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## Effects of Liquitein on weanling pigs administered a Porcine Circovirus Type 2 and *Mycoplasma hyopneumoniae* vaccine strategy

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# Effects of Liquitein on Weanling Pigs Administered a Porcine Circovirus Type 2 and *Mycoplasma hyopneumoniae* Vaccine Strategy<sup>1</sup>

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## Summary

A total of 180 nursery pigs (PIC 327 × 1050, initially  $12.6 \pm 0.22$  lb, and  $19 \pm 2$  d of age) were used in a 35-d study to determine the effects of Liquitein and a porcine circovirus 2 (PCV2)/*Mycoplasma hyopneumoniae* (*M. hyo*) vaccine regimen on the growth performance of weanling pigs. Liquitein (TechMix, LLC Stewart, MN) is a water-soluble source of plasma and energy provided in the drinking water immediately after weaning. Pigs were randomly allotted to 1 of 4 treatments arranged in a  $2 \times 2$  factorial with main effects of Liquitein (with or without) and PCV2/*M. hyo* vaccine regimen (vaccinates or non-vaccinates) with 5 pigs per pen and 9 pens per treatment. At weaning, pigs in the vaccinate group were given a full dose (2 mL) of ResprisureOne (Pfizer Animal Health, New York, NY) and Circumvent (Intervet/Schering-Plough Animal Health, Millsboro, DE). On d 21, pigs in the vaccinate group were administered a second full dose (2 mL) of Circumvent per label instructions. Liquitein was administered to the pigs via water medicators for the first 5 d after arrival to the nursery. No vaccine × Liquitein interactions occurred for ADG or F/G throughout the study. From d 0 to 5, non-vaccinated pigs had a tendency ( $P < 0.07$ ) for increased ADG. From d 21 to 35, pigs previously administered Liquitein had greater ADFI ( $P = 0.05$ ) than those not provided Liquitein; however, overall (d 0 to 35) Liquitein had no effects on growth performance. From d 0 to 35, vaccinated pigs had decreased ( $P < 0.01$ ) ADG and ADFI compared with non-vaccinated pigs. In conclusion, administering Liquitein during the first 5 d in the nursery increased feed intake later in the nursery stage (d 21 to 35), but the response was not great enough to influence overall growth performance. Pigs administered the PCV2 and *M. hyo* vaccine regimen had decreased ADG and ADFI.

Key words: growth, liquid supplement, PCV2, weanling pig

## Introduction

Weaning poses new challenges to the young pig such as a sudden change in diet and navigating social hierarchy. Consequently, postweaning pigs typically do not eat large quantities of feed in the first 24 to 72 h, which becomes problematic because sufficient nutrient intake is imperative to maintain gut integrity. To further compound the issue, anecdotal field reports have indicated that producers are having increased difficulty starting and maintaining weaned pigs on feed. These reports seem to have correlated

<sup>1</sup> Appreciation is expressed to TechMix, LLC, Stewart, MN, for providing the Liquitein and partial financial support.

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with the wide-scale vaccination of weaned pigs for PCV2. Subsequent research trials at Kansas State University have indicated that PCV2 and *M. hyo* result in reduced nursery growth rate because of reduced feed intake (Kane et al., 2009<sup>4</sup>; Potter, 2010<sup>5</sup>).

Spray-dried animal plasma has been shown to improve both growth performance and feed intake in newly weaned pigs. Previous research has indicated that providing water-soluble plasma improved growth performance in newly weaned pigs (Steidinger et al., 2002)<sup>6</sup>. Liquitein, a new product, recently has become available. Liquitein is a high-density, ready-to-use source of plasma and digestible energy. It is shelf-stable and can be administered through water lines during the weaning period or other times of low feed intake and stress; therefore, our hypothesis was that providing nutrients through the water may be an effective method in combating postvaccination feed intake reduction. The objective of the study was to evaluate the effects of Liquitein and a PCV2 and *M. hyo* vaccine regimen on growth performance of nursery pigs.

## Procedures

All practices and procedures used in these experiments were approved by the Kansas State University Institutional Animal Care and Use Committee.

