EVALUATION OF POTATO PROTEIN IN STARTER PIG DIETS[1]

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Summary

In two separate trials, the use of potato protein (75% CP, 5.9% lysine), as a replacement for spray-dried porcine plasma (SDPP) in Phase I and for spray-dried blood meal (SDBM) and select menhaden fish meal (SMFM) in Phase II diets (d 0 to 14 and d 7 to 28 postweaning, respectively), was evaluated. In Exp. 1, 185 weanling pigs (initially 9.7 lb and 15.5 d of age) were blocked by weight and gender and allotted in a randomized complete block design to one of five dietary treatments. The control diet was formulated to 1.5% lysine and .42% methionine and contained 3% SDPP and 25% dried whey. The experimental diets were formulated by substituting, on an equal lysine basis, additional SDPP (2.5 or 5% added; 5.5 or 8% total) or potato protein (2.6% or 5.1%) for soybean meal (SBM) in the control diet. These diets were fed from d 0 to 14 postweaning. From d 14 to 28, all pigs were fed a common Phase II diet. During d 0 to 14 postweaning, pigs fed diets containing 5.5 or 8% SDPP had improved ($P<.05$) average daily gain (ADG) compared with those fed the control diet or the diet with 5.1% potato protein. No differences were observed in ADG and average daily feed intake (ADFI) of pigs fed the diet with 2.6% potato protein compared with pigs fed the control diet or diets with additional SDPP. Feed intake was increased for pigs fed 8% SDPP and decreased for pigs fed the 5.1% potato protein, when compared to the control group. Feed efficiency (G/F) was not affected by dietary treatment. Overall (d 0 to 28), no differences occurred in ADG, ADFI, and F/G among treatments. In Exp. 2, 270 weanling pigs (initially 13.7 lb and 20 d of age) were used. Pigs were blocked by weight and gender and assigned to each of three dietary treatments at weaning. There were 15 pigs per pen with six replicate pens per treatment. From d 0 to 7 postweaning, all pigs were fed the same diet that was formulated to 1.5% lysine and contained 10% SDPP and 25% dried whey. The Phase II experimental diets contained 10% dried whey and were formulated to 1.25% lysine and .34% methionine. The protein sources, 2.50% SDBM, 4.8% SMFM, or 3.92% potato protein, were substituted on an equal lysine basis, with all diets containing 22.63% SBM. From d 7 to 28 postweaning, pigs fed potato protein had decreased ADG and F/G. No differences occurred between pigs fed either SDBM or SMFM. These results suggest that potato protein as a plant protein should replace these more expensive animal protein sources only in limited amounts.

(Key Words: Starter, Performance, Potato Protein, Porcine Plasma.)

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Introduction

Spray-dried porcine plasma, spray-dried blood meal, and select menhaden fish meal are the predominate protein sources in starter pig diets. Potato protein is a high-quality plant-protein source that has the potential for application in starter pig diets. However, the actual nutritional value of potato protein in these diets has not yet been established. If potato protein could replace all or part of more expensive protein sources, the cost of starter pig diets could be reduced greatly.

Procedures

Experiment 1: A total of 185 weanling crossbred pigs (initially 9.7 lb and 15.5 d of age) was used in a 28-day growth assay to determine the effects of potato protein on starter pig performance. Pigs were blocked by weight and gender and allotted to six replicates of five dietary treatments. The pigs were fed experimental diets during Phase I (d 0 to 14 postweaning) and a common Phase II diet (d 14 to 28 postweaning). The five experimental diets were pelleted and formulated to contain 1.5% lysine, .42% methionine, .9% Ca, and .8% P. The control diet was a corn-soybean meal-based diet and contained 3% spray-dried porcine plasma (SDPP) and 25% dried whey. The experimental diets were formulated by adding, on an equal lysine basis, more SDPP (2.5 or 5% added; 5.5. and 8% total) or potato protein (2.6% or 5.1%) in place of soybean meal in the control diet. The common Phase II diet was fed as a meal; contained 10% dried whey, 2.5% spray-dried blood meal; and was formulated to 1.25% lysine, .36% methionine, .9% Ca, and .8% P.

The pigs were housed in 5 × 7 ft pens in an environmentally controlled nursery and had ad libitum access to a four-hole self-feeder and nipple waterers. Pigs were weighed and feed disappearance was measured weekly to determine ADG, ADFI, and (F/G).

