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Effects of ingredients of plant and animal origin on nursery pig performance

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Effects of Ingredients of Plant and Animal Origin on Nursery Pig Performance

K. M. Jones, K. M. Sotak, S. A. Lawson, and J. D. Hancock

Summary

A total of 224 weanling pigs were used in a 34-d growth assay. The pigs were sorted by gender and ancestry, blocked by BW, and assigned to pens (7 pigs/pen and 8 pens/treatment) in a randomized complete block design. From d 0 to 10, treatments were arranged as a 2×2 factorial with main effects of primary protein sources (plant vs. animal) and inclusion of soybean meal (none vs. 30%). The plant products diets had wheat gluten and corn gluten, and the animal products diets had animal plasma and fish meal as primary protein sources. All diets were formulated to be at least 120, 120, and 110% of the requirements for all essential amino acids, vitamins, and minerals, respectively, as suggested in NRC guidelines. Soybean meal replaced corn in the diet to create the diets containing soybean meal. From d 10 to 34, all pigs were fed the same corn-soybean meal-based diets to allow determination of any carryover effects (or disappearance thereof) for the diets fed for the first 10 d immediately after weaning.

No interactions were observed for d 0 to 10, 10 to 34, or 0 to 34 ($P > 0.12$) among primary protein source and inclusion of soybean meal for ADG, ADFI, or F/G. The use of animal products increased ($P < 0.02$) ADG by 61% for d 0 to 10 and 7% for d 0 to 34, respectively. Soybean meal increased ($P < 0.001$) ADG by 31% for d 0 to 10 and tended to improve overall ADG ($P < 0.07$) by 5%; thus, we conclude that use of animal products (plasma protein and fish meal) and inclusion of soybean meal (30% of the diet) enhanced growth performance in weanling pigs.

Key words: animal protein sources, nursery pig, soybean meal

Introduction

The cost of pork production is at an all-time high, and feed represents 60 to 70% of that cost. Diets for weanling pigs routinely are rich in specialty products (e.g., plasma protein, fish meal, and whey powder) that are quite expensive; furthermore, interest is growing in some places (such as Europe) in feeding vegetable-based diets to avoid the possibility of transmitting feedborne illness from animal co-products to livestock and poultry. These concerns lend themselves to the exclusive use of plant protein sources in diets for weanling pigs even if some growth performance might be sacrificed. We designed an experiment to determine the effects of diets with and without animal-derived feed ingredients and high inclusion of soybean meal on growth performance in weanling pigs.

Procedures

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in this experiment. The study was conducted at the K-State Swine Teaching and Research Center in Manhattan, KS.

For this experiment, 224 weanling pigs were used in a 34-d growth assay. The pigs were sorted by gender and ancestry and blocked by BW with 7 pigs per pen and 8 pens per treatment. Treatments were arranged as a 2×2 factorial with main effects of protein sources (plant vs. animal) and inclusion of soybean meal (none vs. 30%). Pigs were assigned to 5-ft \times 5-ft pens equipped with one water nipple and one four-hole dry feeder. Experimental diets were fed from d 0 to 10 and common diets thereafter for d 10 to 23 and d 23 to 34 with all feed and water consumed on an ad libitum basis.

The diets were formulated to be at least 120, 120, and 110% of the requirements for all essential amino acids, vitamins, and minerals, respectively, as suggested in NRC guidelines (Table 1). Soybean meal (30%) replaced corn to form the diets containing soybean meal. Spray-dried animal plasma and fish meal replaced corn gluten and a portion of the wheat gluten to form the diets containing animal proteins. The diets for d 0 to 10 were fed as pellets, and the diets for d 10 to 23 and d 23 to 34 were fed in meal form. Pigs and feeders were weighed on d 0, 10, 23, and 34 with ADG, ADFI, and F/G used as response criteria. The PROC MIXED procedure of SAS (SAS Institute, Inc., Cary, NC) was used for all data analyses in this randomized complete design. Orthogonal contrasts (plant vs. animal protein sources, none vs. 30% soybean meal, and the interaction effect) were used to separate treatment means.

