Evaluation of PEP2 in Nursery Pig Diets[1]

A. J. Myers, M. D. Tokach, R. D. Goodband, S. S. Dritz[2], N. W. Shelton, G. Papadopoulos, J. M. DeRouchey, J. L. Nelssen, and D. McKilligan[3]

Summary

A total of 300 nursery pigs (PIC 327 × 1050, initially 12.0 lb and 21 d of age) were used in a 25-d study to determine the effects of PEP2 (proteins enzymatically processed) on growth performance of weaned pigs. PEP2 is a combination of refined porcine intestinal mucosa co-dried with enzymatically processed vegetable protein. There were 5 dietary treatments: (1) negative control containing no specialty protein sources, (2) positive control containing 4% spray-dried animal plasma (SDAP) in Phase 1 and 4% select menhaden fish meal in Phase 2, (3) 4% PEP2, (4) 8% PEP2, and (5) 12% PEP2. All diets were fed in 2 phases, and treatments containing PEP2 had the same inclusion rate in both phases. Phase 1 diets were fed in pellet form from d 0 to 11 after weaning. Phase 2 diets were fed in meal form from d 11 to 25. In Phase 1, increasing PEP2 improved (linear; $P < 0.01$) F/G. However, pigs fed SDAP had greater ($P < 0.01$) ADG and improved F/G compared with pigs fed the PEP2 diets. In Phase 2, increasing PEP2 increased (quadratic; $P < 0.01$) ADG, and F/G. Pigs fed PEP2 had greater ($P< 0.01$) ADG and ADFI than pigs fed the positive control diet containing fish meal. Overall (d 0 to 25), pigs fed the positive control diet had improved ($P < 0.01$) ADG and F/G compared with those fed the negative control. Pigs fed the diet containing PEP2 had similar performance to pigs fed the positive control diets. In conclusion, although pigs fed SDAP in Phase 1 had better ADG and F/G than pigs fed the increasing levels of PEP2, in Phase 2, pigs fed PEP2 had greater ADG and improved F/G compared with pigs fed 4% select menhaden fish meal.

Key words: fish meal, PEP2, spray-dried animal plasma

Introduction

There is a continual search for quality protein sources that can be used in nursery pig diets. Producers want a low-cost alternative to spray-dried animal plasma (SDAP) to lower feed costs, increase feed intake immediately after weaning, and improve overall nursery growth performance.

Previous research conducted at Kansas State University (Jones et al., 2008[4]) found that nursery pigs fed a coproduct of heparin production, which is derived from porcine intestinal mucosa (DPS 50; Nutra-Flo Company, Sioux City, IA), showed improved growth performance compared with pigs fed select menhaden fish meal. Recently, a new, similar product has become available: PEP2 (proteins enzymatically processed; Protein Resources, West Bend, IA). This protein source is also derived from heparin

[1] The authors wish to thank Protein Resources, West Bend, IA, for providing the PEP2 and partial financial support.
[2] Food Animal Health and Management Center, College of Veterinary Medicine, Kansas State University.
[3] Protein Resources, West Bend, IA.
[4] Jones et al., Swine Day 2008, Report of Progress 1001, pp. 52-61.

manufacturing. It is composed of a blend of porcine intestinal mucosa and vegetable protein that has been enzymatically processed and then co-dried. Because of improvements in the collection procedures in the plant, PEP2 has lower sulfur and ash levels than many of the previous mucosal products that have been tested.

Even though research has indicated improved growth performance in nursery pigs fed products similar to PEP2, we can only hypothesize that similar improvements in growth performance will be seen with PEP2. Thus, the objective of the study was to evaluate the effects of PEP2 on weanling pig performance.

Procedures

The protocol used in this experiment was approved by the Kansas State University Institutional Animal Care and Use Committee. The study was conducted at the Kansas State University Segregated Early Weaning Facility in Manhattan, KS.

A sample of PEP2 was collected and analyzed for CP, crude fat, mineral, and amino acid content (Table 1). The values obtained from the analysis were used in the diet formulation. The standardized digestibilities for individual amino acids in animal plasma were used to estimate the digestible amino acid levels in PEP2. The phosphorus in PEP2 was assumed to be 61% available for diet formulation.

Three hundred nursery pigs (PIC 337 ×1050, initially 12.0 lb and 21 d of age) were used in a 25-d trial to evaluate the effect of PEP2 on growth performance of weaned pigs. Pigs were allotted to 1 of 5 dietary treatments. There were 5 pigs per pen and 12 pens per treatment. Pigs were provided unlimited access to feed and water via a 4-hole dry self-feeder and a cup waterer in each pen (5 × 5 ft).

The 5 dietary treatments were: (1) negative control containing no specialty protein sources, (2) positive control containing 4% SDAP in Phase 1 and 4% select menhaden fish meal in Phase 2, (3) 4% PEP2, (4) 8% PEP2, and (5) 12% PEP2. All diets were fed in 2 phases, and treatments containing PEP2 had the same inclusion rate in both phases. Phase 1 diets were fed in pellet form from d 0 to 11 after weaning (Table 2). Phase 2 diets were fed in meal form from d 11 to 25 (Table 3). Average daily gain, ADFI, and F/G were determined by weighing pigs and measuring feed disappearance on d 0, 5, 11, 18, and 25.

