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Abstract

Three hundred weanling pigs (initially 13.4 lb and 20 Â± 2 d of age) were used in a 14-d growth assay to determine the effects of irradiation processing of specialty protein products on nursery pig performance. Overall, irradiated of AP 920 and Peptide-Plusâ„¢ resulted in increased ADG compared to nonirradiated products. Irradiation of Peptide-PlusÂ® improved feed efficiency compared to its nonirradiated form. Also, ADG was greater for pigs fed diets containing ProtiOneâ„¢ and DPS 30 and tended to increase with AP 920 compared to those fed the control diet. In addition, feed efficiency was improved for pigs fed diets containing ProtiOneâ„¢, DPS 30, Peptide-Plusâ„¢, and spray-dried egg compared to those fed the control diet. Therefore, adding specialty protein products to diets in most cases improved growth performance, and irradiation processing improved growth performance with certain specialty protein products.; Swine Day, Manhattan, KS, November 16, 2000

Keywords

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EFFECTS OF IRRADIATION PROCESSING OF SPECIALITY PROTEIN PRODUCTS ON NURSERY PIG PERFORMANCE

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Summary

Three hundred weanling pigs (initially 13.4 lb and 20 ± 2 d of age) were used in a 14-d growth assay to determine the effects of irradiation processing of specialty protein products on nursery pig performance. Overall, irradiated of AP 920 and Peptide-Plus™ resulted in increased ADG compared to nonirradiated products. Irradiation of Peptide-Plus® improved feed efficiency compared to its nonirradiated form. Also, ADG was greater for pigs fed diets containing ProtiOne™ and DPS 30 and tended to increase with AP 920 compared to those fed the control diet. In addition, feed efficiency was improved for pigs fed diets containing ProtiOne™, DPS 30, Peptide-Plus™, and spray-dried egg compared to those fed the control diet. Therefore, adding specialty protein products to diets in most cases improved growth performance, and irradiation processing improved growth performance with certain specialty protein products.

(Key Words: Nursery Pigs, Irradiation, Speciality Protein.)

Introduction

Currently, a variety of dried blood and egg by-products are commercially available for use in diets for early-weaned pigs. Recent research conducted at Kansas State University has shown improvements in growth performance of nursery pigs fed diets that had irradiated spray-dried animal plasma or spray-dried blood meal compared to nonirradiated forms. Although the mechanism for improved growth performance is unclear, we believe that it may be due to an increase in digestibility. This may involve a breakdown of antinutritional factors associated with the ingredients or structural changes in the protein complex that make the protein more available to the young pig. In addition, a reduction in the bacterial concentration within the product occurs, which may increase pig performance as well. Therefore, our objective was to compare the effects of irradiation of several different commercially available specialty protein products on nursery pig performance.

Procedures

A total of 330 pigs (initially 13.4 lb and 20 ± 2 d of age) were used in a 14-d growth assay. Pigs were blocked by weight and allotted to one of 11 dietary treatments. There were five pigs/pen and six pens/treatment. 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 nipple water to provide ad libitum access to feed and water.

All diets were fed in pelleted form (Table 1). The diets were formulated to contain 1.50% lysine, .90% Ca, .80% P, .46% Na, and .57% Cl. In addition, 2.50% fish meal and .15% crystalline lysine were added to all diets, with other crystalline amino acids (methionine, threonine, isoleucine, and tryptophan) included (if necessary) to maintain similar ratios of amino acids related to lysine. Experimental treatments included a

[1]Food Animal Health and Management Center.

control diet or the control diet with either 5% spray-dried animal plasma (American Protein Corporation, AP 920); animal plasma, dried egg product, animal serum, serum albumin, and serum globulin combination (DuCoa L.P., ProtiOne™); dried porcine digest (Nutra-Flo Protein Products, DPS 30); liquefied and spray-dried beef muscle (Esteem Products Inc., Peptide Plus™); and spray-dried whole egg (California Spray Dry Company). All specialty protein products were either fed irradiated or as-is and originated from the same lot for each source. Irradiated protein sources were processed with gamma ray (cobalt-60 source) irradiation at an average dose of 8.5 kGy. Because all added specialty protein products were included at 5% of the total diet, soybean meal was allowed to vary depending on the nutrient profile of the specialty protein product. All speciality protein products were included in the diet at a fixed amount and not on a nutrient profile basis, so direct comparisons between specialty protein products were not made. Average daily gain, ADFI, and F/G were determined by weighing pigs and measuring feed disappearance on d 7 and 14. Samples of the specialty protein products were obtained prior to feed manufacturing of the complete feed for bacterial analysis.