A total of 180 nursery pigs (C327 × 1050, PIC, Hendersonville, TN) with an initial BW of  $12.6 \pm 0.22$  lb and  $19 \pm 2$  d of age were used in a 35-d study. Pigs were transported approximately 7 h (387 miles) from the sow farm to the K-State Segregated Early Weaning facility in Manhattan. The facility is a totally enclosed, environmentally regulated, mechanically ventilated barn with 40 12.9 ft<sup>2</sup> pens located over metal tri-bar flooring. Each pen housed 5 pigs and provided 3.2 ft<sup>2</sup> floor space per pig. Pigs were provided unlimited access to feed and water via a 4-hole dry self-feeder (17.3 in.) and 1-cup waterer.

After arrival to the segregated early weaning facility, pigs were allotted to 1 of 4 treatments arranged in a 2 × 2 factorial with main effects of Liquitein (with or without) and a PCV2 and *M. hyo* vaccine regimen (vaccinates or non-vaccinates) with 5 pigs per pen and 9 pens per treatment.

Liquitein was provided to the pigs via water medicators (Select Doser 640; Genesis Instruments, Elmwood, WI) set at a ratio of 50:1 (50 parts water to 1 part Liquitein) for the first 5 d after arrival to the nursery. Liquitein is a ready-to-use product, which allowed for the water medicator to draw Liquitein directly out of the container using peristaltic action to pump the product into the water. For all treatments, waterers were shut off until the pigs were allotted and placed into their respective pens for the experiment. After allotment, Liquitein treatment waterers were flushed until Liquitein

<sup>4</sup> Kane, E. M., M. L. Potter, J. R. Bergstrom, S. S. Dritz, M. D. Tokach, J. M. DeRouchey, R. D. Goodband, and J. L. Nelssen. 2009. Effects of diet source and timing of porcine circovirus type 2 (PCV2) and *Mycoplasma hyopneumoniae* vaccines on post-weaning nursery pig performance. *J. Anim. Sci.* 87 (E-Suppl 3):7 (Abstr.).

<sup>5</sup> Potter, M. L. 2010. Effects of Circovirus vaccination on immune responses, viral load, and growth performance of pigs under field conditions. PhD Diss. Kansas State University, Manhattan, KS.

<sup>6</sup> Steidinger, M. U., R. D. Goodband, M. D. Tokach, J. L. Nelssen, S. S. Dritz, B. S. Borg, and J. M. Campbell. 2002. Effects of providing a water soluble globulin in drinking water and diet complexity on growth performance of weaning pigs. *J. Anim. Sci.* 80:3065-3072.

appeared in the cup. For the duration of the Liquitein treatment, the container with the Liquitein was weighed daily and usage recorded. Lines distributing Liquitein were flushed daily to ensure a constant supply of product.

On d 0 (weaning), pigs in the vaccinate group were given a full dose (2 mL) each of ResprisureOne and Circumvent. Again on d 21, pigs in the vaccinate group were administered a second full dose (2 mL) of Circumvent. All vaccines were administered as separate intramuscular injections according to label directions.

Common 3-phase diets were fed for the duration of the trial (Table 1). Phase 1 diets were fed from d 0 to 5 and were in pellet form. Phase 2 and 3 diets were fed from d 5 to 21 and d 21 to 35, respectively, and were in meal form. Pigs were weighed on d 0, 2, 5, 7, 14, 21, 23, 25, and 35. Feed disappearance was measured on d 0, 1, 2, 3, 4, 5, 7, 14, 21, 22, 23, 24, 25, and 35. The frequent weighing and feed intake measurements were done to determine the immediate effects of vaccine administration. These measurements were used to calculate ADG, ADFI, F/G, and DMI.

Data were analyzed as a  $2 \times 2$  factorial in a completely randomized design using the PROC MIXED procedure of SAS (SAS Institute Inc., Cary, NC). Pen was used as the experimental unit. When significant interactions ( $P < 0.05$ ) were observed, least significant differences (LSDs) were the method used to separate the means. Results were considered significant at  $P \leq 0.05$ .

## Results and Discussion

No vaccine  $\times$  Liquitein interactions were observed for ADG or F/G for the duration of the study (Table 2).

