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Effect of Calcium Level and Type of Floor on Performance of Pigs Fed Diets of Low Phosphorus Content

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Most swine diets include the plant products corn and soybean meal as major ingredients. Much of the phosphorus present in these plant materials is found as phytin phosphorus, a form not readily available to the pig. Thus, it is necessary to supplement corn-soybean meal diets with a phosphorus source.

In 1974 supplies of supplemental phosphorus became very scarce. Interest was increased in determining performance of pigs fed diets low in phosphorus and on ways to increase utilization of the phosphorus present in swine diets. The feeding of high levels of calcium has been shown to reduce phosphorus retention. Since these mineral elements are particularly important in bone strength and development and slatted floors seem to put more stress on feet and legs of pigs, it is important to study these interrelationships.

The objectives of this experiment were to study the effect of different levels of dietary calcium on performance of pigs fed diets containing a minimum level of phosphorus and to study these relationships when pigs were kept on different types of slatted floors, concrete floors and dirt lots.

Experimental Procedure

A total of 280 pigs were used in two trials. Five replicate groups of 32 (trial 1) and 24 (trial 2) crossbred pigs averaging about 55 and 62 lb. in trials 1 and 2, respectively, were used. Within each replicate, subgroups of barrows and gilts were formed on the basis of weight and ancestry and random allotment was made from these groups to provide four groups of 8 pigs each in trial 1 and 6 pigs each in trial 2 within each replicate. There were equal numbers of barrows and gilts in each group. These groups were then randomly assigned to treatment within each replicate. Pigs were self-fed the basal diets shown in table 1 that varied in calcium and phosphorus level as follows:

Treatment 1--0.40% calcium, 0.40% phosphorus
Treatment 2--0.60% calcium, 0.40% phosphorus
Treatment 3--0.80% calcium, 0.40% phosphorus
Treatment 4--0.65% calcium, 0.55% phosphorus

Each replicate group was kept in pens of different floor types. Replicates 1, 2 and 3 were housed in an enclosed confinement barn with fully slatted floors. The slats were 8-inch concrete, 5-inch concrete and 3.5-inch aluminum in replicates 1, 2 and 3, respectively. Pen size was 7.5 by 9 feet. Replicate 4 pigs were housed in uninsulated, wooden houses, 8 by 12 feet, with wooden floors and were fed and watered in outside dirt lots approximately 29 by 52 feet. Pigs in replicate 5 were housed in similar wooden houses but with concrete floors in the house and a 12 by 16 foot outside concrete lot where feeders and waterers were located.

Pigs were removed from their respective treatments when each group weighed approximately 210 lb. and the barrows were slaughtered at John Morrell and Company, Sioux Falls. Carcass data obtained were backfat and carcass length and bones from the front feet were obtained to study bone strength. This phase of the experiment is not complete and will be reported later.

Results

The results of feeding varying levels of calcium in diets of low phosphorus content are shown in table 2. Pigs fed the low phosphorus (0.4%) and low calcium (0.4%) diet gained significantly faster than the pigs fed the low phosphorus diet containing 0.6 or 0.8% calcium. These results would appear to agree with other reports where high levels of calcium reduced phosphorus retention and indicate that, if a minimal level of phosphorus is fed, calcium level should also be reduced. Feed consumption was also reduced during the early growth period when pigs were fed the 0.8% calcium diet having a calcium to phosphorus ratio of 2:1.

There were no differences in gain or feed/gain among treatments during the finishing period from 120 lb. to market weight. The pig requires somewhat less calcium and phosphorus as a percentage of his diet during this period. The pigs apparently were obtaining sufficient minerals from all diets to support gains and feed/gain equal to those of pigs fed a recommended level of these minerals, 0.65% calcium and 0.55% phosphorus to 120 lb. and 0.6 and 0.5%, respectively, from 120 lb. to market (ratio of 1.2:1). For the entire period from 58 to 210 lb., gains were 1.64, 1.61, 1.59 and 1.64 and feed/gain 3.33, 3.22, 3.34 and 3.31 for pigs receiving diets containing ratios of calcium to phosphorus of 1:1, 1.5:1, 2:1 and 1.2:1, respectively. The differences were small and nonsignificant. Carcass backfat and length did not differ among treatments.

A summary of the results by type of pen is presented in table 3. Average daily gains were similar during the growing period, but during the finishing period pigs housed in wooden houses on concrete gained 1.87 lb. per day compared to gains of 1.62, 1.66, 1.69 and 1.64 lb. for the other groups. This difference in rate of gain was highly significant. Because of the much faster gains during the finishing period, the average gain for the entire period was also significantly greater for pigs in concrete lots.

Several factors may have been responsible for the difference in gains. The difference in floor type and how it may have affected the comfort and movement of the pigs must be considered. The pigs on concrete had access to the outside environment, but so did those pigs on dirt lots and their performance was similar to pigs housed in enclosed buildings. The two trials were conducted from late May to early September and from mid-August to late November. It is possible that temperature and comfort could have varied among treatments. The dirt lots were limited in size and did become quite dusty. Effects of dust, gases given off by the liquid manure under the slatted pens, noise of continuous running of fans, etc. in the confinement house cannot be evaluated.

Feed/gain or feed consumption did not differ among treatments for the entire trial. However, during the growing period pigs fed on the 8- and 5-inch concrete slats consumed more feed per day and required more feed/gain. Pigs fed on concrete consumed more feed daily during the finishing period when they were gaining faster than pigs in the other treatments.

Summary

Two trials with a total of 280 pigs were conducted to study diets containing a low level of phosphorus and to evaluate performance of pigs on different floor types.