Data were analyzed as a randomized complete block design with pen as the experimental unit. Pigs were blocked based on weaning weight, and analysis of variance was performed using the GLM procedure of SAS.

Results and Discussion

For d 0 to 7 (Table 2), irradiation of AP 920 ($P<.05$) and Peptide-Plus® ($P<.10$) resulted in greater ADG than their nonirradiated forms. Irradiation of Peptide-Plus® improved feed efficiency numerically ($P<.10$) compared to nonirradiated Peptide-Plus®. In addition, nonirradiated AP 920, ProtiOne™, and DPS 30 increased ADG ($P<.05$), and nonirradiated spray-dried egg tended to improve ($P<.10$) ADG compared to the control diet. Also, ADFI was increased ($P<.05$) with ProtiOne™ and tended to increase ($P<.10$) with AP 920 and Peptide-Plus™ compared to the control diet. Furthermore, feed efficiency was improved ($P<.05$) for pigs fed diet diets containing nonirradiated ProtiOne™, DPS 30, and spray-dried egg and tended to improve ($P<.10$) with AP 920 and Peptide-Plus™ compared to pigs fed the control diet. Overall, irradiated AP 920 and Peptide-Plus™ resulted in increased ($P<.05$) ADG more than their nonirradiated forms. Irradiation of Peptide-Plus™ improved ($P<.05$) feed efficiency compared to its nonirradiated form. Also, ADG was greater ($P<.05$) for pigs fed diets containing ProtiOne™ and DPS 30 and tended ($P<.10$) to increase with AP 920 compared to those fed the control diet. In addition, feed efficiency was improved ($P<.05$) for pigs fed diets containing ProtiOne™, DPS 30, Peptide-Plus™, and spray-dried egg compared to those fed the control diet.

Bacterial concentrations of the specialty protein products varied widely, with AP 920 having the highest concentration and Peptide-Plus™ the lowest (Table 3). Irradiation processing did prove to be an effective technique to reduce the bacterial level in each of the products. However, no consistent improvements in growth performance were observed in response to the reduction of bacteria within each source. This is evidenced by AP 920 and Peptide-Plus™, which had the highest and the lowest bacterial concentrations, yet were the only two products that elicited responses to irradiation processing. This suggests that improvements in growth performance are not based on a decrease in bacteria, but rather an increase in digestibility or a decrease in antinutritional factors associated with the product. Therefore, adding specialty protein products to diets improved growth performance in most cases, whereas irradiation processing improved growth performance on a more limited basis in these commercial products. The lack of response to irradiation in some ingredients possibly can be explained by different manufacturing techniques and/or nutrient profiles for each of these products. In addition, alterations of inclusion levels for each specialty protein product may influence the response to irradiation treatment.

Table 1. Compositions of Experimental Diets (As-Fed Basis)

Ingredient, %	Control	AP 920	ProtiOne™	DSP 30	Peptide-Plus™	Spray-Dried Egg
Corn	34.87	42.36	42.24	33.68	39.76	35.15
Soybean meal, 46.5 %	32.81	20.84	20.75	29.52	23.78	27.66
Spray-dried whey	20.00	20.00	20.00	20.00	20.00	20.00
AP 920	-	5.00	-	-	-	-
ProtiOne™	-	-	5.00	-	-	-
DPS 30	-	-	-	5.00	-	-
Peptide-Plus™	-	-	-	-	5.00	-
Spray-dried egg	-	-	-	-	-	5.00
Soybean oil	5.00	5.00	5.00	5.00	5.00	5.00
Fish meal	2.50	2.50	2.50	2.50	2.50	2.50
Monocalcium P, 21 %	1.21	1.10	1.24	1.22	.47	1.22
Limestone	.75	.89	.77	.62	.86	.77
Antibiotic[a]	1.00	1.00	1.00	1.00	1.00	1.00
Salt	.37	.25	.31	.19	.07	.38
Zinc oxide	.39	.39	.39	.39	.39	.39
Vitamin premix	.25	.25	.25	.25	.25	.25
Trace mineral premix	.15	.15	.15	.15	.15	.15
Sodium bicarbonate	.38	-	-	-	-	.28
Calcium chloride	-	-	.08	.18	.38	-
L-Lysine HCl	.15	.15	.15	.15	.15	.15
DL-Methionine	.13	.10	.15	.10	.14	.07
L-Threonine	.04	.01	.02	.04	.08	.03
L-Tryptophan	-	.01	-	.01	.02	-
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated Analysis						
Lysine, %	1.50	1.50	1.50	1.50	1.50	1.50
Met:lysine ratio,	32	28	28	31	35	31
Met & Cys:lysine ratio,%	57	57	57	57	57	57
Threonine:lysine ratio, %	64	64	64	64	64	64
Isoleucine:lysine ratio, %	66	61	61	65	64	69
Tryptophan:lysine ratio, %	19	19	19	19	19	19
Sodium, %	.46	.46	.46	.46	.46	.46
Chloride, %	.58	.58	.58	.58	.58	.58
ME, kcal/lb	1564	1585	1585	1578	1573	1625
dEB	353	297	297	352	308	332

