Determining the Impact of Probicon L28 and BioPlus 2B on Finishing Pig Growth Performance and Carcass Characteristics[1]

Macie E. Reeb, Jimeng Bai, Mike D. Tokach, Jordan T. Gebhardt,[2] Jason C. Woodworth, Robert D. Goodband, Joel M. DeRouchey, Jessie Vipham, Qing Kang,[3] John W. Schmidt,[4] Dayna M. Brichta-Harhay,[3] Morgan Miller,[5] and Sara E. Gragg

Summary

These data represent the growth performance of pigs enrolled in a study to determine the impact of two direct fed microbial products on *Salmonella* and *Escherichia coli* prevalence pre- and post-harvest. A total of 650 finishing pigs in two groups were randomly assigned to pen via a completely randomized design, and pens were assigned to one of three treatments: 1) a control treatment with pigs fed a standard corn-soybean meal finishing diet (with no added probiotic); 2) the control diets with Probicon L28 (NexGen Innovations, LLC, Lubbock, TX) supplemented through water lines using a water medicator system at a target concentration of 1.0×10^6 CFU/head/day; and 3) the control diet with added BioPlus 2B (5.0×10^8 CFU/lb of feed; ~3.0×10^9 CFU/head/day; CHR Hansen, Inc, Milwaukee, WI). No evidence of difference ($P > 0.10$) between treatments was observed for overall ADG, ADFI, or F/G or any of the carcass traits. However, there was a tendency for a treatment effect for loin depth ($P = 0.070$). Pigs fed the BioPlus 2B treatment had numerically greater loin depth compared to other treatments, but there were no significant pairwise differences between treatments ($P > 0.05$). The results of this study suggested that probiotics used in this study and supplied through the water or feed had no impact on growth or carcass characteristics of finishing pigs.

Introduction

Salmonella naturally inhabits the gastrointestinal tract of swine. Recent research also demonstrates that *Salmonella* is harbored in the lymph nodes of market hogs, thereby posing a risk to the final ground product. While interventions at the abattoir are important, emphasis should also be placed on identifying an effective intervention(s)

[1] The authors appreciate the Foundation for Meat and Poultry Research and Education and the Pork Checkoff for funding this research, and NexGen Innovations (Lubbock, TX) for their in-kind donation of Probicon L28 and providing technical assistance. Partial funding support was provided by SafeFoods.

[2] Department of Diagnostic Medicine/Pathobiology, College of Veterinary Medicine, Kansas State University.

[3] Department of Statistics, College of Arts and Sciences, Kansas State University.

[4] U.S. Meat Animal Research Center, United States Department of Agriculture (Clay Center, NE).

[5] Triumph Foods (St. Joseph, MO).

that reduces the *Salmonella* burden in market hogs pre-harvest, which would translate to a reduced *Salmonella* burden entering the abattoir. Probiotics, such as lactic acid bacteria, have been researched extensively as pre-harvest interventions in cattle. Evidence suggests that these direct-fed microbials (DFMs) may reduce the pathogen burden in cattle; however, few studies have investigated the efficacy of probiotics in market pigs. We hypothesize that the newly commercialized Probicon L28 will also reduce *Salmonella* in market hog feces and lymph nodes at harvest when administered during the finishing phase. The objective of this research is to quantify the detection of *Salmonella* and *E. coli* pre- and post-harvest when pigs are fed two direct fed microbial products compared to no intervention. The data herein describe the growth performance results from this research with microbiological results being reported in the companion report.[6]

Procedures

The Kansas State University Institutional Animal Care and Use Committee approved the protocol (#4485) used in this experiment. The study was conducted at the Kansas State University Swine Research and Teaching Center. The facility was totally enclosed and environmentally regulated. Each pen was equipped with a 2-hole dry, single-sided feeder (Farmweld, Teutopolis, IL) and a 1-cup waterer to allow for *ad libitum* access to feed and water, and adjustable gates to allow 7.83 ft^2 (0.72 square meters) of floor space per pig. Pens were located over a completely slatted concrete floor with a 4-ft (1.21 meter) pit underneath for manure storage.

