

Effects of BOWISH MultiBio 3P on Growth Performance and Carcass Characteristics of Grow-Finish Pigs¹

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Summary

This study was conducted to determine the effects of a multi-species direct-fed microbial product based on lactic acid bacteria and *Bacillus subtilis* on growth performance and carcass characteristics of grow-finish pigs. A total of 1,188 pigs (PIC 359 × 1050; initially 57 lb BW) were used in a 121-d growth trial with 27 pigs per pen and 22 pens per treatment. Pigs were allotted to treatments based on initial body weight (BW) in a randomized complete block design. The two experimental diets were Control and Biowish (BOWISH MultiBio 3P, BOWISH Technologies Inc., Cincinnati, OH). The diets were based on corn, distillers dried grains with solubles, and soybean meal, and fed in four dietary phases. The probiotic BOWISH MultiBio 3P was included in the diet at 1.1 lb/ton at the expense of corn. Overall, from d 0 to 121, pigs fed the control diet had greater average daily gain (ADG) ($P < 0.024$) and final BW ($P < 0.001$) compared to pigs fed the Biowish diet. There was no evidence for differences in average daily feed intake (ADFI) and feed efficiency (F/G) between dietary treatments. The difference in final BW resulted in heavier ($P < 0.026$) hot carcass weight (HCW) in control pigs compared to Biowish pigs, but no evidence for differences was observed in carcass yield, backfat, loin depth, and lean percentage between dietary treatments. In conclusion, the inclusion of BOWISH MultiBio 3P in growing-finishing diets reduced ADG in this commercial study. This response was not expected, but could be related to inclusion rate or other factors not identified in this study. This warrants further research to better characterize the effects of this probiotic on pig performance.

Introduction

A balanced intestinal microbiota is intimately related to swine health and efficient utilization of dietary nutrients for growth.³ The movement of the swine industry towards restricting the usage of antibiotic growth promoters prompts the selection of an ideal alternative to compensate for the lost benefits of in-feed antibiotics in swine diets.

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³Liao, S. F., and Nyachoti, M., 2017. Using probiotics to improve swine gut health and nutrient utilization. *Anim. Nutr.* 3:331-343.

Probiotics appear to be a safe and effective feed additive that can improve gut health, nutrient utilization, and growth performance of pigs by enhancing the proliferation of certain species of benign bacteria in the gut at the expense of undesirable ones.⁴

Some probiotics have been shown to increase average daily gain and improve feed efficiency in growing and finishing pigs.⁵ However, the effects of probiotics are not consistent due to variations in microbial strains, inclusion rate, duration of usage, environmental factors, and husbandry practices.⁶ Therefore, the characterization of the effects of probiotics in pigs depends upon extensive research. BOWISH MultiBio 3P (BOWISH Technologies Inc., Cincinnati, OH) is a multi-species direct-fed microbial product based on lactic acid bacteria and *Bacillus subtilis*. However, this particular feed additive has not been previously evaluated in swine. Thus, the objective of this study was to determine the effects of BOWISH MultiBio 3P on growth performance and carcass characteristics of grow-finish pigs in a commercial environment.

Procedures

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in this experiment. The study was conducted at a commercial research facility in southwestern Minnesota. The barn was naturally ventilated and double-curtain-sided. Each pen was equipped with a 4-hole stainless steel dry self-feeder and a cup waterer for *ad libitum* access to feed and water. Feed additions to each individual pen were made and recorded by a robotic feeding system (FeedPro, Feedlogic Corp., Wilmar, MN).

A total of 1,188 pigs (PIC 359 × 1050; initially 57 lb BW) were used in a 121-d growth trial with 27 pigs per pen and 22 pens per treatment. Pigs were allotted to treatments based on initial BW in a randomized complete block design.

Dietary treatments were arranged in a 1-way treatment structure: Control and Biowish (BOWISH MultiBio 3P, BOWISH Technologies Inc., Cincinnati, OH) added at 1.1 lb/ton. This amount was the manufacturer's recommended inclusion level. The guaranteed analysis of BOWISH MultiBio 3P is detailed in Table 1.

Diets were based on corn, distillers dried grains with solubles, and soybean meal and fed in four phases (Table 2). The probiotic BOWISH MultiBio 3P was included in the diet at the expense of corn. Diet samples from each phase were taken from 6 feeders per dietary treatment 3 d after the beginning and 3 d before the end of each phase and stored at -4°F. Composite samples were homogenized, subsampled, and analyzed for dry matter (DM), crude protein (CP), neutral detergent fiber (NDF), ether extract, Ca, and P (Ward Laboratories Inc., Kearney, NE). Composite samples were also analyzed for

⁴Fuller, R. 1989. Probiotics in man and animals. *J. Appl. Bacteriol.* 66:365-378.

⁵Zimmermann, J. A., Fusari, M. L., Rossler, E., Blajman, J. E., Romero-Scharpen, A., Astesana, D. M., Olivero, C. R., Berisvil, A. P., Signorini, M. L., Zbrun, M. V., Frizzo, L. S., and Soto, L. P., 2016. Effects of probiotics in swines growth performance: A meta-analysis of randomised controlled trials. *Anim. Feed Sci. Technol.* 219:280-293.

