Comparison of Hydrolyzed Intestinal By-products

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Summary and Implications

Pigs were weaned at 16 to 20 days of age and fed diets containing either dried whey, dried porcine solubles (DPS), or condensed porcine solubles (CPS) for 3 weeks, followed by a common diet for 2 weeks. The results of the trial showed that 5% of either DPS or CPS can replace dried whey protein in diets for weanling with no effect on growth performance up to 5 weeks after weaning.

Introduction

Porcine solubles is a by-product of the separation of heparin from hydrolyzed small intestines of pigs and contains largely free amino acids in a balance close to "ideal protein." Dried whey, often included in weanling pig diets, also contain protein of high quality. Hence, we hypothesized that porcine solubles could favorably replace dried whey on a lysine basis in diets for weanling pigs.

We designed a feed trial with the objective to compare growth performance of weanling pigs fed dried whey with that of weanling pigs fed one of two forms of porcine solubles, namely, dried and condensed porcine solubles (95 and 45% dry matter, respectively). The drying process, differentiating DPS from CPS, may damage the protein, in which case the growth performance of pigs fed CPS would be superior to that of pigs fed DPS.

Materials and Methods

Ninety-six pigs were weaned at 16 to 20 days of age and allotted to 24 outcome groups on the basis of ancestry and initial body weight (6.4 ± 0.1 kg). Eight blocks, each consisting of three contiguous pens, were assigned three outcome groups according to body weight. Each of the three pens within a block was then randomly assigned one of the three dietary treatments. Thus, a total of 24 pens, each containing four pigs, was used in the trial. The pigs were housed in 1.2 × 1.2-m raised-deck pens with woven-wire floors in an environmentally controlled and continuously lighted nursery room. Each pen was equipped with a four-space, stainless steel self-feeder and nipple waterer to allow ad libitum consumption of feed and water. An electric heating pad (0.3 × 0.9 m) was used for the first 2 weeks of the trial after which it was removed. The trial was concluded following the 5th week after weaning.

The three experimental treatments consisted of three diets: control, a DPS, and a CPS diet. The three diets were formulated by replacing part of the dried whey in the control diet with either 5% DPS or 5% CPS on a lysine basis (Table 1). All three diets were formulated to contain equal amounts of lysine, methionine + cysteine, lactose, and metabolizable energy on a dry matter (DM) basis and analyzed for their DM and crude protein contents (Table 2). The experimental diets were fed for 3 weeks after weaning, followed by a common Phase II diet, containing dried whey, but neither CPS nor DPS (Tables 1 and 2), for another 2 weeks.

The experiment was designed as a randomized complete block with three treatments and eight blocks. Responses to the three dietary treatments were evaluated at weekly intervals using average daily gain (ADG), average daily feed intake (ADFI), and feed utilization (gain-to-feed ratio, G:F) as criteria. Data were analyzed using the GLM procedure of SAS; treatment means (least-squares means) were separated using Fischer's protected least significant differences and considered significant at P values less than .05.

Results and Discussion

Contrary to expectations, partially replacing dried whey with either DPS or CPS had no effect (P>.05) on ADG, ADFI, or G:F during any of the 5 weeks (Table 3). Likewise, no effects (P>.05) on cumulative ADG, cumulative ADFI, or cumulative G:F were observed. In week 3 only, G:F tended to improve (P=.10) in pigs fed CPS compared with pigs fed dried whey.

The diet containing CPS had a DM content more than two percentage points lower than both the dried-whey and DPS diets (Table 2), which was attributed to the low DM content of CPS (45% DM). Therefore, ADFI and G:F were calculated with feed intake on a DM basis to eliminate this inconsistency (Table 4). On a DM basis, ADFI in week 2 tended to be higher (P=.10) in pigs fed DPS than in pigs fed CPS, although neither differed (P>.10) from the ADFI observed with the dried-whey diet. The tendency (P=.10) towards improved feed utilization in week 3 of pigs fed CPS compared with dried whey (control diet) was evident on both an as-fed and DM basis (Tables 3 and 4, respectively).

Results of the trial indicated that porcine solubles could replace dried whey on a lysine basis in diets for weanling pigs. The present trial did not, as hypothesized, demonstrate a benefit of adding CPS over DPS; this indicated that the drying process did not influence the amino acid availability of porcine solubles. With no significant growth performance effect of replacing one protein source with another, decisions whether to include dried whey or porcine solubles as protein sources should be based on a consideration of their relative cost and availability.

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Table 1. Composition of the diets (as-fed basis).

