Kansas Agricultural Experiment Station Research Reports

Volume 8
Issue 10 *Swine Day*

Article 20

2022

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Recommended Citation

Warner, Alan J.; Carrender, Brittany; Tokach, Mike D.; DeRouchey, Joel M.; Woodworth, Jason C.; Goodband, Robert D.; Gebhardt, Jordan T.; Coble, Kyle F.; Labbé, Alain; and Heuser, Walter (2022) "Evaluation of a Dried Fermentation Product Administered Through Drinking Water in a Commercial Environment on Nursery Pig Mortalities, Antibiotic Injections, and Growth Performance," *Kansas Agricultural Experiment Station Research Reports*: Vol. 8: Iss. 10. https://doi.org/10.4148/2378-5977.8373

Evaluation of a Dried Fermentation Product Administered Through Drinking Water in a Commercial Environment on Nursery Pig Mortalities, Antibiotic Injections, and Growth Performance

Abstract

A total of 34,399 commercial nursery pigs (initially 12.2 lb) were used in 20 nursery barns with 10 barns per treatment to determine the effectiveness of a dried fermentation product (DFP) on nursery pig mortalities, antibiotic injection frequency, and close-out growth performance. The target dosage of the DFP for the first 14 d was 35 mg/kg BW based on the actual dosage of a previous experiment. Following the 14-d supplementation period, pigs continued to be monitored until they were moved from the barn at approximately d 45. The first 6 replicates consisted of the DFP as the sole source of water additive from d 0 to 14, while the last 4 replicates included water-soluble antibiotics with the DFP. During the supplementation period, there was no evidence that the DFP influenced the percentage of pigs that died or total mortality. However, the DFP reduced the percentage of pigs that were euthanized. During the common period, the DFP increased the percentage of pigs euthanized and tended to increase mortality percentage. For the overall experiment, providing the DFP did not influence growth performance. When providing the DFP, there was an increase in the percentage of pigs requiring euthanasia and therefore an increase in overall mortality. For injections, providing the DFP for the first 14 d reduced the number of pigs injected from d 14 to d 45 by the end of the nursery and the overall nursery period.

Keywords

dried fermentation product, growth, nursery pig

Cover Page Footnote

Appreciation is expressed to MicroSintesis Inc. (Victoria, British Columbia, CA) for product support, as well as JBS Live Pork (Greeley, CO, USA) personnel and farm staff for use of commercial nursery facilities.

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K·STATE Research and Extension

SWINE DAY 2022

Evaluation of a Dried Fermentation Product Administered Through Drinking Water in a Commercial Environment on Nursery Pig Mortalities, Antibiotic Injections, and Growth Performance

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Summary

A total of 34,399 commercial nursery pigs (initially 12.2 lb) were used in 20 nursery barns with 10 barns per treatment to determine the effectiveness of a dried fermentation product (DFP) on nursery pig mortalities, antibiotic injection frequency, and close-out growth performance. The target dosage of the DFP for the first 14 d was 35 mg/kg BW based on the actual dosage of a previous experiment. Following the 14-d supplementation period, pigs continued to be monitored until they were moved from the barn at approximately d 45. The first 6 replicates consisted of the DFP as the sole source of water additive from d 0 to 14, while the last 4 replicates included water-soluble antibiotics with the DFP. During the supplementation period, there was no evidence that the DFP influenced the percentage of pigs that died or total mortality. However, the DFP reduced the percentage of pigs that were euthanized. During the common period, the DFP increased the percentage of pigs euthanized and tended to increase mortality percentage. For the overall experiment, providing the DFP did not influence growth performance. When providing the DFP, there was an increase in the percentage of pigs requiring euthanasia and therefore an increase in overall mortality. For injections, providing the DFP for the first 14 d reduced the number of pigs injected from d 14 to d 45 by the end of the nursery and the overall nursery period.

