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# Compensatory Growth of Swine Following Protein Insufficiency

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It has been observed (A.S. Series 71-39) that, when pigs are fed abnormal protein sequences of low protein followed by high protein diets, they tended to compensate somewhat for the poorer performance during the early stage of growth by improved performance during the later growth period. If protein level sequence can be altered in this way, it would mean less supplemental protein necessary and more economical production.

The study reported herein was designed to study the ability of the pig to compensate for reduction in gain and efficiency of gain due to a low protein diet during an early growth period when fed adequate or excess protein during a later growth period.

## Experimental Procedure

One hundred twenty-six pigs with an average starting weight of 55 lb. were used in three replicates of six dietary treatments. Each pen consisted of four gilts and three barrows. The pigs were randomly allotted on the basis of sex, weight and ancestry. The pigs were housed in an environment-modified building with slatted floors. The six dietary treatments were protein sequences fed during growth periods from 55 to 115 lb., 115 to 175 lb. and from 175 lb. to market weight of approximately 230 pounds. The treatments and dietary sequences were:

| Treatment | Protein sequences (%) |
|---|---|
| 1 | 12 - 12 - 12 |
| 2 | 12 - 14 - 12 |
| 3 | 12 - 16 - 12 |
| 4 | 16 - 12 - 12 |
| 5 | 16 - 14 - 12 |
| 6 | 16 - 16 - 12 |

During the first growth period, optimum performance was expected from pigs receiving 16% protein and poor performance was expected from pigs receiving 12% protein. During the second growth period 12% protein was considered inadequate, 14% protein adequate and 16% protein in excess of the pig's requirement. During the third growth period, all pigs received 12% protein diets. Composition of the three diets is shown in table 1.

## Results

The average daily gain response to dietary protein levels is shown in table 2. Average daily gain is listed by growth periods and on an accumulative basis from the start of the trial. The table lists the response due to dietary protein during the first growing period (left side), second growing period (middle), and the combination of all growing periods (right side).

Pigs receiving 12% protein from 55 to 115 lb. live weight gained significantly slower, 1.41 lb. per day vs. 1.77 lb. per day, than those receiving 16% protein during this period. However, during the second and third growth periods the average gain of pigs in treatments 1, 2 and 3 was slightly, but not significantly, faster than the average gain of pigs in treatments 4, 5 and 6. On an accumulative basis, the difference in gain due to protein levels during the initial growth period still existed at the end of the experiment. Daily gains for the total experiment averaged 1.57 and 1.66 lb. for pigs fed 12 or 16% protein, respectively, during the initial growth period.

Gains were significantly different due to protein levels fed during the second growth period. Pigs receiving 16% or 14% protein diets during this period gained faster than those pigs receiving 12% protein, indicating that 16% and 14% protein were adequate or in excess of the pig's protein requirement from 115 to 175 pounds.

During the third growth period all treatment groups were fed the 12% protein diet and gains were equal for pigs which had received the three different protein levels during the second growth period. On an accumulative basis no difference in gain was observed at market time due to the different protein levels fed during the 115 to 175 lb. period.

Average daily gains of the six treatments varied considerably during the three growth periods. However, accumulative gain for the entire experiment indicates that pigs fed the 12-12-12% protein sequence had the poorest daily gains, 1.48 lb., compared to gains of 1.60 to 1.69 lb. for the other treatments. Compensatory gains of pigs fed the 12-16-12% protein sequence occurred during the 115 to 175 lb. period when these pigs gained 1.83 lb. daily compared to 1.66 lb. for pigs fed the 16-16-12% protein sequence. For pigs fed the 12-14-12% protein sequence, compensatory gains occurred during the 175 to 230 lb. period when they gained 1.75 lb. per day compared to 1.45 lb. for pigs fed the 16-14-12% protein sequence.

Feed efficiency (table 3) followed the same pattern as average daily gain. Feed/gain was better for pigs receiving 16% protein during the initial growth period and for pigs receiving either 14% or 16% protein during the second growth period. When the treatments were combined, no significant differences were observed due to protein sequence. However, the poorest performance again was observed when pigs received the 12-12-12% protein sequence. Pigs receiving the 12-14-12% and 12-16-12% protein had a closer feed/gain ratio to those pigs that received 16% protein during the initial growth period. This hints at compensatory performance when adequate or excess protein follows suboptimum performance from inadequate protein.

## Summary

One hundred twenty-six pigs were utilized to study compensatory performance due to a low protein diet during an early growth period followed by higher protein levels during the subsequent growth period. Pigs receiving 16% protein during the 55 to 115 lb. growth period gained faster and more efficiently than pigs receiving 12% protein. During the 115 to 175 lb. growth

period pigs receiving 14% or 16% protein performed better than pigs receiving 12% protein. The data showed a trend for compensatory performance when pigs had received a protein-deficient diet from 55 to 115 lb. and an adequate or excess protein level during the 115 to 175 lb. growth period.

