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Calcium and Phosphorus Levels in Rations for  
Growing-Finishing Swine

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Calcium and phosphorus have long been recognized as mineral elements that are seriously deficient in cereal grains and plant by-products. However, some questions arise as to the availability of these minerals, particularly phosphorus, in cereal grains and by-products and the requirements of swine for these minerals. Evidence of lameness of growing-finishing swine is often associated with a calcium or phosphorus problem in the ration although these minerals may or may not be a factor related to this condition.

This experiment was conducted to study the effects of corn-soybean meal rations containing varying levels of added calcium and phosphorus on growth performance, carcass characteristics and levels of calcium and phosphorus in the blood serum of growing-finishing swine.

Experimental Procedure

Sixty-four weanling crossbred pigs were used in Trial 1 and allotted into 8 lots of 8 pigs each. Two lots of pigs received each of the four ration treatments which varied only in phosphorus content. Calcium was included in all rations at approximately 0.60 percent of the ration. Total phosphorus content of the four ration treatments was 0.40, 0.50, 0.61 and 0.81 percent. However, if one assumes, as has been suggested by some research workers, that the phosphorus in corn and soybean meal is only about 40% available to the pig, the levels of phosphorus in the rations fed would then be 0.2, 0.3, 0.4 and 0.6 percent and the calcium to phosphorus ratios would be 3:1, 2:1, 1.5:1 and 1:1. The composition of the rations fed is shown in table 1.

In Trial II, 64 pigs were allotted, 8 pigs per lot, four barrows and four gilts, into two replicated groups of 4 lots each. The rations shown in table 2 were similar to those in Trial I except that calcium and phosphorus levels were different. The level of these two mineral elements in each ration is also shown in table 2. The levels were all equal to or in excess of the requirements for calcium and phosphorus as listed by the National Research Council.

In both trials pigs were confined on concrete with feed and water supplied ad libitum in outside lots. In Trial II all barrows, 8 from each treatment, were slaughtered at an approximate weight of 210 pounds. Blood samples were taken at this time for determination of calcium and phosphorus of the serum and carcass data were collected.

## Results

### Trial I

Results of Trial I are reported in table 3. Although the two replicate groups averaged about 10 pounds difference in initial weight, the data for replicated lots are combined as the response was similar in both replicates.

Pigs receiving the highest level of phosphorus (0.8%) in their ration gained 11 percent faster than those receiving the lowest level (0.4% total phosphorus or 0.2% available). This level is below the NRC recommendation of 0.5% for pigs from 25 to 75 pounds but equal to the recommendation for pigs from 75 to 225 pounds. In this trial a difference in rate of gain was noted at the time the pigs weighed about 75 pounds. At this time the daily gain of pigs receiving the lowest level of phosphorus averaged about 0.12 pound per day less than the gain of pigs fed the other three levels of phosphorus. Feed efficiency was somewhat variable between treatment groups but did not indicate any trend due to phosphorus levels in the ration.

### Trial II

Table 4 summarizes the results of the second trial. Data for the two replicate groups have been combined since both groups had similar performance.

There was no difference in average daily gain between treatments. Pigs receiving increased levels of phosphorus did not show increased gains as had been noted in Trial I. Likewise increasing the calcium level to 1.2% did not affect rate of gain but pigs fed this level of calcium did require slightly more feed per unit of gain.

Serum calcium and phosphorus levels did not differ significantly between treatments. There did not appear to be any trend between level of calcium or phosphorus in the diet and the level of these elements in the blood. Carcass characteristics between groups indicate some differences in average figures of certain traits. However, since only eight animals are involved these differences are not significant.

## Summary

Two trials were conducted to study the effect of various calcium and phosphorus levels in the ration on performance of growing-finishing swine. Pigs fed rations containing 0.4% total phosphorus gained more slowly than pigs fed rations containing 0.5, 0.6 or 0.8% phosphorus. All rations contained 0.6% calcium. Increasing phosphorus above the National Research Council recommendations of 0.5% to 75 pounds and 0.4% from 75 pounds to market weight did not affect rate or efficiency of gain, blood serum calcium and phosphorus levels or carcass characteristics. Increasing the calcium level in the ration to 1.2% to 110 pounds and 0.9% from 110 pounds to market weight did not significantly affect pig performance although these pigs required slightly more feed per unit of gain and had about 10% more backfat than those fed the recommended levels of calcium.