Introduction

An increase in nursery pig post-weaning diarrhea (PWD) has been attributed to bacterial infections, specifically enterotoxigenic *Escherichia coli* (ETEC). Along with enteric infections, PWD increases the effects of diet change, stress, and environmental changes associated with weaning. An *E. coli* challenge in pigs is detrimental to swine producers

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due to decreased weight gain and feed efficiency, and increased costs associated with treatment and prevention, and mortality.[4]

In developing health × nutrition regimens for the treatment of *E. coli* in swine, bioactive molecules from *Lactobacillus acidophilus* growth have been observed to interfere with *E. coli* O157:H7 expression[5] and colonization.[6] These probiotic bacteria act through inhibition of quorum sensing (QS) signals. Inhibition of QS signals reduces the induction of virulence genes and reduces the ability of the pathogens to cause infection.

A recent study[7] in a research nursery provided a DFP in drinking water and described no differences in diarrhea, mortality, or antibiotic injections, despite the presence of *E. coli*, fimbriae genes, and enterotoxins associated with ETEC. The observation that there were no differences in performance was potentially due to the number of pigs per experimental unit (n = 5 pigs per pen). Therefore, the objective of this experiment was to investigate the effects of a DFP provided through drinking water on commercial pig mortality, injections, and growth performance.

Procedures

General

The experiment was conducted at commercial nursery facilities located in the Midwest. At the commercial nurseries, each barn was completely curtain sided with 80 pens that contained between 25 and 30 pigs per pen. Each pen contained a 5-hole, dry self-feeder, and a cup waterer to provide *ad libitum* access to feed and water. Pens (6.0 × 10.0 ft) had fully slatted, plastic flooring that allowed ~ 2.2 ft^2/pig. Barns were equipped with a water medicator (Dosatron DM11F, Dosatron International, LLC., Clearwater, FL) to administer the DFP. Room temperatures started at ~86°F when pigs arrived and decreased according to the animals' comfort.

Animals and diets

A total of 34,399 mixed gender and genetic source pigs (initially 12.2 lb) were used in 2 identical production sites with 4 barns on each site. One site was used for 3 consecutive turns with the other site used for 2 consecutive turns (simultaneously) for 20 total groups of pigs. Thus, there were 10 groups (barns) per treatment. Upon arrival to the nursery facility, pigs on each truck from each originating sow source were divided evenly between pairs of barns, with one barn providing the DFP and the other barn serving as the control. Weights of pigs delivered were obtained for each barn by dividing

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[4] García-Meniño, I., V. García, A. Mora, D. Díaz-Jiménez, S. C. Flament-Simon, M. P. Alonso, J. E. Blanco., M. Blanco, and J. Blanco. 2018. Swine enteric colibacillosis in Spain: pathogenic potential of mcr-1ST10 and ST131 E. coli isolates. Front. Microbiol. 9:2659. doi:10.3389/2fmicb.2018.02659.
[5] Medellin-Peña. M. J. 2007. Interference of virulence in *Escherichia coli* 0157:H7 by molecule(s) secreted by probiotic lactic acid bacteria. Heritage branch. hdl.handle.net/10214/20998.
[6] Medellin-Peña, M. J., and M. W. Griffiths. 2009. Effect of molecules secreted by *Lactobacillus acidophilus* strain La-5 on *Escherichia coli* O157:H7 colonization. Appl. Environ. Microbiol. 75:1165-1172. doi:10.1128/AEM.01651-08.
[7] Warner, A. J., A. L. Gerrard, M. D. Tokach, R. G. Amachawadi, A. Labbé, W. Heuser, R. Kalam, X. Shi, T. G. Nagaraja, J. M. DeRouchey, J. C. Woodworth, R. D. Goodband, and J. T. Gebhardt. 2021. Evaluation of a Dried Fermentation Product Administered Through Drinking Water on Nursery Pig Growth Performance, Fecal Consistency, and Antibiotic Injections. Kansas Agricultural Experiment Station Research Reports: Vol. 7: Iss. 11. https://doi.org/10.4148/2378-5977.8189.

the net weight of each semi-tractor trailer by the number of barns delivered to (n = 2). For the first 8 pairs of barns (blocks), ending weights of pigs were obtained from each barn by weighing each semi-tractor trailer upon shipment from the nursery facility. Feed intake was determined by the difference between the amount of feed delivered that was reported from the feed mill and the feed remaining upon completion of the nursery group that was visually estimated by a trained swine producer. Mortalities were classified as animals that died without intervention or animals that were euthanized for reasons of animal welfare, injury, or continued illness with no signs of recovery. Mortality was recorded from d 0 to 14 (treatment period), d 14 to the end of the nursery (common period), and the overall nursery period.

