrifuged at 2000 • g for 10 min at 4°C. Serum was stored at -80°C until analysis or sent to the ISU Veterinary Diagnostic Laboratory for PRRSV serology analysis.

Serum at 7 dpi were used for the following analysis: Human/Canine/Porcine Insulin using Quantikine ELISA (R&D systems, Minneapolis, MN USA), Glucagon using DuoSet ELISA (R&D Systems, Minneapolis, MN, USA), D-Glucose using Glucose Assay Kit (Sigma-Aldrich, Inc., St. Louis, MO, USA), NEFA concentrations using Wako Diagnostic kit (Wako Chemical USA Inc., Richmond, VA, USA), blood urea nitrogen (BUN) using Quantichrom Urea Assay Kit (BioAssay Systems, Hayward, CA, USA) and Porcine Haptoglobin using ELISA (ALPCO, Salemn, NH, USA). All assays were performed per manufacture instructions and read with a Synergy 4 plate reader using Gen 5 software (BioTeck Instruments, Inc., Winooski, VT, USA).

Pig Behavior

Pig home-pen behavior was recorded on 4 color cameras that were positioned above the pens. Video was collected on days post inoculation (dpi) -1 and 3, 6, 9, 12, 15, and 18. Video observations were recorded using a 10-minute scan sampling interval from 7:00-19:00 hours daily by 1 trained observer. Percent of pigs standing, lying, sitting, eating, and drinking within each pen was collected. Data were analyzed using the Glimmix procedure of SAS with a beta distribution to evaluate treatment and diet differences

Calculations and Statistical Analysis

Weekly ADG, ADFI, and G:F were calculated using BW and pen feed intake. Whole body lean, protein, BW, and bone mineral content (BMC) accretion rates (g/d) were calculated by:

$$g/d = \frac{\text{(corrected final scan measurement – corrected initial scan measurement)}}{\text{days between scans}}$$

Data were analyzed using the MIXED procedure of SAS 9.4 (SAS Inst. Inc., Cary, NC). For performance and serology data, treatment, dpi, and the interaction of treatment and dpi were used as fixed effects and pen was the experimental unit. For tissue accretion data, treatment was the fixed effect and pig was used as the experimental unit. Data are reported as treatment least square means with the pooled SEM. Significance was assessed at $P \leq 0.05$.

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Results and Discussion: Phase 1 basal diet contained 95.29% DM and 23.33% CP. Phase 2 basal diet contained 94.68% DM and 18.76% CP.

Porcine reproductive and respiratory syndrome virus infection

All animals were naïve for PRRSV prior to starting the trial. All pigs were positive for PRRSV as determined by qPCR cycle threshold (Ct) on serum samples at 7 dpi (Table 2). There was an effect of dpi on PRRSV titers ($P < 0.001$), were Ct was the least at 7 dpi indicating greater virus present in serum compared with all other time points. Peak PRRSV viremia is typically within the first 7 dpi (Johnson et al., 2004; Islam et al., 2013), but can persist up to 15 dpi (Yoon et al., 1995). There was no effect of treatment or an interaction on PRRSV titers. The sample:positive ratio for PRRSV antibody was used to assess antibody for PRRSV in the serum. There was an effect of dpi ($P < 0.001$) on antibody levels where there was no circulating antibody at 7 dpi, but antibody was present from 14 dpi and weekly thereafter. This is consistent with published data on PRRSV antibody production (Schweer et al., 2015). Circulating antibodies have been detected for PRRSV as early as 9 dpi and have persisted though 105 dpi (Yoon et al., 1995).

Growth performance and tissue accretion

Pig BW and performance are presented in Table 3. There was no difference ($P = 0.767$) in start BW among treatments and therefore it was not used as a covariate in the analysis. There was no difference in ADG, ADFI, or G:F during weekly performance or overall performance among treatments. From 0 – 7 dpi, all treatments were on average gaining 46% less and consuming 32% less than the predicted ADG and ADFI, respectively for 25-50 kg pigs (NRC, 2012). This agrees with published data were 0 – 14 dpi ADG and ADFI was reduced by 43 and 30%, respectively in pigs challenged with PRRSV compared with naïve pigs (Schweer et al., 2015). From 7 – 14 dpi, all treatments were improving performance, but were still gaining 29% less and consuming 28% less than predicted performance for pigs 25 – 50 kg (NRC, 2012). This is similar to previous research that has shown PRRSV infected pigs had decreased ADFI within the first 14 dpi (Rochell et al., 2015). From 28 – 35 dpi, pigs were on average performing similar to predicted performance for pigs 25 – 50 kg (NRC, 2012). Interestingly, pen water intake (gallon/d) did not appear to be related to pig performance, but treatment 3 had a numerically high water intake (Table 4).

