EFFECTS OF PELLETING LOW-LYSINE DIETS WITH FERMENTATION PRODUCTS FOR WEANLING PIGS

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Summary

One hundred twenty pigs (13.2 lb avg initial wt) were used in an experiment to determine the effects of pelleting on the ability of fermentation products to improve growth performance of nursery-age pigs fed low-lysine diets. Treatments were: 1) positive control (1.15 and .95% lysine for d 0 to 14 and 14 to 35, respectively); 2) diet 1 pelleted; 3) low-lysine regimen (1.05 and .85% lysine for d 0 to 14 and 14 to 35, respectively) supplemented with fermentation product (FP)[1]; 4) diet 3 pelleted; 5) low-lysine regimen supplemented with modified fermentation product (MFP)[2]; and 6) diet 5 pelleted. For pelleting, the diets were pre-conditioned to 131°F and pelleted (5/32" diameter pellets) at an avg production rate of 3,550 lb/h, with an avg exit temperature of 144°F. The pigs were allowed to consume feed and water ad libitum during the 35-d experiment. For d 0 to 7 and 0 to 14, pigs fed the pelleted diets had greater ADG and efficiency of gain than pigs fed diets in meal form. At d 14, apparent digestibilities of DM and N of the control diet were increased by pelleting, but those of the diets with fermentation products added were not affected. CFUs of lactobacilli, streptococci, and coliforms in feces were not affected by treatment. From d 14 to 35, pigs fed pelleted diets were more efficient but consumed less feed and had lower ADG than pigs fed diets in meal form. For d 0 to 35, ADG was not affected by treatment, but pigs fed pelleted diets consumed 8% less feed and had 8% greater efficiencies of gain than pigs fed diets in meal form. Growth performance of pigs fed the low-lysine diets plus the fermentation products was not different than that of pigs fed diets with adequate lysine concentrations. Performance of pigs fed FP or MFP was not different. At d 35, CFUs of lactobacilli in feces were not affected by treatment. CFUs of streptococci were greater for pigs fed the control diet than for pigs fed the treatment diets, but were decreased by pelleting the control diet, whereas pelleting the treatment diets increased CFUs of streptococci in feces. CFUs of coliforms were greater for pigs fed diets with MFP than those fed diets with FP. In conclusion, growth performance of pigs fed low-lysine diets plus fermentation products was equal to that of pigs fed diets with adequate lysine concentrations.

(Key Words: Lysine, Probiotic, Starter, Digestibility, Performance, Fecal Microbes.)

Introduction

Use of fermentation products to spare protein (lysine) could allow nutritionists to formulate low-protein diets that are advantageous from economical and environmental standpoints. Previous research at this station (see 1990 KSU Swine Day Report, page 79) indicated that nursery diets with 17% crude protein and 1.25 lb/ton of FP supported growth performance equal to a 19% crude protein control diet. However, feeding FP at concentrations greater than 1.25 lb/ton was of no benefit to nursery pigs and actually depressed feed intake

[1]Fermentation product was Fermacto®, Pet-Ag, Inc., Elgin, IL 60120.
[2]Modified fermentation product was Modified Fermacto, Pet-Ag, Inc., Elgin, IL 60120.

and rate of gain in growing and finishing pigs. The experiment reported herein was designed to confirm the performance enhancement from inclusion of 1.25 lb/ton of FP in low-lysine nursery diets, and to determine if modification of FP would improve diet palatability and feed intake. Also, the effect of pelleting on any growth-promoting effect of the fermentation products was evaluated.