The target dosage for the DFP was 35 mg/kg BW. The amount of DFP provided to each treatment barn was recorded and used to determine an estimated dosage based on initial BW and estimated average weight through d 14. Diets were provided in a 4-phase nursery feeding program. In the initial 6 blocks used in the commercial research facility, DFP was the only water additive used for the first 14 d. Due to the concern of herd health, blocks 7 through 10 used water-soluble medications and/or electrolytes with the DFP at the discretion of the herd veterinarian, field service personnel, and farm staff. Each pair of barns (replicate) was treated similarly when water-soluble medications and/or electrolytes were provided.

Identification of animals requiring treatment

Pigs that required injectable antibiotics received ceftiofur (Excede, Zoetis, Parsippany, NJ; 5.0 mg/kg BW administered intramuscularly) or enrofloxacin (Baytril 100; Bayer HealthCare LLC, Shawnee Mission, KS; 7.5 mg/kg BW administered intramuscularly) as clinically indicated. Injections were recorded by barn and day as the number of individual pigs receiving an injection on that day.

Statistical analysis

Data were analyzed as a completely randomized block design in R Studio (Version 3.5.2, R Core Team, Vienna, Austria) with barn serving as the experimental unit and pair of 2 barns used as a blocking factor. Data were analyzed using treatment as a fixed effect and block as a random effect. Morbidity and mortality data were analyzed assuming a binomial distribution with a logit link function. Injection data were analyzed and reported as count of injections per day per 1,000 pigs. Injection data were analyzed using a Poisson distribution with an offset function using the log transformed number of days at risk for each experimental unit using the GLIMMIX procedure of SAS (v. 9.4, Cary, NC). Treatment was included in the model as a fixed effect, block as a random effect, and a Kenward-Rodgers denominator degrees of freedom adjustment was incorporated. All results were considered significant at $P \leq 0.05$ and marginally significant at $0.05 < P \leq 0.10$.

Results and Discussion

Although diagnostic testing was not conducted on all groups, *E. coli* was confirmed from intestinal tissue samples and *Salmonella* was confirmed from colonic tissue samples during the beginning of blocks 3 and 4. There was no evidence ($P > 0.05$) for the DFP to influence water intake (Table 1). Pigs provided the DFP consumed approximately 44.7 mg/kg of initial BW and 37.5 mg/kg BW on d 14 with an assumed 1.0 kg total gain from d 0 to 14.[8] For responses in growth performance, providing the DFP had no effect ($P > 0.05$). During the treatment period (d 0 to 14), there were no differences ($P > 0.10$) in the percentage of pigs that died or total mortality; however, a lower ($P = 0.018$) percentage of pigs were euthanized when providing the DFP in drinking water (Figure 1).

During the common period (d 14 to end) after the DFP was removed, there was significant evidence for the percentage of pigs requiring euthanasia ($P < 0.001$) and total mortality ($P = 0.009$) to be greater in pigs previously provided the DFP. This outcome was driven by the later experimental replications (Figure 2).

Overall, euthanasia frequency ($P = 0.010$) and total mortality ($P = 0.049$) were greater for pigs provided the DFP from d 0 to 14. This was again driven by the later replications of the experiment (Figure 3). For injection criteria, from d 0 to 14 there was no evidence ($P > 0.05$) for the DFP to affect the rate of injections. From d 14 to the end of the nursery, providing the DFP decreased ($P < 0.001$) injections compared to the control. Therefore, there was a significant reduction ($P = 0.002$) in the overall injections per day per 1,000 pigs at risk when providing the DFP.

