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Andres F. Tolosa
Kansas State University, atolosa@ksu.edu

Joel M. DeRouchey
Kansas State University, jderouch@ksu.edu

Jason C. Woodworth
Kansas State University, jwoodworth@ksu.edu

See next page for additional authors

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Summary

A total of 1,188 pigs (L337 × 1050; PIC; initial BW of 11.1 lb) were used in a 40-d trial to determine the effect of a combination of mannan oligosaccharides, yeast culture, and beta-glucans (AgriMune Liquid; AFI-Agri Feed International, L.L.C., Rockwell, IA) on growth performance, morbidity, and mortality of pigs during the nursery period. Pigs were weaned at approximately 21 d of age and placed in pens (27 pigs per pen) based on initial BW. Pens were randomly assigned to 1 of 2 treatments in a randomized complete block design with 22 pens (replications) per treatment. Treatments consisted of the control in which pigs only received water through the water line, or pigs were provided the combination of mannan oligosaccharides, yeast culture, and beta-glucans in the water at a rate of 4 mL per head per day (mL/hd/d) from day 1 to 4 and then 2 mL/hd/d from d 5 until the end of the experiment. All pigs were fed the same commercial diets in three phases for the duration of the trial.

Overall, from d 0 to 40, pigs on the control treatment tended ($P = 0.095$) to have increased ADFI compared with pigs provided mannan oligosaccharides, yeast culture, and beta-glucans through the water, with no evidence of difference ($P > 0.10$) on ADG, F/G, or BW. For mortality and morbidity, there was no evidence of difference ($P > 0.05$) observed. In summary, there was no effect on overall nursery performance when a combination of mannan oligosaccharides, yeast culture, and beta-glucans was provided in the water.

Introduction

The weaning age in the US swine industry is approximately 21 days, thus the gastrointestinal tract of the young pig is immature and susceptible to damage, leaking of nutrients, and is routinely exposed to pathogens.[2] Therefore, the period after weaning is associated with low feed intake, poor growth rate, and incidence of diarrhea. AgriMune Liquid (AFI-Agri Feed International, L.L.C.) is combination of mannan oligosaccharides, yeast culture, and beta-glucans, and is suggested to improve gut health of young pigs, resulting in increased gain and improved feed efficiency. Mannan oligosaccharides are associated with benefits in the intestinal integrity and the digestive and absorptive

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

[2] Lee, I. K., Y. C. Kye, G. Kim, H. W. Kim, M. J. Gu, J. Umboh, K. Maaruf, S. W. Kim, and C. H. Yun. 2016. Stress, nutrition, and intestinal immune responses in pigs - A Review. Asian-Australasian Journal of Animal Sciences, 29(8), 1075–1082.

function of the gut in the post-weaning period.[3] Additionally, adding yeast culture to diets for nursery pigs has been shown to improve nitrogen balance, nutrient digestion, and growth performance.[4] Finally, beta-glucans have a positive effect on gastrointestinal functions, and because of their probiotic activity, a positive effect on the immune system has been observed.[5] The objective of this study was to evaluate AgriMune Liquid, a combination of mannan oligosaccharides, yeast culture, and beta-glucans, provided through the water during the nursery period of pigs raised in commercial research conditions.

Materials and Methods

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in this experiment. This experiment was conducted at New Horizon Farms research nursery and finishing facilities located in Pipestone, MN. In the nursery, each pen (12 × 8 ft) had plastic slatted floors and was equipped with a six-hole stainless steel dry feeder and a pan waterer allowing *ad libitum* access to feed and water. Phase 1 diets were manufactured at Hubbard Feeds, (Beloit, KS) and all other diets were manufactured at the New Horizon Farms feed mill in Pipestone, MN. Feed additions to each pen were delivered and recorded by a robotic feeding system (FeedPro, Feedlogic Corp., Wilmar, MN). Pens of pigs were weighed, and feed delivery and disappearance were determined weekly during the nursery phase. Weights and feed measurements were used to determine growth performance (ADG, ADFI, and F/G). If a pig died or was removed off the test, it was weighed and recorded.

A total of 1,188 pigs (L337 × 1050; PIC; initial BW of 11.1 lb) were placed in 44 pens with 27 pigs per pen. Pigs were weaned at approximately 21 d of age and placed in pens based on initial body weight (BW). Pens were randomly allotted to 1 of 2 treatments in a randomized complete block design. The two treatments consisted of a combination of mannan oligosaccharides, yeast culture, and beta-glucans (AgriMune Liquid; AFI-Agri Feed International, L.L.C., Rockwell, IA), which were provided through the water lines at 4 mL/head/day from d 1 to 4, followed by 2 mL/head/day from d 5 to 40, or the control treatment which provided only water through the water line. Nursery diets were the same formulation for each treatment and fed in 3 phases during the experiment (Table 1). Phase 1 was budgeted at 5 lb/pig, Phase 2 was budgeted at 15 lb/pig, and Phase 3 was fed until d 40. Diets were formulated to meet or exceed the requirements for pigs in this facility.