Results and Discussion

No interactions for d 0 to 10, 10 to 34, or 0 to 34 ($P > 0.12$) were observed among primary protein source and inclusion of soybean meal for ADG, ADFI, or F/G (Table 2). The use of animal products increased ($P < 0.02$) ADG by 61% for d 0 to 10 and 7% for d 0 to 34, respectively. Soybean meal increased ($P < 0.001$) ADG by 31% for d 0 to 10 and tended to improve ADG overall ($P < 0.07$) by 5%. Thus, we conclude that use of animal products (plasma protein and fish meal) and inclusion of soybean meal (30% of the diet) enhanced growth performance in weanling pigs.

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

Ingredient, % soybean meal:	d 0 to 10				d 10 to 23	d 23 to 34
	Plant		Animal			
	None	30%	None	30%		
Corn	30.79	0.79	33.03	3.03	43.68	59.51
Soybean meal (48.5%)	---	30.00	---	30.00	22.45	30.10
Dried whey	30.00	30.00	30.00	30.00	20.00	--
Soybean oil	4.00	4.00	4.00	4.00	2.00	5.00
Spray-dried plasma	---	---	10.00	10.00	3.00	---
Fish meal	---	---	10.00	10.00	5.00	---
Wheat gluten	15.00	15.00	10.00	10.00	---	---
Corn gluten	13.00	13.00	---	---	---	
L-lysine-HCl	1.38	1.38	0.17	0.17	0.31	0.47
L-threonine	0.27	0.27	---	---	0.13	0.20
DL-methionine	0.08	0.08	0.02	0.02	0.20	0.19
L-tryptophan	0.09	0.09	---	---	0.03	0.03
L-valine	0.10	0.10	---	---	0.08	0.09
Monocalcium phosphate	1.79	1.79	---	---	0.79	1.80
Limestone	1.30	1.30	0.59	0.59	0.68	1.04
Salt	0.20	0.20	0.20	0.20	0.30	0.38
Vitamins	0.26	0.26	0.25	0.25	0.25	0.25
Minerals	0.65	0.65	0.65	0.65	0.15	0.15
Antibiotic ¹	0.70	0.70	0.70	0.70	0.70	0.70
Zinc oxide ^b	0.39	0.39	0.39	0.39	0.25	---
Copper sulfate ²	---	---	---	---	---	0.09
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated analysis, %						
CP, %	27.60	39.40	28.50	40.30	22.80	20.00
SID lysine ³	1.68	2.43	1.63	2.39	1.52	1.31
Ca	1.03	1.12	0.99	1.09	0.88	0.80
Total P	0.77	0.89	0.80	0.93	0.79	0.75

¹ To provide 154 g/ton oxytetracycline and 154 g/ton neomycin.

² To supply 3,000 ppm Zn for d 0 to 10, 2,000 ppm Zn for d 10 to 23, and 20 ppm Cu for d 23 to 34.

³ Standardized ileal digestible (SID) lysine.

Table 2. Effects of specialty ingredient sources and soybean meal concentration on nursery pig performance¹

Protein source:		Plant		Animal		SE	Probability, $P<^2$		
Item	Soybean meal:	None	30%	None	30%		1	2	3
d 0 to 10									
	ADG, lb	0.24	0.38	0.46	0.54	0.03	0.001	0.002	0.36
	ADFI, lb	0.32	0.36	0.48	0.49	0.02	0.001	0.28	0.52
	F/G	1.39	0.95	0.91	0.89	0.38	0.20	0.148	0.27
d 10 to 34									
	ADG, lb	1.36	1.35	1.34	1.41	0.04	0.50	0.40	0.27
	ADFI, lb	1.69	1.77	1.74	1.78	0.04	0.41	0.11	0.49
	F/G	1.24	1.31	1.30	1.26	0.03	0.98	0.712	0.12
d 0 to 34									
	ADG, lb	1.04	1.08	1.10	1.17	0.03	0.02	0.07	0.49
	ADFI, lb	1.30	1.37	1.38	1.41	0.03	0.04	0.10	0.46
	F/G	1.24	1.27	1.26	1.20	0.03	0.40	0.69	0.15

¹ A total of 227 pigs, initial average weight of 14.2 lb and 21 d of age were used, with 7 pigs per pen and 8 replications per treatment.

² Contrasts were (1) plant vs. animal, (2) without vs. with soybean meal, and (3) plant vs. animal \times without vs. with soybean meal.