In summary, mortality percentages increased when providing the DFP, which was driven by the percentage of pigs that were euthanized post-treatment. It is unclear why the percentage of pigs euthanized was increased, and more research should be conducted to explain the responses observed in the present study. The reason for euthanasia was not documented but providing the DFP did reduce the percentage of pigs that were euthanized from placement until d 14 after placement. Reasons for euthanasia for the first 14 days in the nursery can be attributed to lack of growth performance or increased illness with no signs of recovery. Given that this is the first experiment evaluating the DFP produced from *Lactobacillus acidophilus* in commercial nurseries, more research should be conducted to explain this response. However, in our study, the DFP did not influence the growth of nursery pigs and increased the mortalities of nursery close-outs.

Acknowledgments

Appreciation is expressed to MicroSintesis Inc. (Victoria, British Columbia, CA) for product support, as well as JBS Live Pork (Greeley, CO, USA) personnel and farm staff for use of commercial nursery facilities.

[8] Batson, K. L., H. I. Calderón, M. D. Tokach, J. C. Woodworth, R. D. Goodband, S. S. Dritz, and J. M. DeRouchey. 2021. Effects of feeding diets containing low crude protein and coarse wheat bran as alternatives to zinc oxide in nursery pig diets. J. Anim. Sci. 99:1-14. doi:10.1093/jas/skab090.

Table 1. Effect of a dried fermentation product provided through the drinking water on nursery pig growth performance, mortality, euthanasia, and antibiotic frequency1

Item	Control	DFP[2]	SEM	*P* =
Intake, d 0 to 14				
Water, gal/pig/day	0.24	0.20	0.044	0.162
DFP, mg/kg[3]	---	44.7	---	---
DFP, mg/kg[4]	---	37.5	---	---
Growth performance[5]				
ADG, lb	0.77	0.78	0.035	0.714
ADFI, lb	1.20	1.20	0.059	0.915
F/G	1.57	1.55	0.034	0.725
Treatment period (d 0 to 14)				
Mortality, %	1.14	1.08	0.271	0.575
Died, %	0.58	0.66	0.189	0.266
Euthanized, %	0.41	0.29	0.143	0.018
Injections[6]	10.74	10.79	2.673	0.857
Common period (d 14 to end)				
Mortality, %	3.42	3.94	0.442	0.009
Died, %	0.86	0.72	0.111	0.118
Euthanized, %	2.51	3.17	0.417	< 0.001
Injections[6]	1.76	1.18	0.257	< 0.001
Overall				
Mortality, %	4.67	5.16	0.615	0.049
Died, %	1.51	1.47	0.255	0.766
Euthanized, %	3.07	3.55	0.442	0.010
Injections[6]	4.86	4.48	0.864	0.002

[1] A total of 34,399 weaned pigs were used with 10 barns per treatment and approximately 1,700 pigs per barn.
[2] Treatment provided by Microsintesis (Victoria, British Columbia, CA) was administered through water lines in a dilution rate of 1:128 from d 0 to 14 after weaning. DFP = dried fermentation product.
[3] Dosage was calculated by (# of packets delivered × 460 g/packet) / initial BW, kg / 14 d.
[4] Dosage was calculate based on ~ 1 kg gain from d 0 to 14 (# of packets delivered × 460 g/packet) / (initial BW, kg + 1 kg) / 14 d.
[5] Growth performance was obtained for the initial 8 blocks.
[6] Values represent count of injections per day per 1,000 pigs.

