EFFECT OF IRRADIATED PROTEIN SOURCES, FED IN MEAL OR PELLETED DIETS, ON NURSERY PIG PERFORMANCE

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Summary

A total of 350 pigs (initially 10.8 ± 2.1 lb and 21 ± 3 d of age) were used in a 22-d trial to determine the effects of feeding irradiated protein sources (spray-dried animal plasma, soybean meal, fish meal, or all three), in meal and pelleted diets, on the growth performance of nursery pigs. Pigs were blocked by weight, with 5 pigs/pen and 7 pens/treatment. From d 0 to 11, pigs were fed 1 of 10 experimental treatments, which consisted of the same diet fed in either meal or pelleted form, containing either no irradiated protein sources or containing irradiated spray-dried animal plasma, soybean meal, fish meal, or all three irradiated protein sources; then all pigs were fed a common diet (meal form) from d 11 to 22. Irradiation of the protein sources, as well as pelleting, reduced total bacterial and coliform counts. There were no irradiation by diet form interactions (P>0.16) observed for growth performance. From d 0 to 11, there was no irradiation effect (P>0.16) of protein source on ADG, ADFI, or F/G. But pigs fed pelleted diets had improved (P<0.02) F/G, compared with pigs fed meal diets, with no difference in ADG and ADFI. From d 11 to 22, pigs previously fed meal diets had a tendency for improved (P<0.10) ADFI, compared with that of the pigs fed pelleted diets. Overall (d 0 to 22), pigs fed diets containing irradiated protein sources had a tendency for improved (P<0.13) F/G, compared with that of pigs fed control diets. Pigs fed meal diets had a tendency for improved (P<0.12) ADFI, compared with the ADFI of pigs fed pelleted diets. Pigs fed pelleted diets had improved (P<0.01) F/G, compared with that of pigs fed meal diets. These data confirm that irradiation of protein ingredients, as well as pelleting, will reduce total bacteria and coliform counts within individual feed ingredients or a complete diet. Although irradiation of protein source did not improve performance in this study, pelleting of diets improved feed efficiency.

(Key Words: Nursery Pig, Pellet, Protein Source, Irradiation.)

Introduction

Many studies suggest that weanling pigs fed pelleted diets have increased gain and feed intake, compared with performance of pigs fed meal diets. Because pelleting represents an increase in diet cost, feeding SEW and transition diets in meal form would reduce feed costs for producers. Furthermore, a recent study demonstrated that pigs fed a meal diet with irradiated spray-dried animal plasma had growth performance similar to that of pigs fed pelleted diets. Irradiation of spray-dried animal plasma has been shown to reduce bacteria concentrations, which may be responsible for the growth response. Also, limited data exist

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suggesting that irradiating other ingredients in the diet may improve growth performance. Therefore, the objective of our study was to further evaluate the effects of irradiated protein sources (spray-dried animal plasma, soybean meal, and fish meal) in the diet, and fed in either meal or pelleted form, on nursery pig performance.

Procedures

A total of 350 pigs (initially 10.8 ± 2.1 lb and 21 ± 3 d of age) were used in a 22-d growth assay. Pigs were randomly allotted to pens and blocked by weight and allotted to 1 of 10 dietary treatments. There were 5 pigs/pen and 7 pens/treatment. The pigs were housed in the Kansas State University Segregated Early Weaning Facility. Each pen was 4 × 4 ft, and contained one self-feeder and one cup waterer to provide *ad libitum* access to feed and water.

From d 0 to 11, pigs were fed 1 of 10 experimental treatments, which consisted of the same diet (Table 1), fed in either meal or pelleted form, containing either no irradiated protein sources or irradiated spray-dried animal plasma, soybean meal, fish meal, or all three irradiated protein sources; all pigs were then fed a common diet (meal form) from d 11 to 22. The spray-dried animal plasma, soybean meal, and fish meal were irradiated at Iowa State University Linear Accelerator Facility (Ames, IA), with an average irradiation dose of 10.20 kGy. The 5 meal diets were first manufactured at the Kansas State University Animal Science Feed Mill. One half of each of the meal diet was then pelleted at the KSU Grain Science and Industry Feed Mill, resulting in the 10 experimental dietary treatments.