Water medications were provided at different time points only when needed and according to label indications; ORAL-PRO (Aurora Pharmaceutical, Inc., Northfield, MN) at 11.3 mg/kg of body weight, R-Pen Penicillin G (Alpharma Inc., East Bridge Water, NJ) at a concentration of 297,000 units per liter of water for five days, Gentamed at 25 mg per 1 gallon of drinking water (Bimeda Inc., Oakbrook Terrace, IL) and Lincomycin (Zoetis Inc., Kalamazoo, MI) at 250 mg/gallon.

[3] Halas, V., and I. Nochta. Mannan oligosaccharides in nursery pig nutrition and their potential mode of action. 2012. Animals, 2, 261-274.

[4] Van der Peet-Schwering, C. M. C., A. J. M. Jansman, H. Smidt and I. Yoon. 2007. Effects of yeast culture on performance, gut integrity, and blood cell composition of weanling pigs. J. Anim. Sci. 85, 11, 3099–3109.

[5] Dritz, S.S., T. L. Kielian, R. D. Goodband, J. L. Nelssen, M. D. Tokach, M. M. Chengappa, J. E. Smith, and F. Blecha. 1995. Influence of dietary beta-glucan on growth performance, nonspecific immunity, and resistance to Streptococcus suis infection in weanling pigs. J Anim Sci, vol. 73, pp. 3341–3350.

Data were analyzed using R Studio (Version 4.0, R Core Team, Vienna, Austria) with pen serving as the experimental unit. Data were analyzed as a randomized complete block design with the fixed effect of water treatment, and weight block as the random effect within the model. Model assumptions were checked and considered to be appropriately met. Results were considered significant at $P \leq 0.05$ and marginally significant at $0.05 < P \leq 0.10$.

Results and Discussion

For the overall period (d 0 to 40), pigs on the control treatment tended to have increased ADFI ($P = 0.095$) compared with the pigs provided mannan oligosaccharides, yeast culture, and beta-glucans (AgriMune Liquid) during the nursery period. No differences were found for final BW, ADG, and F/G ($P > 0.10$) between treatments. While numerical improvements were reported at each weigh period for F/G, it was not statistically different at each period or overall. For morbidity or mortality, there were no differences found ($P > 0.80$). The total mortality was lower in this group than historical levels (~2–3%) for this commercial nursery site.

In summary, these data showed that a combination of mannan oligosaccharides, yeast culture, and beta-glucans through the water did not affect growth, removals, or mortality in this study. However, the relatively low level of mortality of this group of commercial pigs may have influenced a potential effect.

Brand names appearing in this publication are for product identification purposes only. No endorsement is intended, nor is criticism implied of similar products not mentioned. Persons using such products assume responsibility for their use in accordance with current label directions of the manufacturer.

Table 1. Composition of nursery diets (as-fed basis)[1]

Item	Phase 1	Phase 2	Phase 3
Ingredient, %			
Corn	42.20	49.97	49.33
Soybean meal (46.5% CP)	15.25	21.73	26.16
Dried whey	17.50	9.00	-
DDGS	5.00	10.00	20.00
Fish meal	5.00	5.00	-
Blood plasma	2.50	-	-
HP 300[2]	6.50	-	-
Corn oil	3.00	1.00	1.00
Calcium carbonate	0.73	0.80	1.25
Monocalcium phosphate (21% P)	0.45	0.30	0.45
Salt	0.30	0.50	0.55
Zinc oxide	0.42	0.27	-
L-Lys-HCl	0.40	0.58	0.60
DL-Met	0.20	0.21	0.16
L-Thr	0.20	0.25	0.20
L-Trp	0.02	0.05	0.04
L-Val	0.09	0.15	0.08
Phytase[3]	0.02	0.05	0.05
Vitamin premix[4]	0.05	-	-
Trace mineral premix[5]	0.13	-	-
Selenium premix	0.05	-	-
Vitamin and trace mineral premix[6]	-	0.15	0.15
Total	100.00	100.00	100.00

continued

Table 1. Composition of nursery diets (as-fed basis)[1]