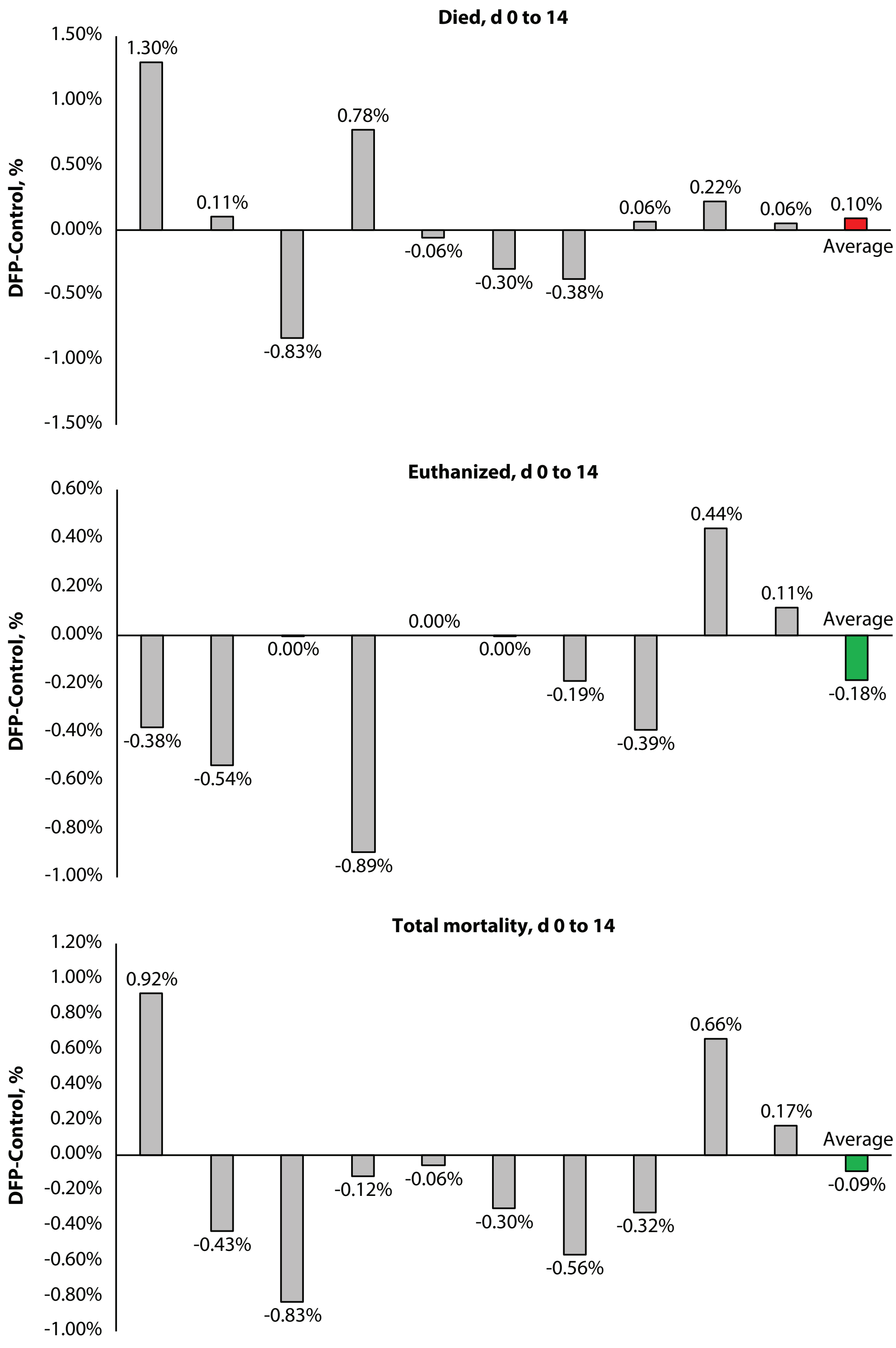

Figure 1. Difference in died, euthanized, and total mortality between the dried fermentation product (DFP) and the control for blocks 1 to 10 (left to right) during the experimental treatment period (d 0 to 14).

