PROTEIN SPARING EFFECT OF A FERMENTATION PRODUCT IN PIG DIETS FROM WEANING TO MARKET

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Summary

One hundred eighty pigs (avg wt of 21.1 lb) were used in an experiment to determine if a fermentation product[1] improves performance and reduces last rib fat thickness in pigs when added to a low-protein diet regimen. Treatments were: 1) positive control (19-16-14% crude protein regimen during the nursery-growing-finishing phases); 2) positive control plus 2.50 lb/ton fermentation product; 3) low-protein regimen (17-14-12% crude protein during the nursery-growing-finishing phases); 4) low-protein regimen plus 1.25 lb/ton fermentation product; 5) low-protein regimen plus 2.50 lb/ton fermentation product; and 6) low-protein regimen plus 5.00 lb/ton fermentation product. As addition of fermentation product was increased from 0 to 5.00lb/ton in the low-protein regimen, average daily feed intake (ADFI) of nursery pigs decreased linearly. However, average daily gain (ADG) and feed to gain ratio (F/G) tended to be best for pigs fed 1.25 lb/ton of fermentation product compared to other treatments. During the growing and finishing phases, feeding the low-protein regimen reduced performance compared to the positive control. Compared to pigs fed the positive control, feeding 2.50 lb/ton of fermentation product tended to decrease ADFI and ADG but improved F/G. Feeding 2.50 and 5.00 lb/ton fermentation product reduced ADG and ADFI, and worsened F/G for pigs fed the low-protein regimen. Overall (from 21 to 220 lb), feeding the fermentation product at more than 1.25 lb/ton in the low-protein diet regimen tended to reduce performance, and pigs fed the low protein diets with or without the fermentation product had poorer performance (ADG, ADFI, F/G, and last rib fat thickness) than pigs fed the 19-16-14% crude protein diets.

(Key Words: Starter, GF, Performance, Probiotic, Carcass, Additive.)

Introduction

The gastro-intestinal tracts of pigs are continually challenged by antinutritional factors, abrasive materials, and potentially pathogenic microorganisms present in feed and feces. Both antibiotics and probiotics have been investigated by the authors (see 1989 KSU Swine Day Report) as feed additives that might improve growth performance of pigs by inhibiting the proliferation of pathogenic microorganisms in the intestine. However, feeding antibiotics and probiotics in combination is generally discouraged because of the negative effects that antibiotics have on the probiotic organisms. An experiment was designed to investigate the efficacy of a microbial fermentation product that can be added to diets with antibiotics. In

[1]Fermacto®, Pet-Ag. Inc., Elgin, IL 60120.

particular, the ability of this fermentation product to increase performance and decrease last rib fat thickness of pigs fed a low-protein diet was determined.

Procedures

One hundred eighty pigs were allotted to six treatments based on sex, weight, and ancestry. The pigs were housed, six pigs/pen and six pens/treatment, in an open-front building with a solid concrete floor. At weaning, the pigs were fed a common diet (a high nutrient-density diet with 1.5% lysine, 10% added fat, and 40% milk products) to an average weight of 21.1 lb. The pigs were fed the treatment diets (Table 1) from 21.1 lb until the end of the finishing phase. Treatments were: 1) positive control (19-16-14% crude protein regimen for the nursery-growing-finishing phases); 2) positive control plus 2.50 lb/ton fermentation product; 3) low-protein regimen (17-14-12% crude protein for the nursery-growing-finishing phases); 4) low-protein regimen plus 1.25 lb/ton fermentation product; 5) low-protein regimen plus 2.50 lb/ton fermentation product; and 6) low-protein regimen plus 5.00 lb/ton fermentation product. Calculated lysine concentrations for the 19-16-14% crude protein regimen were 1.16, .83, and .66%, and for the 17-14-12% crude protein regimen were 1.01, .69, and .52%, respectively. Feed and water consumption was ad libitum. All feed additions were recorded, and pig and feeder weights were collected at 4 wk to end the nursery phase, at 117 lb to end the growing phase, and when pigs in the first pen in a weight block averaged 230 lb to end the finishing phase. At the end of the feeding experiment, the pigs were ultrasonically scanned[2] for fat thickness at the last rib. Response criteria were ADG, ADFI, F/G, and last rib fat thickness. Orthogonal contrasts were used to separate treatment means, and final weight was used as a covariable in the analysis of fat thickness data.