[a]Provided 50 g per ton carbadox.

Table 2. Growth Performance of Nursery Pigs Fed Various Specialty Protein Products (Regular or Irradiated)[a]

		AP 920		ProtiOne™		DPS 30		Peptide-Plus™		Spray-Dried Egg		
Item	Control	Regular	Irradiated	Regular	Irradiated	Regular	Irradiated	Regular	Irradiated	Regular	Irradiated	SEM
D 0 to 7												
ADG, lb	.43	.52[b]	.60[d]	.59[b]	.59	.53[b]	.52	.43	.50[e]	.49[c]	.46	.03
ADFI, lb	.43	.49[c]	.55	.50[b]	.50	.43	.45	.38[c]	.40	.42	.38	.02
F/G	1.01	.94[c]	.92	.85[b]	.85	.81[b]	.86	.88[c]	.80[e]	.86[b]	.83	.04
D 7 to 14												
ADG, lb	.58	.59	.62	.68[b]	.63	.71[b]	.69	.59	.64	.61	.62	.03
ADFI, lb	.71	.72	.76	.73	.70	.75	.75	.66	.67	.70	.68	.03
F/G	1.22	1.22	1.23	1.07[b]	1.11	1.06[b]	1.09	1.11	1.05	1.15	1.10	.05
D 0 to 14												
ADG, lb	.50	.56[c]	.61[e]	.63[b]	.61	.62[b]	.60	.51	.57[e]	.55	.54	.02
ADFI, lb	.57	.61	.65	.62	.62	.59	.60	.52	.53	.56	.53	.02
F/G	1.14	1.09	1.07	.98[b]	1.02	.95[b]	1.00	1.02[b]	.93[d]	1.02[b]	.98	.03

[a]A total of 330 pigs (five pigs per pen and six pens per treatment) with an initial BW of 13.4 lb. Specialty protein products include: spray-dried animal plasma (American Protein Corporation, AP 920); animal plasma, dried egg product, animal serum, serum albumin, and serum globulin combination (DuCoa L.P., ProtiOne™); dried porcine digest (Nutra-Flo Protein Products, DPS 30); liquefied and spray-dried beef muscle (Esteem Products Inc., Peptide Plus™); and spray-dried whole egg (California Spray Dry Company).
[bc]Control diet versus nonirradiated (regular) specialty protein source, P<.05 and P<.10, respectively.
[de]Irradiated versus nonirradiated (regular) specialty protein source, P<.05 and P<.10, respectively.

Table 3. Bacterial Concentrations of Various Specialty Protein Products (Regular or Irradiated)

		AP 920		ProtiOne™		DPS 30		Peptide-Plus™		Spray-Dried Egg	
Item	Control	Regular	Irradiated	Regular	Irradiated	Regular	Irradiated	Regular	Irradiated	Regular	Irradiated
Total Plate Count[a]	N/A	8.7×10^{4}	7.0×10^{1}	6.9×10^{3}	3.0×10^{1}	1.0×10^{3}	3.0×10^{1}	2.6×10^{2}	2.0×10^{1}	4.7×10^{3}	1.0×10^{1}

[a]Samples obtained prior to manufacturing of complete diet.