EFFECTS OF A PREBIOTIC, INULIN, AND A DIRECT FED MICROBIAL ON GROWTH PERFORMANCE OF WEANLING PIGS

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Summary

A 32-day growth study with a total of 252 weanling pigs (18 ± 3 d of age) was conducted to evaluate the effects of a prebiotic, Inulin (a fructooligosaccharide derivative of chicory), and a direct fed microbial (Lactobacillus strain) in diets for weanling pigs. Pigs were fed one of six experimental diets containing: 1) no antibiotic or prebiotic (negative control); 2) carbadox (50 g/ton, positive control); 3) direct fed microbial (DFM, 0.1%); 4) Inulin (0.5% and 0.2% of phase I and phase II diets, respectively); 5) carbadox plus DFM; or 6) carbadox plus Inulin.

Pigs fed carbadox improved (P<0.04) ADG from d 0 to 14, 14 to 32, and overall (0 to 32) compared to pigs fed diets without carbadox. Pigs fed diets containing carbadox increased (P<0.01) ADFI from d 0 to 14 and tended to have increased (P<0.06) ADFI overall compared to pigs fed diets without carbadox. No differences in ADG or ADFI were seen for pigs fed diets containing either Inulin or the DFM compared to pigs fed diets without Inulin or DFM. Pigs fed the DFM had poorer feed efficiency d 0 to 14 (P<0.03), 14 to 32 (P<0.01), and overall (P<0.01) compared to those fed diets without DFM. Also, there was a trend for pigs fed diets containing Inulin to have poorer feed efficiency (P<0.07) from d 14 to 32 and overall when compared to pigs fed diets without Inulin.

There were no additive responses for ADG or ADFI when Inulin or DFM were combined with carbadox. Pigs fed diets containing both the DFM and carbadox resulted in poorer feed efficiency (P<0.02) from d 14 to 32 and overall (0 to 32) than pigs fed diets without carbadox or DFM. Pigs fed the diet containing Inulin and carbadox had poorer feed efficiency from d 0 to 14 (P<0.04) compared to pigs fed diets without carbadox or Inulin. In summary, nursery diets containing either Inulin or the DFM did not enhance growth performance; however, carbadox improved ADG and ADFI.

(Key Words: Antibiotics, Antimicrobials, Weanling Pigs)

Introduction

Recent concerns with antibiotic resistance in humans and animals have led to increased research efforts to evaluate alternative products. Several direct fed microbial products and Lactobacillus strains are available that may improve the environment for gram positive bacteria in the intestinal lining and reduce the amount of gram negative bacteria found in the gut. It is believed that altering the intestinal bacteria may reduce the incidence of scours and increase nutrient digestibility and absorption due to improved intestinal health. In ad-

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dition, nondigestible oligosaccharides (an indigestible fiber source) have been shown to increase the number of lactic acid producing bacteria (gram positive) in the intestinal lining. Inulin, a derivative of chicory, is a fructooligosaccharide that may improve nursery pig performance through these methods. Research involving antibiotic alternatives has not been consistent in improving growth performance in nursery pigs. Therefore, the objective was to determine whether a DFM (Lactobacillus strain) or Inulin can influence weanling pig performance and be a suitable replacement for antibiotics.

Procedures

A total of 252 weaned pigs (PIC, initially 13.1 lb and 18 ± 3 d of age) were blocked by weight and gender in a 32-day growth study. They were randomly allotted to one of six dietary treatments in a randomized complete block design. Each pen contained six pigs (three barrows and three gilts), with seven replicates (pens) per treatment. Pigs were housed at the Kansas State University Swine Teaching and Research Center in an environmentally controlled nursery, with the temperature set at 90ºF at weaning and lowered 2º each week. All pens (4 x 5 ft) contained one stainless steel self-feeder and a nipple waterer to allow ad libitum access to feed and water.

Pigs were fed one of six dietary treatments including: 1) no antibiotic or prebiotic (negative control); 2) carbadox (50 g/ton, positive control); 3) Direct fed microbial (DFM, 0.1%); 4) Inulin (0.5% and 0.2% of phase I and phase II diets, respectively); 5) carbadox plus DFM; or 6) carbadox plus Inulin.

Experimental diets were corn-soybean meal-based and fed in meal form for 32 days post-weaning. Phase I (1.55% lysine) was fed from d 0 to 14 post-weaning, and Phase II (1.45% lysine) was fed from d 14 to 32 post-weaning (Table 1). Diets did not contain growth promoting levels of zinc oxide or copper sulfate. Pigs were weighed and feed disappearance was measured on d 0, 7, 14, 21, 28, and 32 to determine ADG, ADFI, and F/G. Data were analyzed as a randomized complete block design with pen as the experimental unit using the Mixed procedure of SAS.

Table 1. Diet Composition (As-fed)[a]

Ingredient	Phase I[b]	Phase II[c]
Corn	47.50	59.40
Soybean meal, 46.5% CP	29.00	35.10
Spray dried whey	15.00	0.00
Select menhaden fishmeal	3.75	0.00
Monocalcium phosphate, 21% P	1.20	1.85
Limestone	0.70	1.10
Salt	0.40	0.40
Lysine HCl	0.30	0.30
Vitamin premix	0.25	0.25
Trace mineral premix	0.15	0.15
DL-Methionine	0.15	0.15
L-Threonine	0.10	0.10
Corn starch[d]	1.50	1.20
TOTAL	100.00	100.00
Calculated values, %		
Lysine	1.55	1.45
Isoleucine:lysine ratio	60	62
Leucine:lysine ratio	120	129
Methionine:lysine ratio	33	34
Met & Cys:lysine ratio	57	59
Threonine:lysine ratio	63	63
Tryptophan:lysine ratio	18	18
Valine:lysine ratio	68	71
CP	21.7	21.4
ME, kcal/lb	1,485	1,483
Ca	0.91	0.90
P	0.81	0.80

[a]All diets fed in meal form.
[b]Fed to pigs from d 0 to 14 post-weaning.
[c]Fed to pigs from d 14 to 32 post-weaning.
[d]Carbadox (50 g/ton), DFM (0.1%), Inulin (0.5% Phase I, 0.2% Phase II), or a combination of carbadox and either DFM or Inulin replaced cornstarch to provide the additional dietary treatments.

