AN EVALUATION OF ARABINOGALACTAN (LARAFEED® AG) AS A NUTRACEUTICAL GROWTH PROMOTER IN STARTER DIETS FOR WEANLING PIGS[1]

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Summary

A nursery study was conducted at the KSU Segregated Early-Weaning Facility to evaluate the effect of dietary arabinogalactan on weanling pig performance. Arabinogalactan is a water-soluble proteoglycan/polysaccharide, most commonly harvested from the bark of the Western Larch (*Larix occidentalis)* tree, which has demonstrated neutraceutical properties in a limited number of studies with dogs and foals. A total of 288 pigs (initially 14.9 lb) were used in the 35-d experiment. Pigs were blocked by weight and randomly allotted to one of eight dietary treatments fed throughout Phase 1 (d 0 to 14) and Phase 2 (d 14 to 28), followed by a common diet during Phase 3 (d 28 to 35). Four levels of arabinogalactan (0, 0.05, 0.10, and 0.20%) were included in either a negative or positive control diet in a 2 × 4 factorial to form the eight dietary treatments. The negative control diet was a corn-soybean meal based diet without feed-grade antibiotics. The positive control diet was identical to the negative control, but contained a feed-grade antibiotic (Neo-Terramycin with 140 g of neomycin and 140 g of oxytetracycline per ton). The common diet fed during Phase 3 did not contain arabinogalactan, but did contain a feed-grade antibiotic (Neo-Terramycin). From d 0 to 14 (Phase 1), ADG, ADFI, and d 14 weight decreased (linear, $P<0.05$) with increasing level of arabinogalactan in the diet. Also, pigs fed the positive control diet were heavier ($P<0.05$) on d 14 than those fed the negative control. During Phase 2 (d 14 to 28) and for the overall treatment period (d 0 to 28), ADG, ADFI, and d 28 weight were improved ($P<0.01$) for pigs fed the positive control diet compared with pigs fed the negative control. Due to the reduction in ADFI at the highest level (0.20%) of arabinogalactan, ADFI decreased (linear, $P<0.05$) from d 0 to 28 with increasing arabinogalactan. From d 28 to 35 (Phase 3), when all pigs were fed a common diet, ADG and F/G were poorer for pigs previously fed the positive control. Overall (d 0 to 35), ADG tended to be improved ($P<0.07$), and ADFI and d 35 weight were improved ($P<0.05$) for pigs fed the positive control, but F/G was slightly poorer ($P<0.05$) than for pigs fed the negative control. A reduction (linear, $P<0.05$) in ADFI was observed for pigs fed increasing arabinogalactan. In conclusion, the addition of arabinogalactan to weanling pig diets did not improve growth performance with the high level (0.20%) resulting in reduced ADFI. However, ADG,

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ADFI, and d 35 weight were improved by including a feed-grade antibiotic in the Phase 1 and Phase 2 diets.

(Key words: antibiotics, arabinogalactan.)

Introduction

There is increasing public concern about the use of sub-therapeutic levels of feed-grade antibiotics in food animal production. The judicious use of sub-therapeutic (or more commonly "growth promoter") levels of antibiotics in food animal production has served to improve animal health, welfare, and performance/production efficiency. Most often, the use of these feed-grade antibiotics coincides with periods of increased stress, such as weaning.

As an alternative to feed-grade antibiotics, there is increasing interest in identifying suitable nutraceutical compounds. Nutricines are "natural" compounds found in various foodstuffs in trace amounts, with properties that may improve health and immune function but lack an established requirement. An increasing understanding of potential nutraceutical compounds that may enhance immunity and health, and improve the ability to cope with periods of increased stress has stimulated interest in identifying suitable antibiotic replacements. Few nutraceuticals, however, have been evaluated in studies measuring animal performance.

Arabinogalactan is a naturally occurring, water-soluble proteoglycan/polysaccharide that is not generally found in foodstuffs commonly fed to domesticated pigs. A few experiments with dogs and young foals have identified improvements in the digestive health and immune function of animals supplemented with arabinogalactan in their diet. Weanling pigs are particularly vulnerable to enteric diseases and digestive upset, and these contribute significantly to losses in growth performance during the nursery period. A large portion of the "growth promoter" levels of feed-grade antibiotics used in the swine industry are used during this period due to their demonstrated efficacy in nursery pigs. Therefore, the objective of this experiment was to evaluate the influence of dietary arabinogalactan on the growth performance of weanling pigs.