One objective of our study was to evaluate ADG and ADFI immediately following administration of PCV2/*M. hyo* vaccination. To achieve this, we measured ADFI daily for 5 d after the first ResprisureOne and Circumvent (d 0) and second Circumvent vaccination (d 21). By d 3, pigs in the non-vaccinate group had increased ( $P < 0.05$ ) ADFI compared with pigs in the vaccinate group (Figure 1). On d 4, a vaccine  $\times$  Liquitein interaction ( $P < 0.05$ ) was observed for ADFI. The interaction is a result of non-vaccinate pigs that did not receive Liquitein via their drinking water having increased ADFI compared with all other treatments. On d 7, a vaccine  $\times$  Liquitein interaction ( $P < 0.05$ ) for ADFI was observed where pigs in the vaccinate group who had not been previously administered Liquitein demonstrated increased ADFI compared with all other treatments. Average daily gain (data not shown) was affected by dehydration of the pigs during transportation (approximately 7 h from IL) to the facility.

From d 0 to 5, the period immediately following the first injection, a tendency ( $P = 0.07$ ) was observed for pigs administered PCV2/*M. hyo* vaccine regimen to have decreased ADG compared with the non-vaccinate group. Although not significant, pigs administered Liquitein during this period had a numerical tendency ( $P = 0.11$ ) for increased ADG and dry matter ADFI (DMFI).

From d 5 to 21 and 0 to 21, pigs administered PCV2/*M. hyo* vaccine regimen had decreased ( $P < 0.05$ ) ADG compared with pigs in the non-vaccinate group. No significant differences were observed for Liquitein.

From d 21 to 25, pigs administered PCV2/*M. hyo* vaccine regimen had lower ( $P < 0.01$ ) ADG and ADFI compared with pigs in the non-vaccinate group. As a result of the reduced feed intake, a tendency ( $P < 0.07$ ) was measured for pigs administered PCV2/*M. hyo* vaccine regimen to have decreased F/G compared with pigs in the non-vaccinate group. No significant differences were observed for Liquitein.

The stress of diet change and vaccination could perhaps explain the decrease in growth performance seen from d 21 to 23 and 23 to 25, where pigs administered PCV2/*M. hyo* vaccine regimen had decreased ( $P < 0.05$ ) ADG compared with pigs in the non-vaccinate group (Figure 2). On d 23 and 35, pigs in the non-vaccinate group had increased ( $P < 0.05$ ) ADFI compared with pigs in the vaccinate group (Figure 3).

From d 21 to 35, pigs administered PCV2/*M. hyo* vaccine regimen had decreased ( $P < 0.01$ ) ADG and ADFI compared with pigs in the non-vaccinate group. Pigs previously administered Liquitein had increased ( $P < 0.05$ ) ADFI compared with pigs that were not provided Liquitein. Why pigs previously administered Liquitein had increased ADFI during this period is unclear; however, other studies that have evaluated Liquitein also have observed the same postadministration increase in ADFI (unpublished data). Several theories have evolved regarding the increase in ADFI observed post-Liquitein administration. Perhaps Liquitein aids in maintaining the gut brush border, helping to boost immunity and consequently improve the piglet's ability to handle the stress of the second vaccination.

Overall, no significant differences were observed for Liquitein. Pigs administered PCV2/*M. hyo* vaccine regimen had decreased ( $P < 0.01$ ) ADG and ADFI compared with pigs in the non-vaccinate group.

In conclusion, administering Liquitein during the first 5 d in the nursery increased feed intake later in the nursery stage (d 21 to 35), but the response was not great enough to influence overall growth performance; however, pigs administered the PCV2 and *M. hyo* vaccine regimen had decreased ADG and ADFI.