⁶Liao, S. F., and Nyachoti, M., 2017. Using probiotics to improve swine gut health and nutrient utilization. *Anim. Nutr.* 3:331-343.

Ca and P by Midwest Laboratories (Omaha, NE) and the average estimates between the laboratories are reported.

Pens of pigs were weighed and feed disappearance was measured approximately every two weeks to determine ADG, ADFI, and F/G. On d 102, the 3 heaviest pigs in each pen were weighed and marketed according to the farm marketing strategy. On d 121, final pen weights were taken and pigs were tattooed with a pen identification number and transported to a USDA-inspected packing plant (JBS Swift and Co., Worthington, MN) for processing and carcass data collection. Carcass measurements included HCW, backfat, loin depth, and lean percentage. Percentage lean was calculated from plant proprietary equation. Carcass yield was calculated by dividing the pen average HCW by the pen average final live weight obtained at the farm.

Data were analyzed using a linear mixed model with treatment as fixed effect, block as random effect, and pen as the experimental unit. Hot carcass weight was used as a covariate for analyses of backfat, loin depth, and lean percentage. Statistical models were fitted using the GLIMMIX procedure of SAS Version 9.4 (SAS Institute Inc., Cary, NC). Results were considered significant at $P \leq 0.05$.

Results and Discussion

The analyzed DM, CP, NDF, ether extract, Ca, and P content of experimental diets were consistent with formulated estimates (Table 3).

In Phase 1 (d 0 to 28), there was no evidence for differences in ADG, ADFI, F/G, or BW between treatments. In Phase 2 (d 28 to 56), ADG and BW were increased ($P < 0.043$) in control pigs compared to pigs fed the Biowish diet, but there was no evidence for differences in ADFI or F/G. In Phase 3 (d 56 to 86), no evidence for differences was observed on ADG, ADFI, or F/G between dietary treatments, but control pigs were heavier ($P < 0.018$) than Biowish pigs at the end of Phase 3. In Phase 4 (d 86 to 121), ADFI increased ($P < 0.003$) in control pigs compared to Biowish pigs, but there was no evidence for differences ($P > 0.05$) in ADG or F/G.

Overall (d 0 to 121), pigs fed the control diet had greater ADG ($P < 0.024$) and final BW ($P < 0.001$) compared to pigs fed the Biowish diet. There was no evidence for differences in ADFI or F/G. The difference in final BW resulted in heavier ($P < 0.026$) HCW in control pigs compared to Biowish pigs, but no evidence for differences was observed in yield, backfat, loin depth, and lean percentage between dietary treatments (Table 4).

In conclusion, the inclusion of BOWISH MultiBio 3P in growing-finishing diets decreased ADG in this commercial study. This response could be related to inclusion rate or other factors not identified in this study. Because a dose titration study has not been conducted in swine, the optimal inclusion rate for BOWISH MultiBio 3P might be different than the concentration used in this trial.

Table 1. Guaranteed manufacturer analysis of BOWISH MultiBio 3P¹

Item	Analysis
<i>Pediococcus acidilactici</i> , CFU/g	$\geq 1.0 \times 10^8$
<i>Pediococcus pentosaceus</i> , CFU/g	$\geq 1.0 \times 10^8$
<i>Lactobacillus plantarum</i> , CFU/g	$\geq 1.0 \times 10^8$
<i>Bacillus subtilis</i> , CFU/g	$\geq 1.0 \times 10^7$
Crude protein, minimum, %	7.0
Crude fat, minimum, %	1.0
Crude fiber, maximum, %	15.0
Ash, maximum, %	10.0

¹BOWISH MultiBio 3P (BOWISH Technologies Inc., Cincinnati, OH).

Table 2. Composition of experimental diets (as-fed basis)¹

Item	Phase 1	Phase 2	Phase 3	Phase 4
Ingredient, %				
Corn	54.90	61.21	68.76	80.78
DDGS ²	20.00	20.00	20.00	---
Soybean meal, 47% crude protein	21.55	15.41	8.05	16.46
Tallow	0.75	0.75	0.75	0.75
Monocalcium phosphate, 21.5% aP	0.40	0.20	0.12	0.20
Limestone	1.20	1.25	1.15	0.95
Sodium chloride	0.35	0.35	0.35	0.35
L-Lys HCl	0.50	0.50	0.50	0.25
DL-Met	0.05	0.02	---	0.02
L-Thr	0.11	0.11	0.11	0.07
L-Trp	0.03	0.035	0.045	0.01
VTM premix ³	0.15	0.15	0.15	0.15
Phytase ⁴	0.01	0.01	0.01	0.01
Biowish ⁵	+/-	+/-	+/-	+/-
Total	100.0	100.0	100.0	100.0
Calculated analysis				
SID ⁶ amino acids, %				
Lys	1.16	1.01	0.83	0.78
Ile:Lys	60	59	57	64
Leu:Lys	145	153	165	154
Met:Lys	30	29	29	31
Met and Cys:Lys	55	55	57	59
Thr:Lys	62	63	64	65
Trp:Lys	18.6	18.5	18.9	18.9
Val:Lys	69	69	70	73
Total Lys, %	1.33	1.16	0.96	0.89
ME, kcal/lb	1,504	1,509	1,515	1,525
NE, kcal/lb	1,118	1,136	1,158	1,164
SID Lys:NE, g/Mcal	4.71	4.03	3.25	3.04
Crude protein, %	20.4	17.8	14.9	13.8
Ca, %	0.60	0.57	0.50	0.45
STTD P, ⁷ %	0.38	0.33	0.30	0.26

¹DDGS = distillers dried grains with solubles.