There were no visible signs of differences in leg strength, lameness or turbinate atrophy between pigs fed the various levels of calcium and phosphorus in these trials.

Table 1. Composition of Rations (Percent), Trial I

| Phosphorus level                       | Initial to 110 lbs. |      |      |      | 110 to 200 lbs. |      |      |      |
|--|---------------------|------|------|------|-----------------|------|------|------|
|  | 0.4                 | 0.5  | 0.6  | 0.8  | 0.4             | 0.5  | 0.6  | 0.8  |
| Ground yellow corn                     | 79.0                | 79.0 | 79.0 | 79.0 | 89.0            | 89.0 | 89.0 | 89.0 |
| Soybean meal (50%)                     | 18.0                | 18.0 | 18.0 | 18.0 | 8.0             | 8.0  | 8.0  | 8.0  |
| Ground limestone                       | 1.2                 | 0.9  | 0.5  | --   | 1.2             | 0.85 | 0.55 | --   |
| Dicalcium phosphate                    | 0.4                 | 0.9  | 1.5  | 2.25 | 0.45            | 1.00 | 1.50 | 2.35 |
| Disodium phosphate                     | --                  | --   | --   | 0.25 | --              | --   | --   | 0.25 |
| Trace mineral salt                     | 0.5                 | 0.5  | 0.5  | 0.5  | 0.5             | 0.5  | 0.5  | 0.50 |
| Vitamin-antibiotic premix <sup>a</sup> | 0.25                | 0.25 | 0.25 | 0.25 | 0.25            | 0.25 | 0.25 | 0.25 |
| Calculated analysis                    |                     |      |      |      |                 |      |      |      |
| Protein, %                             | 16.1                | 16.1 | 16.1 | 16.1 | 12.0            | 12.0 | 12.0 | 12.0 |
| Calcium, %                             | 0.61                | 0.62 | 0.61 | 0.60 | 0.60            | 0.60 | 0.61 | 0.60 |
| Phosphorus (total), %                  | 0.40                | 0.50 | 0.61 | 0.81 | 0.38            | 0.48 | 0.58 | 0.79 |
| Phosphorus available, % <sup>b</sup>   | 0.20                | 0.30 | 0.41 | 0.61 | 0.20            | 0.30 | 0.40 | 0.61 |

<sup>a</sup> Provided 1125 I.U. vitamin A, 340 I.U. vitamin D, 2 mg. riboflavin, 4 mg. calcium pantothenate, 9 mg. niacin, 10 mg. choline chloride, 10 mcg. vitamin B<sub>12</sub> and 12.5 mg. chlortetracycline per pound of ration.

<sup>b</sup> Based on assumption that only 40% of phosphorus in corn and soybean meal is available.

Table 2. Composition of Rations (Percent), Trial II

|  | Initial to 110 lbs. |      |      |      | 110 to 200 lbs. |      |      |      |
|--|---------------------|------|------|------|-----------------|------|------|------|
|  | 0.65                | 0.65 | 0.65 | 1.2  | 0.50            | 0.50 | 0.50 | 0.90 |
| Calcium level                          | 0.65                | 0.65 | 0.65 | 1.2  | 0.50            | 0.50 | 0.50 | 0.90 |
| Phosphorus level                       | 0.50                | 0.65 | 0.85 | 0.6  | 0.40            | 0.50 | 0.68 | 0.45 |
| Ground yellow corn                     | 79.8                | 79.5 | 79.0 | 77.8 | 90.1            | 89.9 | 89.4 | 88.8 |
| Soybean meal (50%)                     | 17.7                | 17.7 | 17.7 | 18.0 | 7.9             | 7.9  | 7.9  | 8.0  |
| Ground limestone                       | 1.0                 | 0.5  | --   | 2.1  | 0.85            | 0.5  | --   | 1.76 |
| Dicalcium phosphate                    | 0.9                 | 1.7  | 2.45 | 1.5  | 0.55            | 1.1  | 1.95 | 0.8  |
| Disodium phosphate                     | --                  | --   | 0.25 | --   | --              | --   | 0.1  | --   |
| Trace mineral salt                     | 0.5                 | 0.5  | 0.5  | 0.5  | 0.5             | 0.5  | 0.5  | 0.5  |
| Vitamin-antibiotic premix <sup>a</sup> | 0.1                 | 0.1  | 0.1  | 0.1  | 0.1             | 0.1  | 0.1  | 0.1  |