**Table 1. Composition of diets (as-fed basis)<sup>1</sup>**

Item	SEW <sup>2</sup>	Phase 2 <sup>3</sup>	Phase 3 <sup>4</sup>
Ingredient, %			
Corn	38.50	53.45	62.80
Soybean meal (46.5% CP)	25.00	25.85	32.25
Spray-dried animal plasma	5.00	---	---
PEP-NS	---	6.00	---
Spray-dried whey	25.00	10.00	---
Soybean oil	3.00	1.00	1.00
Monocalcium P (21% P)	1.18	1.15	1.25
Limestone	1.03	0.93	1.05
Salt	0.35	0.35	0.35
Zinc oxide	0.25	0.25	0.25
Vitamin premix	0.25	0.25	0.25
Trace mineral premix	0.15	0.15	0.15
L-Lysine HCl	0.16	0.30	0.33
DL-Methionine	0.13	0.15	0.14
L-Threonine	0.03	0.13	0.13
Phytase <sup>5</sup>	---	0.05	0.05
Total	100.00	100.00	100.00
Calculated analysis			
Standardized ileal digestible amino acids, %			
Lysine	1.40	1.30	1.26
Isoleucine:lysine	59	60	61
Methionine:lysine	29	35	34
Met & Cys:lysine	58	58	59
Threonine:lysine	63	63	63
Tryptophan:lysine	19	17	18
Valine:lysine	69	67	68
Total lysine, %	1.55	1.46	1.39
CP, %	22.1	21.1	20.8
ME kcal/kg	3,140	3,331	3,349
Ca, %	0.90	0.75	0.76
P, %	0.79	0.68	0.66
Available P, %	0.55	0.47	0.34

<sup>1</sup> A total of 180 nursery pigs (C327 × 1050, PIC, Hendersonville, TN) with an initial BW of 12.6 lb and 19 ± 2 d of age were used in a 35-d study.

<sup>2</sup> The SEW diet was a common diet fed the first 7 d postweaning and was in pellet form.

<sup>3</sup> Phase 2 diets were fed from d 0 to 14 and were in meal form.

<sup>4</sup> Phase 3 diet was a common diet fed from d 14 to 24 and was in meal form.

<sup>5</sup> Phyzyme 600 (Danisco Animal Nutrition, St. Louis, MO) provided 231 FTU/lb, with a release of 0.10 available P.

**Table 2. Effects of Liquitein and vaccine regimen on nursery pig performance<sup>1</sup>**

Item	Liquitein <sup>2</sup>		No Liquitein		SEM	V × L <sup>3</sup>	Vaccine	Liquitein
	No	PCV2/ <i>M. hyo</i>	No	PCV2/ <i>M. hyo</i>				
d 0 to 5								
ADG, lb	0.39	0.35	0.36	0.30	0.03	0.60	0.07	0.11
ADFI, lb	0.24	0.23	0.24	0.20	0.02	0.30	0.17	0.52
DMADFI, lb	0.23	0.22	0.22	0.17	0.02	0.31	0.17	0.10
F/G	0.607	0.658	0.678	0.665	0.03	0.34	0.58	0.24
DM F/G <sup>4</sup>	0.588	0.640	0.605	0.594	0.03	0.30	0.52	0.63
d 5 to 21								
ADG, lb	0.70	0.63	0.68	0.66	0.02	0.31	0.04	0.86
ADFI, lb	0.92	0.87	0.91	0.87	0.03	0.98	0.19	0.85
F/G	1.316	1.380	1.336	1.322	0.03	0.16	0.35	0.48
d 0 to 21								
ADG, lb	0.47	0.44	0.46	0.41	0.02	0.72	0.05	0.30
ADFI, lb	0.51	0.48	0.50	0.46	0.03	0.83	0.15	0.48
F/G	1.084	1.097	1.088	1.114	0.03	0.84	0.55	0.75
d 21 to 25								
ADG, lb	0.91	0.62	0.77	0.62	0.04	0.11	0.001	0.13
ADFI, lb	1.42	1.05	1.30	1.10	0.05	0.11	0.001	0.49
F/G	1.583	1.740	1.688	1.791	0.07	0.69	0.06	0.26
d 21 to 35								
ADG, lb	1.10	0.98	1.05	0.91	0.05	0.87	0.006	0.18
ADFI, lb	1.91	1.67	1.80	1.60	0.04	0.66	0.001	0.05
F/G	1.744	1.736	1.747	1.783	0.07	0.76	0.85	0.73
d 0 to 35								
ADG, lb	0.82	0.73	0.78	0.71	0.02	0.83	0.001	0.23
ADFI, lb	1.21	1.09	1.17	1.06	0.03	0.78	0.001	0.21
F/G	1.495	1.508	1.505	1.511	0.04	0.92	0.77	0.85

<sup>1</sup> A total of 180 nursery pigs (PIC C327 × 1050) with an initial BW of 12.6 lb and 19 ± 2 d of age were used in a 35-d study to evaluate the effects of Liquitein and porcine circovirus type 2 (PCV2) and *Mycoplasma hyopneumoniae* (*M. hyo*) vaccine regimen on growth performance of nursery pigs.