Results and Discussion

No carbadox by DFM or carbadox by Inulin interactions were detected for ADG or ADFI, therefore the treatment main effects are presented in Table 2. However, some F/G interactions were observed and are presented in Table 3, with main effects of F/G in Table 2.

From d 0 to 14, pigs fed diets containing carbadox had greater ADG ($P<0.01$) and ADFI ($P<0.01$) compared to pigs diets without carbadox. Pigs fed diets with either the DFM or Inulin had similar ADG and ADFI compared to pigs fed diets without DFM or Inulin ($P>0.11$). Also, pigs fed diets containing the DFM had poorer F/G ($P<0.03$) compared to pigs fed diets without DFM. Pigs fed diets containing the combination of Inulin and carbadox had poorer feed efficiency than pigs fed diets without carbadox or Inulin which resulted in a carbadox by Inulin interaction ($P<0.05$).

From d 14 to 32, pigs fed diets containing carbadox had increased ADG ($P<0.04$) compared to pigs fed diets without carbadox. Pigs fed diets with either the DFM or Inulin had similar ADG and ADFI compared to pigs fed diets without DFM or Inulin ($P>0.31$). Also, pigs fed diets containing DFM had poorer feed efficiency ($P<0.01$) than those fed diets without DFM. Furthermore, pigs fed diets containing Inulin tended to have poorer feed efficiency ($P<0.07$) than pigs fed diets without Inulin.

Pigs fed diets containing the combination of DFM and carbadox had poorer feed efficiency compared to pigs fed diets without carbadox or DFM which resulted in a carbadox by DFM interaction ($P<0.01$).

For the overall treatment period (d 0 to 32), pigs fed diets containing carbadox had greater ADG ($P<0.01$) and tended to have greater ADFI ($P<0.06$) compared with pigs fed diets without carbadox. Pigs fed diets containing DFM or Inulin had similar ADG and ADFI compared with pigs fed diets without DFM or without Inulin ($P>0.16$). Pigs fed diets containing the DFM had poorer feed efficiency ($P<0.01$) and pigs fed the diet containing Inulin tended to have poorer feed efficiency ($P<0.06$) than pigs fed diets without DFM or without Inulin. There also was a carbadox by DFM interaction where pigs fed the combination of DFM and carbadox had poorer feed efficiency ($P<0.03$) than pigs fed diets without carbadox or DFM.

Agreeing with many previous trials, feeding nursery pigs diets containing carbadox resulted in improved growth performance. However, neither the DFM nor Inulin improved ADG, ADFI, or F/G in this study. There also were no additive affects of combining these products with carbadox. In conclusion, Inulin and DFM were not suitable replacements for antibiotics to improve growth performance in nursery pigs in this study.

Table 2. Effects of a DFM & Inulin on Growth Performance of Nursery Pigs[a]

	Carbadox		DFM[b]		Inulin			Probability (P<)				
Item	0	50g/ton	0	0.1%	0	0.5% & 0.2%[c]	SE	Carbadox	DFM	Inulin	Carbadox & DFM	Carbadox & Inulin
Replicates	21	21	14	14	14	14						
Day 0 to 14												
ADG, lb	0.41	0.47	0.46	0.42	0.43	0.45	0.022	0.01	0.11	0.43	0.97	0.44
ADFI, lb	0.50	0.56	0.54	0.52	0.51	0.55	0.024	0.01	0.66	0.19	0.63	0.71
Feed/Gain	1.22	1.20	1.17	1.25	1.20	1.22	0.036	0.76	0.03	0.61	0.69	0.05
Day 14 to 32												
ADG, lb	1.15	1.22	1.20	1.16	1.18	1.18	0.031	0.04	0.31	0.85	0.32	0.37
ADFI, lb	1.66	1.71	1.68	1.70	1.67	1.70	0.043	0.22	0.66	0.46	0.63	0.82
Feed/Gain	1.45	1.43	1.41	1.47	1.42	1.46	0.021	0.22	0.01	0.07	0.01	0.27
Day 0 to 32												
ADG, lb	0.83	0.89	0.87	0.84	0.86	0.86	0.023	0.01	0.16	0.85	0.66	0.49
ADFI, lb	1.15	1.21	1.18	1.18	1.16	1.20	0.031	0.06	0.85	0.30	0.83	0.76
Feed/Gain	1.41	1.38	1.36	1.43	1.38	1.41	0.017	0.14	0.01	0.06	0.03	0.89

[a]A total of 252 pigs initially 13.1 lbs and 18 ± 3 d of age.
[b]Lactobacillus strain.
[c]Inclusion rate of: Phase I = 0.5%; and Phase II = 0.2%.

Table 3. Interactive Effects of Pigs Fed the DFM or Inulin with Carbadox

Item	Control	Inulin	Carbadox	Carbadox & Inulin	Interaction (P<)
Day 0 to 14					
Feed/Gain	1.24	1.18	1.16	1.25	0.05

Item	Control	DFM	Carbadox	Carbadox & DFM	Interaction (P<)
Day 14 to 32					
Feed/Gain	1.39	1.51	1.42	1.43	0.01
Day 0 to 32					
Feed/Gain	1.35	1.46	1.37	1.39	0.03