Procedures

Procedures used in this experiment were approved by the Kansas State University Animal Care and Use Committee. The project was conducted at the KSU Segregated Early-Weaning Facility. Pens had steel 'tri-bar' flooring and provided approximately 3 ft^2 per pig. Each pen was equipped with a four-hole, dry, self-feeder and one cup waterer, providing *ad libitum* access to feed and water. The facility was a mechanically ventilated room with a pull-plug manure storage pit underneath the pens' mesh flooring.

A total of 288 pigs were weaned at an average of 14.9 lb and 21 d of age. Pigs were blocked by weight and randomly allotted to one of the eight dietary treatments with eight pens per treatment. Each pen contained either 4 or 5 pigs. Two control diets were used. The negative control diet did not contain any feed-grade antibiotics, while the positive control diet contained a feed-grade antibiotic (Neo-Terramycin with 140 g of neomycin and 140 g of oxytetracycline per ton). Arabinogalactan (Larafeed® AG; to provide 0, 0.05, 0.10 and 0.20% arabinogalactan) was added to each control diet at the expense of corn starch to achieve the eight dietary treatments. Experimental diets were fed in meal form and maintained throughout two dietary phases (Table 1). Phase 1 diets were fed from d 0 to 14 and Phase 2 diets were fed from d 14 to 28. All pigs were fed a common diet that contained a feed-grade antibiotic (Neo-Terramycin with 140 g of neomycin and 140 g of oxytetracy-

cline per ton) during Phase 3 (d 28 to 35). Pigs and feeders were weighed on d 0, 7, 14, 21, 28, and 35 post-weaning to determine the response criteria of ADG, ADFI, and F/G.

Data were analyzed as a randomized complete block design using the PROC MIXED procedure of SAS with pen as the experimental unit. Linear and quadratic polynomial contrasts were used to determine the effects of increasing arabinogalactan.

Results

There were no interactions ($P>0.10$) between the control diet and arabinogalactan (Tables 2 and 3). For the d 0 to 14 (Phase 1) period, ADG, ADFI, and d 14 weight decreased (linear, $P<0.05$) with increasing arabinogalactan in the diet. This was primarily due to the large reductions observed at the highest level fed (0.20%). Also, pigs fed the positive control diet had heavier ($P<0.05$) d 14 weights than those fed the negative control.

During Phase 2 (d 14 to 28), ADG, ADFI, and d 28 weight of pigs fed the positive control diet were improved compared with pigs fed the negative control diet.

For the overall treatment period (d 0 to 28), ADG and ADFI were improved for pigs fed the positive control. Because of the lower ADFI for pigs fed the diet containing the highest level (0.20%) of arabinogalactan, ADFI decreased linearly ($P<0.05$) with increasing arabinogalactan.

From d 28 to 35 (Phase 3), when all pigs were fed a common diet, ADG and F/G were poorer ($P<0.01$) for pigs previously fed the positive control diet.

Overall (d 0 to 35), ADG tended to be improved ($P<0.07$) for pigs fed the positive control. Also, ADFI and d 35 weight were improved ($P<0.05$) for pigs fed the positive control, but F/G was slightly poorer ($P<0.05$). A reduction (linear, $P<0.05$) in ADFI was observed for pigs fed increasing arabinogalactan, primarily at the highest level (0.20%).

In conclusion, the addition of arabinogalactan to weanling pig diets did not improve growth performance. In fact, feeding the highest level (0.20%) resulted in reduced performance. However, ADG, ADFI, and d 35 weight were improved by including a feed-grade antibiotic in the Phase 1 and Phase 2 diets.