Tissue accretion rates were calculated by subtracting initial body composition from final body composition and dividing that by the number of days between scans (Table 5). For total body, BMC, fat, lean, and protein accretion, there was no difference ($P > 0.05$) among treatments. All treatments, on average, had protein accretion rates that were 51% less than those predicted for 25-50 kg pigs (NRC, 2012). Decreased protein accretion may be due to decreased feed intake, but also due to repartitioning of energy in different body tissues. Immune challenges have been shown to alter tissue accretion of pigs compared to naïve pigs (Escobar et al., 2002; Escobar et al., 2004; Gabler et al., 2013). Escobar et al. (2004) determined that PRRSV challenge decreased protein and lipid accretion by 41 and 63% respectively in 4 week old pigs compared with naïve pigs within 7 dpi. In a longer study by Gabler et al. (2013), PRRSV challenge decreased lean and protein accretion

by 14% after 80 dpi in 33 kg pigs. Differences in accretion rates among studies may be due to age of pig, severity of infection, and genetics.

Serum metabolites

Immune stimulation in addition to decreased feed intake would evoke a catabolic state within the animal. Therefore, measured serum metabolites as indicators of metabolic status. We expected the addition of water or water and feed additive would increase circulating glucose, decrease glucagon, and decrease NEFA and BUN concentrations. This was our speculation based on the understanding that the addition of AA and glucose in the water would provide substrates for protein synthesis and energy, respectively, despite the decrease in feed intake and therefore reduce the severity of the catabolism. Serum from 7 dpi were used to determine circulating glucose, glucagon, insulin, haptoglobin, NEFA, and BUN. There were no difference ($P > 0.05$) among treatments for each of these measurements. The average glucose and glucagon concentrations among the treatments were 57.42 mg/dl and 51.80 pg/ml, respectively. Insulin concentrations were on average 0.30 ng/ml. Average haptoglobin concentrations among treatments were similar to serum levels from diseased pigs infected with PRRSV in field conditions (Gutierrez et al., 2009). Serum NEFA concentration was on average 0.24 mmol/l and BUN was on average 5.86 mg/dl. The variability among each of these metabolites were low and therefore the addition of water or feed additive did not change these serum metabolites concentration compared to the PRRSV control. This indicates that post-absorptive metabolic changes that occur because of PRRSV were not ameliorated by either water or water and feed additive.

Pig Behavior

Pigs given the feed supplement showed an increase in sitting behavior compared to the control and water supplement treatments ($P < 0.05$). No differences were observed among treatments for lying, standing, eating, or drinking behaviors ($P > 0.05$). On 6 and 9 dpi an increase in lying behavior was observed compared to -1 dpi ($P < 0.05$). Compared to -1 dpi, a decrease in sitting behavior was observed 9 dpi whereas an increase in sitting behavior was observed 15 dpi ($P < 0.05$). Standing behavior decreased on 6 and 9 dpi compared to -1 dpi ($P \leq 0.05$). On 6 dpi eating behavior decreased whereas on 15 and 18 dpi eating behavior increased compared to -1 dpi ($P < 0.05$). Compared to -1 dpi, drinking behavior was reduced in pigs on 6 – 18 dpi ($P < 0.05$). In conclusion, no differences in sickness behavior were observed until 6 dpi. On 6 and 9 dpi pigs were less active than baseline; however, activity was similar to baseline on 3 and 12 – 18 dpi. Eating behavior was only decreased on 6 dpi; however, drinking behavior decreased on 6 dpi and did not return to baseline by 18 dpi. Furthermore, the nutrient supplement treatments had minimal effect on sickness behaviors of PRRS infected pigs.

In conclusion, the addition of a water and feed supplementation on top of regular diet during a PRRSV challenge did not maintain or improve growth performance or tissue accretion compared with PRRSV control. In addition, serum metabolites were not altered by the addition of either supplementation. It is possible that composition or inclusion of this proprietary water or feed additive may not have been best suited for PRRSV challenge and further work is needed to most likely optimize the amino acid profiles of such supplements.