Two groups of pigs (Group 1: N = 294; Group 2: N = 356, initially 106.6 lb) were enrolled in this study. For each group, a total of 36 pens were used (N = 72 pens total), with 12 pens per treatment (N = 24 pens total), with approximately 10 pigs per pen. Pigs were assigned to pen via a completely randomized design, and pens were assigned to one of three treatments: 1) a control treatment with pigs fed a standard corn-soybean meal finishing diet (with no added probiotic); 2) the control diets with Probicon L28 (NexGen Innovations, LLC, Lubbock, TX) supplemented through water lines using a water medicator system at a target concentration of 1.0×10^6 CFU/head/day; and 3) the control diets with added BioPlus 2B (5.0×10^8 CFU/lb of feed; ~3.0×10^9 CFU/head/day; CHR Hansen, Inc., Milwaukee, WI). Daily feed additions to each pen were accomplished using a robotic feeding system (FeedPro; Feedlogic Corp., Wilmar, MN) able to record the amount of feed provided for individual pens. Dietary treatments were fed in meal form in three BW phases from approximately 80 to 140, 180 to 200, and 200 to 290 lb (Table 1). Pen weights and feed disappearance were recorded approximately every 21 d throughout the study.

For the Probicon L28 treatment, the water medication system (Model D14MZ10; Dosatron International, Clearwater, FL) used on farm was adjusted to approximately a 1:75 dilution of stock solution to water to reach the target concentration of 1.0×10^6 CFU/head/day. The Probicon L28 stock solution was prepared daily and consisted of municipal source tap water, activated Probicon L28 and electrolyte powder, with pH of

[6] J. Bai, M.E. Reeb, M.D. Tokach, J.T. Gebhardt, J.C. Woodworth, R.D. Goodband, J.M. DeRouchey, J. Vipham, Q. Kang, J.W. Schmidt, D.M. Brichta-Harhay, J.M. Bosilevac, M. Miller, and S.E. Gragg. 2023. Exploring the Use of Probicon L28 and BIOPLUS 2B as Direct-Fed Microbials to Reduce Salmonella and Shiga Toxin-Producing Escherichia coli in Market Pigs. Kansas Agricultural Experiment Station Research Reports: Vol. 9: Iss. 7.

the stock solution adjusted to 6.5. Briefly, 2 g of Probicon Calf (NexGen Innovations, LLC, Lubbock, TX) were combined in 10 mL of tryptic soy broth (TSB; BD BioSciences; Franklin Lakes, NJ) and activated for 10 h at 98.6°F (37°C) and stored at 39.2°F (4°C) until use (up to 72 hours). Each day, a fresh Probicon L28 stock solution was prepared in a clean 5-gallon bucket by combining 17 kg of tap water with 17 g of electrolyte powder (DuMor Multi-Species Electrolytes Supplement, distributed by Tractor Supply Company, Brentwood, TN) and one tube (10 mL TSB + 2 g Probicon Calf) of activated Probicon L28. Prior to adding the Probicon L28, the stock solution pH was adjusted to ~6.5 using distilled white vinegar (Great Value, Bentonville, AR). The pH of each stock solution was confirmed by pH strips (two brands were used due to supply chain challenges: API, McLean, Virginia; Dr. Tim Wang, Amazon). The average estimated Probicon intake of Probicon treatment pigs was calculated based on 1) the daily pig water intake record, and 2) laboratory estimates for stock solution concentration, with group 1 consuming an average of 6.7×10^4 CFUs per pig per day and group 2 consuming 1.2×10^5 CFUs per pig per day.

Stock solution intakes were recorded by subtracting the weight of the remaining solution when a new solution was prepared, by the total stock solution weight from the previous day. Daily water intakes for all treatments were recorded via a water meter. Thus, the dilution percentage was calculated by the stock solution intake divided by the daily water intake. As the dilution percentage was tracked over the treatment course of the two groups of pigs and minor adjustments were done to the dilution of the water medication system (Model D14MZ10; Dosatron International, Clearwater, FL) were done in order to reach the target supplementation rate.

On the last day of the trial, final pen and individual weights were obtained and the pigs were tattooed with a treatment and pen identification number and transported to a U.S. Department of Agriculture-inspected packing plant (Triumph Foods, St. Joseph, MO) for carcass data collection. Carcass measurements included HCW, loin depth, backfat, and percentage lean. Percentage lean was calculated from a plant proprietary equation. Carcass yield was calculated by dividing the pen average HCW by the pen average final live weight obtained at the farm.

Statistical analysis

Data were analyzed as a completely randomized design for one-way ANOVA using the lmer function from the lme4 package in R (version 3.5.2 (2018-07-02) with pen as the experimental unit and treatment considered as a fixed effect. Group was included in the model as a random intercept. Carcass data were analyzed with the addition of pen nested within group as a random intercept to account for subsampling of multiple carcass observations within each experimental unit. All carcass characteristics (lean percentage, loin depth, and backfat) included HCW in the model as a covariate.