Table 1. Composition of Experimental Diets[a,b,c]

Ingredient	Phase 1 Negative Control	Phase 2 Negative Control	Phase 3 Common
Corn	50.67	59.85	58.01
Soybean meal (46.5% CP)	30.13	35.05	34.85
Select menhaden fish meal	3.75	-	-
Spray-dried edible whey	10.00	-	-
Corn starch	1.17	1.17	-
Soybean oil	1.00	-	3.00
Monocalcium P (21% P)	1.20	1.50	1.20
Limestone	0.75	1.10	0.93
Salt	0.35	0.35	0.35
L-lysine HCl	0.30	0.30	0.30
DL-methionine	0.13	0.13	0.15
L-threonine	0.15	0.15	0.11
Vitamin premix	0.25	0.25	0.25
Trace mineral premix	0.15	0.15	0.15
Antibiotic[c]	-	-	0.70
Total	100.00	100.00	100.00
Calculated analysis			
Total lysine, %	1.55	1.45	1.44
True digestible amino acids			
Lysine, %	1.41	1.31	1.30
Isoleucine:lysine ratio, %	60	63	62
Leucine:lysine ratio, %	121	129	128
Methionine:lysine ratio, %	33	33	35
Met & Cys:lysine ratio, %	56	58	59
Threonine:lysine ratio, %	63	64	62
Tryptophan:lysine ratio, %	17	18	18
Valine:lysine ratio, %	66	69	69
Protein, %	22.40	21.90	21.60
ME, kcal/lb	1,514	1,492	1,560
TID lysine: ME ratio, g/Mcal	4.22	3.98	3.78
Ca, %	0.81	0.73	0.71
P, %	0.70	0.65	0.65
Available P, %	0.40	0.32	0.33

[a]The positive control contained a feed-grade antibiotic (140 g/ton of Neomycin and 140 g/ton of Oxytetracycline) at the expense of corn starch, but was otherwise identical to the negative control.
[b]Larafeed® AG (to provide 0, 0.05, 0.10 and 0.20% arabinogalactan) was added to the basal diets at the expense of corn starch.
[c]Provided 140 g/ton of Neomycin and 140 g/ton of Oxytetracycline.

Table 2. Growth Performance of Nursery Pigs Fed Increasing Arabinogalactan – Interactive Means[a,b,c]

										P <			
	Negative Control				Positive Control					Negative vs		Arabinogalactan	
Item Arabinogalactan, %	0	0.05	0.10	0.20	0	0.05	0.10	0.20	SE Mean	Positive	Arabinogalactan	Linear	Quadratic
D 0 to 14													
ADG, lb	0.34	0.37	0.32	0.31	0.38	0.38	0.41	0.31	0.04	0.08	0.10	0.05	-
ADFI, lb	0.43	0.43	0.39	0.39	0.44	0.44	0.48	0.39	0.03	0.08	0.06	0.02	-
F/G	1.32	1.19	1.28	1.25	1.19	1.20	1.16	1.60	0.15	-	-	-	-
D 14 to 28													
ADG, lb	1.00	0.98	1.02	1.01	1.15	1.13	1.21	1.07	0.05	0.01	-	-	-
ADFI, lb	1.34	1.33	1.31	1.30	1.50	1.47	1.56	1.39	0.07	0.01	-	-	-
F/G	1.35	1.35	1.28	1.29	1.30	1.32	1.30	1.30	0.03	-	-	-	-
Overall, D 0 to 28													
ADG, lb	0.67	0.68	0.67	0.66	0.76	0.75	0.81	0.68	0.04	0.01	-	-	-
ADFI, lb	0.89	0.88	0.85	0.85	0.96	0.95	1.02	0.88	0.05	0.01	0.08	0.04	-
F/G	1.32	1.30	1.27	1.28	1.27	1.28	1.26	1.31	0.02	-	-	-	-
D 28 to 35 (common diet)													
ADG, lb	1.80	1.74	1.74	1.75	1.61	1.63	1.64	1.59	0.05	0.01	-	-	-
ADFI, lb	2.31	2.24	2.25	2.28	2.25	2.26	2.28	2.14	0.08	-	-	-	-
F/G	1.28	1.29	1.29	1.30	1.41	1.39	1.39	1.35	0.03	0.01	-	-	-
Overall, D 0 to 35													
ADG, lb	0.90	0.89	0.88	0.88	0.93	0.92	0.98	0.85	0.04	0.07	0.10	0.09	-
ADFI, lb	1.17	1.15	1.13	1.13	1.22	1.21	1.27	1.12	0.05	0.01	0.07	0.04	-
F/G	1.30	1.29	1.28	1.28	1.31	1.31	1.30	1.32	0.02	0.04	-	-	-
Pig Weights, lb													
D 0	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	0.70	-	-	-	-
D 14	19.7	20.1	19.3	19.3	20.3	20.2	20.6	19.3	1.04	0.05	0.13	0.05	-
D 28	33.7	33.8	33.6	33.5	36.5	36.4	37.5	35.1	1.62	0.01	-	-	-
D 35	46.3	46.0	45.8	45.7	47.7	47.8	49.0	46.2	1.81	0.01	-	-	-