Procedures

One hundred twenty pigs (13.2 lb avg initial wt) were allotted to six treatments based on ancestry, sex, and weight. The pigs were housed (four pigs/pen and five pens/treatment) in an environmentally controlled nursery equipped with a woven-wire floor. Each pen had a self-feeder and nipple waterer so feed and water could be consumed ad libitum. At weaning (21 d of age), the pigs were given the Phase I diet (Table 1) from d 0 to 14 of the experiment and the Phase II diet from d 14 to 35 of the experiment. The diet ingredients were analyzed for lysine concentration and blended to give the following treatments: 1) positive control (1.15 and .95% lysine for d 0 to 14 and 14 to 35, respectively); 2) diet 1 pelleted; 3) low-lysine regimen (1.05 and .85% lysine for d 0 to 14 and 14 to 35, respectively) supplemented with FP; 4) diet 3 pelleted; 5) low-lysine regimen supplemented with MFP; and 6) diet 5 pelleted. For pelleting, the diets were preconditioned to 131°F and pelleted (5/32" diameter pellets) at an avg production rate of 3,550 lb/h, with an avg exit temperature of 144°F. All feed additions were recorded, and pig and feeder weights were collected weekly. On d 14 and 35 of the experiment, fecal samples were collected from one pig in each pen by rectal massage for determination of colony forming units (CFUs) of lactobacilli (Bacto Lactobacilli MRS broth), streptococci (Slanetz and Bartley medium), coliforms (violet-red bile agar), and total bacteria (plate count agar). Additionally on d 14, fecal samples were collected from all pigs, pooled within pen, and analyzed for DM, N, and Cr concentrations. Apparent digestibilities of DM and N were calculated using the indirect ratio method. Response criteria were ADG; ADFI; F/G; apparent digestibilities of DM and N; percentage fecal moisture; and CFUs of lactobacilli, streptococci, and coliforms in the feces. Orthogonal contrasts were used to compare meal versus pelleted diets, control versus low-lysine diets with fermentation products, FP versus MFP, and all appropriate interaction effects. Total CFUs of fecal bacteria (plate count agar) were used as covariates in the statistical analyses of CFUs of fecal microbes.

Results and Discussion

Samples were evaluated pre- and postpelleting to ensure that pelleting conditions were uniform for all diets. Production rates ranged from 3,464 to 3,599 lb/h, conditioning temperature was constant at 131°F, and exit temperature ranged from 142 to 145°F, so pelleting conditions were quite consistent.

Results from the growth assay are given in Table 2. For d 0 to 7, ADFI was not affected by treatment, but improvements were observed for ADG and F/G when the diets were pelleted. For d 0 to 14, ADG was improved by 16% and F/G was improved by 15% when the diets were pelleted. There were no interactions between pelleting the diets and inclusion of fermentation products for growth performance to d 14. Performance of pigs fed the low-lysine diets supplemented with fermentation products was not different than that of pigs fed diets with adequate lysine concentrations, and there were no differences in performance for pigs fed FP versus MFP. So, the fermentation products appeared to support normal growth performance in pigs fed the low-lysine diets, but either product was equally effective during d 0 to 14 of the experiment. Digestibility of DM was increased by 3% when the control diet was pelleted but was not affected when the treatment diets were pelleted. Digestibility of N was greater for pelleted diets versus meal diets, although this response was more pronounced in the control diet versus the diets with fermentation products. Diets with MFP had greater digestibility of N than diets with FP. Bacterial concentrations in the feces (i.e., CFUs of lactobacilli, streptococci, and coliforms) were not affected by treatment at d 14.

For d 14 to 35, F/G was improved by pelleting the diets, but ADFI was decreased by 11%, to the point that ADG was reduced by 6%. However, for the overall experiment (d 0 to 35), ADG was not affected by pelleting, with an 8% reduction in ADFI and an 8% improvement in F/G. There were no interactions for growth performance between pelleting the diets and inclusion of fermentation products for d 14 to 35 or 0 to 35. CFUs of lactobacilli in feces were not affected by treatment. Streptococci concentration was greater in control pigs than pigs fed the fermentation products and was decreased when the control diet was pelleted but increased when the diets with fermentation products were pelleted. Pigs fed diets with MFP had more CFUs of coliform in their feces than pigs fed FP, with pigs fed the control diets being intermediate.

In conclusion, pelleting nursery diets improved ADG and F/G for the first 2 wk postweaning and F/G for the last 3 wk of the experiment. However, depressed ADFI for pigs fed the pelleted diets during the last 3 wk of the experiment resulted in reduced ADG. Low-lysine diets with fermentation products and diets with adequate lysine supported equal growth performance, and pelleting did not affect growth performance of pigs fed the low-lysine diets differently than pigs fed the control diets.