Results and Discussion

No evidence of difference ($P > 0.10$) between treatments was observed for overall ADG, ADFI, or F/G. However, there was a tendency for a treatment effect for loin depth ($P = 0.070$). Pigs fed the BioPlus 2B treatment had numerically greater loin depths compared to other treatments, but there were no significant pairwise differences between treatments ($P > 0.05$). These data indicate that the direct-fed microbials used in this study and supplied through the water or feed have limited effects on finishing pig growth performance or carcass characteristics under the conditions of this study.

Table 1. Diet composition (as-fed basis)[1]

Item, %	Phase 1	Phase 2	Phase 3
Corn	70.91	77.66	86.29
Soybean meal	26.35	19.89	11.54
Calcium carbonate	1.01	0.95	0.88
Monocalcium phosphate	0.62	0.46	0.33
Sodium chloride	0.35	0.35	0.35
L-Lys-HCl	0.29	0.30	0.30
DL-Met	0.06	0.05	0.01
L-Thr	0.11	0.10	0.09
L-Trp	0.01	0.02	0.03
Vitamin premix with phytase[2]	0.15	0.13	0.10
Trace mineral premix	0.15	0.13	0.10
Direct fed microbial[3]	+/-	+/-	+/-
Total, %	100	100	100
Calculated analysis			
Standard ileal digestible (SID) AA, %			
Lys	1.05	0.90	0.70
Ile:Lys	63	62	60
Leu:Lys	136	142	155
Met:Lys	31	31	30
Met and Cys:Lys	56	57	58
Thr:Lys	64	64	65
Trp:Lys	19.2	19.0	19.3
Val:Lys	70	70	70
His:Lys	42	43	44
Total Lys, %	1.18	1.02	0.79
NE, kcal/lb	1,116	1,136	1,161
SID Lys:NE, g/Mcal	4.27	3.59	2.73
CP, %	18.8	16.3	13.0
Ca, %	0.66	0.57	0.49
P, %	0.50	0.44	0.38
STTD P, %	0.38	0.32	0.27
Ca:P	1.30	1.30	1.30

[1]Phase 1 was fed from approximately 80 to 140 lb, phase 2 from approximately 140 to 200 lb, and phase 3 from approximately 200 to 290 lb.
[2]Vitamin premix contained phytase (Ronozyme HiPhos, DSM Nutritional Products, Parsippany, NJ) to provide 340, 283, and 226 FYT/lb diet and provided an estimated release of 0.11%, 0.10%, and 0.09% STTD P for phases 1, 2, and 3, respectively.
[3]Direct fed microbial was added to the respective treatment (BioPlus 2B, CHR Hansen Inc, Milwaukee, WI) at 0.05% of the diet at the expense of corn.

Table 2. Effects of BioPlus 2B or Probicon as direct-fed microbials on finishing pig performance and carcass characteristics[1]

Item	Control	BioPlus 2B	Probicon	SEM	*P* =
BW, lb					
d 0	106.5	106.9	106.5	5.80	0.948
d 83	289.7	291.2	288.5	14.16	0.628
Overall (d 0 to 83)					
ADG, lb	2.21	2.23	2.22	0.088	0.705
ADFI, lb	5.84	5.85	5.83	0.518	0.975
F/G	2.64	2.62	2.63	0.131	0.492
Carcass characteristics[2]					
HCW, lb	214.3	215.9	214.2	10.16	0.648
Carcass yield, %	74.1	74.2	74.3	0.43	0.825
Lean, %	55.4	55.6	55.3	0.41	0.182
Loin depth, in.	2.61	2.65	2.62	0.044	0.070
Back fat depth, in.	0.56	0.56	0.58	0.025	0.133

[1] A total of 650 pigs (initial BW = 106.6 lb) were used in a 83-d finisher trial with approximately 10 pigs per pen and 24 pens per treatment. Pigs were allotted to treatment in a completely randomized design. BioPlus 2B (CHR Hansen Inc, Milwaukee, WI) was added at 0.05% of the diet at the expense of corn. Probicon L28 (Benebios, Inc, Mishawaka, IN) was supplemented through water lines using a water medicator system at a target concentration of 1.0×10^6 CFU/head/day.

[2]In the analysis for backfat depth, percentage lean, and loin depth, and HCW was used as a covariate in the model.