Samples were collected from all of the regular and irradiated ingredients and from the complete diets, and were analyzed for total bacterial plate counts and total coliform counts. Pigs and feeders were weighed on d 7, 11, 14, and 22 for calculation of ADG, ADFI, and F/G.

Data was analyzed by using Proc MIXED procedures in SAS 8.1. Contrasts were used to test for differences between diets with regular and irradiated ingredients, and meal and pelleted diets.

Results and Discussion

Irradiation of the spray-dried animal plasma, soybean meal, and fish meal reduced total bacterial and coliform counts (Table 2). Pelleting of the diets also resulted in a reduction in the total bacterial counts, compared with counts for the meal diets.

There were no irradiation by diet form interactions ($P>0.16$) observed for growth performance parameters.

From d 0 to 11, there was no irradiation effect ($P>0.16$) of protein source on ADG, ADFI, or F/G. But pigs fed pelleted diets had improved ($P<0.02$) F/G, compared with that of pigs fed meal diets, with no difference in ADG and ADFI.

From d 11 to 22, pigs fed meal diets had a tendency for improved ($P<0.10$) ADFI, compared with ADFI of pigs fed pelleted diets.

Overall (d 0 to 22), pigs fed pelleted diets had improved ($P<0.01$) F/G, compared with that of pigs fed meal diets. Pigs fed diets containing irradiated protein sources had a tendency for improved ($P<0.13$) F/G, compared with that of pigs fed control diets, and pigs fed meal diets had a tendency for improved ($P<0.12$) ADFI, compared with ADFI of pigs fed pelleted diets.

These data confirm that irradiation of protein ingredients will reduce total bacteria and coliform counts within individual feed ingredients and complete diets. Unlike previous

studies, however, there were no differences in growth performance between pigs fed irradiated protein ingredients and pigs fed the control diets. The overall data indicated that weaning pigs onto pelleted diets results in an improved F/G, compared with that of pigs fed meal diets. These data also indicated that current feeding practices of feeding pelleted SEW and transition diets improves growth performance, compared with performance of pigs fed meal diets immediately after weaning. This study contradicts our previous research, in which pigs fed irradiated spray-dried animal plasma in a meal diet had growth performance equal to that of pigs fed a pelleted diet. Therefore, additional research to explain the variation in response is needed.

Table 1. Composition of Diets (As-fed Basis)

Item	Phase 1[a]	Phase 2[b]
Corn	44.02	53.71
Soybean meal (46.5% CP)	19.40	31.54
Spray-dried whey	20.00	10.00
Spray-dried animal plasma	5.00	---
Menhaden fish meal	5.00	---
Soy oil	3.00	---
Monocalcium phosphate (21% P)	0.75	1.50
Limestone	0.65	0.95
Salt	0.25	0.35
L-lysine HCl	0.23	0.33
DL-methionine	0.15	0.15
L-threonine	0.08	0.13
Vitamin premix	0.25	0.25
Trace mineral premix	0.15	0.15
Antibiotic[c]	0.70	0.70
Zinc oxide	0.38	---
	100.00	100.00
Calculated Analysis		
Total lysine, %	1.50	1.30
ME, kcal/lb	1,552	1,474
Protein, %	22.6	20.9
Ca, %	0.88	0.84
P, %	0.80	0.76
Available P, %	0.57	0.46
Lysine:calorie ratio, g/Mcal	4.38	4.00

[a]The Phase 1 (d 0 to 11) diet was feed, in either meal or pelleted form, with irradiated protein sources (plasma, soybean meal, fish meal, or a diet containing all three irradiated protein sources).
[b]The Phase 2 (d 11 to 22) diet was a common diet fed to all pigs in meal form.
[c]Provided 140 g of neomycin sulfate and 140 g oxytetracycline HCl per ton of complete feed.