Data were analyzed as a completely randomized design with pen as the experimental unit. Analysis of variance was performed using the MIXED procedure in SAS (SAS Institute, Inc., Cary, NC). Contrast statements used were: (1) linear and quadratic effects of increasing PEP2, (2) mean of PEP2-fed pigs vs. that of pigs fed the positive control, and (3) positive control vs. negative control.

Results and Discussion

In Phase 1 (d 0 to 11), pigs fed the positive control diet had improved ($P < 0.04$) ADG and F/G compared with pigs fed the negative control diet (Table 4). Additionally, increasing PEP2 inclusion improved (linear; $P< 0.01$) F/G. However, pigs fed SDAP had greater ($P < 0.05$) ADG and ADFI as well as an improved ($P < 0.04$) F/G compared with pigs fed PEP2.

During Phase 2 (d 11 to 25), pigs fed the positive control diet had improved ($P < 0.01$) ADG and F/G compared with pigs fed the negative control diet. Furthermore, ADG and ADFI of pigs fed PEP2 were greater ($P < 0.01$) than those for pigs fed the positive control diet (SDAP and then switched to fish meal on d 11). Increasing PEP2 improved (quadratic; $P < 0.01$) ADG and F/G.

Overall (d 0 to 25), pigs fed the positive control diet had improved ($P < 0.01$) ADG and F/G compared with pigs fed the negative control diet. There were no differences in ADG or ADFI, but F/G improved ($P < 0.02$) for pigs fed SDAP followed by fish meal compared with pigs fed the PEP2 diets. Increasing PEP2 in the diet improved ADG and F/G (quadratic; $P < 0.02$) compared with the negative control diet, with the greatest improvement observed as PEP2 increased from 0 to 4%.

In conclusion, in Phase 1, pigs fed SDAP had better ADG and F/G than pigs fed the treatments containing PEP2. However, in Phase 2, when pigs were switched from the positive control (SDAP to fish meal), ADG and F/G improved for pigs fed PEP2, with the greatest improvement observed in pigs fed 4% PEP2. These results suggest that 4% or higher levels of PEP2 can replace fish meal in Phase 2 diets and that PEP2 may be a suitable replacement for a plasma-fish meal regimen in Phase 1 and 2 diets for weaned pigs.

Table 1. Analyzed composition of protein enzymatically processed (PEP2)[1]

Nutrient	%	Amino acids	%
DM	92.0	Arginine	3.46
CP	55.2	Histidine	1.28
Crude fat	11.6	Isoleucine	2.43
Crude fiber	1.2	Leucine	4.22
Ash	9.0	Lysine	3.70
Ca	0.27	Methionine	0.88
P	0.82	Phenylalnine	2.47
S	1.2	Theronine	2.18
		Tryptophan	0.65
		Valine	2.76

[1] Amino acids were analyzed by the University of Missouri Agricultural Experiment Station Chemical Laboratories, and the analyzed values were used in diet formulation. Other analytical values were from Midwest Laboratories, Inc.

Table 2. Composition of diets, Phase 1 (as-fed basis)[1,2]

			Proteins enzymatically processed (PEP2)[3]		
Ingredient, %	Negative control	Positive control	4%	8%	12%
Corn	37.80	43.80	43.30	44.55	45.75
Soybean meal, (46.5% CP)	40.40	30.50	30.50	25.30	20.10
Spray-dried animal plasma	---	4.00	---	---	---
PEP2	---	---	4.00	8.00	12.00
Spray-dried whey	15.00	15.00	15.00	15.00	15.00
Soybean oil	3.00	3.00	3.00	3.00	3.00
Monocalcium P (21% P)	1.40	1.18	1.40	1.30	1.25
Limestone	0.88	1.05	0.93	1.00	1.03
Salt	0.30	0.30	0.30	0.30	0.30
Zinc oxide	0.38	0.38	0.38	0.38	0.38
Vitamin premix	0.25	0.25	0.25	0.25	0.25
Trace mineral premix	0.15	0.15	0.15	0.15	0.15
Lysine HCl	0.20	0.20	0.35	0.35	0.35
DL-Methionine	0.16	0.14	0.21	0.21	0.21
L-Threonine	0.08	0.05	0.14	0.13	0.14
L-Valine	---	---	0.08	0.08	0.08
Total	100	100	100	100	100
Calculated analysis					
SID amino acids, %[4]					
Lysine	1.45	1.45	1.45	1.45	1.45
Isoleucine:lysine	65	60	59	58	57
Methionine:lysine	33	30	36	36	36
Met & Cys:lysine	58	58	58	58	58
Threonine:lysine	62	62	62	62	62
Tryptophan:lysine	19.1	18.8	17.0	17.0	16.9
Valine:lysine	69	69	69	69	69
Total lysine, %	1.61	1.60	1.59	1.59	1.58
CP, %	24.2	23.2	22.5	22.3	22.2
ME kcal/lb	1,546	1,557	1,542	1,538	1,535
Ca, %	0.85	0.85	0.85	0.85	0.85
P, %	0.79	0.76	0.77	0.75	0.74
Available P, %	0.48	0.48	0.48	0.48	0.48

[1] A total of 300 nursery pigs (initial BW 12.0 lb) were used in a 25-d trial to determine the effects of PEP2 on nursery pig growth performance.
[2] Phase 1 diets were fed from d 0 to 11.
[3] Protein Resources, West Bend, IA.
[4] Amino acid digestibility values for plasma were used as the estimate of standardized amino acid digestibility of amino acids in PEP2.