Item	Phase 1	Phase 2	Phase 3
Calculated analysis			
Standardized ileal digestible (SID) amino acids, %			
Lysine	1.40	1.38	1.35
Ile:Lys	54	53	57
Leu:Lys	115	115	132
Met:Lys	37	38	35
Met and Cys:Lys	58	58	58
Thr:Lys	64	64	64
Trp:Lys	18.2	18.1	18.2
Val:Lys	70	70	70
His:Lys	35	34	38
Total Lys, %	1.57	1.55	1.53
ME, kcal/lb	1,602	1,529	1,495
NE, kcal/lb	1,209	1,147	1,113
SID Lys:NE, g/Mcal	5.25	5.46	5.50
CP, %	22.2	21.7	23.1
Ca, %	0.70	0.69	0.66
P, %	0.65	0.61	0.58
STTD[7] P, %	0.56	0.50	0.45

[1] Phase 1 was budgeted at 5 lb/pig, Phase 2 was budgeted at 15 lb/pig, and Phase 3 fed until d 40.
[2] HP 300 (Hamlet Protein, Findlay, OH).
[3]Quantum Blue 5G (AB Vista, Marlborough, UK) provided 510 phytase units (FTU)/lb of diet, for an estimated available phosphorus release of 0.14% that was used in Phase 1 in diets provided from Hubbard Feeds (Beloit, KS). Optiphos 2000, (Huvepharma Inc., Peachtree City, GA) provided 450 phytase units (FTU)/lb of diet, for an estimated release of 0.14% available P that was used in Phases 2 and 3 in diets provided from the mill at New Horizon Farms (Pipestone, MN).
[4] Provided per kg of premix: 11,100,196 IU vitamin A; 2,000,360 IU vitamin D; 59,996 IU vitamin E; 6000 mg vitamin K; 50 mg vitamin B_{12}; 8,001 mg riboflavin; 41,000 mg pantothenic acid; 45,002 mg niacin; 1,200 mg folic acid; and 200 mg biotin.
[5] Provided per kg of premix: 160,090 mg Zn from zinc sulfate; 134,000 mg Fe from ferrous sulfate; 40,000 mg Mn from manganese oxide; 13,340 mg Cu from copper sulfate; and 666 mg I from calcium iodate.
[6] Each kg of premix contained 66,700 mg Fe from ferrous sulfate; 73,300 mg Zn from zinc oxide; 26,700 mg Mn from manganese oxide; 10,000 mg Cu from copper sulfate; 500 mg I from calcium iodate; 200 mg Se; 5,344,484 IU vitamin A; 100,210 IU vitamin E; 21 mg vitamin B_{12}; 4,007 mg riboflavin; 15,366 mg pantothenic acid; 29,061 mg niacin; 668 mg folic acid; 1,201 mg vitamin B_6; 67 mg biotin; 1,336,122 IU vitamin D_3; and 1,671 mg vitamin K.
[7] Standardized total tract digestible P.

Table 2. Effects of a combination of mannan oligosaccharides, yeast culture, and beta-glucans provided in the drinking water on growth performance of nursery pigs[1]

Item	Control	Mannan oligosaccharides, yeast culture, and beta-glucans[2]	SEM	Probability, *P* =
BW, lb				
d 0	11.1	11.1	0.11	0.271
d 14	17.0	17.1	0.26	0.602
d 28	28.8	29.0	0.39	0.497
d 40	40.3	40.2	0.47	0.913
d 0 to 14				
ADG, lb	0.40	0.41	0.011	0.444
ADFI, lb	0.74	0.72	0.014	0.485
F/G	1.90	1.79	0.057	0.106
d 14 to 28				
ADG, lb	0.84	0.84	0.015	0.836
ADFI, lb	1.31	1.27	0.022	0.242
F/G	1.56	1.52	0.031	0.338
d 28 to 40				
ADG, lb	0.94	0.93	0.015	0.498
ADFI, lb	1.47	1.44	0.023	0.313
F/G	1.40	1.38	0.034	0.706
d 0 to 40				
ADG, lb	0.71	0.71	0.010	0.872
ADFI, lb	1.15	1.12	0.014	0.095
F/G	1.62	1.58	0.021	0.179
Removals, %				
Morbidity	4.3	4.0	0.21	0.897
Mortality	0.6	0.6	0.06	0.936
Total	4.9	4.6	0.21	0.794

[1] A total of 1,188 pigs (initially 11.1 lb) were used with 27 pigs per pen and 22 replications per treatment.
[2] A specialty liquid product containing a blend of mannan oligosaccharides, beta glucans, and yeast culture (Agri-Mune Liquid; AFI-Agri Feed International, L.L.C., Rockwell, IA) was provided in the drinking water to supply 4 mL/hd/day from d 1 to 4 and 2 mL/hd/day from d 4 to 40.