Table 1. Composition of Experimental Diets (%)

| Ingredient | Protein levels | | |
|---|---|---|---|
| | 12% | 14% | 16% |
| Corn | 87.5 | 81.9 | 76.2 |
| Soybean meal, 44% | 9.3 | 15.0 | 20.7 |
| Dicalcium phosphate | 1.3 | 1.2 | 1.2 |
| Limestone | 0.9 | 0.9 | 0.9 |
| Trace mineral salt, 1.0% zinc | 0.5 | 0.5 | 0.5 |
| Vitamin premix[a] | 0.5 | 0.5 | 0.5 |

[a]Supplied per lb. of diet: vitamin A, 1500 IU; vitamin D, 150 IU; vitamin E, 5 IU; riboflavin, 1.25 mg; pantothenic acid, 5 mg; niacin, 8 mg; choline, 25 mg; vitamin $B_{12}$, 5 mcg and aureomycin, 10 milligrams.

Table 2. Average Daily Gain by Periods and Accumulative

| | Treatments | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1,2,3 | 4,5,6 | 1,4 | 2,5 | 3,6 | 1 | 2 | 3 | 4 | 5 | 6 |
| | Protein % | | | | | | | | | | |
| 55-115 lb. | 12 | 16 | | | | 12 | 12 | 12 | 16 | 16 | 16 |
| 115-175 lb. | | | 12 | 14 | 16 | 12 | 14 | 16 | 12 | 14 | 16 |
| 175-230 lb. | | | | | | 12 | 12 | 12 | 12 | 12 | 12 |
| | Average Daily Gain by Period, Lb. | | | | | | | | | | |
| 55-115 lb. | 1.41 | 1.77** | 1.62 | 1.58 | 1.58 | 1.41 | 1.38 | 1.45 | 1.84 | 1.77 | 1.71 |
| 115-175 lb. | 1.69 | 1.63 | 1.55 | 1.69 | 1.74** | 1.54 | 1.70 | 1.83 | 1.55 | 1.68 | 1.66 |
| 175-230 lb. | 1.62 | 1.59 | 1.62 | 1.60 | 1.61 | 1.53 | 1.75 | 1.59 | 1.71 | 1.45 | 1.62 |
| | Average Daily Gain Accumulative, Lb. | | | | | | | | | | |
| 55-115 lb. | 1.41 | 1.77** | 1.62 | 1.58 | 1.58 | 1.41 | 1.38 | 1.45 | 1.84 | 1.77 | 1.71 |
| 55-175 lb. | 1.55 | 1.69** | 1.57 | 1.63 | 1.65 | 1.47 | 1.54 | 1.63 | 1.68 | 1.72 | 1.67 |
| 55-230 lb. | 1.57 | 1.66** | 1.59 | 1.61 | 1.63 | 1.48 | 1.60 | 1.61 | 1.69 | 1.63 | 1.66 |

**Significant difference P<.01.

Table 3. Feed/gain by Periods and Accumulative

| | Treatments | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1,2,3 | 4,5,6 | 1,4 | 2,5 | 3,6 | 1 | 2 | 3 | 4 | 5 | 6 |
| | Protein % | | | | | | | | | | |
| 55-115 lb. | 12 | 16 | | | | 12 | 12 | 12 | 16 | 16 | 16 |
| 115-175 lb. | | | 12 | 14 | 16 | 12 | 14 | 16 | 12 | 14 | 16 |
| 175-230 lb. | | | | | | 12 | 12 | 12 | 12 | 12 | 12 |
| | Feed/gain by Periods | | | | | | | | | | |
| 55-115 lb. | 3.21 | 2.49** | 2.94 | 2.83 | 2.79 | 3.35 | 3.21 | 3.08 | 2.53 | 2.45 | 2.49 |
| 115-175 lb. | 3.38 | 3.33 | 3.70 | 3.14 | 3.22* | 3.83 | 3.21 | 3.11 | 3.58 | 3.06 | 3.34 |
| 175-230 lb. | 4.04 | 3.81 | 4.13 | 3.79 | 3.86 | 4.54 | 3.60 | 3.99 | 3.72 | 3.97 | 3.74 |
| | Feed/gain Accumulative | | | | | | | | | | |
| 55-115 lb. | 3.21 | 2.49** | 2.94 | 2.83 | 2.79 | 3.55 | 3.21 | 3.08 | 2.53 | 2.45 | 2.49 |
| 55-175 lb. | 3.29 | 2.90** | 3.32 | 2.97 | 3.00* | 3.59 | 3.19 | 3.09 | 3.04 | 2.74 | 2.91 |
| 55-230 lb. | 3.57 | 3.18* | 3.58 | 3.27 | 3.28 | 3.91 | 3.43 | 3.38 | 3.26 | 3.10 | 3.18 |

*Significant difference P<.05.
**Significant difference P<.01.