Table 1. Composition of Diets, %[ab]

	Phase I		Phase II	
Ingredient	Control (1.15% lys)	Low-lysine (1.05% lys)	Control (.95% lys)	Low-lysine (.85% lys)
Corn	48.41	48.54	64.41	64.54
Soybean meal (48% CP)	19.65	19.65	20.75	20.75
Whey	20.00	20.00	5.00	5.00
Select menhaden fishmeal	3.00	3.00	—	—
Lysine-HCl	.13	—	.13	—
Choice white grease	5.00	5.00	5.00	5.00
Vitamins and minerals	2.21	2.21	3.36	3.36
Antibiotics[c]	1.10	1.10	1.10	1.10
Chromic oxide	.25	.25	—	—
Treatment premix[d]	.25	.25	.25	.25

[a]Diets were formulated to supply .9% Ca, and .8% P in all diets, 3.22 and 2.65 g lys/Mcal DE for the Phase I and II control diets, and 2.93 and 2.37 g lys/Mcal DE for the Phase I and II treatment diets.
[b]The diets were fed in meal and pellet form.
[c]Supplied per ton of diet: 100 g chlortetracycline; 100 g sulfathiazole; 50 g penicillin; 250 ppm Cu.
[d]The treatment premix was finely ground corn for the control diets and supplied either 1.25 lb/ton of FP or 2.25 lb/ton of MFP for the treatment diets.

Table 2. Growth Response of Pigs Fed Low-lysine Diets Supplemented with Fermentation Products[a]

	1.15/.95% lysine control diet		1.05/.85% lysine + FP		1.05/.85% lysine + MFP		
Item	Meal	Pellet	Meal	Pellet	Meal	Pellet	CV
d 0-7							
ADG, lb[d]	.49	.60	.53	.57	.52	.66	21.6
ADFI, lb[b]	.67	.71	.66	.63	.65	.79	19.0
F/G[d]	1.41	1.20	1.28	1.12	1.27	1.18	15.2
d 0-14							
ADG, lb[d]	.61	.74	.68	.71	.60	.75	16.3
ADFI, lb[b]	.93	.91	.93	.86	.88	.96	12.7
F/G[f]	1.55	1.24	1.39	1.22	1.46	1.29	10.7
d 14-35							
ADG, lb[c]	1.18	1.18	1.21	1.06	1.15	1.10	8.4
ADFI, lb[e]	2.13	2.02	2.25	1.87	2.09	1.90	9.5
F/G[e]	1.79	1.72	1.85	1.76	1.83	1.73	4.4
d 0-35							
ADG, lb[b]	.96	1.00	1.00	.92	.93	.96	9.0
ADFI, lb[d]	1.65	1.58	1.72	1.46	1.61	1.52	9.1
F/G[f]	1.72	1.58	1.72	1.60	1.73	1.59	3.5

[a]Five pens/treatment and four pigs/pen. Fermentation products were Fermacto® (FP) and Modified Fermacto (MFP).
[b]No treatment effect (P>.15).
[cdef]Meal vs pellet (P<.10, P<.05, P<.01, and P<.001, respectively).

Table 3. Effects of Fermentation Products on Nutrient Digestibility and Colony Forming Units (CFUs) of Fecal Microbes[a]

	1.15/.95% lysine control diet		1.05/.85% lysine + FP		1.05/.85% lysine + MFP		
Item	Meal	Pellet	Meal	Pellet	Meal	Pellet	CV
Apparent digestibility (d 14), %							
DM[f]	77.3	79.5	77.9	75.7	77.6	78.0	2.7
N[cef]	63.6	69.0	65.3	64.4	67.0	69.6	5.0
Fecal moisture (d 14), %[b]	78.2	79.1	77.3	79.7	76.3	78.5	5.8
CFUs of fecal microbes (d 14), $\log_{10}$							
Lactobacilli[b]	7.96	8.29	8.01	8.10	8.36	7.94	8.8
Streptococci[b]	4.25	4.16	3.38	3.76	3.86	2.94	32.1
Coliforms[b]	4.66	4.65	4.10	4.28	5.58	3.87	36.1
CFUs of fecal microbes (d 35), $\log_{10}$							
Lactobacilli[b]	7.94	6.89	6.07	7.32	6.74	7.15	21.1
Streptococci[df]	4.93	3.21	2.02	4.06	1.80	2.74	60.3
Coliforms[e]	5.99	5.90	5.59	4.93	6.66	6.25	19.0

[a]Fermentation products were Fermacto® (FP) and Modified Fermacto (MFP).
[b]No treatment effect (P>.13).
[c]Meal vs pellet (P<.10).
[d]Control vs fermentation products (P<.10).
[e]FP vs MFP (P<.05).
[f]Meal vs pellet × control vs fermentation products (P<.10).