Experiment 2: Two-hundred seventy crossbred pigs (initially 13.7 lb and 20 d or age) were used in a 28-d growth assay to examine the effect of potato protein in a Phase II starter pig diet. During d 0 to 7 postweaning, a common Phase I diet was fed to all pigs. The Phase I diet was a pelleted corn-soybean meal-based diet that contained 10% spray-dried porcine plasma and 25% dried whey. It was formulated to contain 1.5% lysine, .42% methionine, .9% Ca, and .8% P.

The experimental diets were fed from d 7 to 28. The three Phase II diets all were fed in a meal form; contained 10% dried whey; and were formulated to 1.25% lysine, .34% methionine, .9% Ca, and .8% P. The protein sources examined, select menhaden fish meal (4.87%), spray-dried blood meal (2.5%), and potato protein (3.92%), were substituted on an equal lysine basis, with the soybean level maintained at 22.63% in all diets.

Pigs were blocked by gender and weight and allotted to one of three treatments. There were 15 pigs per pen and six replicate pens per dietary treatment. Each pen contained a six-hole self-feeder and two nipple waterers to allow ad libitum access to feed and water. Pigs were weighed and feed disappearance was measured weekly to determine ADG, ADFI, and F/G.

Results and Discussion

Experiment 1: During d 0 to 14, pigs fed the diets containing 5.5 and 8% SDPP had higher ADG ($P<.05$) than pigs fed the 5.1% potato protein and control diets. However, pigs fed 2.6% potato protein had intermediate ADG: less than those pigs the 5.5 or 8% SDPP and greater than that of pigs fed the control diet. This result suggests that a part of the SDPP in a Phase I diet can be replaced by potato protein. However, the observed differences in ADG and ADFI between pigs fed diets containing 8% SDPP and 5.1% potato protein indicate that this replacement is restricted. During the Phase II portion, when the common diet was fed, no differences occurred in ADG, ADFI, or G/F. Additionally, cumulative results (d 0 to 28) indicate no differences in pig performance from protein source fed d 0 to 14 postweaning.

Experiment 2: During d 7 to 14, no differences were observed in ADG, ADFI, and F/G among treatments. However, at the conclusion of this experiment, the pigs fed the SDBM and SMFM diets outperformed the pigs fed potato protein for ADG and F/G ($P<.01$). ADFI was lower ($P<.01$) for pigs fed the potato protein diet than for those fed the diet containing SDBM. Between pigs fed potato protein or SMFM, no difference was observed in ADFI. No differences occurred between pigs fed either SDBM or SMFM diets.

Conclusion

When analyzed, potato protein is a high-quality protein source. However, our results suggest that SDPP, SDBM, and SMFM are superior protein sources in starter pig diets. This conclusion is related to decreased feed intake by pigs fed diets containing 3.9% or more potato protein. Therefore, potato protein as a plant protein should replace these more expensive animal protein sources only in limited amounts.

Table 1. Composition of Diets (Exp. 1)[a]

	Porcine plasma, % : Potato protein, %					
Ingredient, %	3 : 0	5.5 : 0	8 : 0	3 : 2.6	3 : 5.1	Phase II
Ground corn	37.24	39.70	42.08	39.66	41.97	60.27
Dried whey	25.00	25.00	25.00	25.00	25.00	10.00
Soybean meal, 48% CP	24.07	18.98	13.97	18.9	13.97	22.81
Soy oil	5.00	5.00	5.00	5.00	5.00	--
Spray-dried porcine plasma	3.00	5.50	8.00	3.00	3.00	--
Spray-dried blood meal	1.75	1.75	1.75	1.75	1.75	2.50
Potato protein	--	--	--	2.63	5.15	--
Monocalcium phosphate	1.62	1.73	1.87	1.75	1.86	1.90
Limestone	.64	.64	.64	.64	.64	.84
Vitamin premix	.25	.25	.25	.25	.25	.25
Trace mineral premix	.15	.15	.15	.15	.15	.15
DL-Methionine	.11	.12	.14	.10	.08	.05
L-Lysine	.10	.10	.10	.10	.10	.15
Copper sulfate	.075	.075	.075	.075	.075	.075
Antibiotic[b]	1.00	1.00	1.00	1.00	1.00	1.00
Total	100.00	100.00	100.00	100.00	100.00	100.00

[a]Phase I diets were formulated to contain 1.5% lysine, .42% methionine, .9% Ca, and .8% P and fed d 0 to 14 postweaning. Phase II diets were formulated to contain 1.25% lysine, .36% methionine, .9% Ca, .8% P and fed from d 14 to 28 postweaning.
[b]Provided 150 g/ton of apramycin in Phase I and 50 g/ton carbadox in Phase II.

