Dried Porcine Solubles and Feed Additives

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ASL–R650

Summary and Implications

Pigs were weaned at 16 to 20 days of age and fed diets containing either dried whey or 6% dried porcine solubles (DPS), partially replacing dried whey protein, and one of two combinations of feed additives (either ZnO + CSP 250 or $CuSO_4$ + Mecadox) in a 2 × 2 factorial arrangement. The diets were fed for 2 weeks and followed by a common diet for 3 weeks. Feeding the DPS-containing diet during week 1 and 2 post-weaning improved average daily gain in week 3 after weaning (when no DPS was fed), as well as cumulative average daily gain in weeks 0 to 3. However, it tended to lessen feed utilization in week 4 and 5. Furthermore, it was shown that the combination of ZnO and CSP 250 improved growth performance over $CuSO_4$ and Mecadox in weanling-pig diets. Neither feed-additive combination influenced the utilization of DPS.

Introduction

Diets fed to early weaned pigs often include dried whey for its content of high-quality protein and lactose. DPS contains an amino balance close to that of ideal protein—and therefore similar to that of whey protein. Consequently, it was expected that the protein of DPS could replace the whey protein in early weaned pig diets. However, previous trials in which DPS replaced whey protein have showed inconsistent results, which may have been caused by the use of different feed additives in the trials. Therefore, we designed a trial with the objective to compare growth performance of early weaned pigs fed dried whey with that of weanling pigs fed DPS. In addition, dried whey and DPS were fed in conjunction with two feed additive combinations (either ZnO + CSP 250 or $CuSO_4$ + Mecadox) in a factorial arrangement to investigate potential interactions between DPS and feed additives.

It was hypothesized that pigs fed the DPS-containing diets would show improved gain, feed intake, and feed utilization over pigs fed the control diets. Moreover, it was expected that there would be interactions between DPS and feed additives and, in addition, that pigs fed the ZnO + CSP 250 combination would exhibit an improved growth performance compared with that of pigs fed the $CuSO_4$ + Mecadox combination.

Materials and Methods

Eighty pigs were weaned at 16 to 20 days of age and allotted to 20 outcome groups on the basis of ancestry and initial body weight (5.8 ± 0.1 kg). Five blocks, each consisting of four contiguous pens, were assigned four outcome groups according to body weight. Each of the four pens within a block was then randomly assigned one of the four dietary treatments. Thus, a total of 20 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 after completion of the 5th week after weaning.

The four dietary treatments were formulated to contain equal amounts of lysine (1.40%) and lactose (17.5%) by partially replacing dried whey with 6% DPS and adding combinations of either ZnO + CSP 250 or $CuSO_4$ + Mecadox in a 2 × 2 factorial arrangement (Table 1). The experimental diets were fed for 2 weeks after weaning and followed by a common Phase II diet (1.21% lysine) fed for 3 weeks. The common diet contained Mecadox and dried whey but not DPS, $CuSO_4$, ZnO, or CSP 250 (Table 1).

The experiment was designed as a randomized complete block with four treatments in a 2 × 2 factorial arrangement and five blocks. Responses to the four 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 contrasts appropriate for a 2 × 2 factorial arrangement of treatments (i.e., Zn versus Cu and DPS versus no DPS) and considered significant at P values less than .05.

Results and Discussion

Pigs fed DPS during week 1 and 2 after weaning had an improved ($P<.05$) ADG in week 3, which resulted in a higher ($P<.05$) cumulative ADG in weeks 0 to 3 as compared with pigs fed diets without DPS (Table 2). However, this improvement was delayed in that it did not appear until week 3—one week after the cessation of feeding DPS. The improved gain was attributed to a higher ($P<.05$) feed intake in week 3 of the pigs previously fed DPS. DPS tended ($P<.10$) to improve feed utilization in week 1, although this effect was reversed ($P<.10$) in weeks 4 and 5.

Thus, the results implied a benefit of partially replacing dried whey protein with DPS in weaning diets. However, this benefit diminished after week 3, where no significant effects of DPS on growth performance were observed. We presently cannot explain the observed delayed growth response to DPS.

The combination of dietary ZnO and CSP 250 in the first 2 weeks after weaning resulted in improved ADG (P=.01) in week 2, as well as higher (P<.05) cumulative ADG in the subsequent weeks (Table 2) compared with the combination of dietary $CuSO_4$ and Mecadox. Similar increases (P<.05) were observed in ADFI. The feed utilization of Zn-fed pigs improved (P<.05) in week 2 of the trial leading to an improved (P<.05) cumulative G:F ratio in weeks 0 to 2. The combination of ZnO and CSP 250 thus resulted in improved growth performance over the combination of $CuSO_4$ and Mecadox.