Table 2. Aerobic Bacteria Concentration[a]

Item	Total Plate Count, CFU/g	Total Coliform Count, CFU/g
Protein Source		
Spray-dried animal plasma	4.8×10^4	2.9×10^2
Soybean meal	3.3×10^3	3.8×10^2
Fish meal	5.4×10^5	2.6×10^2
Irradiated Protein Source		
Spray-dried animal plasma	3.0×10^1	$< 1.0 \times 10^1$
Soybean meal	1.8×10^1	$< 1.0 \times 10^1$
Fish meal	4.1×10^1	$< 1.0 \times 10^1$
Complete Meal Diet		
Control	1.5×10^5	3.6×10^2
Irradiated plasma	2.0×10^3	$< 1.0 \times 10^1$
Irradiated soybean meal	2.1×10^3	$< 1.0 \times 10^1$
Irradiated fish meal	1.8×10^4	$< 1.0 \times 10^1$
All three sources	1.8×10^3	$< 1.0 \times 10^1$
Complete Pelleted Diet		
Control	1.7×10^2	$< 1.0 \times 10^1$
Irradiated plasma	1.4×10^2	$< 1.0 \times 10^1$
Irradiated soybean meal	1.8×10^2	$< 1.0 \times 10^1$
Irradiated fish meal	1.6×10^2	$< 1.0 \times 10^1$
All three sources	1.4×10^2	$< 1.0 \times 10^1$

[a]The plasma, fish meal, and soybean meal were irradiated at Iowa State University Linear Accelerator Facility (Ames, IA), with an average irradiation dose of 10.20 kGy.

Table 3. Effects of Irradiation of Protein Source, Fed in Meal or Pelleted Diets, on Nursery Pig Growth Performance[abc]

	Meal Diet					Pellet Diet							
		Irradiated Ingredient					Irradiated Ingredient						
Item	Control	Plasma	SBM	Fish Meal	All 3	Control	Plasma	SBM	Fish Meal	All 3	SE	Irr vs Non	Meal vs Pellet
d 0 to 11													
ADG, lb	0.52	0.53	0.57	0.51	0.57	0.50	0.55	0.56	0.56	0.52	0.05	0.28	0.95
ADFI, lb	0.61	0.60	0.61	0.57	0.59	0.54	0.55	0.57	0.58	0.56	0.04	0.99	0.17
F/G	1.20	1.16	1.08	1.12	1.06	1.11	1.02	1.02	1.05	1.10	0.04	0.16	0.02
d 11 to 22													
ADG, lb	1.30	1.27	1.30	1.29	1.23	1.29	1.22	1.28	1.26	1.26	0.07	0.37	0.57
ADFI, lb	1.69	1.60	1.66	1.59	1.59	1.58	1.54	1.59	1.60	1.53	0.08	0.33	0.10
F/G	1.29	1.26	1.29	1.24	1.30	1.22	1.27	1.23	1.28	1.22	0.04	0.91	0.23
d 0 to 22													
ADG, lb	0.80	0.79	0.83	0.78	0.80	0.78	0.79	0.83	0.80	0.78	0.05	0.71	0.90
ADFI, lb	1.00	0.95	0.99	0.93	0.95	0.91	0.91	0.94	0.94	0.90	0.05	0.59	0.12
F/G	1.25	1.22	1.20	1.18	1.19	1.17	1.15	1.14	1.17	1.16	0.02	0.13	0.01

[a]A total of 350 pigs (5 pigs/pen and 7 pens/treatment) with an average initial weight of 10.8 ± 2.1 lb were used in the study.
[b]The Phase 1 (d 0 to 11) diet was feed, in either meal or pelleted form, with irradiated protein sources (plasma, soybean meal, fish meal, or a diet containing all three irradiated protein sources). The Phase 2 (d 11 to 22) diet was a common diet fed to all pigs in meal form.
[c]No interactions between (P>0.16) irradiation of protein source and diet form were observed.