Table 1. Composition of Diets, %[a]

	---------- Diet CP, % ----------		
Ingredient	19	16	14
Corn	43.73	73.24	79.86
Soybean meal	23.05	20.93	14.78
Dried whey	20.00	—	—
Fish meal	4.00	—	—
Choice white grease	5.00	2.00	2.00
Vit and Min	2.52	3.23	2.81
Antibiotics[b]	1.20	.10	.05
Trt premix[c]	.50	.50	.50

[a]Diets were formulated to supply .90% Ca and .80% P in the nursery phase, .75% Ca and .65% P in the growing phase, and .65% Ca and .55% P in the finishing phase. Ratios of corn and soybean meal were adjusted to give the low-protein regimen (17-14-12% CP).
[b]Provided 50 g/ton carbadox, 96 g/ton pyrantel tartrate and 250 ppm Cu in the nursery phase, 100 g/ton chlortetracycline in the growing phase, and 50 g/ton chlortetracycline in the finishing phase.
[c]Provided 0 or 2.50 lb/ton fermentation product in the 19-16-14% crude protein diets, and 0, 1.25, 2.50 and 5.00 lb/ton fermentation product in the 17-14-12% crude protein diets.

[2]Scanoprobe.

Results and Discussion

Samples of ingredients were analyzed for crude protein content before the diets were formulated. Crude protein percentages for the "48% soybean meal" ranged from 44.9 to 48.5%. Crude protein percentages for the corn ranged from 7.9 to 8.8%. From these analyses, it is apparent that "book values" for nutrient composition of feedstuffs should not be assumed correct in experiments designed to test the consequences of nutrient concentrations in diets.

Results from the growth assay are given in Table 2. In the nursery phase, there were no differences (P>.42) in ADG, ADFI, or F/G for pigs fed the 19 or 17% crude protein diets. The lack of difference when the low-protein regimen was fed probably resulted from the addition of good lysine sources (i.e., dried whey and fish meal) to the diets. Although the daily lysine intakes were still lower than those recommended by British scientists (i.e., ARC guidelines) and Australian scientists, lysine intakes were calculated to be roughly adequate according to the National Research Council guidelines (i.e., intakes of 8.5 to 9.7 g/d for pigs fed the low-protein regimen diets vs the NRC recommendation of 9.0 g/d).

As the concentration of fermentation product was increased from 0 to 5.00 lb/ton in the low-protein diets, ADG was reduced from 1.21 to 1.13 lb (a 7% reduction), an effect that corresponds to the 12% reduction (P<.05) in feed intake. However, it should be noted that pigs fed the 17% crude protein diet with the lowest level of inclusion (1.25 lb/ton) of fermentation product gained as well and were 10% more efficient than pigs fed the 19% crude protein diet without fermentation product (F/G of 1.61 vs 1.78, respectively).

Decreasing the crude protein concentration in the grower diet from 16 to 14% resulted in a 9% decrease in ADG (P<.001), a 4% decrease in ADFI (P<.10), and a 6% poorer F/G (P<.05). Increasing the concentration of fermentation product from 0 to 5.00 lb/ton resulted in a linear decrease in ADG and ADFI; however, the reduced performance resulted from the two greatest levels of addition (2.50 and 5.00 lb/ton).

In the finishing phase, decreasing the crude protein concentration of the diet resulted in a 13% reduction in ADG (P<.01), a 5% reduction in ADFI (P<.05), and a 9% poorer F/G (P<.001). Feed intake was reduced when 2.50 lb/ton of the fermentation product was added to the 14% crude protein diet (P<.05). The reduced feed intake was probably responsible for the 5% reduction in ADG and the 5% improvement in F/G, responses that are common with restricted feed intake. For pigs fed the low-protein diets (12% crude protein), ADG and ADFI were reduced by 11 and 9% as concentration of the fermentation product was increased from 0 to 5.00 lb/ton. However, as in the growing phase, the two greatest levels of inclusion (2.50 and 5.00 lb/ton) were responsible for the reduced growth performance. When pigs were fed the lowest level of inclusion (1.25 lb/ton), ADFI was reduced by 4% and ADG was reduced by 2%, but F/G was improved by 2%. This slight improvement in F/G cannot be explained by a restriction of feed intake, because with the low protein diets, a reduction in feed intake would intensify the protein deficiency. It is possible that a protein sparing effect may have occurred at the lowest level of fermentation-product inclusion.