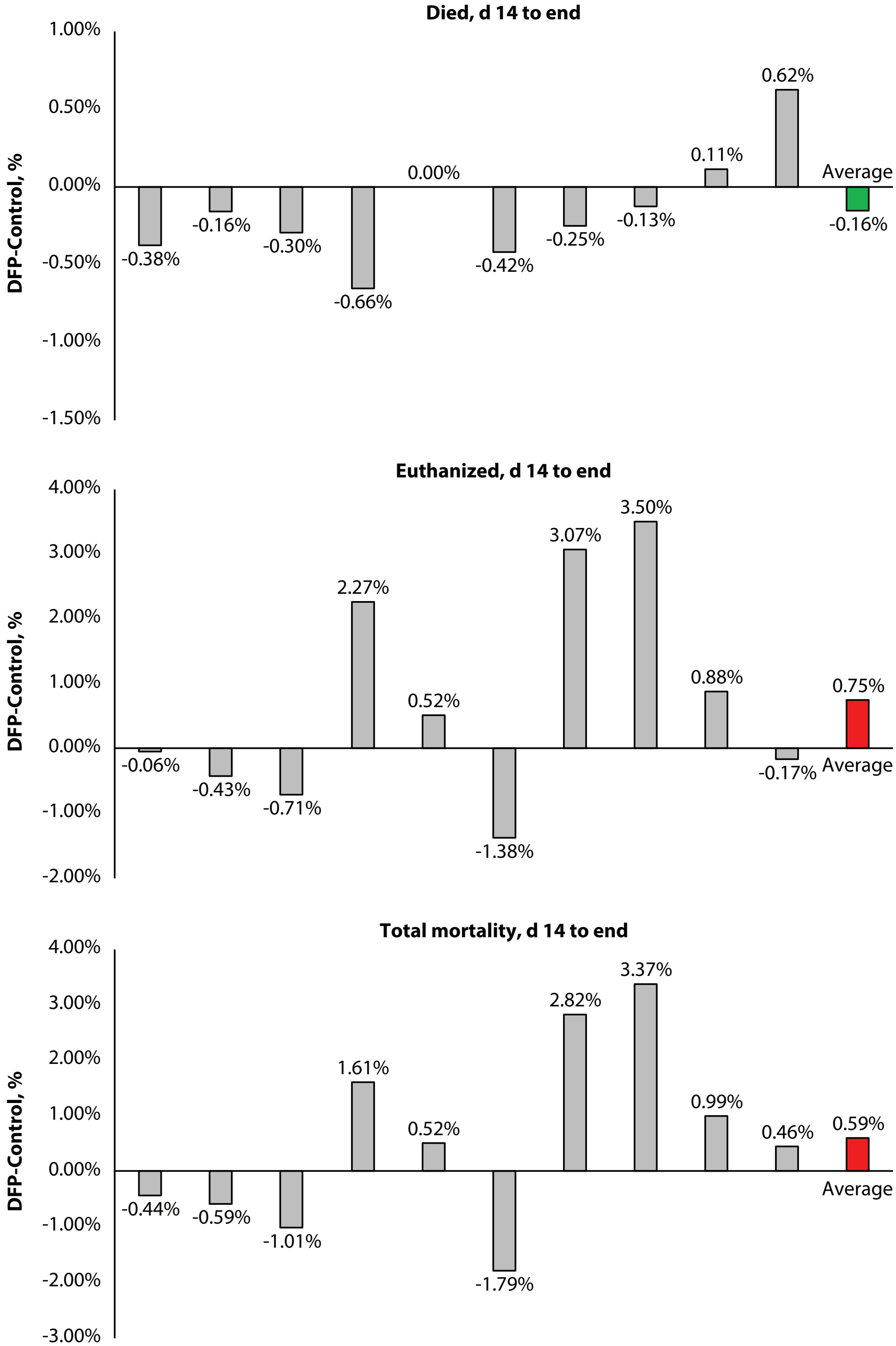

Figure 2. Difference in died, euthanized, and total mortality between the dried fermentation product (DFP) and the control for blocks 1 to 10 (left to right) during the common period (d 14 to end).