²Diets were fed *ad libitum* in meal form from 57.0 to 271.2 lb BW. Phases 1, 2, 3, and 4 were fed from 60 to 110 lb, 110 to 160 lb, 160 to 220 lb, and 220 lb to marketing, respectively.

³Vitamin and trace mineral premix provided per lb of diet: 111 ppm Zn, 111 ppm Fe, 33 ppm Mn, 17 ppm Cu, 0.33 ppm I, 0.30 ppm Se, 2,400 IU vitamin A, 600 IU vitamin D, 12 IU vitamin E, 1.2 mg vitamin K, 22.5 mg niacin, 7.5 mg pantothenic acid, 2.25 mg riboflavin, and 10.5 µg vitamin B12.

⁴Optiphos 2000 (Huvepharma Inc, Peachtree City, GA) provided 91 FTU per lb of diet.

⁵BIOWISH MultiBio 3P (BIOWISH Technologies Inc., Cincinnati, OH) was included at 0.055% at the expense of corn.

⁶Standardized ileal digestible.

⁷Standardized total tract digestible phosphorus.

Table 3. Chemical analysis of experimental diets (as-fed basis)¹

Item	Phase 1		Phase 2		Phase 3		Phase 4	
	Control	Biowish	Control	Biowish	Control	Biowish	Control	Biowish
Proximate analysis, % ²								
Dry matter	88.1	88.6	87.9	88.4	88.5	88.5	87.2	87.1
Crude protein	20.3	19.8	18.1	18.8	15.2	15.3	14.8	14.1
Neutral detergent fiber	11.8	10.6	9.5	10.3	10.4	12.3	6.1	7.0
Ether extract	4.6	4.4	4.3	4.5	4.4	4.5	3.2	3.4
Ca	0.82	0.78	0.69	0.70	0.68	0.73	0.72	0.51
P	0.52	0.47	0.44	0.47	0.42	0.46	0.34	0.35

¹Diet samples from each phase were taken from 6 feeders per dietary treatment throughout the study. Composite samples were homogenized, subsampled, and submitted to Ward Laboratories Inc. (Kearney, NE) for analysis. Composite samples were additionally analyzed for Ca and P by Midwest Laboratories (Omaha, NE) and the average estimates between the laboratories were reported.

Table 4. Effects of BIOWISH MultiBio 3P on growth performance and carcass characteristics of grow-finish pigs¹

Item ³	Control	Biowish ²	SEM	Probability, <i>P</i> =
BW, lb				
d 0	57.1	57.0	0.477	0.278
d 28	104.7	104.3	0.684	0.292
d 56	162.3	161.0	0.953	0.041
d 86	222.3	220.4	1.051	0.018
d 121	273.4	269.9	1.174	0.001
d 0 to 28				
ADG, lb	1.69	1.69	0.010	0.734
ADFI, lb	3.08	3.06	0.023	0.504
F/G	1.82	1.81	0.008	0.554
d 28 to 56				
ADG, lb	2.05	2.02	0.013	0.043
ADFI, lb	4.72	4.68	0.033	0.241
F/G	2.29	2.31	0.009	0.129
d 56 to 86				
ADG, lb	1.99	1.98	0.014	0.331
ADFI, lb	5.51	5.50	0.032	0.811
F/G	2.76	2.78	0.017	0.195
d 86 to 121				
ADG, lb	1.55	1.52	0.022	0.177
ADFI, lb	5.37	5.29	0.032	0.003
F/G	3.48	3.50	0.054	0.746
d 0 to 121				
ADG, lb	1.81	1.79	0.007	0.024
ADFI, lb	4.69	4.67	0.022	0.124
F/G	2.59	2.60	0.011	0.213
Carcass characteristics				
HCW, lb	202.5	200.4	0.830	0.026
Carcass yield, %	74.0	74.2	0.149	0.163
Backfat, in. ⁴	0.58	0.59	0.006	0.180
Loin depth, in. ⁴	2.60	2.61	0.018	0.982
Lean, % ⁴	57.7	57.6	0.095	0.099

¹A total of 1,188 pigs (PIC 359 × 1050; initially 57 lb BW) were used with 27 pigs per pen and 22 pens per treatment.

²BIOWISH MultiBio 3P (BIOWISH Technologies Inc., Cincinnati, OH) added at 1.1 lb/ton.

³BW = body weight. ADG = average daily gain. ADFI = average daily feed intake. F/G = feed-to-gain ratio. HCW = hot carcass weight

⁴Adjusted for HCW.