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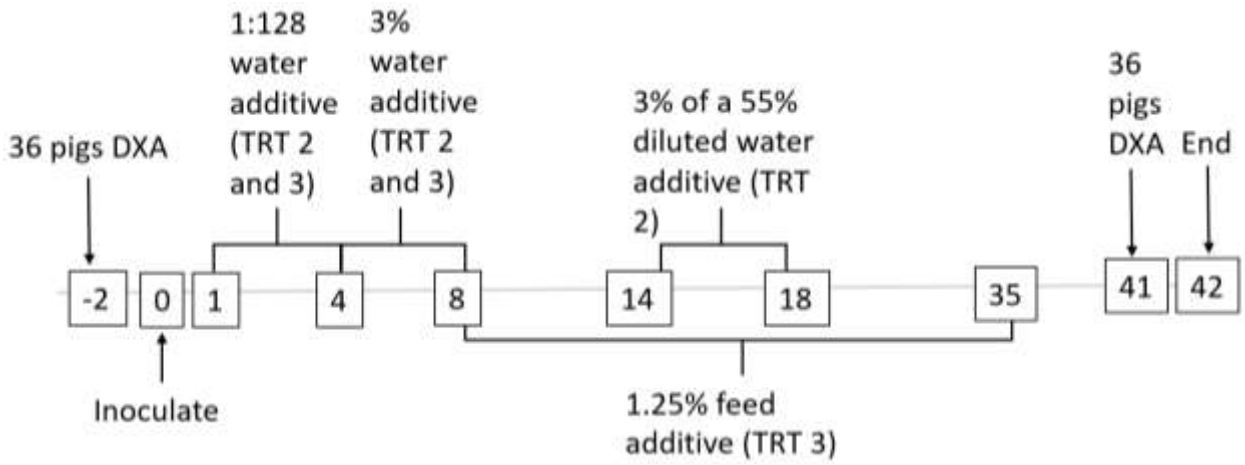

Figure 1. Timeline (days) of, PRRS incolution, water and feed additives and body compositiuon (DXA) scanning.

Table 1. Composition of basal diet, % as-fed

Ingredient	Phase 1[a]	Phase 2[b]
Corn	42.85	53.82
Soybean meal, 46.2% CP	30.35	19.60
DDGS	20.00	20.00
Fat	3.75	3.44
Calcium	1.14	1.31
Monocalcium diphosphate 21%	0.50	0.78
SG Sow 3# #6727 w-Bac	0.15	-
SG G/F 3# #6700 No XYL	-	0.15
Salt	0.41	0.43
Lysine sulfate, 54.6%	0.53	0.39
Dry – MHA	0.17	0.04
Vitamin E, 20K	0.05	-
L-Threonine	0.05	0.02
Optiphos 1000	0.02	-
Copper chloride	0.03	0.02
Calculated composition		
ME, kcal/kg	3450	3422
Crude protein, %	23.1	18.7
Total Lysine, %	1.25	1.07
Ca:P ratio	1.15	1.20
Analyzed composition		
DM, %	95.29	94.68
CP, %	23.33	18.76

[a]Phase 1 was fed up through week 4.
[b]Phase 2 was fed starting week 5 through the end of the trial.

Table 2. Viremia and antibody titers of barrows inoculated with porcine respiratory and reproductive syndrome virus (PRRSV) and supplemented with a water and/or feed additive.

Parameter	Control	Additive		SEM	TRT[4]	DPI[5]	TRT*DPI
		Water[1]	Water + Feed[1,2]				
PRRS titer (qPCR Ct[3])							
7 dpi	20.47[c]	20.78[c]	20.92[c]	0.525	0.120	<0.001	0.986
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]				
PRRSX3 antibody (S/P ratio)							
7 dpi	0.38[b]	0.52[b]	0.36[b]	0.097	0.235	<0.001	0.694
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]				

[1]Water additive provided from 1 dpi to 4 dpi at 1:128 inclusion, increased to 3% inclusion from 4 dpi to 8 dpi. Water + feed treatment didn't receive water additive after 8 dpi. A 55% additive (45% water) was included at 3% from 14 dpi to 18 dpi.

[2]Feed additive was included at 1.25% of ration. It was hand mixed in to ration from 8 dpi to 35 dpi.

[3]Ct = cycle threshold; a Ct > 37 is considered negative.

[4]TRT = treatment.

[5]DPI = days post inoculation.

Table 3. Growth performance of barrows inoculated with porcine respiratory and reproductive syndrome virus (PRRSV) for 41 days and supplemented with a water and/or feed additive.