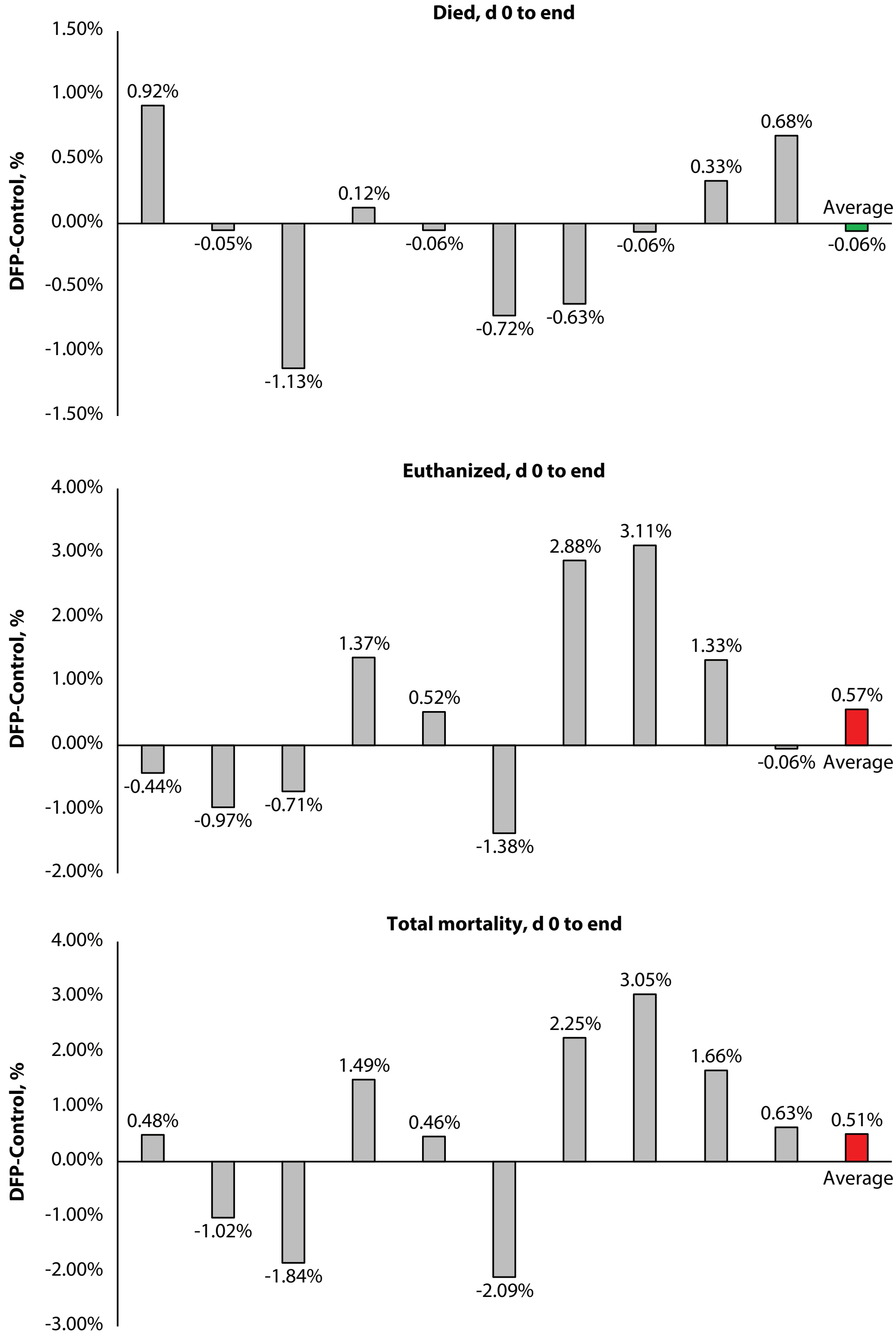

Figure 3. Difference in died, euthanized, and total mortality between the dried fermentation product (DFP) and the control for blocks 1 to 10 (left to right) during the overall nursery period.

