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EFFECTS OF DIET COMPLEXITY AND REPLACEMENT OF SOYBEAN MEAL ON GROWTH PERFORMANCE OF WEANLING PIGS

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Summary

A total of 192 pigs (avg initial BW of 13.9 lb and avg initial age of 21 d) was used to determine the effects of complex diet formulations (with plasma protein and whey) in nursery diets with wheat gluten used to replace soybean meal. Treatments were arranged as a 2 x 2 factorial, with main effects of diet complexity (no animal plasma and 10% dried whey vs 7% animal plasma and 20% dried whey) and soybean meal (25% vs none). For d 0 to 14, the complex diet formulations increased ADG while replacement of the soybean meal with wheat gluten decreased ADG ($P<0.001$). Efficiency of gain was improved by 7% when plasma and whey were increased in the formulations ($P<0.04$) but not affected by deletion of soybean meal ($P=0.15$ or greater). When all the pigs were changed to a common Phase 2 diet (with soybean meal and without plasma) for d 14 to 28, ADG and ADFI were less for those pigs fed the more complex formulations during the first 14 d of the experiment ($P<0.002$). Overall (d 0 to 28), pigs fed diets with soybean meal for d 0 to 14 had greater ADG and ADFI, and pigs fed the diets with plasma and 20% whey had better feed/gain ($P<0.007$). In conclusion, complex formulations (i.e., with 7% plasma and 20% whey) for d 0 to 14 improved growth performance regardless of the absence or presence of soybean meal, and using wheat gluten to rid the Phase 1 diets of soybean meal was of no benefit.

(Key Words: Nursery, Plasma, Whey, Soybean Meal)

Introduction

Research reports from Kansas State University indicate few (if any) problems with 20 to 30% soybean meal in Phase 1 nursery diets with complex formulations (e.g., with high inclusions of animal plasma, whey powder and fishmeal). Yet, anecdotal reports from Latin America, where milk products and animal plasma are too expensive or not available, suggest limiting inclusion of soybean meal to 10% or less in Phase 1 diets. Therefore we conducted an experiment to determine the effects of complex diet formulations on the response of weanling pigs to deletion of soybean meal in Phase 1 diets.

Procedures

A total of 192 pigs (avg initial BW of 13.9 lb and avg initial age of 21 d) were used in the 28-d growth assay. The pigs were sorted by sex, blocked by weight, and allotted to pens (six pigs per pen and eight pens per treatments). The pens were 3.5-ft × 5-ft with a self-feeder and nipple waterer to allow ad libitum consumption of feed and water. For d 0 to 14, dietary treatments were arranged as a 2 x 2 factorial with main effect of diet complexity (no plasma and 10% dried whey vs 7% plasma and 20% dried whey) and inclusion of SBM (25% vs none). Fishmeal was increased in the simple diet formulations to replace the protein from plasma, and whey powder and wheat gluten were increased primarily in the formulations for the diets without soybean meal. All diets for d 0 to 14 had 1.8% lysine, 0.9% Ca, and 0.8% P (Table 1). For d 14 to 28, all pigs were given the same corn-soybean

meal based diet (Table 2) with 1.5% lysine, 0.8% Ca, and 0.7% P.

To begin the experiment and on d 14 and 28, the pigs and feeders were weighed to allow calculation of ADG, ADFI, and F/G. All data were analyzed as a randomized complete block design with a 2 × 2 factorial arrangement of treatments using the PROC MIXED procedure of SAS.

Table 2. Diet Composition for Day 14 to 28[a]

Ingredient	%
Corn	51.61
Soybean meal	26.75
Dried whey	10.00
Fishmeal	5.00
L-lysine HCl	0.29
D,L-methionine	0.12
L-threonine	0.11
L-tryptophan	0.00
Soybean oil	3.00
Dicalcium phosphate	0.79
Limestone	0.48
Salt	0.35
Vitamin premix	0.25
Mineral premix	0.15
Copper sulphate	0.09
Antibiotics[b]	1.00

[a]Formulated to 1.5% lysine, 0.8% Ca, and 0.7% P.
[b]Provided 50 g/ton carbadox.

Results and Discussion

For d 0 to 14 (Table 3), there were no interactions among complexity of diet formulation and removal of the soybean meal (P=0.15 or greater). However, the complex diet formulations (with 7% plasma and 20% dried whey) increased ADG by 14%, ADFI by 19% (P<0.001), and F/G by 7% (P<0.04). Replacing the soybean meal decreased ADG by 17% and ADFI by 22%. So, the diets with plasma protein and more whey powder increased growth performance, and replacing soybean meal was of no benefit, regardless of diet complexity.