<sup>a</sup> Provided 1125 I.U. vitamin A, 340 I.U. vitamin D, 2 mg. riboflavin, 4 mg. calcium pantothenate, 9 mg. niacin, 10 mg. choline chloride, 10 mcg. vitamin B<sub>12</sub> and 12.5 mg. of chlortetracycline per pound of ration.

Table 3. Results of Varying Levels of Phosphorus in Swine Rations

|                        | Phosphorus levels, % |                 |       |       |
|------------------------|----------------------|-----------------|-------|-------|
|                        | 0.4                  | 0.5             | 0.6   | 0.8   |
| No. of pigs            | 16 <sup>a</sup>      | 15 <sup>b</sup> | 16    | 16    |
| Initial wt., lb.       |                      |                 |       |       |
| Rep. I                 | 43.8                 | 44.7            | 43.8  | 43.5  |
| Rep. II                | 33.6                 | 33.6            | 33.6  | 33.4  |
| Final wt., lb.         | 201.4                | 202.6           | 205.4 | 205.9 |
| Av. daily gain, lb.    | 1.47                 | 1.52            | 1.55  | 1.64  |
| Av. daily feed, lb.    | 5.41                 | 5.98            | 5.61  | 5.90  |
| Av. feed/lb. gain, lb. | 3.69                 | 3.92            | 3.60  | 3.60  |

<sup>a</sup> Two replicate lots of 8 pigs each.

<sup>b</sup> One pig died in replicate I, data are for 7 pigs in that replicate.

Table 4. Results of Different Levels of Calcium and Phosphorus in Swine Rations

| Calcium level, % <sup>a</sup>    | 0.65-0.50 | 0.65-0.50 | 0.65-0.50 | 1.2-0.90 |
|----------------------------------|-----------|-----------|-----------|----------|
| Phosphorus level, % <sup>a</sup> | 0.50-0.40 | 0.65-0.50 | 0.85-0.68 | 0.6-0.45 |
| No. of pigs <sup>b</sup>         | 16        | 16        | 16        | 16       |
| Initial wt., lb.                 | 36.4      | 36.5      | 36.5      | 36.4     |
| Final wt., lb.                   | 210.2     | 209.2     | 213.8     | 210.5    |
| Av. daily gain, lb.              | 1.61      | 1.65      | 1.62      | 1.60     |
| Av. daily feed, lb.              | 5.22      | 5.25      | 5.20      | 5.45     |
| Av. feed/lb. gain, lb.           | 3.24      | 3.18      | 3.22      | 3.40     |
| Serum calcium, mg. %             | 10.58     | 10.46     | 10.18     | 10.11    |
| Serum phosphorus, mg. %          | 9.36      | 8.49      | 8.16      | 8.44     |
| Av. backfat, in.                 | 1.34      | 1.36      | 1.40      | 1.52     |
| Av. length, in.                  | 29.8      | 29.8      | 30.2      | 30.0     |
| Av. loin eye area, sq. in.       | 4.28      | 4.51      | 4.99      | 4.21     |
| Percent ham and loin             | 36.48     | 35.68     | 36.45     | 36.40    |

<sup>a</sup> Levels of calcium and phosphorus in rations fed to 110 lb. and from 110 to 200 lb.

<sup>b</sup> Two lots of 8 pigs each per treatment.