A level of 0.4% phosphorus and 0.4% calcium supported performance equal to that of pigs fed diets with recommended levels, 0.55% phosphorus and 0.65% calcium reduced to 0.5 and 0.6% at 120 pounds. Gains of pigs fed diets of 0.4% phosphorus and 0.6 or 0.8% calcium were reduced during the early growth period.

Pigs housed in concrete floored pens with outside concrete feeding area gained significantly faster during the finishing period than pigs housed in an enclosed building with 8-inch or 5-inch concrete slatted floors or 3.5-inch aluminum slatted floors or pigs in dirt lots. There were no differences in feed efficiency during this period or for the overall feeding period.

Table 1. Composition of Diets (Percent)

	To 120 lb.				120 to 210 lb.			
Ingredients	1A	2A	3A	4A	1B	2B	3B	4B
Corn	79.78	79.15	78.52	78.6	86.2	85.52	84.86	85.25
SBM, 44%	18.5	18.6	18.7	18.7	12.0	12.15	12.28	12.2
Dicalcium	0.36	0.37	0.38	1.2	0.48	0.49	0.50	1.05
Limestone	0.66	1.18	1.7	0.8	0.62	1.14	1.66	0.8
Trace mineral salt[a]	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Premix[b]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Calculated content, %								
Protein	15.3	15.3	15.3	15.3	13.0	13.0	13.0	13.0
Calcium	0.4	0.6	0.8	0.65	0.4	0.6	0.8	0.6
Phosphorus	0.4	0.4	0.4	0.55	0.4	0.4	0.4	0.5

[a]Supplied in addition to NaCl the following parts per million of trace minerals: zinc, 40; manganese, 20; iron, 16.5; copper, 2.4; cobalt, 1.1 and iodine, 0.55.

[b]Supplied per lb. of diet: vitamin A, 1500 IU; vitamin D, 150 IU; riboflavin, 1.25 mg; pantothenic acid, 5 mg; niacin, 10 mg; choline, 50 mg; vitamin B_{12}, 7.5 mcg and aureomycin, 10 milligrams.

Table 2. Effect of Calcium and Phosphorus Levels on Performance of Growing-Finishing Pigs

Calcium, %	0.4	0.6	0.8	0.65-0.6
Phosphorus, %	0.4	0.4	0.4	0.55-0.5
Number of pigs[a]	70	70	70	70
Avg. initial wt., lb.	58.6	58.7	58.7	58.4
Avg. final wt., lb.	214.0	211.1	208.8	213.4
Initial to 120 lb.				
Avg. daily gain, lb.	1.57[b]	1.46	1.45	1.61[b]
Daily feed consumed, lb.	4.51	4.30	4.22[c]	4.57
Feed/gain	2.86	2.95	2.91	2.81
120 to 210 lb.				
Avg. daily gain, lb.	1.70	1.73	1.69	1.66
Daily feed consumed, lb.	6.14	5.86	6.16	5.98
Feed/gain	3.59	3.39	3.65	3.60
Initial to 210 lb.				
Avg. daily gain, lb.	1.64	1.61	1.59	1.64
Daily feed consumed, lb.	5.48	5.18	5.31	5.43
Feed/gain	3.33	3.22	3.34	3.31
Carcass data[d]				
Avg. backfat, in.	1.21	1.19	1.17	1.22
Avg. length, in.	30.3	30.0	29.9	30.2

[a] Five lots of 8 pigs, trial 1, and 5 lots of 6 pigs, trial 2, per treatment.
[b] Significantly greater than treatments 2 and 3 ($P<.005$).
[c] Significantly less than treatments 1 and 4 ($P<.01$).
[d] Barrows only.

Table 3. Effect of Type of Floor on Performance of Pigs Fed Diets of Different Calcium and Phosphorus Content

	Type of pen				
	8-inch slat concrete	5-inch slat concrete	3.5-inch slat aluminum	Concrete lot	Dirt lot
Number of pigs[a]	56	56	56	56	56
Avg. initial wt., lb.	58.1	59.6	59.6	58.0	57.7
Avg. final wt., lb.	209.7	206.7	206.6	207.7	224.0
Initial to 120 lb.					
Avg. daily gain, lb.	1.56[b]	1.51[b]	1.49	1.53	1.53
Daily feed consumed, lb.	4.75	4.64	4.09	4.25	4.28
Feed/gain	3.03[c]	3.07[c]	2.74	2.79	2.79
120 lb. to 210 lb.					
Avg. daily gain, lb.	1.62	1.66	1.69	1.64	1.87[d]
Daily feed consumed, lb.	5.84	5.83	5.99	6.04	6.47
Feed/gain	3.59	3.50	3.55	3.68	3.46
Initial to 210 lb.					
Avg. daily gain, lb.	1.58	1.59	1.60	1.59	1.73[d]
Daily feed consumed, lb.	5.36	5.29	5.22	5.27	5.61
Feed/gain	3.37	3.32	3.26	3.31	3.23
Carcass data[e]					
Avg. backfat, in.	1.16	1.17	1.23	1.19	1.25
Avg. length, in.	30.0	30.1	29.6	30.2	30.6

[a]Four lots of 8 pigs, trial 1, and 4 lots of 6 pigs, trial 2, per treatment.
[b]Significantly greater than treatments 3, 4 and 5 ($P<.005$).
[c]Significantly greater than treatments 3, 4 and 5 ($P<.005$).
[d]Significantly greater than all other treatments ($P<.005$).
[e]Barrows only.