For d 14 to 28, pigs previously fed the complex formulations (for d 0 to 14) had lower ADG (P<0.002) and ADFI (P<0.003) than pigs initially fed the simpler diet formulations. This response suggested that having to deal with the simple diets for d 0 to 14 better prepared the piglets for the transition to the simple Phase 2 formulation. Finally, there was an interaction for F/G among diet complexity and soybean meal inclusion (P<0.03) with replacement of the soybean meal having a negative effect when pigs were fed the simple diets in Phase 1 and a positive effect in pigs fed the more complex formulations in Phase 1.

Overall (d 0 to 28), F/G was 3% better (P<0.007) when pigs were fed the complex formulations for d 0 to 14. Also, there was 6% greater ADG and ADFI for pigs fed diets with soybean meal in Phase 1 (P<0.003). So, even though the pigs fed simpler diets for the first 14 d postweaning made the transition to the Phase 2 diets more readily, they never overcame their sharply lower performance for that first 14 d after weaning.

In conclusion, the more complex formulations improved growth performance for d 0 to 14 of the nursery phase. There was some difficulty with transition to the simple Phase 2 diet for pigs fed the more complex formulations in Phase 1, with lower ADG and ADFI, but that short lag in performance was outweighed by the better early growth for pigs given the more complex diet for d 0 to 14. Finally, we were not able to demonstrate a benefit when wheat gluten was used to replace soybean meal in Phase 1 diets.

Table 1. Diet Composition (d 0 to 14)[a]

	Simple Formulations		Complex Formulations	
Ingredient, %	25% soybean meal	0% soybean meal	25% soybean meal	0% soybean meal
Corn	47.02	45.65	34.17	40.95
Soybean meal	25.00	-	25.00	-
Dried whey	10.00	10.00	20.00	20.00
Spray-dried animal plasma	-	-	7.00	7.00
Wheat gluten	5.04	30.94	5.00	22.23
Fish meal	6.00	6.00	3.00	3.00
L-lysine HCL	0.61	1.15	0.11	0.77
DL-methionine	0.26	0.28	0.10	0.20
L-threonine	0.22	0.06	-	-
L-valine	0.15	0.14	-	0.04
L-tryptophan	0.04	0.05	-	0.01
Soybean oil	2.00	2.00	2.00	2.00
Dicalcium phosphate	1.10	0.99	0.75	0.87
Limestone	0.43	0.61	0.82	0.89
Salt	0.35	0.35	0.25	0.25
Vitamin premix	0.25	0.25	0.25	0.25
Mineral premix	0.15	0.15	0.15	0.15
Zinc oxide	0.39	0.39	0.40	0.39
Antibiotic[b]	1.00	1.00	1.00	1.00

[a]Diets were formulated to 1.8% lysine, 0.9% Ca, and 0.8% P.
[b]Provided 50 g/ton carbadox.

Table 3. Effect of Plasma and Soybean Meal Inclusion on Growth Performances of Nursery Pigs[a]

	Simple Formulations		Complex Formulations					
Item	25% soybean meal	0% soybean meal	25% soybean meal	0% soybean meal	SE	Simple vs complex	Soybean meal effect	Interaction effect
Phase 1 (d 0 to 14)								
ADG, lb	0.76	0.59	0.87	0.74	0.03	0.001	0.001	-[b]
ADFI, lb	0.77	0.66	0.88	0.75	0.02	0.001	0.001	-
F/G	1.06	1.15	1.03	1.04	0.03	0.04	-	-
Phase 2 (d 14 to 28)								
ADG, lb	1.28	1.32	1.20	1.18	0.03	0.002	-	-
ADFI, lb	1.80	1.74	1.64	1.62	0.04	0.009	-	-
F/G	1.42	1.34	1.38	1.40	0.02	-	-	0.03
Overall (0 to 28)								
ADG, lb	1.02	0.95	1.04	0.96	0.03	-	0.002	-
ADFI, lb	1.28	1.20	1.26	1.19	0.03	-	0.003	-
F/G	1.28	1.28	1.23	1.25	0.01	0.007	-	-

[a]A total of 192 pigs with an avg initial BW of 13.9 lb and an average starting age of 21d.
[b]Dashes indicate P = 0.15 or greater.