Ingredient, %	Week 1 to 2			Week 3 to 5
	Dried whey	DPS[1]	CPS[1]	Common diet
Corn	41.48	39.92	39.50	55.38
Soybean meal (48%)	22.80	22.00	21.63	24.12
Spray-dried plasma	5.00	5.00	5.00	—
Dried whey	25.00	13.80	17.56	15.00
Dried Porcine Solubles	—	5.00	—	—
Condensed Porcine Solubles	—	—	5.00	—
Lactose	—	8.15	5.42	—
Soy oil	2.00	2.00	2.00	2.00
Dicalcium phosphate	1.42	1.83	1.64	0.98
Limestone	0.65	0.64	0.70	0.72
Salt	0.25	0.25	0.25	0.25
DL-Methionine	0.23	0.20	0.18	0.19
L-Lysine·HCl	0.06	0.10	0.01	0.25
CSP 250	0.50	0.50	0.50	0.50
Zinc oxide	0.30	0.30	0.30	0.30
Selenium premix	0.05	0.05	0.05	0.05
Endox	0.01	0.01	0.01	0.01
Trace mineral salt[2]	0.05	0.05	0.05	0.05
Vitamin premix[3]	0.20	0.20	0.20	0.20

[1]DPS, dried porcine solubles; CPS, condensed porcine solubles.
[2]Supplied 4,400 IU vitamin A; 1,100 IU vitamin D_3; 22 IU vitamin E; 7 mg of riboflavin; 18 mg of pantothenic acid; 33 mg of niacin; and 22 µg of vitamin B_{12} per kg diet.
[3]Supplied 165 ppm Zn; 193 ppm Fe; 66 ppm Mn; 19 ppm Cu; and 0.2 ppm I per kg diet.

Table 2. Calculated and chemical analyses of the diets (dry matter basis).

Item	Week 1 to 2			Week 3 to 5
	Dried whey	DPS[1]	CPS[1]	Common diet
Calculated analysis				
Crude protein, %	23.53	23.06	24.00	20.24
Lysine, %	1.54	1.54	1.54	1.33
Methionine + cysteine, %	0.96	0.97	0.96	0.81
Calcium, %	0.88	0.88	0.88	0.72
Phosphorus (total), %	0.77	0.77	0.77	0.65
Lactose, %	18.20	18.20	18.20	10.92
Dry matter, %	91.07	91.52	88.97	88.92
Metabolizable energy, kcal/kg	3,648	3,629	3,618	3,703
Chemical analysis				
Crude protein, %	23.73	24.18	24.22	21.17
Dry matter, %	89.41	89.04	86.92	88.66

[1]DPS, dried porcine solubles; CPS, condensed porcine solubles.

Table 3. Effects of dried porcine solubles and condensed porcine solubles on weanling pig growth performance (ADFI and G:F on as-fed basis).[1]

	Week	Treatment			P value[2]	CV[2]
		Dried whey	DPS[2]	CPS[2]		
ADG, g	1	156	135	179	.20	29.8
	2	400	388	375	.52	10.9
	3	398	419	444	.28	13.2
	4	627	635	663	.27	7.0
	5	679	671	680	.93	7.6
	0 to 2	287	271	284	.62	12.8
	0 to 3	326	323	340	.60	11.0
	0 to 4	404	404	424	.42	8.3
	0 to 5	461	459	477	.45	6.5
ADFI, g	1	228	192	252	.12	24.1
	2	520	545	497	.22	10.1
	3	715	721	735	.91	12.9
	4	1,014	1,040	1,066	.58	9.4
	5	1,241	1,249	1,233	.95	7.9
	0 to 2	385	382	384	.99	11.1
	0 to 3	501	501	508	.97	10.3
	0 to 4	634	641	652	.81	8.7
	0 to 5	759	766	772	.92	7.8
G:F, g/kg	1	676	662	715	.64	16.4
	2	777	716	759	.24	9.4
	3	557[a]	580[ab]	606[b]	.10	7.2
	4	621	620	628	.92	6.7
	5	548	542	553	.83	6.8
	0 to 2	749	710	746	.36	7.9
	0 to 3	652	645	676	.30	5.9
	0 to 4	639	635	654	.37	4.4
	0 to 5	608	604	621	.39	4.2

[1]Least-squares means.

[2]P value, probability of the null hypothesis; CV, coefficient of variation; DPS, dried porcine solubles; CPS, condensed porcine solubles.

[ab]Means with different superscripts tend to differ (P=.10).

Table 4. Effects of dried porcine solubles and condensed porcine solubles on selected parameters[1] of weanling pig growth performance (ADFI and G:F on DM basis).[2]

	Week	Treatment			P value[3]	CV[3]
		Dried whey	DPS[3]	CPS[3]		
ADFI, g	1	208	176	224	.17	24.1
	2	473[ab]	499[a]	442[b]	.10	10.2
	3	636	642	654	.91	12.9
	4	902	925	948	.58	9.4
	5	1,103	1,111	1,096	.95	7.9
	0 to 2	360	357	354	.96	11.4
	0 to 3	457	457	459	.99	10.4
	0 to 4	572	578	586	.86	8.8
	0 to 5	691	697	702	.92	7.8
G:F, g/kg	1	743	724	803	.43	16.4
	2	854	783	854	.15	9.4
	3	626[a]	653[ab]	681[b]	.10	7.2
	4	698	697	706	.92	6.7
	5	617	609	622	.84	6.8
	0 to 2	801	760	809	.28	7.9
	0 to 3	715	708	746	.20	6.0
	0 to 4	708	703	728	.27	4.4
	0 to 5	668	663	682	.38	4.1

[1]See Table 3 for average daily gain.
[2]Least-squares means.
[3]P value, probability of the null hypothesis; CV, coefficient of variation; DPS, dried porcine solubles; CPS, condensed porcine solubles.
[ab]Means with different superscripts tend to differ (P=.10).