		Additive			
Parameter	Control	Water[1]	Water + Feed[1,2]	SEM	*P*-value
Start BW, lbs	69.81	69.56	68.17	1.620	0.767
0 – 7 dpi					
End BW, lbs	76.81	76.25	76.06	1.978	0.962
ADG, lbs/d	1.00	0.96	1.13	0.128	0.628
ADFI, lbs/d	2.36	2.39	2.36	0.070	0.934
G:F	0.43	0.39	0.48	0.054	0.518
7 – 14 dpi					
End BW, lbs	85.03	85.31	83.56	1.752	0.754
ADG, lbs/d	1.18	1.29	1.07	0.104	0.344
ADFI, lbs/d	2.47	2.58	2.49	0.060	0.431
G:F	0.48	0.50	0.43	0.040	0.464
14 – 21 dpi					
End BW, lbs	95.25	97.39	95.71	1.517	0.587
ADG, lbs/d	1.46	1.73	1.59	0.116	0.295
ADFI, lbs/d	3.56	3.60	3.26	0.103	0.070
G:F	0.41	0.48	0.48	0.031	0.194
21 – 28 dpi					
End BW, lbs	115.17	116.56	114.98	1.892	0.816
ADG, lbs/d	2.85	2.54	2.75	0.133	0.273
ADFI, lbs/d	4.91	4.53	4.61	0.116	0.077
G:F	0.58	0.56	0.60	0.031	0.742
28 – 35 dpi					
End BW, lbs	128.64	131.83	128.48	1.798	0.356
ADG, lbs/d	1.93	2.18	1.93	0.098	0.135
ADFI, lbs/d	4.86	5.03	5.08	0.177	0.662
G:F	0.40	0.44	0.38	0.024	0.321
35 – 42 dpi					
End BW, lbs	143.89	147.33	144.03	2.091	0.440
ADG, lbs/d	2.54	2.58	2.52	0.157	0.960
ADFI, lbs/d	5.05	4.79	4.91	0.130	0.390
G:F	0.51	0.54	0.51	0.035	0.784
0 – 42 dpi					
End BW, lbs	1.82	1.88	1.83	0.033	0.445
ADG, lbs/d	3.87	3.82	3.79	0.059	0.626
ADFI, lbs/d	0.47	0.49	0.48	0.010	0.456

[1]Water additive provided from 1 dpi to 4 dpi at 1:128 inclusion, increased to 3% inclusion from 4 dpi to 8 dpi. Water + feed treatment didn't receive water additive after 8 dpi. A 55% additive (45% water) was included at 3% from 14 dpi to 18 dpi.

[2]Feed additive was included at 1.25% of ration. It was hand mixed in to ration from 8 dpi to 35 dpi.

Table 4. Average daily pen water intake (gallons/day) for barrows challenge with porcine respiratory and reproductive syndrome virus (PRRSV) for 41 days and supplemented with a water and feed additive[1].

		Additive	
Days post inoculation	Control	Water[2]	Water + Feed[2,3]
7	5.9	6.0	8.6
14	5.1	6.1	4.5
21	6.5	6.6	10.8
28	9.3	8.6	14.7
35	8.6	8.2	13.7
41	8.0	7.9	13.4

[1]Control treatment was represented by 1 pen's water intake. Water and Water + Feed treatments were represented by two water meters that measured 6 pens intakes per treatment.
[2]Water additive provided from 1 dpi to 4 dpi at 1:128 inclusion, increased to 3% inclusion from 4 dpi to 8 dpi. Water + feed treatment didn't receive water additive after 8 dpi. A 55% additive (45% water) was included at 3% from 14 dpi to 18 dpi.
[3]Feed additive was included at 1.25% of ration. It was hand mixed in to ration from 8 dpi to 35 dpi.

Table 5. Whole body accretion (g/d) of bone mineral content, adipose, lean, protein, body weight and bone mineral density of barrows inoculated with porcine respiratory and reproductive syndrome virus (PRRSV) for 41 days and supplemented with a water and feed additive.

Parameter	Control	Additive		SEM	*P*-value[3]
		Water[1]	Water + Feed[1,2]		
Total body[4], g/d	922.59	953.93	950.43	30.926	0.732
BMC[5], g/d	28.90	31.24	28.14	1.202	0.181
Fat, g/d	156.92	167.65	168.80	7.035	0.427
Lean, g/d	720.85	736.87	733.67	23.346	0.874
Protein, g/d	135.55	138.56	137.96	4.390	0.874
BMD[6], g/cm^2	0.934	0.939	0.943	0.014	0.801

[1]Water additive provided from 1 dpi to 4 dpi at 1:128 inclusion, increased to 3% inclusion from 4 dpi to 8 dpi. Water + feed treatment didn't receive water additive after 8 dpi. A 55% additive (45% water) was included at 3% from 14 dpi to 18 dpi.
[2]Feed additive was included at 1.25% of ration. It was hand mixed in to ration from 8 dpi to 35 dpi.
[3]There was no significant ($P < 0.05$) effect of genetics or an interaction between genetics and treatment for any of the parameters.
[4]BW = DXA predicted total body weight accretion.
[5]BMC = bone mineral content.
[6]BMD = End time point whole body bone mineral density