[a]A total of 288 pigs were used in a 35-day experiment with eight replications and 4 or 5 pigs per pen. Experimental diets were fed in two phases, with phase 1 from d 0 to 14 after weaning and phase 2 from d 14 to 28. A common diet containing an antibiotic (Neo-Terramycin with 140 g of neomycin and 140 g of oxytetracycline per ton) was fed during the third phase from d 28 to 35.

[b]The negative control diet did not contain a feed-grade antibiotic. The positive control diet contained a feed-grade antibiotic (Neo-Terramycin with 140 g of neomycin and 140 g of oxytetracycline per ton).

[c]No interactions, $P>0.10$

Table 3. Growth Performance of Nursery Pigs Fed Increasing Arabinogalactan – Main Effects[a,b,c]

	Control		Arabinogalactan, %					*P* <			
								Negative vs		Arabinogalactan	
Item	Negative	Positive	0	0.05	0.10	0.20	SE Mean	Positive	Arabinogalactan	Linear	Quadratic
D 0 to 14											
ADG, lb	0.34	0.37	0.36	0.38	0.36	0.31	0.04	0.08	0.10	0.05	-
ADFI, lb	0.41	0.44	0.44	0.43	0.43	0.39	0.03	0.08	0.06	0.02	-
F/G	1.26	1.29	1.26	1.20	1.22	1.42	0.15	-	-	-	-
D 14 to 28											
ADG, lb	1.00	1.14	1.08	1.05	1.11	1.04	0.05	0.01	-	-	-
ADFI, lb	1.32	1.48	1.42	1.40	1.44	1.34	0.07	0.01	-	-	-
F/G	1.32	1.30	1.32	1.33	1.29	1.30	0.03	-	-	-	-
Overall, D 0 to 28											
ADG, lb	0.67	0.75	0.72	0.71	0.74	0.67	0.04	0.01	-	-	-
ADFI, lb	0.86	0.95	0.93	0.91	0.93	0.86	0.05	0.01	0.08	0.04	-
F/G	1.29	1.28	1.29	1.29	1.27	1.29	0.02	-	-	-	-
D 28 to 35 (common diet)											
ADG, lb	1.76	1.62	1.70	1.68	1.69	1.67	0.05	0.01	-	-	-
ADFI, lb	2.27	2.23	2.28	2.25	2.27	2.21	0.08	-	-	-	-
F/G	1.29	1.38	1.34	1.34	1.34	1.33	0.03	0.01	-	-	-
Overall, D 0 to 35											
ADG, lb	0.89	0.92	0.91	0.91	0.93	0.87	0.04	0.07	0.10	0.09	-
ADFI, lb	1.15	1.21	1.19	1.18	1.20	1.13	0.05	0.01	0.07	0.04	-
F/G	1.29	1.31	1.31	1.30	1.29	1.30	0.02	0.04	-	-	-
Pig Weights, lb											
D 0	14.9	14.9	14.9	14.9	14.9	14.9	0.70	-	-	-	-
D 14	19.6	20.1	20.0	20.1	20.0	19.3	1.04	0.05	0.13	0.05	-
D 28	33.7	36.4	35.1	35.1	35.6	34.3	1.62	0.01	-	-	-
D 35	46.0	47.7	47.0	46.9	47.4	46.0	1.81	0.01	-	-	-

[a]A total of 288 pigs were used in a 35-day experiment with eight replications and 4 or 5 pigs per pen. Experimental diets were fed in two phases, with phase 1 from d 0 to 14 after weaning and phase 2 from d 14 to 28. A common diet containing an antibiotic (Neo-Terramycin with 140 g of neomycin and 140 g of oxytetracycline per ton) was fed during the third phase from d 28 to 35.

[b]The negative control diet did not contain a feed-grade antibiotic. The positive control diet contained a feed-grade antibiotic (Neo-Terramycin with 140 g of neomycin and 140 g of oxytetracycline per ton).

[c]No interactions, $P>0.10$