Table 3. Composition of diets, Phase 2 (as-fed basis)[1,2]

			Proteins enzymatically processed (PEP2)[3]		
Ingredient, %	Negative control	Positive control	4%	8%	12%
Corn	55.10	62.90	62.05	63.25	64.50
Soybean meal, (46.5% CP)	40.10	28.75	28.75	23.50	18.30
Spray-dried animal plasma	---	4.00	---	---	---
PEP2	---	---	4.00	8.00	12.00
Spray-dried whey	---	---	---	---	---
Soybean oil	1.00	1.00	1.00	1.00	1.00
Monocalcium P (21% P)	1.60	1.10	1.55	1.53	1.45
Limestone	0.92	0.72	1.02	1.05	1.10
Salt	0.35	0.35	0.35	0.35	0.35
Zinc oxide	0.25	0.25	0.25	0.25	0.25
Vitamin premix	0.25	0.25	0.25	0.25	0.25
Trace mineral premix	0.15	0.15	0.15	0.15	0.15
Lysine HCl	0.15	0.30	0.35	0.35	0.35
DL-Methionine	0.09	0.12	0.15	0.15	0.15
L-Threonine	0.04	0.11	0.13	0.13	0.13
L-Valine	---	---	---	0.01	0.01
Total	100	100	100	100	100
Calculated analysis					
SID amino acids, %[4]					
Lysine	1.32	1.32	1.32	1.32	1.32
Isoleucine:lysine	69	61	60	59	58
Methionine:lysine	32	35	34	35	35
Met & Cys:lysine	58	58	58	58	58
Threonine:lysine	62	62	62	62	62
Tryptophan:lysine	19.9	16.9	16.9	16.9	16.9
Valine:lysine	75	68	68	68	68
Total lysine, %	1.47	1.45	1.45	1.45	1.44
CP, %	23.6	21.7	21.4	21.3	21.1
ME kcal/lb	1,513	1,526	1,511	1,507	1,503
Ca, %	0.80	0.80	0.80	0.80	0.80
P, %	0.77	0.73	0.73	0.73	0.71
Available P, %	0.42	0.42	0.42	0.42	0.42

[1] A total of 300 nursery pigs (initial BW 12.0 lb) were used in a 25-d trial to determine the effects of PEP2 on nursery pig growth performance.
[2] Phase 2 diets were fed from d 11 to 25.
[3] Protein Resources, West Bend, IA
[4] Amino acid digestibility values for plasma were used as the estimate of standardized amino acid digestibility of amino acids in PEP2.

Table 4. Effects of proteins enzymatically processed (PEP2) on nursery pig performance[1]

Item	Negative control[2]	Positive control[3]	PEP2[4] 4%	PEP2[4] 8%	PEP2[4] 12%	SEM	Negative vs. Positive	Positive vs. PEP2	*P*-value Linear	*P*-value Quadratic
d 0 to 11										
ADG, lb	0.43	0.49	0.41	0.42	0.43	0.02	0.04	<0.01	0.85	0.55
ADFI, lb	0.43	0.46	0.41	0.43	0.43	0.02	0.32	0.05	0.89	0.50
F/G	1.04	0.94	1.00	1.02	1.00	0.05	<0.01	0.04	<0.01	0.64
d 11 to 18										
ADG, lb	0.82	0.88	0.96	0.94	0.92	0.03	0.01	<0.01	<0.01	<0.01
ADFI, lb	1.23	1.20	1.28	1.30	1.25	0.03	0.35	<0.01	0.50	0.07
F/G	1.50	1.36	1.34	1.38	1.36	0.03	<0.01	0.78	<0.01	<0.01
d 0 to 25										
ADG, lb	0.65	0.71	0.71	0.71	0.70	0.02	<0.01	0.93	0.02	0.02
ADFI, lb	0.88	0.87	0.89	0.91	0.89	0.02	0.74	0.27	0.64	0.35
F/G	1.37	1.23	1.26	1.29	1.27	0.01	<0.01	0.02	<0.01	<0.01

[1] A total of 300 nursery pigs (initial BW 12.0 lb) were used in a 25-d trial to determine the effects of PEP2 on nursery pig growth performance.
[2] Contained no specialty protein products
[3] Contained 4% spray-dried animal plasma in Phase 1 (d 0 to 11) and 4% select menhaden fish meal in Phase 2 (d 11 to 25).
[4] Protein Resources, West Bend, IA.