<sup>2</sup> Liquitein (Protein Resources; West Bend, IA) was added to the water lines at a ratio of 50:1. Liquitein disappearance was measured by weighing the container and was 1.10, 1.70, 5.20, 0.40, and 1.61 lb for days 1, 2, 3, 4, 5, respectively.

<sup>3</sup> V × L = vaccine × Liquitein interaction.

<sup>4</sup> Calculated by dividing ADG by DMI from both feed and liquid.



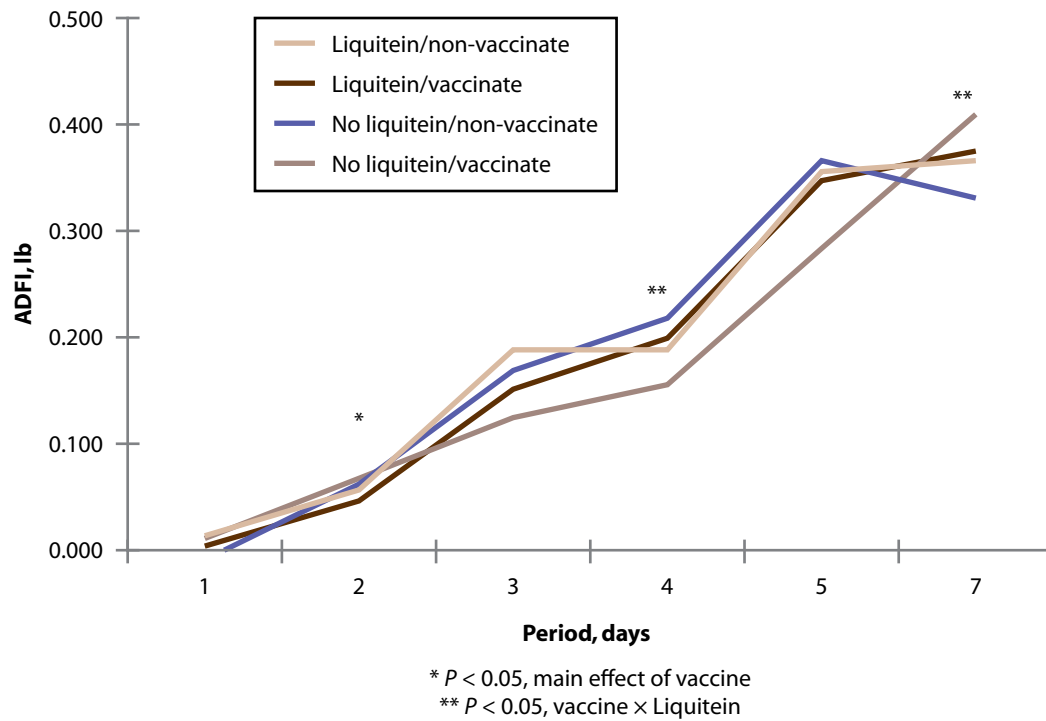


Figure 1: Effects of Liquitein and PCV2/*M. hyo* vaccine strategy on ADFI.