No interaction effects (P>.10) between DPS and feed additives were observed in this trial as theorized from results of previous trials. Inconsistencies among those trials must, therefore, be explained using other approaches.

Acknowledgments

We thank NutraFlo of Sioux City, IA, for donating the DPS used in the trial.

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

Ingredient, %	Week 1 to 2				Week 3 to 5
	Zn	Cu	Zn+DPS	Cu+DPS	Common diet
Corn	38.56	38.33	36.56	36.33	55.68
Soybean meal (48%)	30.90	30.90	30.90	30.90	24.12
Dried whey	25.00	25.00	10.00	10.00	15.00
Lactose	—	—	10.50	10.50	—
Dried Porcine Solubles	—	—	6.00	6.00	—
Zinc oxide[1]	0.35	—	0.35	—	—
CSP 250	0.50	—	0.50	—	—
$CuSO_4$[2]	—	0.08	—	0.08	—
Mecadox	—	1.00	—	1.00	0.50
Soy oil	2.00	2.00	2.00	2.00	2.00
L-Lysine·HCl	0.20	0.20	0.20	0.20	0.25
DL-Methionine	0.14	0.14	0.17	0.17	0.19
Dicalcium phosphate	1.15	1.15	1.59	1.59	0.98
Limestone	0.64	0.64	0.67	0.67	0.72
Salt	0.25	0.25	0.25	0.25	0.25
Selenium premix	0.05	0.05	0.05	0.05	0.05
Endox	0.01	0.01	0.01	0.01	0.01
Trace mineral salt[3]	0.05	0.05	0.05	0.05	0.05
Vitamin premix[4]	0.20	0.20	0.20	0.20	0.20

[1]Supplied 3000 ppm Zn.
[2]Supplied 250 ppm Cu.
[3]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.
[4]Supplied 165 ppm Zn; 193 ppm Fe; 66 ppm Mn; 19 ppm Cu; and 0.2 ppm I per kg diet.

Table 2. Effects of feed additives (ZnO + CSP 250 or $CuSO_4$ + Mecadox) and dried porcine solubles (DPS) on weanling pig growth performance.[1]

Item	Week	Treatment				P Values			
		Zn	Cu	Zn+DPS	Cu+DPS	Overall[2]	Zn/Cu[3]	DPS[4]	CV[5]
ADG, g	1	77	60	115	76	.34	.21	.22	57.67
	2	374	295	424	260	.01	.01	.77	16.36
	3	458	404	544	529	.04	.34	.01	16.11
	4	671	635	661	671	.86	.71	.70	11.37
	5	707	708	743	690	.69	.42	.78	9.97
	0 to 2	226	178	269	168	.01	.01	.43	22.40
	0 to 3	303	253	361	288	.02	.01	.04	15.74
	0 to 4	395	349	436	384	.10	.05	.11	13.06
	0 to 5	457	421	498	445	.16	.07	.18	11.33
ADFI, g	1	132	138	157	134	.72	.62	.56	27.19
	2	479	388	515	383	.03	.01	.64	16.65
	3	774	675	899	789	.03	.04	.02	12.90
	4	1,033	972	1,129	1,041	.29	.20	.15	11.78
	5	1,260	1,265	1,409	1,278	.53	.45	.34	13.93
	0 to 2	306	263	336	259	.10	.02	.59	18.20
	0 to 3	462	401	524	435	.05	.02	.11	14.18
	0 to 4	605	544	675	587	.08	.04	.11	12.44
	0 to 5	736	688	822	725	.18	.10	.16	12.60
G:F, g/kg	1	493	406	725	537	.17	.18	.08	40.59
	2	787	765	826	676	.08	.04	.53	11.21
	3	593	596	605	672	.21	.24	.15	10.47
	4	651	654	588	646	.05	.10	.06	6.13
	5	567	559	529	544	.31	.79	.09	5.84
	0 to 2	735	676	803	643	.02	.01	.63	10.89
	0 to 3	656	635	689	661	.37	.26	.18	7.19
	0 to 4	654	642	646	655	.88	.90	.85	4.49
	0 to 5	624	611	606	616	.60	.91	.46	3.34

[1]Least-squares means.
[2]Probability of the null hypothesis.
[3]Effect of the contrast Cu versus Zn.
[4]Effect of the contrast DPS versus no DPS.
[5]Coefficient of variation.