Table 2. Composition of Diets (Exp. 2)[a]

		Experimental protein sources		
Ingredients, %	Phase I	Spray-dried blood meal	Select menhaden fishmeal	Potato protein
Ground corn	37.18	57.47	56.11	56.05
Dried whey	25.00	10.00	10.00	10.00
Soybean meal, 48 % CP	18.69	22.63	22.63	22.63
Spray-dried porcine plasma	10.00	--	--	--
Spray-dried blood meal	--	2.50	--	--
Select menhaden fishmeal	--	--	4.87	--
Potato protein	--	--	--	3.92
Soy oil	5.00	3.00	3.00	3.00
Monocalcium phosphate	1.77	1.945	1.33	2.00
Limestone	.63	.83	.49	.83
Vitamin premix	.25	.25	.25	.25
Trace mineral premix	.15	.15	.15	.15
DL - Methionine	.15	.05	--	--
L - Lysine	.10	.10	.10	.10
Copper sulfate	.075	.075	.075	.075
Antibiotic[b]	1.00	1.00	1.00	1.00
Total	100.00	100.00	100.00	100.00

[a]Phase I diets were formulated to contain 1.5% lysine, .42% methionine, .9% Ca, and .8% P and fed d 0 to 7 postweaning. Phase II diets were formulated to contain 1.25% lysine, .36% methionine, .9% Ca, .8% P and fed from d 7 to 28 postweaning.
[b]Provided 150 g/ton of apramycin in Phase I and 50 g/ton carbadox in Phase II.

Table 3. Effect of Potato Protein on Starter Pig Performance (Exp. 1)[a]

	Porcine plasma, % : Potato protein, %					
Item	3 : 0	5.5 : 0	8 : 0	3 : 2.6	3 : 5.1	CV
D 0 to 14						
ADG, lb	.34[c]	.42[b]	.44[b]	.38[bc]	.33[c]	16.4
ADFI, lb	.47[cd]	.52[bc]	.56[b]	.48[cd]	.42[d]	12.4
F/G	1.38	1.27	1.30	1.25	1.28	10.4
D 0 to 28						
ADG, lb	.64	.67	.65	.67	.64	12.4
ADFI, lb	1.03	1.07	1.06	1.10	1.02	15.2
F/G	1.67	1.56	1.64	1.61	1.59	12.3

[a]One hundred eighty five weanling pigs were used (initially 9.7 lbs 15.5 d of age), with six pens per treatment. Diets fed from d 0 to 14 were formulated to contain 1.5% lysine, .42% methionine, .9% Ca, and .8% P. From d 14 to 28, all pigs were fed the same Phase II diet formulated to contain 1.25% lysine, .36% methionine, .9% Ca, and .8% P.
[b,c,d]Means within the same row without a common superscript differ (P<.05).

Table 4. Effect of Potato Protein on Starter Pig Performance (Exp. 2)[a]

	Experimental protein sources			
Item	Blood meal	Fishmeal	Protein	CV
D 7 to 14				
ADG, lb	.36	.34	.32	22.2
ADFI, lb	.76	.73	.73	8.6
F/G	2.13	2.22	2.33	17.7
D 7 to 28				
ADG, lb	.77b	.79[b]	.64[c]	6.1
ADFI, lb	1.20[b]	1.19[bc]	1.11[c]	4.7
F/G	1.54[b]	1.49[b]	1.72[c]	4.1

[a]Two hundred seventy weanling pigs were used (initially 13.7 lb and 20 d of age), with six replicates per treatment. From day 0 to 7, pigs were fed the same Phase I diet formulated to contain 1.5% lysine, .42% methionine, .9% Ca, and .8% P. Experimental diets fed from d 7 to 28 were formulated to contain 1.25% lysine, .36% methionine, .9% Ca, and .8% P.
[b,c,d]Means within the same row without a common superscript differ (P<.05).