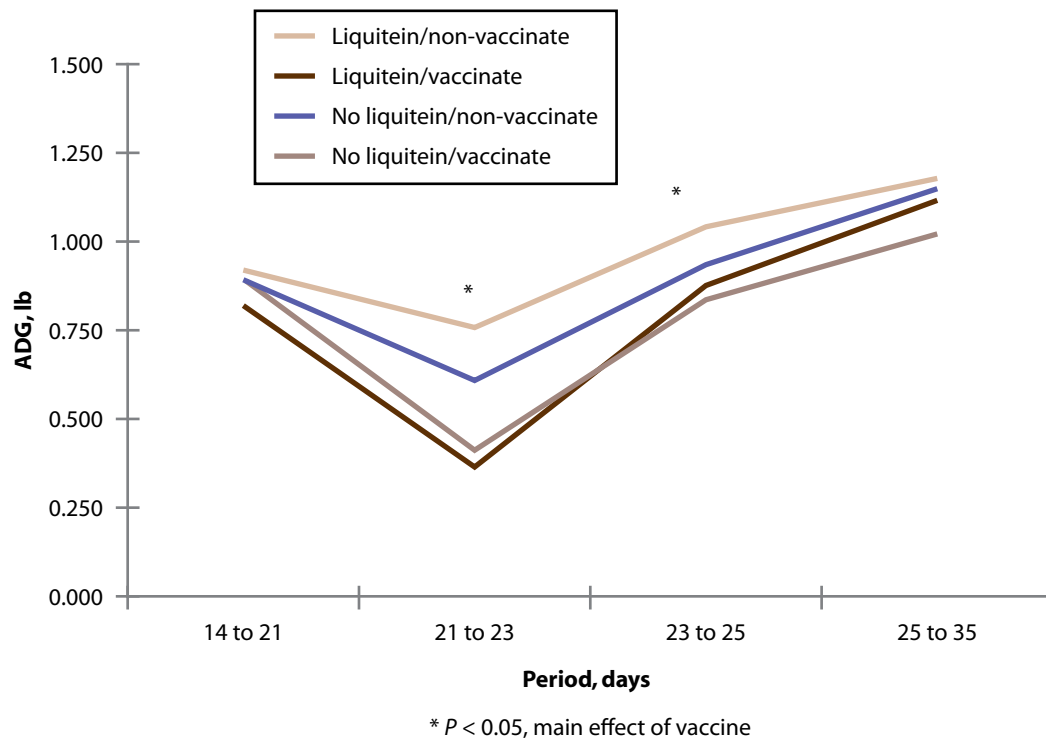
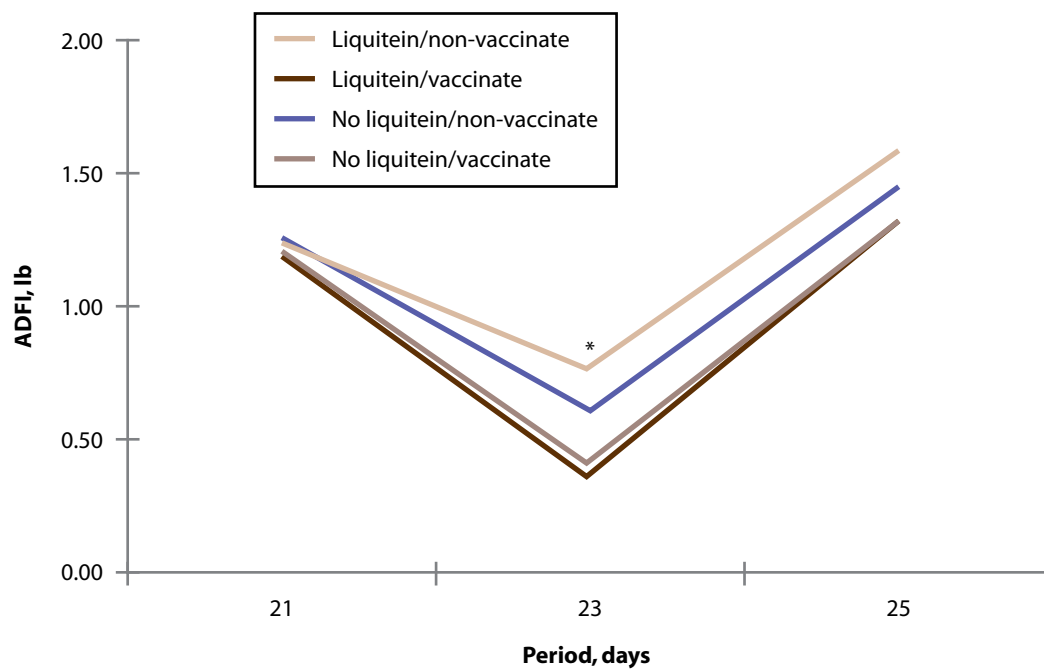


Figure 2: Effects of Liquitein and PCV2/*M. hyo* vaccine strategy on ADG.



\*  $P < 0.05$ , main effect of vaccine

Figure 3: Effects of Liquitein and PCV2/*M. hyo* vaccine strategy on ADFI.