Overall (from 21 lb to market weight), the reduced protein regimen (17-14-12%) resulted in reduced ADG and ADFI, and poorer F/G compared to the 19-16-14% protein regimen (P<.05). Adding 2.50 lb/ton of fermentation product to the 19-16-14% regimen reduced ADFI by 8% (P<.05). The fermentation product tended to reduce ADG but improved F/G by 5% (P<.05). Increasing the concentration of fermentation product in the low-protein diets from 0 to 5.00 lb/ton reduced ADG and ADFI (P<.05). However, at the lowest level of inclusion (1.25 lb/ton), ADG was not affected and F/G was improved by 2%. Last rib fat thickness was increased by 11% by feeding the low-protein regimen. Adding fermentation product to the diets did not affect fat thickness (P>.16).

In conclusion, feeding the low-protein regimen (17-14-12% crude protein) reduced growth performance and increased carcass fatness compared to feeding the 19-16-14% crude protein regimen. Adding 2.50 lb/ton of fermentation product to diets with 19-16-14% crude protein tended to depress feed intake, resulting in small reductions in ADG but small improvements in F/G. Increasing concentration of fermentation product from 0 to 5.00 lb/ton in the 17-14-12% crude protein regimen reduced growth performance, although this effect was due primarily to the 2.50 and 5.00 lb/ton additions. Finally, adding fermentation product to the low-protein diets did not result in growth performance or last rib fat thickness comparable to those of pigs fed the positive control.

Table 2. Growth Response of Pigs fed Low Protein Diets and a Fermentation Product[a]

	19-16-14% regimen		17-14-12% regimen				
Item	0	2.50	0	1.25	2.50	5.00	CV
Nursery phase (21 to 54 lb)							
ADG, lb[b]	1.19	1.15	1.21	1.22	1.14	1.13	11.0
ADFI, lb[i]	2.12	1.96	2.11	1.96	2.02	1.85	8.5
F/G[j]	1.78	1.70	1.74	1.61	1.77	1.64	8.9
Growing phase (54 to 117 lb)							
ADG, lb[f,i]	1.81	1.76	1.67	1.69	1.56	1.55	6.6
ADFI, lb[c,h]	4.31	4.15	4.15	4.17	3.94	3.94	5.8
F/G[d]	2.38	2.36	2.49	2.47	2.53	2.54	4.9
Finishing phase (117 to 220 lb)							
ADG, lb[e,i]	1.94	1.85	1.75	1.72	1.56	1.56	9.8
ADFI, lb[d,g,i]	6.75	6.15	6.47	6.24	5.78	5.91	6.6
F/G[f]	3.48	3.32	3.70	3.63	3.71	3.79	5.6
Overall (21 to 220 lb)							
ADG, lb[f,i]	1.73	1.66	1.61	1.60	1.46	1.47	6.2
ADFI, lb[d,g,i]	4.98	4.56	4.79	4.66	4.38	4.41	5.5
F/G[f,g]	2.88	2.75	2.98	2.91	3.00	3.00	2.7
Last rib fat thickness, in[e]	.90	.87	.95	1.03	.96	.98	17.0

[a]Five pens/treatment, six pigs/pen. Fermentation products added at 0, 1.25, 2.50 and 5.00 lb/ton.
[b]No treatment effect (P>.21).
[c,d,e,f]Effect of protein concentration (P<.10, P<.05, P<.01, and P<.001, respectively).
[g]19-16-14% regimen with vs without fermentation product (P<.05).
[h,i]Linear effect of fermentation product concentration (P<.10 or P<.05, respectively).
[j]Cubic effect of fermentation product concentration (P<.10).