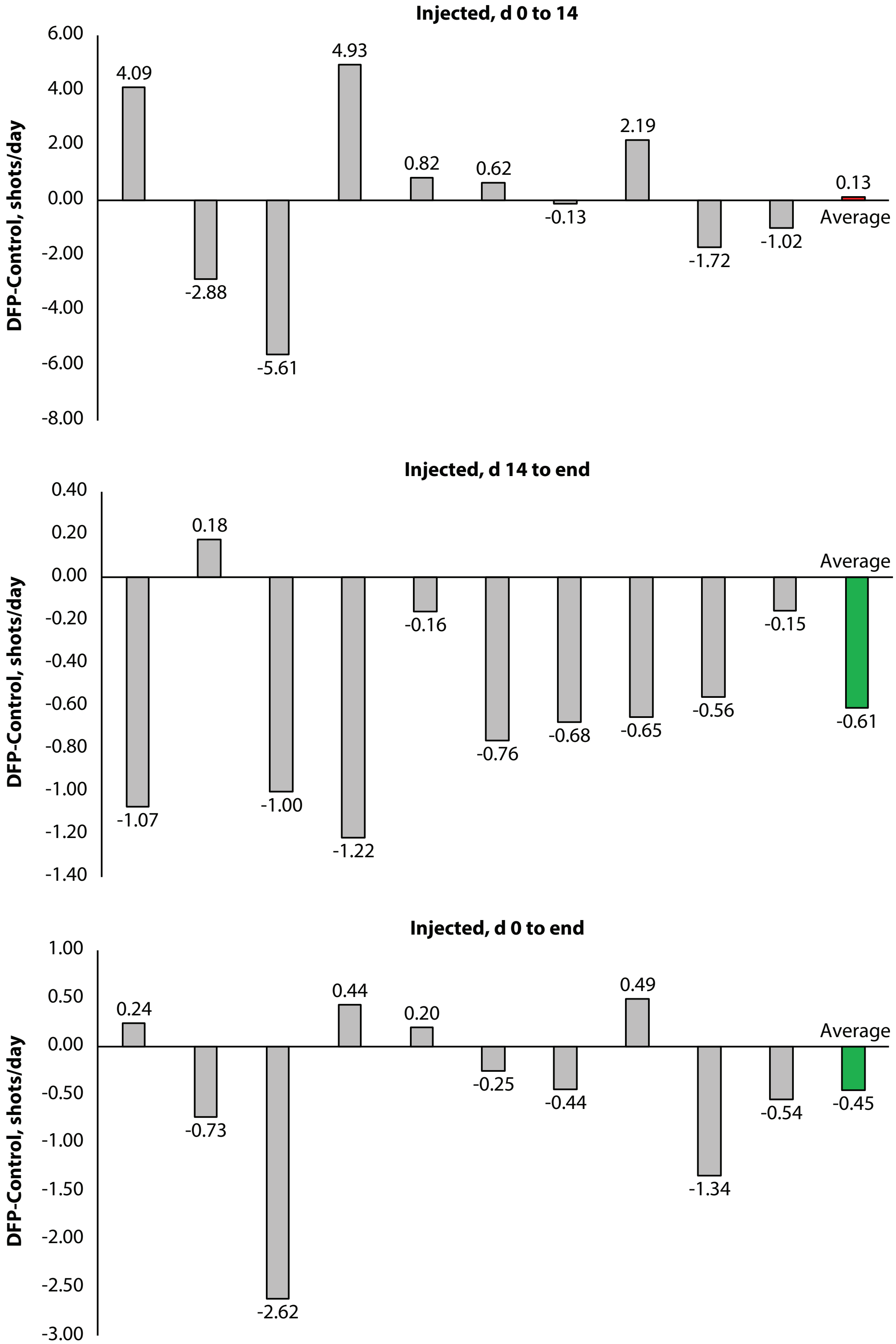

Figure 4. Difference in antibiotic injections per day per 1,000 pigs between the dried fermentation product (DFP) and the control for blocks 1 to 10 (left to right) during the treatment period (d 0 to 14), common period (d 14 to end), and the overall nursery period (d 0 to end).